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**Title:** Systematic review of the use of financial incentives in treatments for obesity and overweight.

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**Key words:** Obesity, financial incentives, systematic review

**Running title:** Long-term Effects of Financial Incentives in Treatments for Obesity: A Systematic Review of Randomised Controlled Trials.

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### **Abstract:**

Nine studies met the criteria for inclusion in this systematic review of randomised controlled trials of treatments for obesity and overweight involving the use of financial incentives, with reported follow-up of at least one year. All included trials were of behavioural obesity treatments. Justification of sample size and blinding procedure were not mentioned in any study. Attrition was well described in three studies and no study was analyzed on an intention to treat basis. Participants were mostly women recruited through media advertisements. Mean age ranged from 35.7 to 52.8 years, and mean body mass index from 29.3 to 31.8kg/m<sup>2</sup>.

Results from meta-analysis showed no significant effect of use of financial incentives on weight loss or maintenance at 12 months and 18 months. Further sub-analysis by mode of delivery and amount of incentives although also non-statistically significant, suggested very weak trends in favour of use of amounts greater than 1.2% personal disposable income, rewards for behaviour change rather than for weight, rewards based on group performance rather than for individual performance and rewards delivered by non psychologists rather than delivered by psychologists.

### **Introduction**

Advice on lifestyle modification has been widely recommended as first line treatment for obesity (1) as well as keeping its place as adjuvant therapy to

pharmacological and surgical obesity treatments. Tailoring this advice to suit the individual patient's needs in keeping with evidence based medicine is mostly based on behavioural approaches to weight control. Behavioural approaches to weight control aim to modify environmental influences through the concept of controlling the antecedent environment and/or the consequent lifestyle behaviours such as eating and physical activity (2,3), and the use of rewards falls into the latter category. There has been a recommendation for the use of (non-food) rewards in obesity treatments (4). Some reviews have studied the effects of economic or financial incentives in improving compliance in a variety of patient behaviours (5-7). Wall et al (8) more specifically studied the effects of financial incentives in modifying eating behaviour, but the outcome of interest was not necessarily weight loss. To date, there is no systematic review of evidence for the effects of financial contingencies in the behavioural treatment of obesity, necessitating this review. Unlike some similar reviews, (5-8) this review focused on the use of only guaranteed incentive schemes rather than non-guaranteed schemes (e.g. lottery methods). This was to avoid possible confounding from participants' perception of uncertainty in receiving the financial incentive.

## **Methods**

The methods used in this review were based on a pre-specified protocol with the aim of reviewing randomized controlled trials (RCTs) of obesity treatments using financial incentives as rewards contingent on weight loss or other behaviour change, with outcome data including weight change, and follow up for a minimum of one year. Participants in all included studies were to be adults (age>18years) with a BMI  $\geq 28\text{kg/m}^2$ . This cut-off was based on a previous review by one of the authors, Avenell

et al (9), based on the cut-off for pharmaceutical trials. Allowance was to be made for ethnic groups with specific data available to justify a lower cut off (10).

### Literature search

We updated the search done (with appropriate modifications in keeping with database changes to search terms/symbols) by Avenell et al (9) in Medline, Embase, Cinahl, PsychINFO, Cochrane Database of Systematic Reviews, Cochrane register of controlled clinical trials and Sportdiscus. Biweekly citation alerts to new studies were set up in all but the Cochrane databases where we were unable to do this. We searched relevant journals (International Journal of Obesity, Addictive Behavior, Eating Behavior, Journal of Consulting and Clinical Psychology, Journal of Applied Behaviour Analysis, Journal of Health Psychology and Professional Psychology) using words like ‘financial’, ‘contract(ing)’, ‘money’, ‘monetary’, ‘pay(ment)’, ‘reward’, ‘contingency’, ‘motivation’, ‘reinforcement’ and ‘obesity’ or ‘overweight’. We also searched for authors who had published in this field (results of preceding searches and reviewing reference lists) in the above databases and journals, and reviewed reference lists of retrieved articles and books. Titles and abstracts were scanned and full text articles of identified relevant studies retrieved. Full text articles were also retrieved where the decision to include or exclude was unclear from abstracts alone. Authors were contacted for studies where there was a stated intention to report results at a latter follow-up date that may have allowed for study inclusion.

### Selection of studies

Both reviewers were independently involved in identifying and retrieving likely articles. To be included in the review however, both reviewers had to agree to relevance of the study to the review according to the *a priori* criteria.

#### Quality assessment of studies

Consensus also had to be reached by both reviewers on the quality score of the study using the quality assessment form from Avenell et al (9).

#### Data abstraction

The data abstraction form from Avenell et al (9) was used. Data were abstracted by one researcher and checked by the second researcher and consensus reached in areas of differences through discussion. Authors were contacted for further details as required. Where only graphical weight data were provided, images were scanned onto computer and analysed.

The monetary value of the incentive (maximum possible reward) calculated as a percentage of personal disposable income at the year of publication was generated using published data for the appropriate country (11,12).

All weight data were converted to kg where necessary, and calculations undertaken in kg. Missing standard deviations (SD) were computed using the linear regression plot of the SD of the mean change in weight on the absolute mean change for weight already derived in Avenell et al (9):

SD of weight change =  $5.915 + (0.283 \times \text{absolute value of mean change in weight})$ .

#### Data analysis

Studies were entered into Review Manager by author and year, and accompanying alphabet characters (see explanations under ‘other observations’ in table 1) to allow for different within-study groups comparisons. Statistical meta-analysis was undertaken to determine the effect size of financial incentives by calculating the weighted mean difference (WMD) for weight change and 95% confidence interval (CI). Individual within-study groups differing only on the provision of financial incentives were compared, but for studies where groups were combined for meta-analysis, this is stated under the ‘other observations’ column in table 1. Further pre-specified subgroup analyses were planned to compare duration of use of incentives above and below the median intervention period; monetary value of incentive (as a percentage of personal disposable income) above and below the median of the maximum value; reward based on weight change and reward based on other behaviour change; reward for group performance and reward for individual performance; reward by psychologist and reward by non-psychologist. Sub group analysis was also planned to compare ethnic groups at high risk for metabolic syndrome with those who were not. Heterogeneity across studies was explored and where  $I^2$  was <50% a fixed effects approach was used. A random effects approach was used where the  $I^2$  was >50 % (13).

## **Results**

### **Result of search strategy**

Of the 45,589 publications identified (see figure 1), 38 were identified as RCTs of obesity treatments using financial incentives. Of these, nine studies met criteria for inclusion in the review, of which seven were used for meta-analysis. Mahoney 1974 (17) was not included in meta-analysis because the weight related

outcome reported was ‘percentage of subjects maintaining or improving weight’ rather than ‘weight change’. Wing 1981 (20) was not included in meta-analysis primarily because a cross-over method was employed in the delivery of refund and there was no control group to which a possible combination (as done for some studies) of the two cross-over treatment groups could be compared.

(suggest figure 1 here)

Many studies involving financial incentives in obesity treatments were not indexed in the databases we searched. Most retrieved studies were the result of hand searching of journals and following reference lists of authors cited for behavioural treatment of obesity or in reviews of effects of financial incentives in a more general health related behaviour context.

#### Quality of included studies

All but two studies stated random allocation without giving description to inform concealment of allocation. (14,15) Blinding of outcome assessors was not mentioned in any of the included studies. Drop outs and withdrawals were adequately described in Jeffery 1983, Jeffery 1984 and Saccone 1978 (14-16), not mentioned by Mahoney (17), and partially reported in all other studies. No studies were analyzed on an intention to treat basis.

#### Description of included studies and participants

All nine studies (see table 1) were trials of behavioural obesity treatments. One study was conducted in Canada (18) and all others in the United States. Two

studies were conducted in the 70s (16,17), four in the 80s (14,15,19,20) and three the 90s (2,3,18).

Source of recruitment of participants was not clear in the study by Saccone and Israel (16). Jeffery et al (14) used an existing pool of volunteers only, while Jeffery et al (15) compared participants from an existing pool of volunteers with those from fresh media recruitment. The remaining studies recruited participants through media advertisements suggesting that the population represented in this review may be individuals with high levels of motivation to lose weight.

Mean age of participants in all studies ranged from 35.7 to 52.8 years, and mean body mass index from 29.3 to 31.8kg/m<sup>2</sup>. None of the studies had values to suggest any participants were morbidly obese, and studies generally excluded persons with significant medical conditions.

There were more female participants in all studies except one all-male study (14) with participants recruited from an already existing trial pool of men.

Socioeconomic status was not indicated in most studies, but where indicated, female participants were of lower socioeconomic status than male participants (14,15).

Ethnicity was only referred to in two studies, where percentage of participants who were white in the various groups were given (2,3) and ranged from 71% to about 98%. Smokers were excluded from one study (2). No other studies described the smoking status of participants.

(suggest table 1 here)

#### Description of interventions:

In two studies the financial incentives were freely supplied (2,3). All other studies used financial incentives provided from and based on participants' deposited money. Refunds were made for weight loss or compliance with behaviour change or

attendance at treatment sessions. Some studies compared refund for weight change with refund for compliance with behaviour change (16,17,19).

All included studies were coordinated by psychologists, and treatment groups received behavioural, diet and exercise advice. Some treatment groups had other motivators such as provision of food (2) and provision of personal exercise trainers (3). Monitoring varied in the different studies and could be provided by the participants themselves, psychologist, or some other individual. In one study, (16) reward by a psychologist was compared with reward by a non-psychologist.

Duration of use of incentives ranged from eight weeks (17) to 18 months (2). Wing et al (20) made out contingencies using pre-written cheques from participants and Jeffery et al (2) made cheques out to participants at weekly weigh ins. All other studies delivered the financial incentive in cash except Jeffery et al (3) which did not explicitly state the form of the financial incentive. The monetary value of the incentive (total refundable or maximum possible reward) calculated as a percentage of personal disposable income at the year of publication ranged from 0.2% PDI (18) to 10.2% PDI (2), with median at 1.2% PDI (15).

Where the incentive was used for less than or more than a year, further estimation was done to aid comparisons using simple *pro rata* calculations, and making allowance for situations where the size of the incentive payment changed over time. These additional estimates of the monetary value of financial incentives used then ranged from 0.5 % PDI (18) to 8.8% PDI (14), with a median value of 3.1% PDI (20).

The longest reported follow-up period was 30 months in a later publication (32) to Jeffery 1993 (2). The lowest recorded overall study rate of attrition was 1.1% at 24 months due to death of one participant (14) while the highest overall attrition rate

of 57.9% at 13 months was reported by Wing 1981 (20), in which greater attrition (approaching significance  $p < 0.10$ ) was observed when the weight loss contract was in place than when an attendance contract was in place.

### Outcomes and Meta-analyses

Analysis was undertaken at 12-month, 18-month and 30-month follow-up (figure 2). No weight change data were available for 24-month analysis.

(Suggest figure 2 here)

The use of financial incentives was associated with a WMD weight change at 12 months of -0.4kg (95% CI -1.6 to 0.8kg), at 18 months of -0.7kg (95% CI -2.5 to 1.1kg), and at 30 months of 1.1kg (95% CI -1.3 to 3.4kg), compared with groups where financial incentives were not used in treatment (see figure 2).

At one year, the use of financial incentives of monetary equivalents less than 1.2% of personal disposable income was associated with a WMD for weight change of 0.0kg (95% CI -1.5 to 1.6kg) compared to groups without use of financial incentives (see figure 3). The use of monetary amounts equivalent to 1.2% PDI and above, was associated with a WMD change in weight of -1.1kg (95% CI -3.1 to 0.9kg) and -0.7kg (95% CI -2.5 to 1.1kg), compared to not receiving any financial incentive, at 12 months and 18 months respectively. Assuming use of financial incentives for one year in all studies, comparison of groups receiving financial incentives equivalent to less than 3.1% PDI to groups not receiving any financial incentive gave a WMD change in weight of -0.4kg (95% CI -1.7 to 0.9kg), and comparison of groups receiving 3.1%PDI and above to groups not receiving any financial incentive gave a WMD change in weight of -0.9kg (95% CI -2.8 to 1.1kg).

(suggest figure 3 here)

Comparing groups receiving greater than 1.2% PDI equivalent of money with groups receiving less than 1.2% PDI monetary equivalents gave a WMD for weight change of -0.7kg (95% CI -4.1 to 2.7kg), which was the same as comparing groups receiving monetary equivalents greater than 3.1% PDI with groups receiving monetary equivalents less than 3.1% PDI (assuming financial incentive use for one year in all groups).

At 12 months, treatment with financial incentives for less than 16 weeks (the median intervention period) was associated with a WMD weight change of -0.8kg (95% CI -2.3 to 0.7kg) compared to treatment without financial incentives (see figure 4).

(suggest figure 4 here)

Use of financial incentives for more than 16 weeks was associated with a WMD weight change of 0.4kg (95% CI -1.7 to 2.5kg) compared with no financial incentive. It is worth noting that the financial incentive was usually discontinued after about 16 -24 weeks or became less regular in the longer studies.

In conducting the planned sub-analysis of effect of use of financial incentives by source of money used as incentives, we had insufficient data to allow us compare both the freely supplied incentive groups and the groups receiving refunded deposits (see under description of interventions above) at the same time. We have therefore conducted and reported these analyses separately at 18 months and 12 months respectively, as follows. WMD weight change was -0.7kg (95% CI -2.5 to 1.1kg) at 18 months comparing groups with freely supplied financial incentives with control or comparison groups not receiving financial incentives. Comparing groups with the financial incentives provided by participants as refundable deposits with no financial

incentive control or comparison groups gave a WMD weight change was -0.5kg (95% CI -1.8 to 0.9kg) at 12 months.

Comparison of groups rewarded for weight versus groups rewarded for behaviour change or attendance was associated with a WMD weight change of 1.0kg (95% CI -1.5 to 3.4kg) (fixed effects), and 3.9kg (95% CI -2.60 to 10.47) (random effects). Comparing groups rewarded by non-psychologists (such as a family member) to groups rewarded by psychologists, the WMD weight change was 3.0kg (95% CI -2.5 to 8.6kg). Comparing reward by psychologist to non-psychologist. A final comparison of groups with rewards based on group performance to groups with rewards based on individual performance gave a WMD weight change of -2.1kg (95% CI -5.4 to 1.2kg).

Sub-group analysis of ethnic groups at high risk of metabolic syndrome and of participants from lower socio-economic groups was not done due to insufficient data.

## **Discussion**

Results of the literature search demonstrate the need for hand searching as we found that many studies (included and excluded) were not indexed as RCTs of obesity interventions in the electronic databases, and were retrieved through hand searching. Although no language limitations were placed in our electronic database searches, all our studies were in English including a study with an added French translation (18). This might be because such studies were not indexed in our databases or are yet unpublished. All studies found in this review were conducted in North America which might limit the generalisability to other geographical population groups.

Strict criteria led to our exclusion of non-randomised or quasi-randomised studies or studies where it was not possible to isolate the effects of financial

incentives from other components of the intervention. We found that many studies did not provide important participant characteristics which led to our inability to conduct the pre-planned subgroup comparisons of ethnic groups at higher risk for the metabolic syndrome. This finding of inadequate reporting is similar to the findings of a review of quality of randomised trials in diet and exercise for weight loss (21). Concern has been expressed over the under-representation of vulnerable population groups in studies involving the use of economic incentives for conditions requiring sustained behaviour change (like obesity), compared to studies involving simple preventive care (such as immunization) (6). The implication of the above, especially in view of recent evidence indicating that patient specific sub-groups within the same socio-economic income bracket may respond differently to varying levels of treatment modifiers (22), is that we have very limited evidence of the specific impact of financial incentives on socio-economically and ethnically diverse populations that could be translated into practice aimed at meeting the objective of equity in health care (7). This is particularly important as obesity in developed countries, for example, has a higher prevalence amongst the lower socioeconomic groups, and is reported to be more resilient to diet-induced weight loss treatment and maintenance among black than white ethnic groups (23, 24).

Sample sizes were not justified in any studies and most studies had very small sample sizes (implying low statistical power) and/or employed multiple factorial combinations with small samples. From the results of quality assessment of included studies, it is clear that future studies would need to be more explicit on randomisation procedure and blinding and conduct intention to treat analyses of results in keeping with recommendations for improving quality of randomised controlled trials in the CONSORT statement (25).

From our results, a very weak trend for more positive effects tended to be seen with the use of monetary amounts equivalent to 1.2% PDI and above. The choice of the amount frequency or method of administration of the financial incentives used was not justified in any study. This lack of linking or justification of the financial incentives with the targeted population was similarly reported by Kane et al (6).

Wing et al (20) involved the use of pre-written cheques of amount equivalent to 2.3% PDI and reported very high attrition rates (57.9% at 13 months) and uncertainty as to whether the attrition was due to the contracting procedure or the length of contracting period. The above, compounded by the lack of cost-effectiveness calculations in any of our included studies, also observed by Kane et al (6), poses a limitation in our being able to inform on the cost effectiveness of the use of financial incentives in behavioural obesity treatments (there was no reported use of financial incentives with pharmacological or surgical obesity treatments to allow for comparisons done in this review). Future studies could be informed by discrete choice experiments to estimate money or equivalents that can serve as sufficient motivation for use as rewards and include cost effectiveness data. A more recent study shows that the trend is now to include financial incentives as part of a multi-component intervention (26) as recommended for obesity treatment (27).

One excluded study (28) used a financial contract independently as a treatment condition rather than as an adjuvant treatment or motivator. The authors reported a very high attrition rate (58%) in a first experiment, and total decline by all assigned to that condition in the second experiment, the typical reason being financial. It is recommended that a financial incentive should not be used as a therapy in itself but as adjuvant to treatments for obesity.

The follow up period for future studies should be long enough to allow for long term effects of treatment to be studied. Most of our excluded studies were rejected on this premise. It is important to note the trend towards a reversal of effects observed in groups with 30 month follow-up data (collected 12 months after all treatment was stopped in these groups) (2) in view of contemporary arguments over the sustained effectiveness of treatments following withdrawal of extrinsic motivators in treatments for conditions requiring long term lifestyle changes (6). One study tried to address this by providing an intrinsic angle (i.e. self administered rewards) to the extrinsic use of financial incentives (17), although we were unable to determine the effect of this due to lack of weight data for a meta-analysis. Future studies could incorporate aspects aimed at addressing these in the study design.

Although no statistically significant differences were observed in meta-analysis, the confidence intervals for some comparisons were wide enough to include clinically important weight differences (of approximately 5% weight loss) in one year. For example, a very weak trend was observed in favour of reward for behaviour change than reward for weight. The study by Mahoney (17) (not included in meta-analysis for reasons discussed under ‘results of search strategy’ above) also reported percentage of subjects maintaining or improving weight loss to be highest in the group rewarded for behaviour or habit change (70%), followed by the group rewarded for weight (40%), and least in the self-monitoring only (no-reward) group (37.5%). Wing et al (20) reported no difference in the effect of financial incentives between contracting for weight loss and contracting for attendance at meetings (no group was rewarded for behaviour change). Other very weak trends from meta-analysis were in favour of rewards based on group performance rather than rewards based on individual performance, which may have relevance to some commercial groups, and

rewards delivered by non psychologists than rewards by psychologists. Further randomised controlled trials informed by qualitative research or a theoretical framework, such as that provided by discrete choice experiments, could help in establishing the roles of these attributes to the design and delivery of obesity treatments involving the use of financial incentives, as is recommended in the design and evaluation of complex interventions (29).

Although there is the possibility of interactions existing between other motivators used in some studies (e.g. personal trainers and food provision) and financial incentives, we are unable to account for the effect(s) of these within the scope of this review. This observation of the potential for confounding by other intervention components with economic incentive use on consumers' preventive behaviour was also documented by Kane et al (6). Even though we found a very weak trend for more effect to be observed when a behaviour change contingency was in place than a weight change contingency in this review, it is more challenging to objectively measure behaviour change (being usually self-reported) than to measure weight change in everyday practice. There is also difficulty in explaining the motivational aspect of contingency management when both target behaviour and consequences or reward comes from the same patient as noted by Foreyt et al, (30), i.e. should the source of the financial reward for obesity treatments come from or outside the patients' pockets? Our review incorporated both studies with financial incentives freely supplied to participants and studies with financial incentives provided by participants, and this appeared not to have led to any significant differences in effectiveness in the population represented (interpreted with caution as we acknowledge the limitation in using results of sub-analysis conducted at different time frames for these groups as discussed earlier). How the source of financial

incentives used as rewards in obesity treatment might impact on participants from lower socio-economic groups or those who may be less motivated than those represented in this review remains to be explored through qualitative studies and trials.

Although this review is limited by the sample sizes of the individual studies, and generalisability because all trials were from North America, there were very weak trends in favour of the use of financial incentives under certain situations when compared to others. Other similar and less focused systematic reviews have reported significantly greater effectiveness when financial incentives are used in patient treatment and preventive behaviour than when not used (6-8). It is reported that financial incentives tend to be more effective than other methods of improving compliance (7). We found that some studies involved the use of other motivators e.g. food provision or use of personal trainers but made no attempt to compare the use of financial incentives with any of these motivators because unlike financial incentives, no other motivator or treatment enhancer was delivered contingent on participants' performance.

Financial incentives were reported by Giuffrida and Torgersen (7) to be more cost-effective than alternative interventions for achieving greater compliance in a dental health screening and referral programme, and to be likely cost effective in situations where substantial treatment benefits accrue to the larger society. In view of the externalities to obesity treatments (such as current attributable costs to the National Health Service in the UK (31), a study of the cost effectiveness of financial incentives in obesity treatments compared to current practice or other intervention(s) is recommended. Particular areas of study design to be addressed include sample size justification and reporting of long term outcomes. Future studies should be informed

by qualitative research and discrete choice experiments to measure attributes such as amount, frequency and method of administration of financial (or other) incentives that can serve as sufficient motivation for use as rewards.

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Figure 1: Flow diagram for locating RCTs for systematic review.

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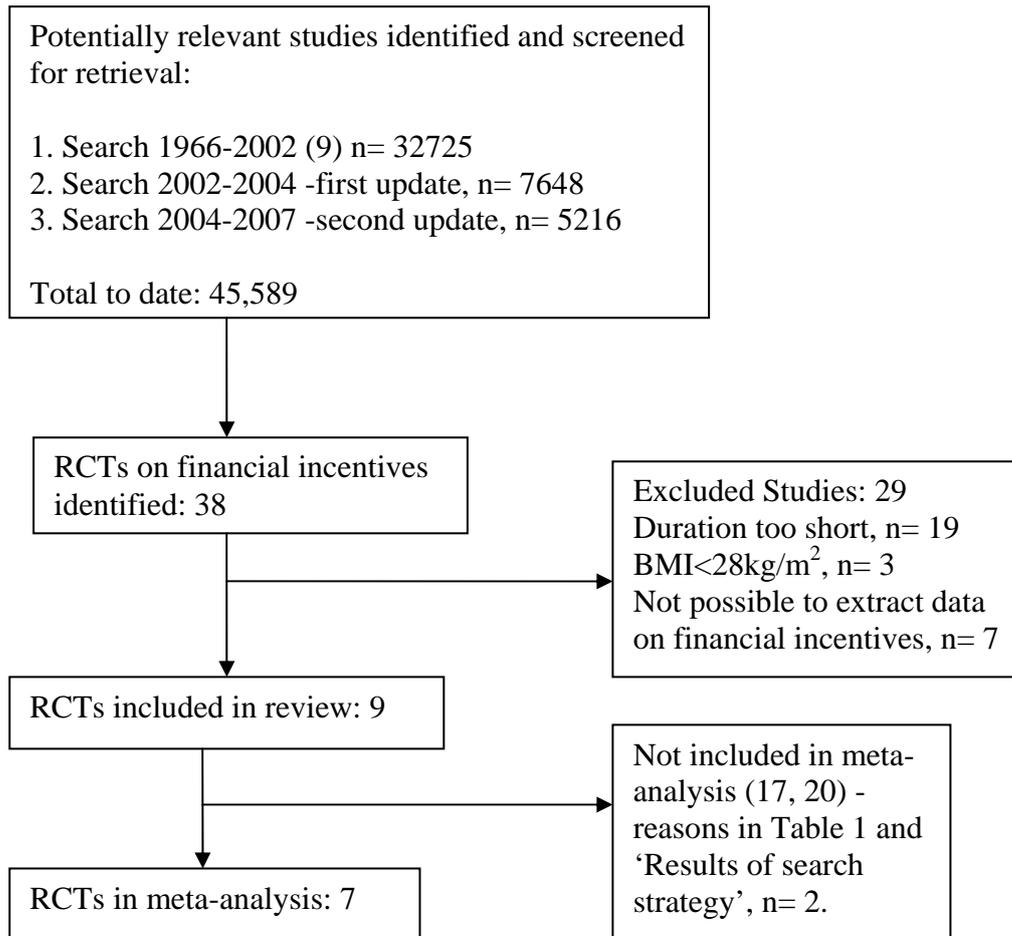


Table 1: Details of included studies

Study (Author and Year)	Participants	Interventions	Outcomes	Other observations
Cameron 1990	<p><i>Country:</i> Canada  <i>Source:</i> local media and telephone screening.  <i>Age</i>(mean) years: M= 42.4, F= 41.7;  <i>Sex</i>(n): M= 6, F=169;  <i>Weight</i>(mean) kg: M= 99.0, F= 77.7;  <i>BMI</i>(mean) kg/m<sup>2</sup>: M= 31.7; F= 29.3  <i>SES</i> (% employed outside home): M= 81.3, F= 66.9  <i>Other:</i>  <i>Average number of years of education:</i> M= 15.3, F= 13.5</p>	<p><i>All:</i>  L= mailed 15 printed lessons on diet, exercise and behaviour; and \$21 refunded for attendance at 1 year follow-up.   <i>Duration:</i> 15 weeks   <i>Groups by assignment:</i>  i) received L after other groups  ii) L only  iii) L+ W (weigh ins and face to face consultation as needed) n= 12  iv) L+ H (homework- one page record of changes made and weight; telephone consultation as needed) n= 12  v) L+W+D (\$21 deposit refunded for homework and attendance) n= 12  vi) L+H+D n= 10  vii) L+H+W n= 12  viii) L+H+W+D n= 9</p>	<p><i>Follow up:</i> 16 months   <i>Overall attrition rate</i> (females only): 17.6%  Overall drop out rates given but results based only on outcomes from participants meeting the minimum of a set of criteria used to determine active participation in study.   <i>Outcome:</i>  1. Weight (and BMI)</p>	<p>Delayed treatment control group ‘i’ excluded from analysis.   Main analysis done for female participants (numbers given for different groups in meta-analysis are for treated females only).  Description of results for male participants did not allow for extraction of data on financial incentives.   There is a possibility that the planned refund for all groups at one year affected the role of ‘D’ as a financial incentive.   Comparisons for all meta-analyses:  a = v vs iii  b= vi vs iv  c= viii vs vii</p>

<p>Jeffery 1983 Jeffery 1984a</p>	<p><i>Country:</i> USA <i>Source:</i> ineligibles from an existing trial pool <i>Age</i> (mean) years: 52.8 (35-57) years. <i>Sex:</i> 100% male <i>Weight</i>(mean) kg: 100.2 <i>BMI</i>(mean) kg/m<sup>2</sup>: 31.8 <i>SES:</i> (Hollingshead two factor index of social position)= 33.1 <i>Others:</i> <i>Age of onset</i> (mean) = 26.7 years. <i>% with prior weight program experience</i>= 27</p>	<p><i>All:</i> Educational programme on behaviour, diet and exercise; weekly group meetings; calorie and exercise records.</p> <p><i>Duration:</i> 16 weeks</p> <p><i>Groups assignment:</i> by mode of refund (for weight) / initial deposit. i) n= 16: individual/ \$30 ii) n= 15: individual/ \$150 iii) n= 14: individual/ \$300 iv) n= 17: group/ \$30 v) n= 14: group/ \$150 vi) n= 13: group/ \$300</p>	<p><i>Follow up:</i> 12 and 24 months</p> <p><i>Overall attrition rates:</i> 3.4% at 12 months and 1.1% at 24 months</p> <p><i>Outcomes:</i> 1. Weight 2. % at least achieving contracted goal.</p>	<p>Heavier individuals happened to be in groups with larger monetary deposits.</p> <p>Results used only for subgroups analysis.</p> <p>Comparisons in figure 3 (use of financial incentives of 1.2% PDI or more vs use of financial incentives &lt;1.2% PDI at 12 months) a= ii &amp; iii vs i b= v &amp; vi vs iv</p> <p>Comparisons in figure 4 ( group versus individual delivery) a= iv vs i b= v vs ii c= vi vs iii</p>
<p>Jeffery 1984b</p>	<p><i>Country:</i> USA <i>Source:</i> <u>Self-referred</u> through newspapers (SR) and <u>existing trial pool</u> (PS)</p>	<p><i>All:</i> \$150 deposit, instructional programme on diet, exercise and behaviour; weekly group meetings;</p>	<p><i>Follow up:</i> 12 months</p> <p><i>Overall attrition rate:</i> 2.6%</p>	<p>Female participants were of lower socioeconomic status (higher score on Hollingshead two factor index).</p>

	<p><u>A) SR group</u>  <i>Numbers:</i> M= 28; F= 31  <i>Age (mean) years:</i>  M= 44.3; F= 44.5  <i>Weight (mean) kg:</i>  M= 105.1; F= 84.0  <i>BMI(mean) kg/m<sup>2</sup>:</i>  M= 32.6; F= 31.5  <i>SES (Hollingshead):</i>  M= 29.5; F= 43.2</p> <p><u>B) PS group</u>  <i>Numbers:</i> M= 27; F= 29  <i>Age (mean) years:</i>  M= 52.3; F= 50.3  <i>Weight (mean) kg:</i>  M= 106.5; F= 82.5  <i>BMI(mean) kg/m<sup>2</sup>:</i>  M = 33.0; F= 30.5  <i>SES (Hollingshead):</i>  M= 28.5; F= 42.3</p>	<p>individual weight loss objectives (13.6kg for men, and 9.1kg for women).</p> <p><i>Duration:</i> 16 weeks</p> <p><i>Groups assignment:</i>  by recruitment source and pattern of refund (for weight).  i) SR; complete refund at first visit.  ii) SR; fixed weekly \$30 refunds.  iii) SR; increasing weekly refunds from \$5 to \$75.  iv) PS; complete refund at first visit.  v) PS; fixed weekly \$30 refunds.  vi) PS; increasing weekly refunds from \$5 to \$75.</p>	<p><i>Outcome:</i>  1. Weight</p>	<p>Further randomisation of willing participants into either of two optional maintenance programmes. Success at initial weight loss significantly associated with maintenance programme enrolment. Sub-group analysis showed women in intensive maintenance group did better than men.</p> <p>Comparisons in meta-analyses  a= ii &amp; iii vs i (males)  b= v &amp; vi vs iv (males)  c= ii &amp; iii vs i (females)  d= v &amp; vi vs iv (females)</p>
Jeffery 1993	<p><i>Country:</i> USA  <i>Source:</i> newspaper, radio and mailed invitations.  <i>Age (mean) years:</i> 35.7-38.5  <i>Sex:</i> ratios not given  <i>Weight(mean)kg:</i> 88.1-92.3  <i>BMI(mean) kg/m<sup>2</sup>:</i> 30.8-</p>	<p><i>Duration:</i> 78 weeks</p> <p><i>Groups by assignment:</i>  i) n=40, no treatment control  ii) n=40 Standard behavioural treatment</p>	<p><i>Follow up:</i>  12/18/30 months.</p> <p><i>Overall attrition rates:</i>  13%/15%/12%</p> <p><i>Outcomes:</i></p>	<p>No contact with any groups between 18 months and final follow-up at 30 months.</p> <p>Comparisons in meta-analyses</p>

	<p>31.1  <i>SES</i> (% non college graduates): 35.0 - 58.5%)  <i>Others:</i>  <i>Ethnicity</i> (% white): 87.5-97.5  <i>% Married</i>: 65.0-75.6</p>	<p>(SBT) with 20 weekly meetings and weigh ins, then monthly meetings and weekly weigh ins till 18 months  iii) SBT and food provision(FP), n=40  iv) SBT and financial incentives(FI) for weight from \$2.50 to \$25/week, n=41  v) SBT and FP and FI, n=41</p>	<ol style="list-style-type: none"> <li>1. weight (BMI)</li> <li>2. perceived barriers to abstinence</li> <li>3. caloric intake from fat</li> <li>4. total caloric intake</li> <li>5. physical activity levels</li> </ol>	<p>a= iv vs ii  b= v vs iii</p>
Jeffery 1998	<p><i>Country</i>: USA  <i>Source</i>: media  <i>Age</i>(mean) years: 40.0-42.6;  <i>Sex</i> (%female) 79-86;  <i>Weight</i>(mean)kg: 84.7-87.7;  <i>BMI</i>(kg/m<sup>2</sup>): 30.6-31.5;  <i>SES</i> (% college graduates and above): 65-83;  <i>Others:</i>  <i>Ethnicity</i> (% white): 71-88  <i>% Married</i> = 52-68;  <i>% with prior weight program experience</i>: 45-71.</p>	<p><i>Duration</i>: 24 weeks  <i>Groups by assignment</i>:  i) n= 40, standard behavioural treatment(S) with diet and exercise, caloric intake diaries and weigh-ins. Progress reviews and group discussions.  ii) n= 41, S+ supervised thrice weekly walk sessions(E)  iii) n= 42, S+ E+ personal trainer to remind and walk with participants(T)  iv) n= 37, S+ E+ financial</p>	<p><i>Follow up</i>:18 months  <i>Overall attrition rate</i>: 22%  <i>Outcomes</i>:</p> <ol style="list-style-type: none"> <li>1. weight change</li> <li>2. psychological status</li> <li>3. caloric intake from fat</li> <li>4. total caloric intake</li> <li>5. physical activity levels</li> </ol>	<p>Comparisons in meta-analyses  a= iv vs ii  b= v vs iii</p>

		incentive for attendance at exercise sessions from \$1 to \$3 per walk session (I) v) n= 36, S+E+T+I		
Kramer 1986	<p><i>Country:</i> USA  <i>Source:</i> newspaper, worksite and another trial pool  <i>Age</i>(mean)years: 41.6-45.1  <i>Sex</i> (%female): 41-43  <i>Weight</i>(mean)kg: 81.2-82.1  <i>BMI</i>(mean) kg/m<sup>2</sup>: not given  <i>SES:</i> not indicated  <i>Other:</i>  % with prior weight programme experience: 39-52</p>	<p><i>All:</i>  prior 16 weeks behavioural treatment with use of financial contingencies across all groups based on average group weight loss.</p> <p><i>Duration:</i> 1year</p> <p><i>Groups by assignment:</i>  i) n= 28,(control) reminder letter at six months, \$100 immediate refund, and \$20 refund at one year.  ii) n= 29,(skill focused) monthly group meetings, diet and physical activity information, financial contingencies for attendance only  iii) n= 28, (weight focused) monthly group meetings, non-specific subject initiated discussions about maintenance, monthly financial contingencies for</p>	<p><i>Follow-up:</i> 1 year (this is also the maintenance phase of earlier weight loss treatment).</p> <p><i>Attrition rate:</i> 2.4%</p> <p><i>Outcomes:</i></p> <ol style="list-style-type: none"> <li>1. weight</li> <li>2. % initial weight loss maintained</li> <li>3. % subjects maintaining weight in groups.</li> </ol>	<p>Financial incentives used differentially during the maintenance phase. All subjects had had a 16-week intervention with uniform incentive use and only successful losers (<math>\geq 10\%</math> of body weight) during earlier intervention were offered enrolment in this maintenance programme.</p> <p>Comparison in main meta-analysis (figure 2), and figure 3 (use of financial incentives &lt;1.2% PDI vs no financial incentive at 12 months)  a= ii &amp; iii vs i</p> <p>Comparison in figure 4 (reward for weight loss vs reward for behaviour change at 12 months)</p>

		attendance and weight maintained- \$10 returned per meeting but withheld if weighing more than post treatment weight.		a= iii vs ii
Mahoney 1974	<p><i>Country:</i> USA  <i>Source:</i> Newspapers  <i>Age (mean)years:</i> not given  <i>Sex (n):</i> M= 3, F= 46  <i>Groups (numbers) amount overweight</i>  i. (n= 11) not given  ii. (n= 13) 23.4kg  iii. (n= 11) 21.5kg  iv. (n= 14) 14.0kg  <i>BMI (kg/m<sup>2</sup>):</i> not given  <i>SES:</i> not indicated.</p>	<p><i>All:</i>  \$35 deposit and \$5 for absences; and  S= self control program with weekly weigh ins and group meetings, and given pamphlets on dietary behaviour control   <i>Duration:</i> 8 weeks   <i>Groups by assignment:</i>  i) delayed treatment control  ii) S+ weekly self reward for weight  iii) S+ weekly self reward for habit improvement  iv) S only</p>	<p><i>Follow-up:</i> 12 months   <i>Attrition rate:</i> not given   <i>Outcomes:</i>  % subjects maintaining or improving weight loss.</p>	<p>Baseline differences with control group being significantly older; and obesity having been more chronic in groups 'ii' and 'iii'.   Delayed treatment control group 'i' excluded from analysis.   No weight change data to allow for meta-analysis.   Gift certificates also used but not clear how.   Study more directed at determining which of reward for weight or for behaviour is the more effective.</p>
Saccone 1978	<i>Country:</i> USA	<i>All:</i>	<i>Follow up:</i> 12 months	Delayed treatment control

	<p><i>Source:</i> unspecified (general community)  <i>Age(range)</i> years: 16-56  <i>Sex</i> (numbers): M= 1, F= 48  <i>Weight(mean) kg by groups:</i>  i.(n= 5) 82.8  ii.(n= 6) 73.7  iii.(n= 8) 84.2  iv.(n= 8) 79.1  v.(n= 7) 77.5  vi.(n= 8) 82.0  vii. (n=7) 79.6  <i>BMI(kg/m<sup>2</sup>):</i> not given  <i>SES:</i> not indicated</p>	<p>Basic program (P) on behaviour, diet and exercise.  <i>Duration:</i> 9 weeks    <i>Groups by assignment:</i>  i) delayed treatment control  ii) P+ weight monitoring by individual(W)  iii) P+ eating behaviour monitoring by individual(B)  iv) P+W +reward by therapist for weight at \$1.50/lb to maximum of \$5 weekly.  v) P+B+ reward by therapist for eating behaviour change on point scale from \$0 to \$5 weekly.  vi) P+W+ reward by significant other for weight loss as in 'iv'.  vii) P+B+ reward by significant other for eating behaviour change as in 'v'.</p>	<p><i>Attrition rate:</i> 19.2%    <i>Outcomes:</i>  1. Weight</p>	<p>group 'i' excluded from final analysis.    Comparisons for meta-analysis (figure 2) and figure 3 (use of financial incentives &lt;1.2% PDI vs no incentive at 12 months)  a= iv &amp; vi vs ii  b= v &amp; vii vs iii    Comparison in figure 4 (reward for weight loss vs reward for behaviour change at 12 months)  a= vi vs vii  b= iv vs v</p>
Wing 1981	<p><i>Country:</i> USA  <i>Source:</i> newspapers  <i>Age(mean) years:</i> not given  <i>Weight (mean) by groups:</i></p>	<p><i>All:</i>  \$225 deposit (15 checks, each for \$15).  Educational programme on</p>	<p><i>Follow-up:</i> 13 months    <i>Attrition rate:</i> 57.9%</p>	<p>Financial refund being in the form of bank checks thought to have negatively influenced the</p>

	<p>i= 93.5kg  ii= 88.6kg  <i>BMI(kg/m<sup>2</sup>):</i> not given  <i>Sex by groups:</i>  i) M= 3, F= 17  ii) M= 2, F= 16  <i>SES:</i> not indicated</p>	<p>behaviour, diet and exercise; weekly(monthly during maintenance) group meetings; self monitoring diaries and weight charts</p> <p><i>Duration:</i> 9 months</p> <p><i>Groups by assignment:</i>  i) first 8 checks returned weekly for attendance then remaining 7 returned monthly for weight loss  ii). first 8 checks returned weekly for weight loss and other 7 returned monthly for attendance.</p>	<p><i>Outcomes:</i>  1. Weight.</p>	<p>effectiveness of the financial incentive.</p> <p>Not included in meta-analysis because of the cross-over method employed in the delivery of refund.</p>
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Key:  
SES: socio economic status  
n: number  
M: males  
F: females  
vs: versus

Figure 2: Weight change in studies comparing use of financial incentives versus no financial incentive

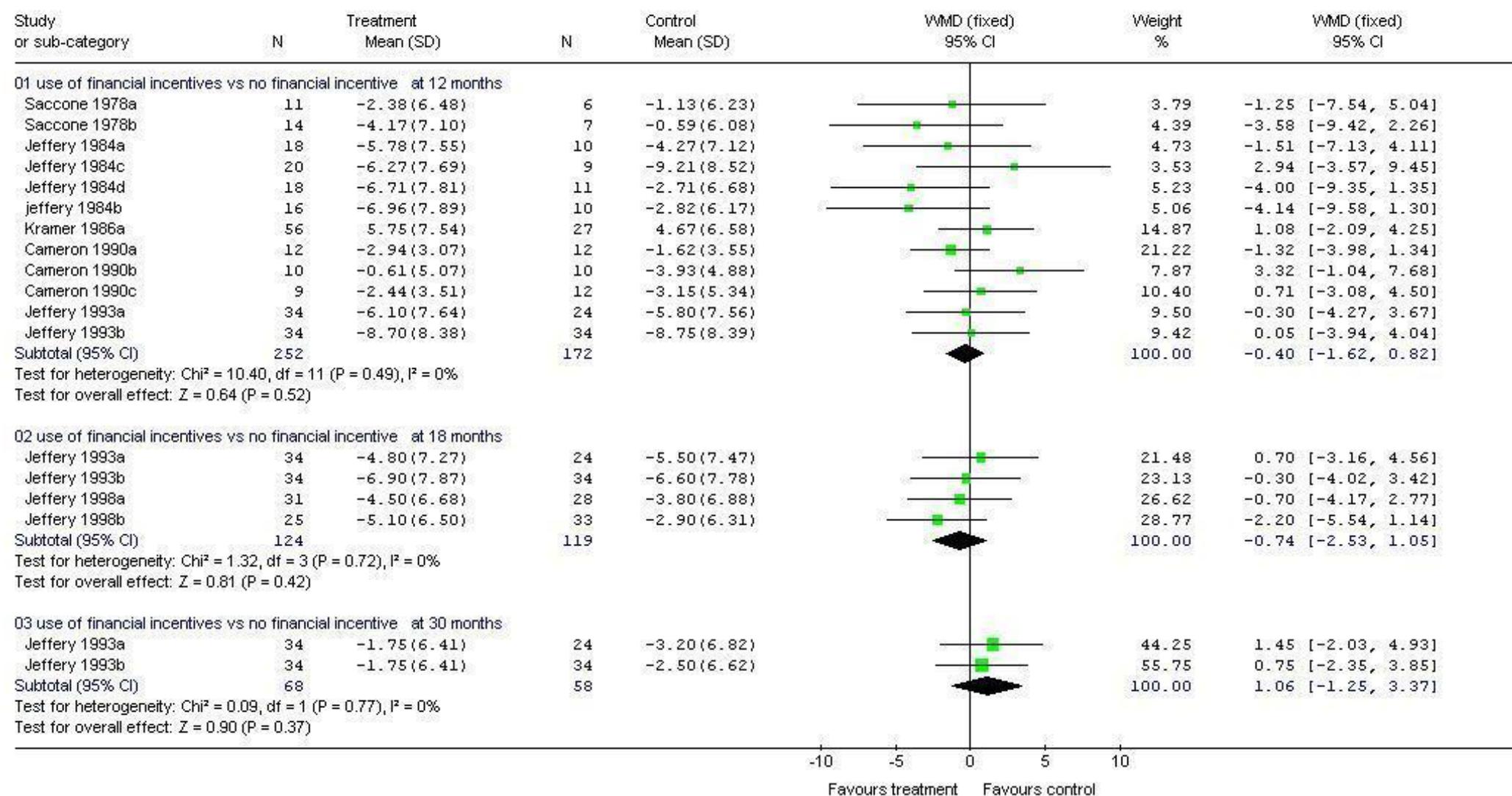


Figure 3: Effects of use of financial incentives compared by percentage PDI, and compared without financial incentives.

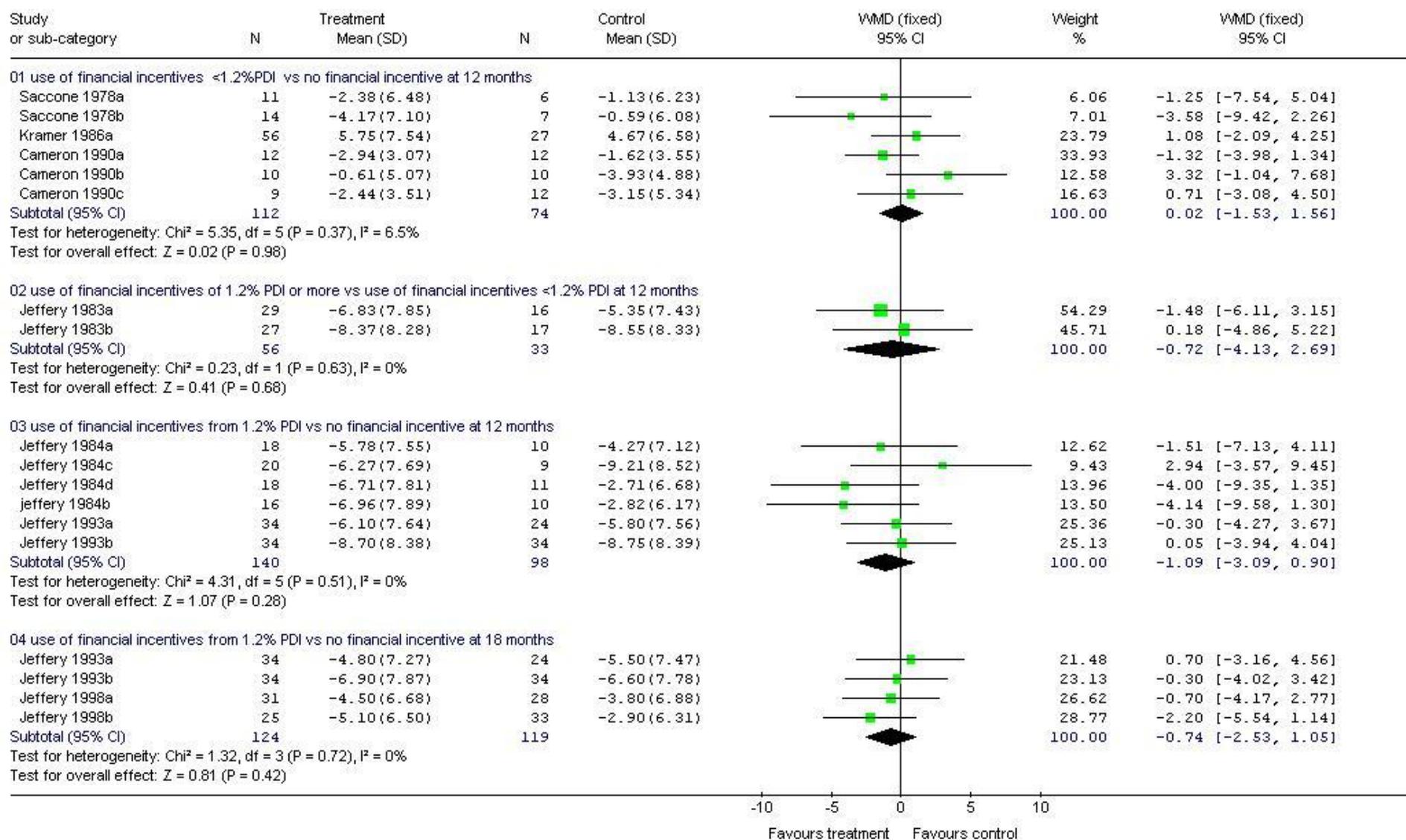


Figure 4: Comparisons of different methods of delivering reward using financial incentives

