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TITLE PAGE

TEXT MESSAGES WITH FINANCIAL INCENTIVES FOR MEN WITH OBESITY, A RANDOMIZED CLINICAL TRIAL

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KEY POINTS

Question: Do text messages with or without financial incentives promote weight loss in men with obesity?

Findings: In this randomized trial that included 585 men with obesity, text messaging with behavioral messages combined with a financial incentive resulted in a 5% weight loss at 12 months, compared to weight loss of 3% for text messaging alone and 1% for the control group. The difference in weight loss was statistically significant for the comparison between text messaging with financial incentives and the control group, but not between the text messaging alone and the control group.

Meaning: In men with obesity, a 12-month intervention consisting of text messaging with financial incentives resulted in modest but statistically significant weight loss, compared to control.

ABSTRACT

IMPORTANCE

Effective weight loss interventions are needed for men with obesity.

OBJECTIVE

To determine whether an intervention that combined text messaging with financial incentives attained significant weight loss at 12-month follow-up, compared to a control group. To determine whether an intervention of text messaging alone attained significant weight loss at 12-month follow-up, compared to a control group.

DESIGN, SETTING, and PARTICIPANTS

An assessor-blinded randomized clinical trial conducted in Belfast, Bristol and Glasgow areas in the UK. 585 men with body mass index (BMI) ≥ 30 kg/m^2 were enrolled between July 2021 and May 2022. Final follow-up occurred June, 2023.

INTERVENTIONS

Participants were randomly assigned to either 12 months of behavioral focused text messages combined with financial incentives (N=196), 12 months of behavioral focused text messages alone (N=194), or a control group (N=195). The financial incentive consisted of a monetary reward that was lost if weight loss targets were not met. All participants received weight management information and a pedometer at baseline.

MAIN OUTCOME(S)

The two primary outcomes are within-participant weight change expressed as a percentage of baseline weight at 12 months comparing the text messaging with financial incentives versus control group and comparing the text messaging alone versus the control group (minimum clinically important difference: 3%). The P value for statistical significance was defined as P<0.025.

RESULTS

Of 585 men (mean age 50.7 (standard deviation (SD): 13.3) years; mean weight: 118.5 kg (SD: 19.9), mean BMI: 37.7 kg/m^2 (SD:5.7)), 227 (39%) lived in postal code areas with lower socioeconomic status, and 426

(73%) completed 12-month follow-up. Mean percentage weight changes from baseline (SD) were -4.8% (6.1) for text messaging with financial incentives, -2.7% (6.3) for text messaging alone, and -1.3% (5.5) for the control group. Compared to the control group, mean percent weight loss was significantly greater in the text messaging with financial incentives group [mean difference -3.2% (97.5 % CI, -4.6, -1.9, p <0.001)], but was not significantly greater in the text messaging alone group -1.4% (97.5% CI, -2.9, 0.0, p =0.053). At 12-month follow-up, mean weight changes were -5.7kg (SD 7.4) for text messaging with financial incentives, -3.0kg (SD 7.5) for text messaging alone, and -1.5kg (SD 6.6) for the control group. Of 366 adverse events reported, the most common were infections (23%). Of the 23 (6.3%) serious adverse events, 12 (52%) were in the text messaging with financial incentives group, five (22%) were in the texts messaging alone group and six (26%) were in the control group.

CONCLUSION AND RELEVANCE

Among men with obesity, a text-messaging with financial incentive intervention significantly improved weight loss, compared to a control group, while text messaging alone was not significantly better than control. These findings support text messaging combined with financial incentives to attain weight loss in men with obesity.

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BACKGROUND

Obesity increases rates of Type II diabetes, heart disease, stroke, mobility problems and some cancers, and affects approximately 800 million people worldwide.[1,2] Approximately 26% of UK adult men have obesity.[3] However, men are less likely than women to participate in weight loss interventions.[4,5] Effective interventions to attain weight loss in men are needed.[6]

Behavior change interventions delivered with text messaging can be effective and scalable components of weight loss programs. A systematic review that included 12 randomized clinical trials reported that text messaging-based weight loss interventions were associated with a mean weight change of -2.3 kg (95% confidence interval [CI] -3.2 to -1.4kg), compared to control.[7] However, in this systematic review, only three clinical trials reported weight loss at 12 months (mean intervention duration 6 months), and no trials included a large proportion of men. Financial incentives can help men with overweight and obesity to lose weight[8,9] and adding behavior change techniques and economic theory can enhance effectiveness.[10-12]

The Game of Stones clinical trial was designed to assess whether text messaging combined with financial incentives could help men with obesity lose weight at 12-month follow-up, compared to a control group. This clinical trial also evaluated whether text messaging alone could attain significant weight loss at 12-month follow-up, compared to a control group.

METHODS

TRIAL DESIGN

We conducted a three-group assessor-blind superiority randomized clinical trial in three UK areas: around Belfast, Bristol, and Glasgow. Enrolment was between July 2021 and May 2022. Final follow-up occurred June 2023. The trial protocol can be found in Supplement 1.[13] The statistical analysis plan is in Supplement 2. Eligible men were randomized to one of three groups: 12 months of text messaging with financial incentives; text messages alone, or a 12-month waiting list, in which participants could receive the first three months of text messages at the end of the clinical trial. Ethical approval was provided by North of Scotland Research Ethics Committee 2 [20/NS/0141]. All participants provided written informed consent.

This trial is reported using the extension to CONSORT 2010 guidelines for multi-arm parallel group randomized trials and the CONSORT harms statement 2022 available (https://www.equator-network.org/).

PARTICIPANTS

We recruited participants through letters sent by general family practices and through the community, such as information stands in supermarkets, leaflets, posters, social media, and word of mouth.[14,15]

INCLUSION AND EXCLUSION CRITERIA

Men ≥18 years and BMI ≥30kg/m^2 were eligible. Men were excluded if they had no mobile phone, were unable to understand English, planned to move from the area or have bariatric surgery within 12 months, had participated in a weight loss intervention <6 months ago, or had a terminal or severe psychiatric illness.

RANDOMIZATION

Men were randomly allocated 1:1:1 by researchers within each area using a secure remote web-based system to: 12 months of automated text messages with financial incentives, text messages alone, or a control group. Randomization was stratified by area using permuted blocks of random sizes of 3, 6 or 9.

INTERVENTIONS

Text messages and financial incentives were developed with feedback from potentially eligible men and healthcare clinicians and were designed to promote inclusivity, sustainability, minimal effort from participants and clinical staff, and to have a low risk of harm.[16,17]

Text Messages

Daily text messages were identical for the two intervention groups and did not mention financial incentives. They incorporated weight management evidence, website links to information resources and theory-based behavior change techniques based on the Health Action Process Approach[18], Self-Determination Theory[19] and the Behaviour Change Maintenance Model.[20] Examples are provided in Box 1 and eTable 1. Text messages commenced within one week of randomization, with options for participants to pause, restart or reduce frequency. The total number of text messages that a participant could receive

was 370, of which 364 were behavioural, three were weight appointment reminders and three were notifications of weight goal attainment. Participants could respond to text messages but were advised that they would usually not receive a reply unless a participant safety issue was identified.

Financial Incentives

Participants allocated to the text messaging with financial incentives group were told that $490 (£400) had been placed in a study account for them that they could access at the end of the clinical trial, but that money would be lost if weight loss goals were not attained. The goals were 5% weight loss from baseline at 3 months ($64 secured), 10% from baseline at 6 months ($191 secured), and maintaining 10% weight loss at 12 months ($254 secured) (eMethods in supplement 3). If all goals were met, participants could retain $490 providing they were weighed in person within 23 days of their follow-up due date on the study scales. For each 1% weight lost between 5% and 10% at 6- and 12 months additional money was secured. The money due was automatically calculated from the weight data and sent to participants by text after each weight assessment (Box 1, eTable 2) and participants were paid at 12 months follow up through bank transfer.

Interventions received by all three groups

All participants received a pedometer and access to a study website with evidence-based information about weight management (eMethods in supplement 3). Participants in intervention groups had personal login accounts that allowed them to track their weight and step count, and access information about local weight management and physical activity services. Staff directed participants to study materials rather than giving weight management advice.

PRIMARY OUTCOME

The two primary outcomes are within-participant weight change expressed as a percentage of baseline weight at 12 months comparing the text messaging with financial incentives versus the control group and comparing the text messaging alone versus the control group.

SECONDARY OUTCOMES

Secondary outcomes at 12-month follow up were as follows: absolute weight change in kg compared to baseline; the percent of participants with any weight loss compared to baseline, the percent of participants with at least 5% weight loss compared to baseline, the percent of participants with at least 10% weight loss compared to baseline, categories of weight loss defined as: 0 to <5%, ≥5% to <10%, ≥10% weight loss, % of participants gaining weight, EuroQol-5 Dimension (EQ-5D-5L); Warwick-Edinburgh Mental Well-Being Score (WEMWBS); Weight Self-Stigma Questionnaire (WSSQ). New secondary outcomes were added after the trial start to investigate mental health: EuroQol-5 Anxiety/Depression Dimension (EQ-5D-5L-AD), Patient Health Questionnaire (PHQ-4) and all possible categories for % weight change from baseline were specified. Data collection for PHQ-4 commenced in November 2021 during enrolment and before collection of 12-month follow-up data.

EXPLORATORY OUTCOMES

The exploratory outcomes (no minimally important clinical difference defined) consisted of program satisfaction assessed using a 0–100-point scale, (100 was most satisfied); satisfaction with weight loss progress assessed using 7 categories 1 (very unhappy) -7 (very happy); and publicly funded weight management services including ”yes” or “no” for medication and meal replacements used. Behavioral exploratory outcomes will be reported separately with the study process evaluation to understand mechanisms of change: weight management strategies; self-monitoring weight; self-monitoring steps; physical activity; alcohol use; smoking status; confidence in ability to lose weight; confidence in ability to maintain weight loss long term.

ASSESSMENTS

Staff measuring weight and analyzing outcomes, harms and benefits data were unaware of group allocations. Weight was measured in-person within three weeks of the target date for follow-up using study scales and verified independently by another researcher. If the participant was not able to return for measurement of weight in person, participants were offered a video call to measure weight on study scales delivered to their home. If participants declined or did not respond to this option, they were mailed a letter requesting email or postal return of a questionnaire with self-reported weight on their own scale.

Weights were measured at baseline and 12 months for all three groups, and at 3 and 6 months for the two intervention groups. Staff asked participants at each assessment about helpful or harmful consequences of taking part in the study and adverse events including serious adverse events (eMethods in Supplement 3). Self-report questionnaires at baseline included socio-economic measures consistent across UK countries obtained from the UK Office for National Statistics.[21] Data on racial and ethnic group were collected to assess the potential generalisability of results to UK regions with different populations. Participants were asked to select one of the following six options: White; Mixed or Multiple ethnic groups; Asian or Asian British; Black, African, Caribbean or Black British; Other ethnic group or Prefer not to say.

Power Calculation

The sample size calculation was based on detecting a target difference in weight between intervention groups and control group of at least 3.3kg, assuming a standard deviation of 8kg.[7,14] The 3.3kg was based on 3% of the mean baseline weight of 109kg in the feasibility study and The National Institute of Health and Care Excellence guidance.[22] We required outcome data on 146 participants per group for 90% power with two-sided alpha of 2.5% (to account for two comparisons). We increased this to 169 per group (total sample size, 585 participants) to allow for 25% loss to follow-up.

STATISTICAL ANALYSES

All participants (including those with missing primary outcome data) were included in the primary analysis according to treatment group allocation, regardless of adherence to their assigned group. For the primary outcome, two analyses estimated the mean differences in percentage weight change at 12 months between groups (text messaging with financial incentives group versus control group; and text messaging alone group versus control group) using a linear regression model adjusted for recruitment area (three) and recruitment route (general practice or community), with missing data accounted for using multiple imputation under a missing at random assumption. The P value for statistical significance was defined as $P<0.025$. The imputation model used: baseline weight, recruitment method, area deprivation quintile using country-specific Index of Multiple Deprivation (eMethods in supplement 3), recruitment area, height, and age to impute missing weights at 12 months for each group. In sensitivity analyses, analyses

were repeated among people with 12-month weight values obtained in person (including video) if on study scales within 23 days of target date, with missing data imputed using the model above. Additional sensitivity analyses used the same analysis model on all observed data (a missing completely at random assumption) and two missing-not-at-random models with either baseline observations carried forward or last observation carried forward (for the intervention groups only). Stata 16 was used for all analyses.

SECONDARY AND EXLORATORY ANALYSES

Secondary and exploratory outcomes were analyzed in a similar manner as the primary outcome, using a generalised linear model suitable for the outcome distribution and effect sizes presented with 97.5% confidence intervals.

POST-HOC ANALYSES

An exploratory *post hoc* analysis repeated the primary analyses after excluding participants who reported taking weight loss medications or meal replacements at any point during the trial.

RESULTS

Between July 2021 and May 2022, 1073 men expressed interest in enrolling, of whom 93 were ineligible, 304 declined participation, 91 expressed interest after enrolment was completed, and 585 were randomized to text messaging with financial incentives (196 participants), text messaging alone (194 participants) or the control group (195 participants) (Figure 1). Weight at 12 months was completed by 426 (73%) participants, including 146 (75%) participants randomized to text messaging with financial incentives, 128 (66%) randomized to text messaging alone, and 152 (78%) randomized to control. Overall, 397 (68%) completed 12-month weight measurement on study scales within 23 days of target date, 137 (70%) participants randomized to text messaging with financial incentives including one participant by video, 118 (61%) randomized to text messaging alone, and 142 (73%) randomized to control (eTable 3). Nineteen participants (3%) provided written weight by questionnaire, four were randomized to text messaging with financial incentives, eight to text messaging alone, and seven to control. Weight assessments at 3 months were completed by 170 (87%) men in the text messaging with financial

incentives group, compared to 136 (70%) men in the text messaging alone group. Weight assessments at 6 months were completed by 140 (71%) men in the text messaging with financial incentives group, compared to 121 (63%) men in the text messaging alone group (eTable 4). The reasons for 66 (11%) men declining follow-up were comparable across groups (eTable 5).

Baseline characteristics were similar across trial groups (Table 1; eTables 6-7). Overall, mean age was 50.7 (SD, 13.3) years, 525 (90%) were white, 227 (39%) lived in the two more disadvantaged quintile areas, 416 (71%) self-reported an obesity-related health condition, 104 (18%) had diabetes, 235 (40%) had multiple long-term conditions and 165 (29%) reported a physical or mental health disability (Office for National Statistics definition). Mean body weight was 118.5kg (SD, 19.9) and mean BMI 37.7kg/m^2 (SD, 5.7). More participants were recruited through community strategies (368, 63%) than general practices (217, 37%).

Of a maximum of 370 texts over 12 months, the mean number sent to participants was 332.4 (SD, 80.9) in the text messaging with financial incentives group and 317.3 (SD 100.8) in the text messaging alone group. The mean number of responses to the text messages received was 8.8 (SD, 18.9) in the text messaging with financial incentives group and 8.6 (SD, 33.8) in the text messaging alone group (eTable 8). Participants who visited the trial website are provided in eTables 9-10.

A mean of $159 (£128) was paid per participant randomized to text messaging with financial incentives for meeting weight loss goals (eTable 4). Of 146 participants who provided a 12-month weight, payments were made to 90 (62%) men adhering to the payment protocol (eMethods in supplement 3), with five men missing either 3- or 6-month targets but paid for attaining ≥5% weight loss at 12 months. Six participants met 3- and/or 6-month targets of ≥5% but received no money as their 12-month weight was greater than at baseline. Twenty-seven men received the full $490 (£400).

PRIMARY OUTCOME

At 12-month follow-up, mean percent weight change was -4.8% (SD, 6.1) for the text messaging with financial incentives group, -2.7% (SD, 6.3) for the text messaging alone group, and -1.3% (SD, 5.5) for the control group. Compared to control, the text messaging with incentive group had significantly greater weight loss (mean difference in percentage change from baseline of -3.2% (97.5% CI -4.6, -1.9), p <0.001,

but the text messaging alone group did not have significantly greater weight loss (mean difference in percentage change from baseline -1.4% (97.5% CI -2.9, -0.0), p = 0.053, Figure 2, eTable 11.

SECONDARY OUTCOMES

Participants lost a mean (SD) of 5.7kg (7.4) in the text messaging with financial incentives group, 3.0kg (7.5) in the text messaging alone group and 1.5kg (6.5) in the control group (eTable 12). At 12-month follow-up, 114/146 (78%) participants in the text messaging with financial incentives group lost some weight, compared to 86/128 (67%) in the text messaging only group and 92/152 (61%) in the control group (Table 2). At least 5% weight loss was attained by 65/146 (45%) participants in the text messaging with financial incentives group compared to 32/128 (25%) in the text messaging alone group and 28/152 (18%) in the control group. At least 10% weight loss was attained by 40/146 (27%) in the text messaging with financial incentives group, 8/128 (6%) in the text messaging alone group and 11/152 (7%) in the control group. Figure 3 shows weight loss over time with weight outcomes at 3 and 6 months (eTable 13). There were no statistically significant differences in EQ-5D-5L; EQ-5D-5L-AD; WEMWBS; PHQ-4; WSSQ scores between the text messaging with financial incentives compared to control; or between text messaging alone and control (eTable 14). PHQ-4 data was missing for 291 participants, of which 163 did not receive the question at baseline. Text messaging plus financial incentives improved the EQ-5D Visual Analogue Scale by 5.00 points (97.5% CI, 0.76, 9.25), compared to control. The text messaging alone group improved the EQ-5D Visual Analogue Scale by 3.71 points (97.5% CI, -0.75, 8.16) compared to control.

Number Needed to Treat

For the outcome of weight loss of 5% or more, the number needed to treat (NNT) (97.5% CI) with text messaging with financial incentives at 12 months was 4 (3, 8). For the outcome of weight loss of 10% or more, the number needed to treat was 5 (4, 10). The number needed to treat with text messaging alone for ≥5% weight loss at 12 months is 15 (97.5% CI NNT(harm) 33 to ∞ to NNT(benefit) 6) and for ≥10% weight loss it is NNT(harm) 102 (97.5% CI NNT(harm) 15 to ∞ to NNT(benefit) 18).

EXPLORATORY OUTCOMES

Compared to control, the text messaging with financial incentives group significantly improved the satisfaction scale by +18.6 points (97.5% CI 11.4, 25.8, p <0.001) and the text messaging alone group improved the satisfaction scale by +10.3 points (97.5% CI 2.7, 17.8, p=0.002) (eTable 15). Compared to control, the text messaging with financial incentives group significantly improved satisfaction with weight loss +1.7 (97.5% CI 1.0, 2.6 p=0.017) and the text messaging alone group improved the satisfaction scale for weight loss by + 1.3 points (97.5% CI 0.8, 2.1 p=0.179).

SENSITIVITY ANALYSES

All sensitivity analyses for missing data are reported in eTable 16. In analyses limited to participants weighed on study scales within 23 days of the target date (in person or video), compared to control the text messaging with financial incentives group changed percentage weight by -3.6% (97.5% CI -5.2, -2.0), p<0.001 the text messaging group changed percentage weight by -1.5% (97.5% CI -3.2, 0.2), p=0.053.

POST_HOC ANALYSES

Fifty-one participants reported taking weight loss medications, including injectable therapies, or meal replacements (eTable 17). In a *post hoc* exploratory analysis in which observed 12-month follow-up data for these 51 participants were removed and then imputed, text messaging with financial incentives significantly improved weight loss, compared to the control group (mean difference: -2.7% (97.5% CI -4.2, -1.1) p =0.001, while text messaging alone was not significantly different compared to control -1.1% (97.5% CI -2.7, 0.5), p = 0.2 (eFigure 1; eTable 18).

ADVERSE EVENTS

Overall, 366 adverse events were reported including 83 (23%) infections, 58 (17%) social harms; and 39 (11%) musculoskeletal and connective tissue adverse events; 160 (44%) adverse events were in the text messaging with financial incentives group, 137 (37%) in the text messaging alone group and 69 (19%) in the control group. Of the 366 adverse events, 23 (6.3%) were classified as serious adverse events, including 12 (52%) in the text messaging with financial incentives group; five (22%) in the text messaging

alone group and six (26%) in the control group. None were considered associated with participation in the clinical trial (eTables 19-22).

DISCUSSION

In this randomized clinical trial of 585 men with obesity, behavioral text messages combined with financial incentives reduced weight by 3.2%, compared to a control group. Text messaging alone did not significantly reduce weight, compared to the control group. This study included 39% of men from lower socioeconomic backgrounds, who have typically been under represented in clinical trials of weight loss in people with obesity.[23]

While five percent weight loss is typically considered clinically meaningful, some evidence has suggested that weight loss of less than five percent may be clinically important.[24,25] Providing participants with cash that they could retain if they met study goals allowed participants on low incomes to enrol, unlike deposit contract financial incentives where participants risk losing their own money.[10,11] The inclusion of men with obesity living in disadvantaged areas in decisions about the design of the incentives, number of assessments, goals and text messages[16,17] may have contributed to the effectiveness of the text messaging with financial incentives intervention. Twelve in person contacts are recommended to deliver individual or group behavioural weight management interventions in primary care compared to four weight assessments in this trial, which is important for time-poor participants and staff workload.[26] The National Institute for Health and Care Excellence recommend lifestyle weight management programmes that last at least 3 months, and that sessions are offered at least weekly or fortnightly and include a 'weigh-in' at each session.[27]

LIMITATIONS

This study had several limitations. First, generalisability to women, diverse ethnic groups, people without mobile phone access, and people with low literacy, poor vision, or inability to attend weight assessments is uncertain. Second, the drop-out rate was higher among men in the group with text messaging alone. Third, weight regain is common following weight loss trials and may be greater for financial incentive

interventions.[28] Follow-up weight beyond 12 months is not yet available for this study. Fourth, because the clinical trial did not include a two-by-two factorial design, it is not possible to know whether text messaging with financial incentives were more effective than financial incentives alone in this population. Fifth, harms were collected more frequently in the intervention groups compared to the control group and might have influenced rates.

CONCLUSIONS

Among men with obesity, a text messaging with an endowment financial incentive intervention significantly improved weight loss, compared to a control group, while text messaging alone was not significantly better than control. These findings support text messaging combined with financial incentives to attain weight loss in men with obesity.

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BOX AND FIGURE LEGENDS

Box 1. Example text messages

Figure 1. CONSORT diagram of participant flow.

Figure 2. **Primary outcome: baseline and 12-month follow-up weight, weight change at 12 months, and percent weight change at 12 months.**

Figure 3. Box plots of weight in kg over time by treatment group. The thick lines in the boxes represent the median, the bottom and top of the box represent the first and third quartiles respectively, the whiskers represent an additional 1.5 times the interquartile range below the first quartile and above the third quartile, and dots represent more extreme values that lie outside 1.5 times the interquartile range.

BOX 1. Example text messages[a]

Baseline: ' Ok, here's the deal. Some texts will be useful and others maybe won't. Just pick whatever works for you and ignore the rest. If you want to reply to any of the texts please do. We read every text but usually we won't be able to write back. Sorry.'

3 months: 'Rick says that when he's got a special occasion coming up he prepares for it and makes sure he has a period where you are doing well before making loads of sensible eating choices – this way you will have earned it even more.'

6 months: 'That's the 6 months mark! Two things are important now: Keep off any weight lost, and have your 1 year goal in mind. How confident are you that you can manage this?'

9 months: 'Weekend coming up, finally! Remember Gavin's tip: the power of meal prep. Helps you stay ahead. Time for another batch prep session?'

Automated incentive calculation text with {algorithm):
12 months:
'Thanks for attending the weigh-in. You lost {0} kg ({1} st {2} lbs}), or {3}% of your starting weight. You have secured £{4} and lost £{5}. Well done! Your total Game of Stones payment is £{3m+6m+12m} Look forward to seeing you in 12 months time'.

a. eTable 1 provides more examples of daily text messages and the embedded behaviour change techniques; eTable 2 provides more examples of the automated texts with {algorithms} for the money secured and lost following each weight assessment.

Table 1: Baseline characteristics by group

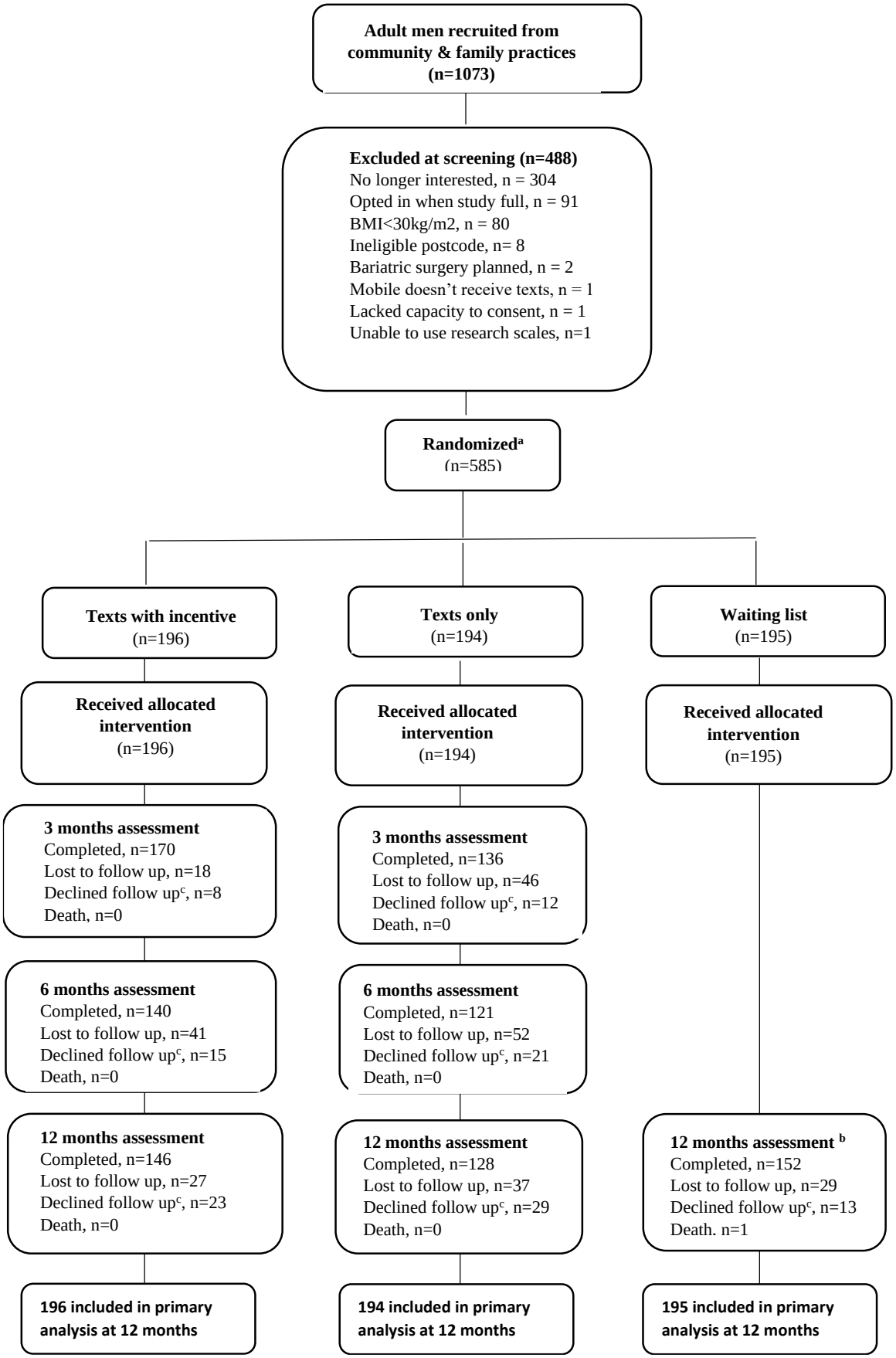
	Text messages with financial incentives (N=196)	Text messages only (N=194)	Control Group (N=195)
Recruitment strategy[a]	N=196	N=194	N=195
General Practice n (%)	74 (38)	79 (41)	64 (33)
Community n (%)	122 (62)	115 (59)	131 (67)
Age[b] **- mean (SD); n**	50.0 (12.7); 195	51.7 (13.3); 194	50.2 (13.9); 195
Deprivation Category[c]**- n (%)**	N = 195	N = 192	N = 194
Most deprived	48 (25)	36 (19)	50 (26)
More deprived	28 (14)	37 (19)	28 (14)
Deprived	25 (13)	33 (17)	29 (15)
Less deprived	39 (20)	40 (21)	31 (16)
Least deprived	55 (28)	46 (24)	56 (29)
Ethnic Group[b] **- n (%)**	N=190	N=186	N=188
Asian/ Asian British	2 (1.1)	3 (1.6)	6 (3.2)
Black/ African/ Caribbean/ Black British	3 (1.6)	3 (1.6)	3 (1.6)
Mixed/ multiple ethnic groups	2 (1.1)	-	4 (2.1)
Other	3 (1.6)	3 (1.6)	2 (1.1)
Prefer not to say	1 (0.5)	3 (1.6)	1 (0.5)
White	179 (94)	174 (94)	172 (92)
Relationship status[b] **- n (%)**	N=193	N=191	N=190
Married / civil partnership	126 (64)	116 (60)	113 (56)
Co-habiting	25 (13)	34 (18)	37 (19)
Single (never married; never in a civil partnership)	30 (16)	19 (9.8)	27 (14)
Divorced	5 (2.6)	8 (4.1)	6 (3.1)
Separated	5 (2.6)	6 (3.1)	3 (1.5)
Widowed	-	3 (1.5)	3 (1.5)
Prefer not to say	2 (1.0)	5 (2.6)	1 (0.5)
Co-morbidities[b,d] **- n (%)**	N = 196	N = 193	N = 194
High Blood Pressure	93 (47)	83 (43)	86 (44)
Mental health condition	51 (26)	46 (24)	49 (25)
Arthritis	40 (20)	55 (28)	47 (24)
Possible Latent Mental Health Condition	50 (26)	48 (25)	44 (23)
Diabetes	37 (19)	38 (20)	29 (15)
Heart condition such as angina or atrial fibrillation	29 (15)	34 (18)	28 (14)
Stroke (including mini stroke)	9 (4.6)	3 (1.5)	8 (4.1)
Cancer	6 (3.1)	8 (4.1)	5 (2.6)
One or more co-morbidity	136 (69)	136 (70)	144 (74)
Multiple Long-Term Conditions (MLTC) [b]	82 (42)	82 (42)	71 (36)
MLTC including self-reported diabetes [b]	33 (17)	34 (18)	23 (12)
Physical or Mental Disability [a,e]	N=193	N=193	N=192
Disability - n (%)	60 (31)	47 (24)	58 (30)
Measured weight	N=196	N=194	N=195
Weight (kg) - mean (SD); n	120.3 (20.1)	117.2 (17.9)	118.1 (21.6)
BMI (kg/m^2) - mean (SD); n	38.2 (5.9)	37.3 (4.7)	37.8 (6.4)

[a] see eTables 6 and 7 for more detail.

[b] self reported.

[c] To measure disadvantage participant postcodes of residence were looked up in the following country specific databases and assigned an Index of Multiple Deprivation quintile (see eMethods):
Scotland: https://www.gov.scot/publications/scottish-index-of-multiple-deprivation-2020v2-postcode-look-up/
England: https://imd-by-postcode.opendatacommunities.org/imd/2019
Northern Ireland: https://www.nisra.gov.uk/publications/central-postcode-directory-jul-2023-downloads
[d] In the questionnaire, participants were asked 'Has a doctor ever told you that you have/had? (Please tick all that apply) followed by the following list of obesity related conditions: a stroke or mini-stroke; high blood pressure; a heart condition such as angina or atrial fibrillation; diabetes; cancer, arthritis, a mental health condition, or none of the above. Multiple long-term conditions were defined as ticking two or more of the conditions listed above. Derivation of the category a possible latent mental health condition is described in the statistical analysis plan (Supplement 2).
[e] Disability was measured using the Harmonised standards and guidance, Government Statistical Service, Office for National Statistics; 2021. In the questionnaire, participants were asked: Do you have any physical or mental health conditions or illnesses lasting or expected to last 12 months or more? If you answered YES to the question above - do any of your conditions or illnesses reduce your ability to carry-out day-to-day activities? (Please tick one) Yes, a lot; Yes, a little; Not at all. To be categorized as disabled, participants must answer yes to the first question and yes to the second question.

Figure 1. Identification, eligibility, and randomization in a trial of text messages and financial incentives for weight loss.



[a] Randomization was stratified by area using permuted blocks of random sizes of 3, 6 or 9.
[b] There were no 3- and 6-month assessments for the waiting list control group.
[c] eTable 5 reports reasons for declining follow-up.

Table 2: Secondary outcomes at 12 months

Weight at 12 months	**Texts with Incentives**	**Texts only**	**Waiting list control**	**Risk differences (97.5% CI)**		**Odds ratios (97.5% CI)**	
	N=146	N =128	N=152	Texts with incentives v control	Texts only v control	Texts with incentives v control	Texts only v control
Any weight loss	114 (78)	86 (67)	92 (61)	17 (5.6, 29) [a]	6.2 (6.6, 19) [a]	2.3 (1.3, 4.2) [a]	1.3 (0.7, 2.3) [a]
Weight loss ≥5%	65 (45)	32 (25)	28 (18)	26 (15, 38) [a]	6.9 (4.2, 18) [a]	3.6 (2.0, 6.6) [a]	1.5 (0.8, 2.9) [a]
Weight loss ≥10%	40 (27)	8 (6.3)	11 (7.2)	20 (11, 30) [a]	-0.8 (-5.9, 7.6) [a]	4.9 (2.2, 11.1) [a]	0.9 (0.3, 2.6) [a]
Weight change categories n (%)							
Weight gain	32 (22)	42 (33)	60 (39)			3.2 (2.0, 5.3) [b]	1.3 (0.8, 2.2) [b]
0<5% weight loss	49 (34)	54 (42)	64 (42)				
≥5-<10% weight loss	25 (17)	24 (19)	17 (11)				
≥10% weight loss	40 (27)	8 (6.3)	11 (7.2)				

[a] Odds ratio from a binary logistic regression, adjusting for area and method of recruitment and using all observed outcome data, the absolute risk difference and confidence intervals were also estimated from this model and presented as a percentage.

[b] Odds ratio from an ordered categories logistic regression adjusting for area and method of recruitment and using all observed outcome data.

Secondary outcomes for weight change in kilograms, EQ-5D-5L; EQ-5D-5L-AD; WEMWBS; PHQ-4; WSSQ are reported in eTables 12 and 14.

Figure 2. **Primary outcome: baseline and 12-month follow-up weight, weight change at 12 months, and percent weight change at 12 months.**

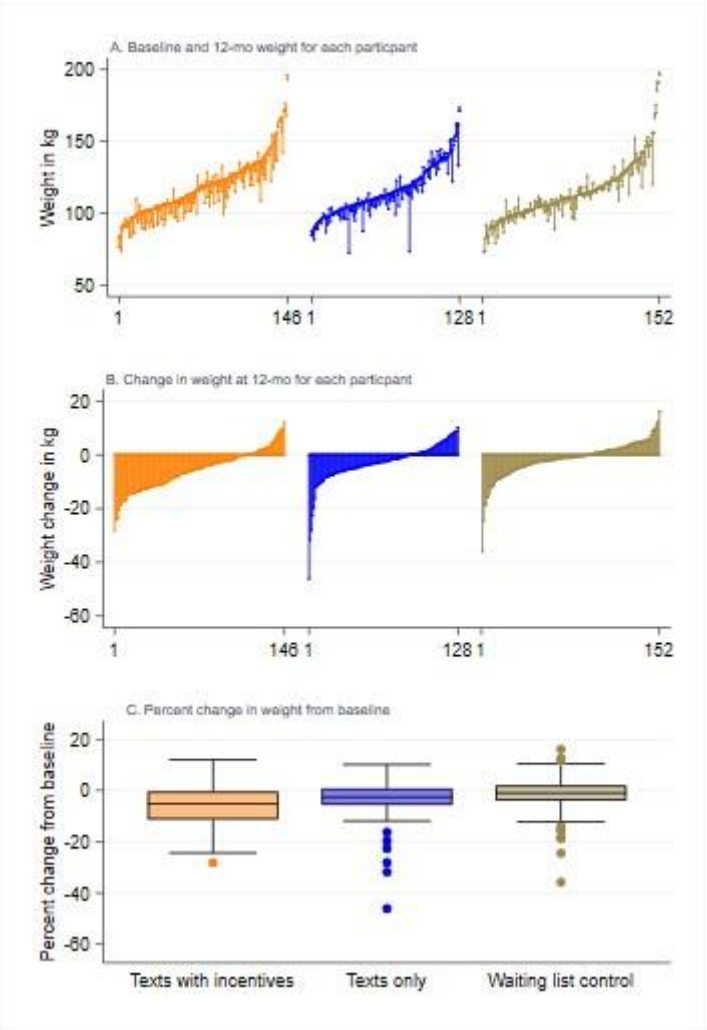


Figure 3. Box plots of weight in kg over time by treatment group. The thick lines in the boxes represent the median, the bottom and top of the box represent the first and third quartiles respectively, the whiskers represent an additional 1.5 times the interquartile range below the first quartile and above the third quartile, and dots represent more extreme values that lie outside 1.5 times the interquartile range.