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The effect of pair-based monetary contingency contracts for weight loss: Results from a randomized controlled pilot study

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What is already known?

- Continued provision of financial incentives supports motivation to lose weight, but poses ethical and moral dilemmas, including issues of coercion and fairness.
- Monetary contingency contracts, in which an individual deposits a sum of money that is returned contingent on weight loss, could alleviate some of the concerns associated with financial incentives, as they do not involve the offer of external financial gain.
- Evidence suggests that the use of monetary contingency contracts could boost weight loss and lower participant attrition in weight loss trials.

What does this study add?

- This study provides the first test of the effect of MCCs on adiposity reduction (as opposed to weight/BMI only).
- Pair-based monetary contingency contracts, in which individuals are put into pairs, with refund of monetary deposit contingent on the weight loss of the focal individual and their weight loss partner, have not been tested but could help individuals lose weight.
- Amount of money deposited significantly predicts degree of reduction in weight/BMI, with individuals who opted to deposit more money leading to significantly greater weight loss. The large effect size associated with the effect of pair-based MCCs on body fat mass suggests that it would be valuable to conduct a fully-powered randomized controlled trial.

Abstract

Objective: Monetary contingency contracts (MCCs), in which deposited money is returned contingent on weight loss, could promote weight/adiposity reduction. The present study piloted individual- and pair-based MCCs (when refunds are contingent on two individuals losing weight), and assessed effects on weight/body composition.

Methods: Seventy-seven participants with BMI > 25kg/m^2 were recruited. In a non-blinded randomised controlled trial conducted in a university laboratory setting, participants were randomised in pairs via a computer generated sequence to receive pair-based (P-PBR), individual (I-IR), individual with the support of a weight loss partner (P-IR) or no MCC (comparison). Refunds were contingent on weight loss after 4 and 8 weeks; weight/body composition were measured at 0, 4 and 8 weeks. Primary outcome measures are change in weight and fat mass.

Results: Seventy seven participants (P-PBR n=16; P-IR n=20; I-IR n=22; comparison n=19) were recruited. Deposit amount was significantly positively associated with reductions in weight/BMI. At 8 weeks, the P-PBR condition reduced fat mass more than all other conditions (ps < .05) and reduced weight/BMI more than the I-IR condition (p < .05).

Conclusions: The large effect of P-PBR on fat mass suggests it would be valuable to conduct a fully-powered randomized controlled trial of pair-based MCCs.

Keywords: Weight Loss; Monetary Contingency Contracts; Incentives

Despite substantial efforts to reduce overweight and obesity, the marked increase in prevalence during the last decade suggests little progress has been made[1]. Recently, the use of financial incentives as a motivational strategy for weight loss has been explored[2,3]. However, providing financial incentives poses ethical dilemmas, including issues of coercion

and fairness[4]. In light of these concerns, monetary contingency contracts (MCCs) could provide an alternative way of providing financial incentives. MCCs require an individual to choose an amount they are willing to deposit that is refunded contingent on weight loss. A recent meta-analysis shows that, unless they are removed, MCCs boost weight loss and lower participant attrition[5].

Typically, MCCs are administered individually, but pair-based contracts, involving individuals being paired up to form 'weight loss partners', may be more effective. In pair-based MCCs, both partners pay separate deposits with the refund of each deposit contingent on weight loss of the focal individual and their partner. Pair-based contracts have not been investigated[†] but may be effective for two reasons: Partners provide a source of social support additional to the existing social network, and preservation of one's social self, motivates people to avoid failure. Social self-preservation theory[6] predicts that pairs of strangers are less likely to take shared responsibility for successful and unsuccessful outcomes and more likely to blame their partner for failure than pairs of friends[7].

Beyond pair-based MCCs, the effect of MCCs in general on body composition has not been investigated, which is important because adiposity is a more accurate predictor of obesity related disease risk and morbidity than BMI[8,9]. Additionally, the conservation of lean mass is important in order to preserve resting metabolic rate, which can aid weight loss maintenance[10]. Thus, the aim of the present study was to pilot the delivery of pair-based MCCs to individuals with overweight, and to generate effect sizes associated with the influence of individual- and pair-based contracts on weight loss and body composition.

[†] Although pair-based contracts using pairs of friends/family members have been investigated by Zitter and Fremouw (Zitter RE, Fremouw WJ. Individual versus partner consequation for weight loss. Behavior Therapy. 1978;9(5):808-813), this is theoretically unlikely to be effective, as no additional source of social support would be provided, and people are likely to be less motivated to avoid failure in front of their friend/family member than a stranger. Indeed, in the previous study by Zitter and Fremouw, anecdotal reports suggested that one partner within the friend/family member-pairing often convinced the other to deviate from the weight loss regime.

Method

Participants

Participants with BMI greater than 25kg/m^2 who were motivated and safe to lose weight were eligible. The University of Leeds, School of Psychology Ethics Committee approved the research and all participants provided informed consent. Julious (2005)[11] recommends a sample of 12 per group for a pilot study based on feasibility (a round number divisible by 2, 3, 4 and 6) and precision about the mean and variance (after 12, the gain in precision becomes less pronounced). We thus recruited and retained 49 participants (see Online Supplementary Figure S1).

Design

Participants were randomly allocated to one of four conditions: Partner with pair-based refund (P-PBR); Partner with individual refund (P-IR); Individual weight loss with individual refund (I-IR); or Comparison condition. The researcher was not blinded and there was no concealment of allocation. All participants were randomised in pairs using a computer generated randomization sequence.

Manipulations

Participants in the two partner conditions were put into contact with another participant in the same condition as them, with whom they could liaise for weight loss support. However, only in the P-PBR condition was the refund contingent on weight loss by both partners. See Table 1 for a summary of each condition.

Procedure

Participants were required to attend 3 testing sessions (baseline, 4 and 8 weeks). Participants were set a goal to lose 4.56% of their baseline weight within 8 weeks (based on

weight losses achieved in previous behavioural interventions[12]). At baseline and 4 weeks, participants chose an amount to deposit, to be returned contingent on achieving half of the weight loss goal over the following 4 weeks (previous evidence suggests paying the deposit in more than on installment leads to more weight loss[5]). Printed weight loss materials were provided at baseline. For more detailed methodology, see Online Supplementary File 1.

Measures

Primary outcome measures are change in weight and body fat mass (kg). Secondary outcome measures are change in BMI, %fat and muscle mass (kg). These anthropometric measures were measured via bio-electrical impedance (BIA) analysis (Tanita BC-420MA) at baseline, 4 weeks and 8 weeks. Weight loss intention was also measured. Further details of the measures are presented in Online Supplementary File 1. Additional psychosocial and feasibility measures taken are not presented in this paper.

Statistical Methods

No outliers were identified (using Z-scores with cut off ± 3). Chi-square and MANOVA analyses were conducted for preliminary analyses. Data were analysed with missing data replaced using multiple imputation (see Online Supplementary File 2 for details). To produce pooled results, regressions were conducted to predict 8 week change in anthropometric outcomes from total amount of deposit paid and to compare the outcomes at follow up across groups controlling for baseline scores. No substantive differences between the intention-to-treat and per-protocol analyses mean that only the results of the intention-to-treat analyses are reported. All effect sizes were calculated using the n of each group and the p-value for the difference between groups (for effect sizes and confidence intervals for primary outcomes, see Online Supplementary File 2).

Results

Preliminary Analysis

Baseline characteristics are shown in Table 2. No differences were detected between conditions, or between completers and drop-outs in any demographics, intention or anthropometric measures (ps > .05). There were no differences in deposit amounts paid by completers and drop-outs or by participants in each condition. Dropout rates did not differ across individual conditions (see Online Supplementary File 2).

Main Analyses

Total deposit paid predicted 8 week reductions in weight (B = -0.066, SE =0.01, p = .001, CI = -0.10 to -.004) and BMI (B = -0.024, SE =0.01, p = .001, CI = -0.04 to -0.01). Deposit amount did not predict change in fat mass, %fat or muscle mass (ps > .05). There were no significant changes in anthropometric measures between groups after 4 weeks (ps > .05). After 8 weeks, the P-PBR condition significantly reduced their %fat by 2.19% and fat mass by 2.43kg, significantly more than the P-IR, I-IR and comparison conditions (ps < .05). The P-PBR condition reduced their weight and BMI significantly more than the I-IR condition, and maintained muscle mass significantly more than the P-IR condition (ps < .05). See Table 3 for changes in anthropometric measures across groups. Additional analyses presented in Online Supplementary File 2 (see Tables S3-S5 for results of additional body composition measures, Tables S6 and S8 for effect sizes and 95% CI's for primary outcome measures and Table S7 for results of regression analyses for comparisons between experimental conditions).

Discussion

This study is the first to investigate pair-based MCCs for weight loss. The principal finding was that the group receiving the pair-based contract experienced significant

reductions in markers of adiposity compared to participants receiving individual contracts (with or without the support of a partner) or no contract. Additionally, participants receiving pair-based contracts maintained their muscle mass significantly more than those receiving individual contracts with the support of a partner. This conservation of muscle mass in those receiving pair-based contracts may have contributed to the lack of significant weight loss effects in comparison to the individual contract and comparison conditions. A lack of previous evidence on the effect of monetary contracts on body composition changes makes it impossible to compare the effect on body composition with effects in previous studies.

Although retention rates (65.5% and 57.9% in the three intervention conditions and comparison conditions respectively) were lower than previous studies investigating weight loss MCCs (85.1% and 71.7% in intervention and comparison conditions respectively)[5], retention rates did not differ between MCC vs. no MCC conditions (p=.55). This shows that retention was not associated with the MCCs, but another factor (e.g., printed weight loss materials). Retention rates for the partner groups (72.2%) were notably higher than for the non-partner groups (56.1%) suggesting partner-based strategies may reduce attrition but, with limited power, the comparison was non-significant (p=.14).

Limitations of this study include the mainly female sample. The 8 week duration makes it difficult to infer long term effects. The use of BIA to assess adiposity may not be considered as accurate as 'gold standard' methods (e.g., dual energy X ray absorptiometry (DEXA)) and its accuracy can be affected by extraneous factors such as hydration levels, but BIA assessment of fat mass has been found to be highly correlated with that of DEXA[13]. The lack of control for physical activity could have confounded body composition results. Finally, although MCCs could alleviate some of the ethical concerns associated with incentives, other ethical issues could arise (e.g., negative emotions if money is withheld) that need to be monitored in future studies.

Conclusion

Pair-based MCCs potentially reduce adiposity. Encouraging individuals to pay higher deposits may lead to more weight loss. Fully powered trials are needed to further investigate the effect of pair-based and individual MCCs on weight loss and adiposity.

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Table 1: Manipulations for each experimental condition

	Provided with weight loss partner	Deposit refund contingency
P-PBR	✓	% of deposit refunded according to average % of weight loss goal achieved by both partners
P-IR	✓	% of deposit refunded according to % of weight loss goal achieved by individual only
I-IR	**x**	% of deposit refunded according to % of weight loss goal achieved by individual only
Comparison	**x**	Full deposit returned immediately after paying at baseline (to ensure individuals with similar baseline motivation were recruited into each condition)

Note. P-PBR = partner with pair-based refund, P-IR = partner with individual refund, I-IR = individual with individual refund

Table 2: Means and standard deviations for sample characteristics at baseline

	Mean (SD)				
	P-PBR	P-IR	I-IR	Comparison	Total
n	16	20	22	19	77
Age (years)	41.06 (13.08)	37.40 (12.01)	41.23 (11.78)	38.89 (12.28)	39.62 (12.11)
% Male	18.8	5.0	22.7	10.5	14.0
Weight (kg)	86.21 (21.98)	85.81 (14.80)	85.03 (16.61)	84.20 (16.16)	85.27 (16.99)
Body Mass Index	31.28 (7.93)	30.90 (4.32)	30.75 (4.45)	31.33 (4.97)	31.04 (5.33)
Percent body fat	37.96 (6.07)	39.18 (5.56)	36.87 (8.76)[a]	38.40 (5.53)	38.09 (6.62)[b]
Fat Mass (kg)	33.39 (13.42)	34.09 (10.31)	31.93 (11.41)[a]	32.82 (10.19)	33.03 (11.10)[b]
Muscle Mass (kg)	50.16 (10.19)	49.10 (6.16)	50.21 (11.05)[a]	48.80 (7.62)	49.55 (8.79)[b]
Weight Loss Intention[c]	6.40 (0.50)	6.33 (0.69)	6.58 (0.64)	6.72 (0.36)	6.51 (0.58)
Monetary Deposit at Baseline (£)	20.38 (7.46)	22.25 (14.74)	21.14 (6.71)	19.95 (6.29)	20.97 (9.38)
Monetary Deposit paid at 4 weeks (£)	13.17 (9.78)	12.00 (10.49)	11.53 (10.80)	N/A	11.88 (10.22)

Note. P-PBR = partner with pair-based refund, P-IR = partner with individual refund, I-IR = individual with individual refund [a] n = 21, [b] n = 76, [c] Scores range from 1 to 7

Table 3: Means and standard errors for change in anthropometric measures with regression statistics for all experimental conditions vs. comparison condition and means and standard deviations for monetary refund amounts

		P-PBR	P-IR	I-IR	Comparison	P-PBR vs. Comparison B (SE)	P-IR vs. Comparison B (SE)	I-IR vs. Comparison B (SE)
Weight (kg)	4 weeks	-1.54 (0.52)	-0.89 (0.28)	-1.06 (0.33)	-1.24 (0.35)	-0.237 (0.63)	0.384 (0.42)	0.200 (0.49)
	8 weeks	-2.30 (0.59)	-1.33 (0.39)	-0.24 (0.45)	-1.19 (0.47)	-1.075 (0.81)	-0.140 (0.60)	0.942 (0.63)
Body Mass Index	4 weeks	-0.55 (0.19)	-0.33 (0.11)	-0.41 (0.12)	-0.44 (0.13)	-0.118 (0.24)	0.087 (0.16)	0.011 (0.18)
	8 weeks	-0.86 (0.22)	-0.53 (0.15)	-0.13 (0.17)	-0.46 (0.19)	-0.405 (0.31)	-0.079 (0.24)	0.326 (0.25)
Percent body fat	4 weeks	-0.56 (0.57)	-0.64 (0.45)	0.15 (0.48)	-0.08 (0.34)	-0.443 (0.63)	-0.551 (0.58)	0.348 (0.60)
	8 weeks	-2.19 (0.66)	-0.03 (0.40)	0.16 (0.60)	-0.52 (0.44)	-1.639* (0.75)	0.460 (0.45)	0.750 (0.78)
Fat Mass (kg)	4 weeks	-0.89 (0.71)	-0.84 (0.62)	-0.24 (0.65)	-0.66 (0.46)	-0.244 (0.74)	-0.141 (0.87)	0.416 (0.81)
	8 weeks	-2.43 (0.57)	-0.71 (0.42)	0.14 (0.53)	-0.69 (0.63)	-1.749* (0.73)	-0.026 (0.89)	0.610 (0.84)
Muscle Mass (kg)	4 weeks	-0.36 (0.39)	0.17 (0.37)	-0.44 (0.43)	-0.53 (0.39)	0.197 (0.50)	0.683 (0.59)	0.252 (0.71)
	8 weeks	0.17 (0.56)	-0.95 (0.30)	-0.22 (0.62)	-0.97 (0.53)	1.213 (0.78)	0.027 (0.55)	0.791 (0.88)
Monetary Refund (£)[a]	4 weeks	13.67 (10.61)	12.60 (13.78)	11.60 (9.54)	N/A	-	-	-
	8 weeks	5.33 (4.27)	5.43 (8.68)	0.75 (1.77)	N/A	-	-	-

Note. Pooled statistics following multiple imputation. Although change data is presented for anthropometric measures, analyses were conducted with time 2 and time 3 outcome measures as dependant variables, and time 1 outcome measures as co-variates. For all regressions, the conditions were coded as 1 vs. 0. P-PBR = partner with pair-based refund, P-IR = partner with individual refund, I-IR = individual with individual refund. [a] Per protocol data presented for monetary refund * $p < .05$