

Obesity Management

Motivational interviewing to improve weight loss in overweight and/or obese patients: a systematic review and meta-analysis of randomized controlled trials

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Summary

Motivational interviewing, a directive, patient-centred counselling approach focused on exploring and resolving ambivalence, has emerged as an effective therapeutic approach within the addictions field. However, the effectiveness of motivational interviewing in weight-loss interventions is unclear. Electronic databases were systematically searched for randomized controlled trials evaluating behaviour change interventions using motivational interviewing in overweight or obese adults. Standardized mean difference (SMD) for change in body mass, reported as either body mass index (BMI; kg m⁻²) or body weight (kg), was the primary outcome, with weighted mean difference (WMD) for change in body weight and BMI as secondary outcomes. The search strategy yielded 3540 citations and of the 101 potentially relevant studies, 12 met the inclusion criteria and 11 were included for meta-analysis. Motivational interviewing was associated with a greater reduction in body mass compared to controls (SMD = -0.51 [95% CI -1.04, 0.01]). There was a significant reduction in body weight (kg) for those in the intervention group compared with those in the control group (WMD = -1.47 kg [95% CI -2.05, -0.88]). For the BMI outcome, the WMD was -0.25 kg m⁻² (95% CI -0.50, 0.01). Motivational interviewing appears to enhance weight loss in overweight and obese patients.

Keywords: Behaviour change, motivational interviewing, obesity, weight loss.

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Introduction

Obesity has reached epidemic proportions. In the USA, more than 33% of adults are obese and 68% of adults are overweight with a body mass index (BMI) of 25.0 kg m⁻² or higher (1). The health consequences of excess weight include an increased risk of type 2 diabetes, cardiovascular disease, high blood pressure, osteoarthritis, some cancers and a decrease in quality of life (2). In addition, individuals may experience psychosocial problems, functional limitations and physical disability as a result of excess adiposity. Given the increasing prevalence and health-related con-

sequences of obesity, developing effective treatment approaches has been identified as a research and population health priority (3).

The aetiology of obesity is largely multifactorial; however, given the influence of individual and personal choice in its development, psychological strategies to assist individual behaviour change are crucial to the clinical management of obesity. Motivational interviewing is a strategy designed to enhance patients' motivation for change and adherence to treatment (4). It is a directive, patient-centred counselling style that aims to help patients explore and resolve ambivalence surrounding complex behaviour

change. Traditionally, recommendations for behaviour change are delivered through brief education and advice giving, in which overt recommendations are provided. Motivational interviewing is fundamentally different from educational approaches in that motivation for change is elicited from individuals, rather than imparted by a health-care provider (4).

Motivational interviewing was initially developed for application within the substance abuse field (5), and its effectiveness in this setting has been demonstrated in several systematic reviews and meta-analyses (6–8). To date, several reviews (7,9–13) have focused, in part, on the effectiveness of motivational interviewing for weight loss and modifying diet and physical activity behaviours, with effect sizes ranging from 0.23 to 0.77 standard deviations (SDs). However, many of these meta-analyses combined studies of weight management behaviours with studies of substance-abuse behaviours. In weight management, in contrast to substance abuse, the behaviour change process involves modification or addition rather than elimination of a behaviour (reshaping rather than abstaining) (14). The concepts of abstinence and relapse as seen in the addictions' field are less applicable for weight management behaviours; however, despite this, there has been increased recommendation for the use of motivational interviewing in clinical practice to address weight loss (14–16). As such, there is a need to evaluate the effectiveness of motivational interviewing within weight management independent of other addictive behaviours.

The aim of this paper was to systematically review randomized controlled trials (RCTs) that investigate the effectiveness of motivational interviewing for reducing body mass, measured by change in body weight or BMI in adults who are overweight or obese. To our knowledge, this is the first meta-analysis on this topic based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (17). Furthermore, it incorporates eight RCTs (18–25) evaluating motivational interviewing for weight loss published since 2007, which have not previously been incorporated into a systematic review or meta-analysis.

Methods

Data sources and search strategy

We performed this systematic review using a predetermined protocol and in accordance with standardized reporting guidelines (17). Two reviewers (M. J. A. and T. A. M.) performed independent searches of the following electronic databases regardless of publication language: MEDLINE (1950 through November 2009), EMBASE (1980 to November 2009), PsycINFO (1967 to November 2009), CINAHL (Cumulative Index to Nursing and Allied Health

and CENTRAL (Cochrane Central Registry of Controlled Trials). Two comprehensive search themes were developed. To identify the relevant population of interest the first search was undertaken using the Boolean operator, 'or' to explode and map the Medical Subject Heading (MeSH) such terms included: obesity, obese, overweight, body mass index, adult, aged, middle aged, young adult, diabetes mellitus, hypertension and hyperlipidaemias. To identify relevant interventions, a second search was performed using the following search terms: counselling, psychological intervention, directive counselling, interview, motivation*, motivation* interview and motivational interviewing. We combined these themes by using the Boolean 'and' operator. We then used the randomized controlled trial filter described by the Cochrane collaboration (26) for MEDLINE and EMBASE to limit our search to RCTs. The reference lists of prior reviews and all identified research articles were hand searched to find other potentially eligible studies. Experts in the field were contacted for information about other ongoing or unpublished studies.

Study selection

Articles were independently evaluated for eligibility in a two-stage procedure by each of the two reviewers (M. J. A. and T. A. M.). In the first stage, all identified titles and abstracts were reviewed. In the second stage, we performed a full-text review of articles that met the inclusion criteria and for articles for which there was uncertainty as to eligibility. If an article was selected by either reviewer, it was included in full-text review and evaluated by both reviewers. Inclusion criteria consisted of (i) study population (overweight or obese adults defined by having a BMI ≥ 25.0 kg m⁻²); (ii) intervention (behaviour change using motivational interviewing) differing between groups only in the use of motivational interviewing in one group but not the other; (iii) comparison (standard care, education, attention control or no treatment); (iv) outcome (body mass measured as body weight in kg or BMI in kg m⁻²) and (v) study design (RCT).

We included RCTs where authors defined the intervention as 'motivational interviewing' or if within the description of the intervention the authors indicated the use of methods developed by Miller and Rollnick (4). Studies were included if outcomes reported change in body mass, reported either as weight (kg) and/or BMI (kg m⁻²). Studies were excluded if they involved children or adolescents due to differences in weight outcome indices. Studies involving more than one intervention (e.g. a behavioural weight-loss programme) were included if the intervention and comparator groups differed only in the use of motivational interviewing in one group but not the other. Studies were excluded if the motivational interviewing intervention was used combined with other strategies or compared to a no-treatment control. This was in order to examine the

unique effect of motivational interviewing and not a variety of weight-loss approaches.

Data extraction and quality assessment

Both reviewers independently extracted data from all identified studies that fulfilled the inclusion criteria. Agreement between reviewers on the relevance of records was assessed using Cohen's kappa statistic (κ), which adjusts the proportion of records for which there was agreement by the amount of agreement expected by chance alone (27). Any disagreements in data extraction and/or specific study inclusion were resolved through consensus by discussion with other authors (B. R. H. and R. J. S.). The primary outcome was change in body mass reported as either body weight in kg or BMI in kg m^{-2} . For our purposes, we refer to the term 'body mass' to encompass both BMI and body weight. Baseline and post-intervention means and SDs for body mass change were extracted from intervention and control groups. The authors of potentially eligible studies were contacted when necessary to resolve ambiguities in reported results and to seek missing or incomplete data. In four of the studies, SDs for mean change were not directly reported and we were unable to obtain this information from the authors. In three of these instances (18,28,29), SDs for mean changes were calculated using the 95% confidence intervals (30) for within-group means. In the other two cases (22,24), SDs were computed based on the standard error of the mean. One study (29) investigated the effect of high- and low-dose motivational interviewing on behaviour change in hypertensive patients using a single control group. In this instance we divided the control sample in half as recommended in the Cochrane Handbook (31). In another study (25), outcomes were reported at several time points including 6, 12 and 18 months. We chose to include the 12-month reported data because this study was much longer in duration than the other included studies and there was not a motivational interviewing intervention applied for the last 6 months of the intervention. Other data extracted included sample size, mean age, percentage of female, baseline demographics, ethnicity, study period and length of follow-up. Characteristics of the motivational interviewing intervention were also extracted, including professional background of individuals delivering the intervention, mode (i.e. face-to-face, telephone, computer or group) and dose of delivery (frequency and duration). The use of treatment fidelity, a measurement tool used to assess the quality of motivational interviewing was extracted; more specifically, we assessed if a validated motivational interviewing treatment coding scale was employed. Measures of study quality were also extracted including allocation concealment, randomization, intention-to-treat analysis, blinding and loss to follow-up. These measures were scored by each reviewer

and assessed using the validated 5-point scale described by Jadad *et al.* (32).

Data analysis

Statistical analysis was performed using Stata, version 11.0 (Stata Corp., College Station, TX, USA). In each study the effect size for the intervention was calculated by the change in mean body mass (in kg or kg m^{-2}) from baseline to end of follow-up and compared between groups. This allowed for a comparison of weight lost over and above what was lost in the control group, and not simply a comparison of weight lost in each study. As a result of the outcome being measured on different scales (i.e. kg and/or kg m^{-2}), the outcomes were combined and the mean difference was standardized by dividing it by the within-group SD to account for the different units. If both outcomes were presented, BMI was used in the analysis. The results were then weighted by sample size and the average taken (standardized mean difference [SMD]). We initially pooled the SMD in each study using a fixed-effects model. To assess heterogeneity across studies, we visually inspected forest plots and calculated both the Q (significance level of $P \leq 0.10$) and I^2 statistics. The I^2 statistic quantifies the percentage of variability that can be attributed to between-study differences (33). When significant heterogeneity was evident, the DerSimonian and Laird (34) random-effects model to account for the heterogeneity of studies was used to estimate pooled effects.

We also stratified the results by each of the two outcome measures, weight (kg) and BMI (kg m^{-2}), using the weighted mean difference (WMD). If a study reported both outcomes we included the study in both analyses. We further stratified studies by variables that may affect heterogeneity of study results including whether body weight was the primary outcome of the study, the duration of treatment, if an attention control was used, if there was a motivational interviewing fidelity measure employed and if motivational interviewing was used as an adjunct to a behavioural weight-loss programme. Univariate meta-regression was also performed to explore whether the methodological factors mentioned above mediated the effects of motivational interviewing on weight loss. Finally, publication bias was assessed through visual inspection of funnel plots, the Begg and Mazumdar's (35) (rank correlation) test for asymmetry and Egger *et al.*'s (34) (weighted regression) test. A significant statistical test ($P < 0.05$) or funnel plot asymmetry suggests potential publication bias.

Results

The progress through the stages of the systematic review is summarized in Fig. 1. The initial database search yielded 3048 citations, with duplicates removed. Through title and

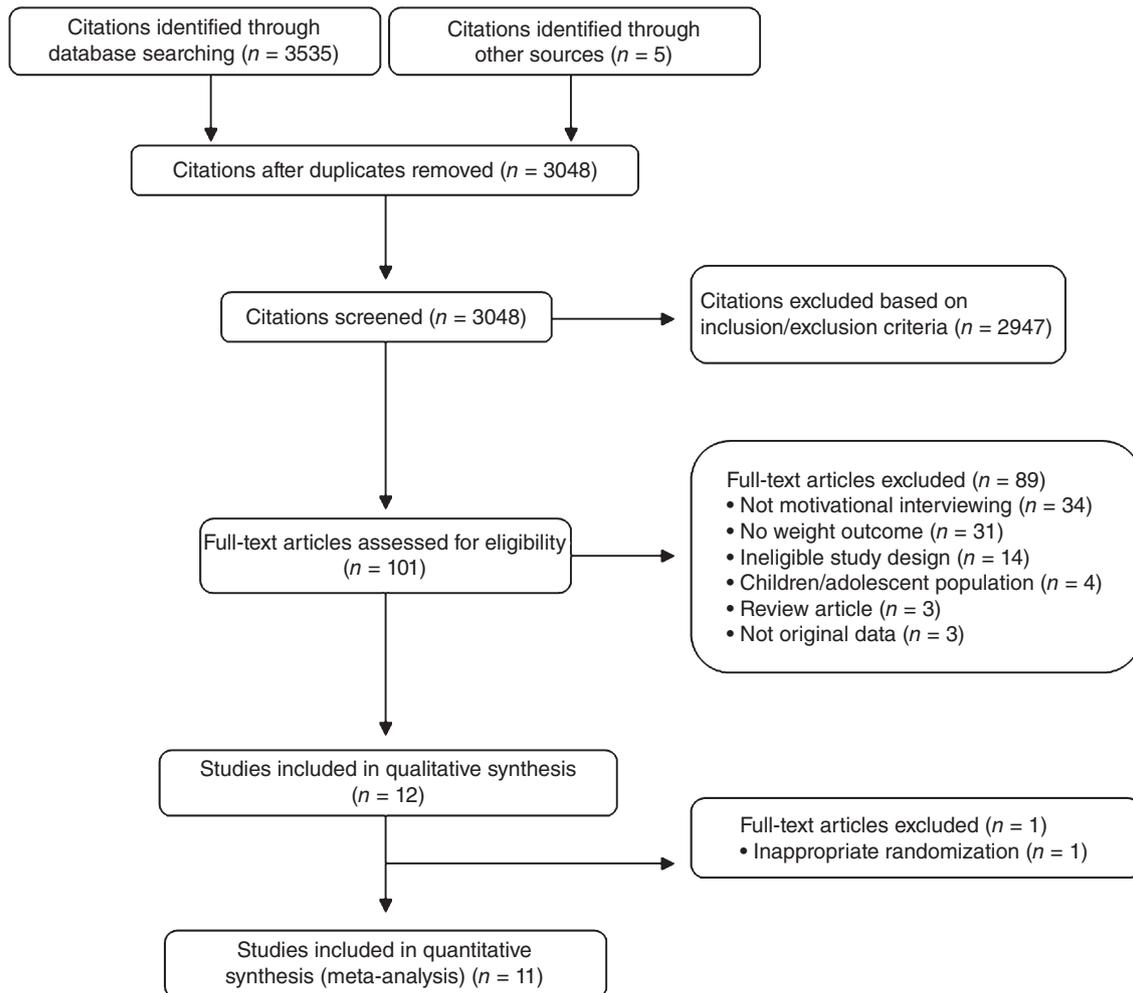


Figure 1 Study flow.

abstract review, we excluded 2947 articles ($\kappa = 0.71$). The most common reasons for exclusion were inappropriate population, intervention or outcomes, as well as not being a RCT. For the remaining 101 citations, full-text articles were obtained for more detailed evaluation. We excluded 88 articles during this screening phase due primarily to use of multiple simultaneous interventions (making it impossible to isolate the effects of motivational interviewing), the lack of a motivational interviewing intervention or lack of a weight outcome (BMI or body weight). Overall, 12 studies ($\kappa = 0.86$) were deemed appropriate for inclusion for the review (18–25,28,29,36,37). For the purpose of meta-analysis, 11 studies were deemed eligible for the SMD analysis. One study (37) was excluded due to the interventionists being randomized rather than the participants.

Study characteristics

The characteristics and weight outcomes of the 12 trials that met our inclusion criteria are shown in Table 1 and a

summary of the methodological details of the trials is presented in Table 2. Publication dates ranged from 1995 to 2009 with the number of participants per study varying from 22 to 599 and proportion of women from 3% to 100%. Mean baseline BMI ranged from 27.1 to 37.9 while mean age ranged from 41 to 62 years. One of the 13 trials (29) presented data for two comparisons (high dose, low dose) hence both interventions are presented.

For the meta-analysis of weight outcomes, four studies (23,25,29,36) reported change in body weight (kg) only and three studies (18,21,28) reported change in BMI (kg m^{-2}) only. An additional four studies (19,20,22,24) reported changes in both BMI and body weight and were included in both analyses. Weight loss was the primary outcome in six of the studies (19,20,23–25,36). The delivery of the motivational interviewing intervention varied across studies, as did follow-up duration (range from 3 to 18 months). Professional background of the interventionists was variable and included nurses, psychologists, graduate students in psychology, dietitians,

Table 1 Characteristics of included studies by outcome measure

Study (first author and year)	Sample size, n	n analysed (loss to follow-up, %)	Mean age	% female	Outcome	Intervention group			Control group		
						Pre	Post	Change	Pre	Post	Change
Smith, 1997 (36)	22	16 (27)	62	100	BMI	34.7 (4.9)	NR	NR	34.9 (4.9)	NR	NR
Mhurchu, 1998 (28)	97	84 (14)	NR	49	BMI	26.7 (3.9)*	NR	-0.45 (0.7)*	27.3 (4.2)*	NR	-0.44 (0.6)*
Brug†, 2007 (37)	209	142 (32)	59	NR	BMI	30.7 (5.7)	29.6 (5.5)	NR	29.8 (4.3)	28.7 (4.0)	NR
Elliot, 2007 (22)	599	480 (20)	41	3	BMI	27.1 (3.9)†	27.3 (3.9)†	+0.2 (3.9)†	27.9 (3.5)†	28.4 (4.6)†	+0.5 (4.2)†
Carels, 2007 (20)	55	46 (16)	48	87	BMI	37.0 (7.4)	34.7 (8.3)	-2.3 (1.9)	36.0 (7.6)	34.5 (8.0)	-1.48 (2.0)
West, 2007 (25)	217	195 (8)	53	100	BMI	36.5 (5.5)	NR	NR	36.5 (5.4)	NR	NR
Hardcastle, 2008 (24)	334	218 (35)	51	67	BMI	33.7 (5.4)†	33.5 (5.8)†	-0.2 (1.0)†	34.3 (7.0)†	33.4 (4.4)†	+0.15 (1.1)†
Greaves, 2008 (23)	141	141 (18)	55	64	BMI	>28.0§	NR	NR	NR	NR	NR
Befort, 2009 (19)	44	33 (23)	44	100	BMI	37.92 (6.7)	36.9 (7.4)	-1.0 (1.5)	40.7 (5.9)	39.6 (6.2)	-1.1 (2.0)
Armit, 2009 (18)	136	136 (15)	NR	60	BMI	28.3 (4.6)	28.2 (4.6)	-0.1 (4.6)*	27.9 (5.1)	29.7 (5.1)	+1.8 (5.1)*
DiMarco, 2009 (21)	39	26 (33)	NR	82	BMI	33.1 (3.2)	31.6 (3.1)	-1.48 (3.1)	31.62 (2.8)	30.9 (3.1)	-0.7 (2.9)
Woolard, 1995 (29) (low dose)	166	146 (12)	58	47	Weight (kg)	78.5 (16.2)*	NR	-1.0 (3.8)*	78.4 (9.5)*	NR	+0.05 (2.0)*
Woolard, 1995 (29) (high dose)	166	146 (12)	58	47	Weight (kg)	78.6 (16.8)*	NR	-1.7 (3.6)*	78.4 (9.5)*	NR	+0.05 (2.0)*
Smith, 1997 (36)	22	16 (27)	62	100	Weight (kg)	NR	NR	-5.5 (3.9)	NR	NR	-4.5 (2.2)
Elliot, 2007 (22)	599	480 (20)	41	3	weight (kg)	87.4 (12.3)	87.9 (12.3)	+0.54 (12.3)	89.1 (13.7)	90.7 (14.8)	+1.6 (14.3)
Carels, 2007 (20)	55	46 (16)	48	87	weight (kg)	100.6 (23.2)	96.1 (23.7)	-4.5 (3.0)	99.8 (25.8)	97.7 (26.3)	-2.1 (2.8)
West, 2007 (25)	217	195 (8)	53	100	Weight (kg)	97.0 (17)	NR	-4.8 (0.6)	97.0 (15)	NR	-2.7 (0.6)
Hardcastle, 2008 (24)	334	218 (35)	51	67	Weight (kg)	93.7 (17.1)†	91.9 (21.9)†	-0.7 (3.6)†	91.73 (17.2)†	93.0 (13.1)†	+0.12 (3.3)†
Greaves, 2008 (23)	141	141 (18)	55	64	Weight (kg)	91.6 (13.3)	89.7 (13.7)	-1.86 (3.7)	94.4 (14.2)	93.9 (14.8)	-0.54 (3.0)
Befort, 2009 (19)	43	33 (23)	44	100	Weight (kg)	101.3 (22.8)	98.6 (24.8)	-2.62 (4.2)	109.9 (18.5)	106.7 (18.1)	-3.2 (5.7)

*Standard deviation calculated from 95% confidence interval.

†Not included in meta-analysis.

‡Standard deviation from standard error of the mean.

§BMI > 28.0 was study inclusion criteria.

BMI, body mass index; NR, not reported.

Table 2 Methodological characteristics of included studies

Reference (first author and year)	Study duration (months)	Population	Primary outcome(s)	Base intervention	Additional motivational interviewing intervention used	Motivational interviewing delivery	Attention control	Motivational interviewing fidelity	Results
Woollard, 1995 (29) (low dose)	4.2	Adults with hypertension	Blood pressure	GP usual care	One single face-to-face counselling session, followed by 5 x 15 min telephone sessions every 4 weeks. Goal was to change diet, alcohol, smoking and physical activity behaviours	Nurse	No	No	No change in weight or blood pressure, decrease in alcohol (164 g week ⁻¹ , <i>P</i> < 0.05), decrease in sodium (33 mmol per 24 h, <i>P</i> < 0.05). Physical activity and smoking behaviours not described
Woollard, 1995 (29) (high dose)	4.2	Adults with hypertension	Blood pressure	GP usual care	Six 45-min individual face-to-face counselling sessions. Motivational interviewing to change diet, smoking and activity behaviours	Nurse	No	No	Decrease in body weight (1.7 kg, <i>P</i> < 0.05), decrease in systolic pressure (6 mmHg, <i>P</i> < 0.05), decrease in diastolic pressure (5 mmHg, <i>P</i> < 0.05), no change alcohol or sodium intake. Physical activity or smoking behaviours not described
Smith, 1997 (36)	4	Older obese women with type 2 diabetes	Adherence, HbA1c, weight loss	16-session behavioural weight-loss programme	Three individual motivational interview sessions (in addition to behavioural weight-loss programme)	Psychologist	No	No	Decrease in weight (no significant difference between groups). Intervention group had greater attendance (<i>P</i> = 0.01), completed more diaries and better glucose control (<i>P</i> = 0.05)
Mhurchu, 1998 (28)	3	Patients with hyperlipidaemia	Diet knowledge, intake and lipid levels	Standard dietary care	Adapted MI for use by non-specialists applied over three sessions. Dietary counselling also provided at each visit	Dietitian	No	Yes (audiotaped and coded using adapted coding tool)	Decrease in fat and energy intake in both groups. No significant differences between groups for weight, daily nutrient intakes, total and HDL cholesterol, and triglycerides
West, 2007 (25)	18	Overweight women with type 2 diabetes	Weight loss, HbA1c	42-session behavioural weight-loss programme and attention control	Five 45-min MI sessions every 3 months (all participants received 42-session weight-control programme)	Psychologist	Yes (health education sessions)	Yes (weekly review of audiotaped sessions using 'standardized' coding)	Intervention group lost more weight at 6 (<i>P</i> = 0.01), 12 (<i>P</i> = 0.02) and 18 (<i>P</i> = 0.04) months. Glycaemic control was better in the intervention group at 6 months (<i>P</i> = 0.02). African-American women lost less weight compared with Caucasian women
Elliot, 2007 (22)	12	Firefighters	Physical activity, diet behaviours	Test results only	Four face-to-face sessions of a mean of 42 min, with the possibility of 5 h of additional contacts	Counsellor	No	Yes (10% of tapes were evaluated using Motivational Interviewing Skill Code)	MI intervention group had less weight gain (<i>P</i> < 0.05), increased fruit and vegetables consumption (<i>P</i> < 0.05), increased number of sit-ups per minute (<i>P</i> < 0.05)
Carels, 2007 (20)	6	Obese sedentary adults	Weight loss	Behavioural weight-loss programme with stepped care	Upon completion of a 20-session behavioural weight-loss programme, those who failed to meet weight-loss goals (weight reduction by 10%) were randomized to MI or no-MI groups. 45- to 60-min individual face-to-face sessions were undertaken until weight-loss goals were achieved	Psychology Students	No	Yes (25% of sessions randomly coded using Motivational Interviewing Treatment Integrity Code)	MI intervention group lost more weight (<i>P</i> < 0.05), increased planned physical activity (58 min week ⁻¹ , <i>P</i> < 0.05). No between-group differences in change of physical fitness or macronutrient intake

Table 2 Continued

Reference (first author and year)	Study duration (months)	Population	Primary outcome(s)	Base intervention	Additional motivational interviewing intervention used	Motivational interviewing delivery	Attention control	Motivational interviewing fidelity	Results
Brug, 2007 (37)*	NR	Adults with type 2 diabetes	Diet	Dietitians with no MI training	Trained dietitians randomized to receive MI training and recruited up to 10 patients each. Patients had an initial 30- to 45-min face-to-face counselling session followed by 3-4 15-min follow-up sessions	Dietitians	No	Yes (first 15 min of two sessions audiotaped and scored using Motivational Interviewing Treatment Integrity Code)	MI patients showed increase in fruit intake ($P=0.03$). Both groups reported significant decrease in BMI, waist circumference, HbA1c and saturated fat intake
Greaves, 2008 (23)	6	Adults with BMI $>28.0 \text{ kg m}^{-2}$	Weight loss, physical activity	Print education materials	Up to 11 individual MI sessions over 6 months. Both face-to-face and phone contacts were used with a mean duration of 34 min per contact	Health Promotion Counsellors	No	Yes (interview transcripts coded using Behaviour Change Counselling Index)	A significantly higher proportion of those in the intervention group achieved 5% weight loss (24% in intervention vs. 7% in control). No significant increase was found in physical activity
Hardcastle, 2008 (24)	6	Obese adults	Coronary heart disease risk	Usual care (health promotion leaflet)	Up to five individual sessions for 20-30 min over 6 months	Physical Activity Specialist/ Registered Dietitian	No	Yes (analysis of consulting transcripts)	Significant decrease in BMI and increase in physical activity in intervention group. Intervention group also had reduced blood pressure and cholesterol
Befort, 2009 (19)	4	Obese African-American women	Weight loss	16-session behavioural weight-loss programme	Four 30-min sessions (two face-to-face, two phone)	Student Psychologist	Yes (health education sessions)	Yes (all sessions taped, 25% selected for review and assessed by fidelity check(ist))	No significant differences between groups for body weight, BMI, programme adherence or dietary behaviours. Both groups lost significant weight, decreased energy intake and increased fruit and vegetable. Both groups experienced significant reductions in motivation
Armit, 2009 (18)	3	Inactive adults	Physical activity	GP 'usual care'	One 30-min individual counselling session followed by three 10- to 15-min phone calls over 12 weeks	Exercise Scientists	No	No	Small decrease in BMI at 12 weeks in MI group compared with an increase in the control group. MI group also showed non-significant increase in proportion reaching physical activity guidelines at 12 weeks (42% vs. 26%)
DiMarco, 2009 (21)	3	Overweight adults	Weight loss	Eight session-guided self-help behavioural weight-loss programme	Two 60-min MI sessions at first and fifth treatment sessions	Student Psychologist	Yes	Yes (audiotapes reviewed)	Intervention group had a decrease in BMI ($P < 0.001$), as well as an improvement in eating concern and control over-eating

*Not included in meta-analysis. BMI, body mass index; GP, general practitioner; HDL, high-density lipoprotein; MI, motivational interviewing.

health counsellors and exercise scientists. The delivery mode of motivational interviewing varied from individual face-to-face to telephone and group sessions. Three studies (18,19,29) used face-to-face motivational interviewing at an initial consultation and provided follow-up via telephone. In seven of the 11 studies (19,20,22–25,28), a motivational interviewing fidelity measure was used in order to ensure treatment integrity. This was most commonly performed by evaluating tapes of the intervention session using the Motivational Interviewing Treatment Integrity Code (38), or the Motivational Interviewing Skill Code (39). The dose of motivational interviewing, calculated as a product of the number of motivational interviewing sessions multiplied by mean session duration, ranged from 50 to 323 min. The comparison conditions varied from usual care, to print materials, to attention control. Three studies (19,21,25) employed an attention control condition, where persons in this placebo condition receive a treatment that mimics the amount of time and attention received by the treatment group. This is to control for any impact that individual attention from a healthcare professional might produce. Motivational interviewing was used in five studies (19–21,25,36) as an adjunct to a behavioural weight-loss programme, which traditionally involves 16–24 treatment sessions over 6 months with a team of healthcare professionals.

Quality assessment

The quality of trials according to the Jadad *et al.* score (32) was moderate to low (Table 3). Nine trials (18–20,22–25,28) reported allocation concealment and blinding was reported in eight (18,19,22–25,36,37) of the 13 studies. Common sources of potential bias included research staff not blinded to the treatment groups, non-reporting of intention-to-treat analysis and unclear description of randomization. All trials adequately described dropouts, except one (29).

Effect of motivational interviewing on body mass

A total of 1448 participants were included in the 11 studies reporting a mean change in body mass. There were 801 participants who underwent the motivational interview intervention and 651 control comparator participants. Studies were grouped based on reported weight outcome (BMI in kg m⁻² or body weight in kg) and pooled to assess effect estimates. Using a random-effects model, the SMD for the effect of motivational interviewing on reduction in body mass was -0.51 (95% CI $-1.04, 0.01$; $P = 0.053$; Fig. 2). Significant heterogeneity was observed in this pooled estimate ($I^2 = 95.0\%$; $P < 0.001$). There was no evidence of publication bias with Begg and Mazumdar's test ($P = 0.30$), Egger *et al.*'s test ($P = 0.62$) or with visual

Table 3 Study quality characteristics

Reference (first author and year)	Inclusion/exclusion criteria	Randomization described	Allocation concealment	Blinding	Intention to treat analysis	Loss to follow-up described	Loss to follow-up, %	Jadad scoring
Woolard, 1995 (29)	NR	Unclear	Unclear	NR	Unclear	Yes	12	1
Smith, 1997 (36)	Yes	Unclear	Unclear	Outcome technicians	Unclear	Yes	27	2
Mhurchu, 1998 (28)	Yes	Yes	Yes	NR	Unclear	Yes	14	3
Brug, 2007 (37)	Unclear	Unclear	Unclear	Participants, MI fidelity scorer	Unclear	Yes	32	1
Carels, 2007 (20)	Yes	Yes	Yes	NR	Yes	Yes	16	3
Elliot, 2007 (22)	Yes	Yes	Yes	Researchers	Unclear	Yes	20	3
West, 2007 (25)	Yes	Yes	Yes	BWLP team, researchers	Unclear	Yes	8	3
Greaves, 2008 (23)	Yes	Yes	Yes	Researchers/statisticians	Yes	Yes	18	3
Hardcastle, 2008 (24)	Yes	Yes	Yes	Statistician, practice nurse	Yes	Yes	35	3
Armit, 2009 (18)	Yes	Yes	Yes	Participants	Yes	Yes	15	3
Beafort, 2009 (19)	Yes	Yes	Yes	Participants	Yes	Yes	23	3
DiMarco, 2009 (21)	Yes	Unclear	Unclear	NR	Unclear	Yes	33	2

BWLP, behavioural weight-loss programme; MI, motivational interviewing; NR, not reported.

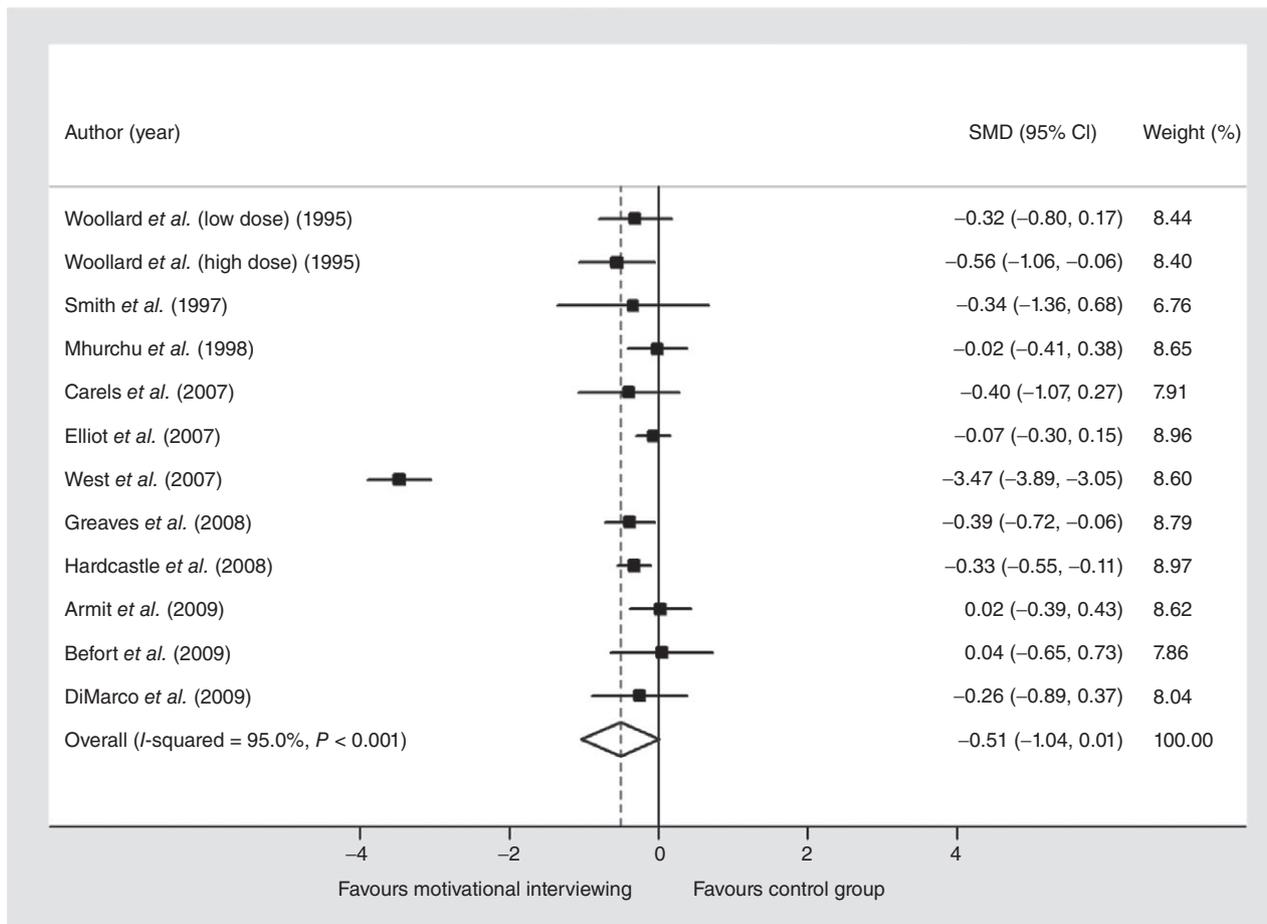


Figure 2 Meta-analysis of standardized change scores in body mass in motivational interviewing intervention group compared with control. Degree of shading corresponds with study weighting in random-effects model. SMD, standardized mean difference.

inspection of the funnel plots. Using stratified analysis limited to studies with weight loss as the primary outcome, a larger reduction in weight was observed compared to studies where weight loss was not the primary outcome of interest (SMD = -0.83 [95% CI -1.91, 0.25] vs. -0.13 [95% CI -0.29, 0.21] respectively; Table 4).

Effect of motivational interviewing on body weight and body mass index

We further analysed the body weight and BMI data separately using the WMD and a random-effects model, allowing for mean differences to be analysed in separate units (kg and kg m⁻²). The WMD for the decrease of body weight between those in the intervention group and those in the control group was statistically significant at -1.47 kg (95% CI -2.05, -0.88; $P < 0.01$; $I^2 = 54.7\%$; Fig. 3). In the analysis of BMI, the WMD was -0.25 kg m⁻² (95% CI -0.50, 0.01; $P = 0.058$; $I^2 = 24.5\%$; Fig. 4). There was significant heterogeneity in studies reporting change in body weight;

however, heterogeneity was not significant in studies reporting BMI.

We further stratified studies based on whether or not weight was the primary outcome, the duration of treatment intervention (less than or greater than 6 months), whether an attention control was used, whether there was a treatment fidelity measure used and whether motivational interviewing was used as an adjunct to a behavioural weight-loss programme. These results are summarized in Table 4. Having weight as the primary outcome, duration of treatment longer than 6 months, the use of an attention control, a treatment fidelity measure and the use of a behavioural weight-loss programme, each were associated with an increased effect of the motivational interviewing treatment on body mass. Given the heterogeneity observed in the pooled body mass studies above, further analyses were conducted in an attempt to identify potential sources. Upon meta-regression of these variables, none were found to be significant sources of heterogeneity, although results are limited by the small number of available studies.

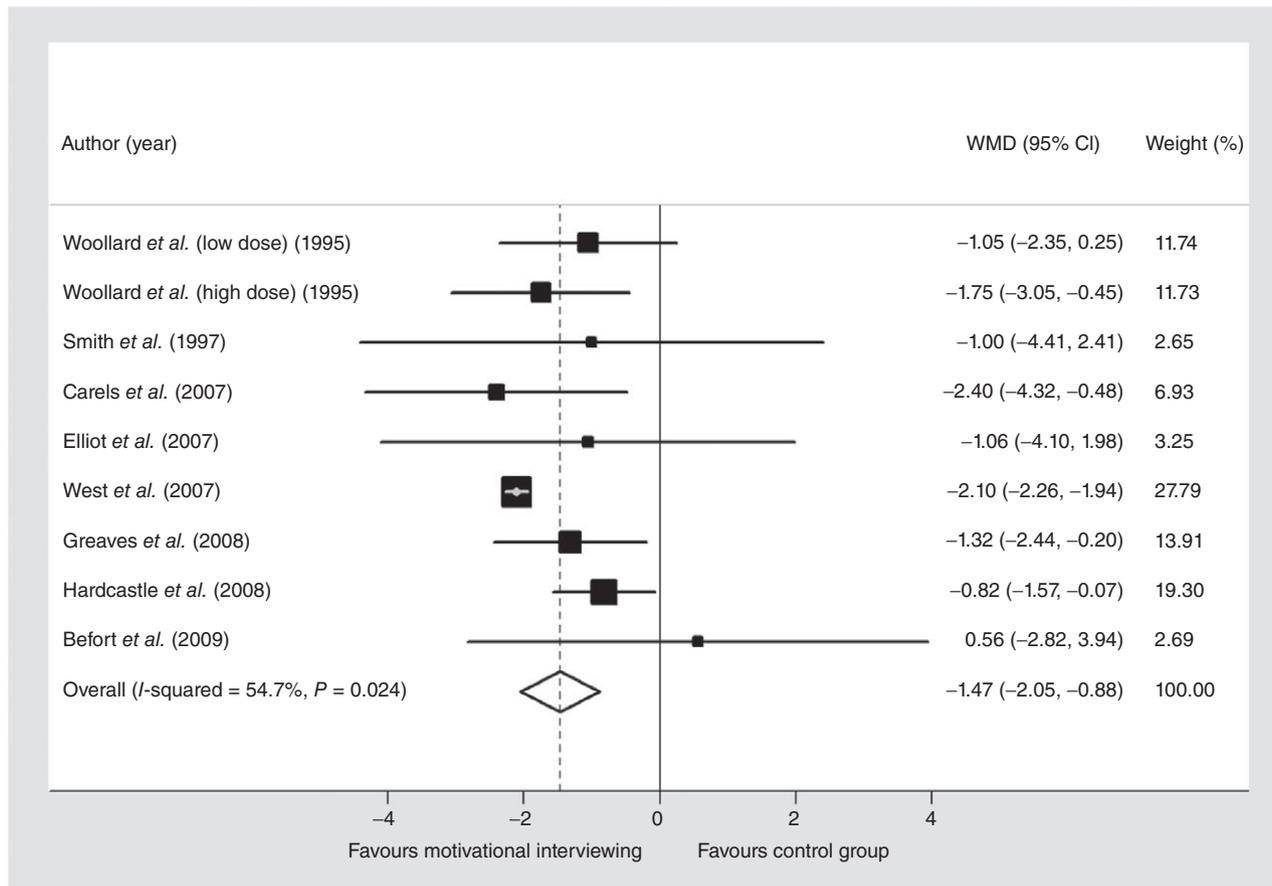


Figure 3 Meta-analysis of weighted change scores in body weight (kg) in motivational interviewing group compared to control. Degree of shading corresponds with study weighting in random-effects model. WMD, weighted mean difference.

Discussion

We identified 12 RCTs examining the effect of motivational interviewing on weight loss in overweight and/or obese people. One study was excluded due to the interventionists, not the participants, being randomized and the available weight data were incomplete. Using the SMD to meta-analyse 11 of these trials, motivational interviewing demonstrated an effect size of 0.51 SDs for reducing body mass over and above the control interventions. This is similar to the effect size of 0.56 SDs found in a prior motivational interviewing review and meta-analyses (9) of four studies in the area of diet and exercise, and would be considered a 'medium' effect size by Cohen's criteria (40). Some reviews have published effect sizes as large as 0.72 (13); however, their inclusion criteria were not as strict and there was an assumption of homogeneity between study estimates. More specifically, in studies reporting body weight as an outcome, the WMD showed motivational interviewing significantly enhanced weight loss (1.47 kg greater than control treatments). This signifies that those in the intervention groups lost 1.47 kg over and above those in the

control groups, it should be noted that in several cases both the intervention and control groups lost significant amounts of weight. In studies reporting change in BMI, motivational interviewing interventions showed an enhanced, but non-significant reduction of 0.25 kg m⁻² over controls.

It is important to note that several prominent large-scale studies have included motivational interviewing as a component of their lifestyle weight-loss interventions, most notably the Diabetes Prevention Program (41) and the Look AHEAD trial (42). However, these studies did not meet our inclusion criteria and thus were not included in this meta-analysis. These trials used a range of methods in their lifestyle modification interventions. It was not the goal of these trials to examine the unique effects of motivational interviewing, but rather a combination of interventions and strategies within a 'lifestyle intervention'. Studies included in this meta-analysis only differed on the use of motivational interviewing. However, this speaks to the importance of evaluating motivational interviewing for weight loss and to evaluate its unique effects independent of other behavioural strategies.

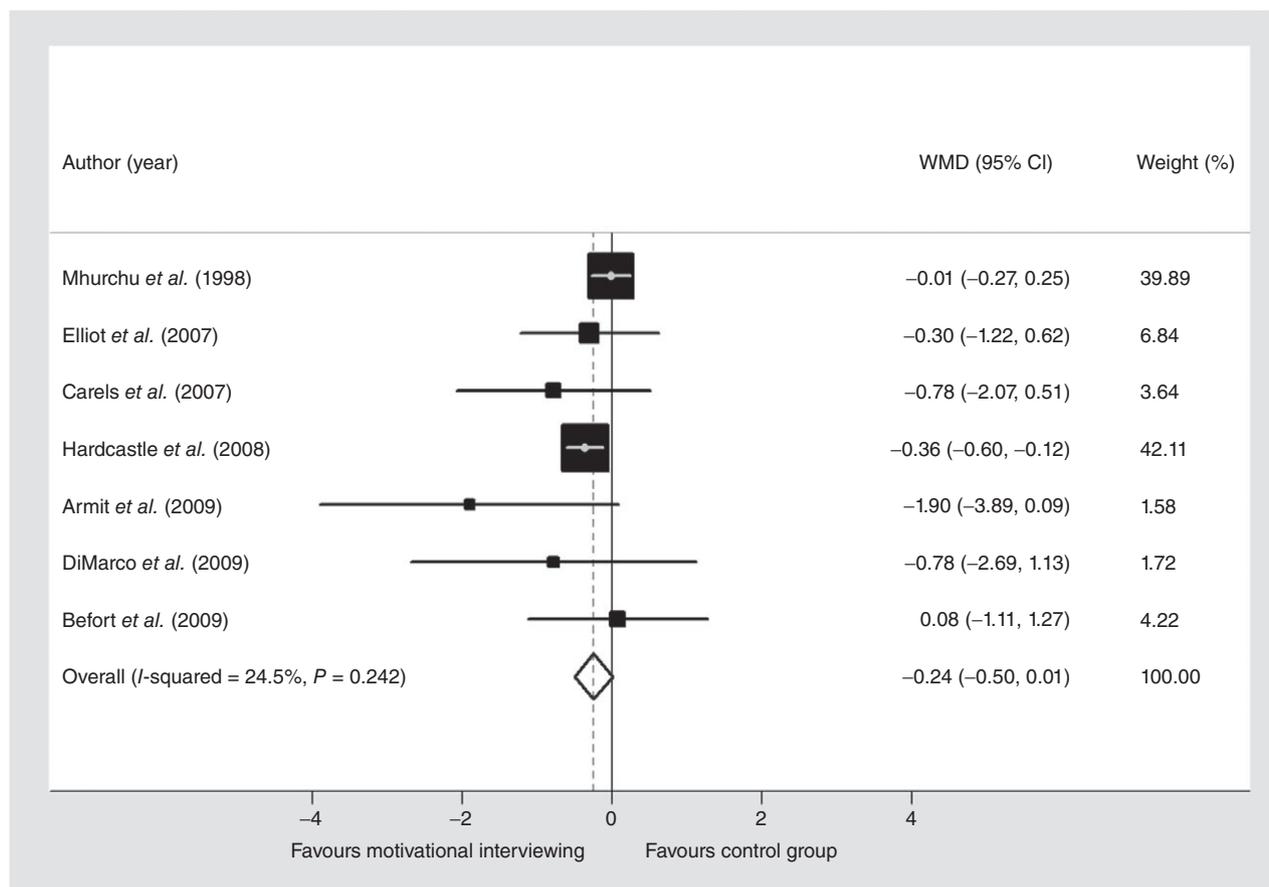


Figure 4 Meta-analysis of weighted change scores in body mass index (kg m^{-2}) in motivational interviewing group compared to control. Degree of shading corresponds with study weighting in random-effects model. WMD, weighted mean difference.

Table 4 Stratified analysis

	Standardized mean differences (95% CI)	Weight (kg) Weighted mean difference (95% CI)	BMI (kg m^{-2}) Weighted mean difference (95% CI)
Overall pooled estimate	-0.51 (-1.04, 0.01), <i>n</i> = 12	-1.47 (-2.05, -0.88), <i>n</i> = 9	-0.25 (-0.50, 0.01), <i>n</i> = 7
Primary outcome	-0.83 (-1.91, 0.25), <i>n</i> = 6	-1.47 (-2.25, -0.70), <i>n</i> = 6	-0.36 (-0.59, -0.13), <i>n</i> = 3
Secondary outcome	-0.13 (-0.29, 0.02), <i>n</i> = 6	-1.37 (-2.25, -0.49), <i>n</i> = 3	-0.26 (-0.79, 0.28), <i>n</i> = 4
≥6 months	-0.93 (-1.94, 0.08), <i>n</i> = 5	-1.57 (-2.33, -0.81), <i>n</i> = 5	-0.37 (-0.60, -0.14), <i>n</i> = 3
<6 months	-0.17 (-0.37, 0.03), <i>n</i> = 7	-1.25 (-2.11, -0.39), <i>n</i> = 4	-0.20 (-0.78, 0.38), <i>n</i> = 4
Attention control	-1.24 (-3.69, 1.21), <i>n</i> = 3	-1.33 (-3.69, 1.04), <i>n</i> = 2	-0.16 (-1.17, 0.85), <i>n</i> = 2
No attention control	-0.23 (-0.35, -0.11), <i>n</i> = 9	-1.19 (-1.68, -0.70), <i>n</i> = 7	-0.27 (-0.59, 0.04), <i>n</i> = 5
Fidelity measure	-0.70 (-1.52, 0.11), <i>n</i> = 7	-1.47 (-2.24, -0.70), <i>n</i> = 6	-0.39 (-1.22, 0.44), <i>n</i> = 2
Fidelity measure not employed	-0.18 (-0.41, 0.04), <i>n</i> = 5	-1.37 (-2.26, -0.48), <i>n</i> = 3	-0.25 (-0.58, 0.08), <i>n</i> = 5
MI and BWLP (vs. BWLP alone)	-0.90 (-2.55, 0.75), <i>n</i> = 5	-2.09 (-2.25, -1.93), <i>n</i> = 4	-0.40 (-1.19, 0.40), <i>n</i> = 3
MI without BWLP (vs. minimal intervention alone)	-0.22 (-0.37, -0.08), <i>n</i> = 7	-1.11 (-1.62, -0.60), <i>n</i> = 5	-0.25 (-0.58, 0.09), <i>n</i> = 4

BMI, body mass index; BWLP, behavioural weight-loss programme; CI, confidence interval; MI, motivational interviewing.

Achieving long-term, sustainable weight loss is difficult. The ‘medium’ effect on weight loss demonstrated by motivational interviewing interventions in our analysis is promising. A previous meta-analysis of weight-loss interventions

comparing diet only with diet and physical activity showed average changes of 1.64 kg or 1.24 kg m^{-2} after a combination of improved dietary and increased physical activity interventions (43). Similarly, in a recent systematic review

(44) of long-term non-pharmacological weight-loss intervention for adults with type 2 diabetes, Norris and colleagues found a pooled weight loss of 1.7 kg which translated to a reduction of 3.1% of baseline body weight among 517 subjects. Weight loss as low as 1 to 9 pounds (0.45–4.08 kg) has been shown to be associated with decreased mortality in overweight individuals with diabetes (45), whereas 3% decreases in weight have been shown to improve metabolic control significantly (46). Recently, it has been asserted that clinical evidence does not provide support for the existence of a clinically significant minimum level of weight loss that must be achieved to impart benefit (47). Additionally, many practitioners assert that at a minimum, the goal of obesity treatment is to prevent further weight gain (48). This ‘minimum clinical standard’ further supports the effectiveness of motivational interviewing as only two of the 11 studies (18,19) found no additional benefit of the intervention on weight loss.

In our stratified analysis, targeting weight loss as the primary outcome resulted in significantly more weight loss compared to studies not identifying weight loss as the primary outcome (instead, behaviour changes were the outcomes of interest; Table 4). When weight loss is not the primary outcome, targeting multiple behaviours such as physical activity, diet, and hypertension or diabetes treatment may saturate patients so that applying these behavioural principles to weight management becomes less of a priority; however, the small sample size and a degree of heterogeneity in this meta-analysis does not allow specific conclusions to be drawn. The notion of targeting the behaviour (e.g. diet and exercise) or targeting the outcome (e.g. weight loss) is vexing in clinical practice. It may be preferable to focus on prioritizing the greatest patient need, whether it is achieving successful behaviour change or enhancing weight-loss outcome.

Additional stratified analysis found duration of treatment longer than 6 months, the use of an attention control and ensuring motivational interviewing fidelity all increased the amount of weight loss in the intervention group. The one study (25) that demonstrated the greatest effect on weight loss (4.8 kg at 12 months) applied all of these factors and defined weight loss as the primary outcome. Such methodological rigour and focused effort may have enhanced the effectiveness of motivational interviewing on weight loss. If so, this protocol could be replicated by other studies to confirm this observation. Of importance, however, is that this study was also the longest in duration. Therefore, increasing the time taken to overcome the inertia of behaviour change using motivational interviewing may have contributed to the observed improvements in weight loss.

Of the studies reviewed, those demonstrating the greatest amount of weight loss employed motivational interviewing as an adjunct to group-based behavioural weight-loss pro-

grammes (19–21,25,36), which is considered by some to be the most effective non-surgical treatment available for obesity (49). This is further supported by the stratified analysis (Table 4), where the SMD was -0.90 in the studies using a behavioural weight-loss programme versus -0.22 in those studies using a minimal intervention. In other words, the difference between motivational interviewing plus behavioural intervention and behavioural intervention alone tended to be greater than the difference between motivational interviewing alone and minimal intervention control. In these studies, motivational interviewing appeared to improve adherence to the behavioural weight-loss programme. The degree of adherence to weight-loss interventions can be a strong predictor of weight loss. Smith *et al.* (36) observed significantly increased attendance by motivational interviewing participants at behavioural weight-loss programme sessions than controls ($P < 0.01$). In a study investigating the effect of weight management programme adherence on weight loss, Finley *et al.* (50) demonstrated that improved programme adherence enhanced absolute weight loss over 1 year. Given these improvements in retention, it seems possible that motivational interviewing may work to increase attendance to a behavioural weight-loss programme resulting in greater weight loss. However, in this systematic review there were a limited number of available studies thereby limiting the generalizability of this conclusion. It may be important to consider the base intervention to which motivational interviewing is applied.

In contrast, it is possible that standard motivational interviewing is not as effective among some ethnic minority groups. Befort *et al.* (19) failed to improve outcomes of a behavioural weight-loss programme, with motivational interviewing, for obese African–American women. Women in the motivational interviewing intervention group lost a mean of 2.6 kg, whereas women in the control group actually lost more weight, a mean of 3.2 kg. Similarly, West *et al.* (25) reported that African–American women lost 3.0 kg (compared with Caucasian women, who lost 4.5 kg) and appeared to have a diminished benefit from the addition of motivational interviewing. This highlights a potential need to make adaptations to the motivational interviewing approach for ethnic minority groups. It should also be noted that the participants in the included studies were predominantly female, so we cannot be certain whether motivational interviewing would be as effective in men. The low statistical power of the small number of studies, and study participants, in this analysis does not permit firm conclusions on these issues; however, it does warrant further research.

Sources of heterogeneity

A number of confounders may have influenced the moderate effect (-0.51 ; $P = 0.05$; Fig. 2) of motivational inter-

viewing on weight loss, including methodological and statistical heterogeneity. The I^2 test for statistical heterogeneity was significant in both the SMD in body mass and the WMD in body weight; therefore, cautionary considerations are required in interpreting this meta-analysis. Variations on the dose and duration of motivational interviewing, the use of motivational interviewing fidelity measures and whether weight loss was the primary outcome of the study were identified as potential sources of heterogeneity.

Previous reviews (9,13) have suggested that length and number of motivational interviewing sessions are positively associated with behaviour change. In one review (13) of studies with at least two motivational interviewing sessions and at least 60 min of contact per encounter, 81% of the studies showed significant positive effects. However, this review included studies predominantly from the addictions field, with few studies representing other health behaviours. In the present meta-analysis, the dose of motivational interviewing ranged from 50 to 323 min.

Ensuring the fidelity of motivational interviewing is a salient characteristic of studies examining this behavioural intervention. In this systematic review, three of the motivational interviewing studies failed to assess treatment integrity over the course of the intervention while seven of the 10 studies included a measure of motivational interviewing fidelity. There is a growing body of literature surrounding the use of coding systems. The Motivational Interviewing Skills Code (39) and the Motivational Interviewing Treatment Integrity Code (38) are both validated tools that have been developed and are widely used in other fields using motivational interviewing.

A number of limitations of the present analysis should be acknowledged. As discussed, one must consider the heterogeneity of dose, delivery and duration of motivational interviewing interventions. Half of the included studies lacked allocation concealment and/or blinding, which may introduce bias in the estimation of the effect of motivational interviewing. Six studies recruited less than 50 participants to each treatment group, and there were a relatively small number of studies included in the analysis. Furthermore, the use of varying outcome measures, such as body weight and BMI, limited the number of studies able to be stratified and reduced the ability to make inferences about potential sources of heterogeneity.

Despite these limitations, this meta-analysis includes the most recently published studies using motivational interviewing and is the first to use the PRISMA guidelines for systematic reviews (17). Although only a medium effect was observed, this review supports the effectiveness of motivational interviewing in weight-loss treatments. In order to draw firm conclusions regarding the effectiveness of motivational interviewing, there is a need to operationalize its implementation in order to reduce methodological heterogeneity. To really understand the benefit of motiva-

tional interviewing, it would be important to standardize the treatment. Results from this meta-analysis should be considered in future trial design; evaluating motivational interviewing as an adjuvant treatment in behavioural weight-loss programmes appears to warrant further exploration. Ensuring the use of a fidelity measure, an attention control and a follow-up of more than 6 months may also lead to improved trial design in this area.

The optimal dose and delivery of motivational interviewing for successful weight loss have yet to be determined and is an area for more investigation. Ensuring the fidelity of the intervention is essential for quality assurance and can improve the transparency of the implementation of motivational interviewing in interventions. It is also unclear which patients would benefit most from motivational interviewing. Recruiting ethnic minority and male participants in future studies will enable further examination of its effectiveness in these populations. Doing so may also confirm whether modifications to this counselling approach need to be made.

In conclusion, motivational interviewing appears to be a promising value add for weight-loss interventions in obesity management. It is consistent with recommendations from patients, healthcare providers and researchers for more 'patient-centred' approaches in health care, where the provider-patient relationship is seen as a partnership, rather than an expert-recipient one. It provides practitioners with a means of working with patients who are ambivalent about change. This meta-analysis suggests that motivational interviewing is a useful intervention in weight management and its effectiveness may be enhanced when applied alongside behavioural weight management programmes.

Conflict of Interest Statement

The authors declare no conflict of interest.

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