Financial incentive strategy for weight loss and maintenance of weight loss

YAHYA PASDAR1,2, FARID NAJAFI1,3, MITRA DARBANDI1, SHAHAB REZAELAN1,4, PARISA NIAZI5, BEHROOZ HAMZEH6
1 Research Center for Environmental Determinants of Health (RCEDH), Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran; 2 Cardiovascular Research center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran; 3 Social Development and Health Promotion Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran; 4 Clinical Research Development Center, Imam Reza Hospital, Kermanshah University of Medical Sciences, Kermanshah, Iran; 5 Department of Nutrition, School of Nutritional Science and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran

Introduction. The aim of this study was to investigate the effect of financial incentives on weight loss, maintain in obese women and biochemical factors.

Methods. This quasi-experimental study was conducted on 103 women with body mass index (BMI) ≥ 30 kg/m². The participants were assessed over a 12-month follow-up in eight phases. Money payment for losing weight was incentive intervention in this study. The participants were given diet and physical activity.

Results. Mean of BMI was 34.78 ± 4.29 kg/m² in baseline, that reduced to 32.41 ± 3.51 kg/m² in the sixth phase, and 31.64 ± 3.71 kg/m² in the final phase (P < 0.001). At baseline, mean of percentage of body fat (PBF) was 40.77 ± 2.81 that reduced to 37.34±4.02 at the end of the study (P < 0.001). Waist to hip ratio (WHR) and lean body mass (LBM) decreased significantly over the 12-month (P < 0.001). At the end of each phase, the mean of BMI reduction of 0.39 units was observed in the subjects, and 9 units of change were achieved by the end of the study compared to the baseline. The mean of triglyceride in the first, fourth and seventh phases were 128.57 ± 13.33, 101.43 ± 57.99 and 87.40 ± 57.59 mg/dl, respectively (P = 0.003). The mean of serum glutamic oxaloacetic transaminase (SGOT) and serum glutamate-pyruvate transaminase (SGPT) decreased significantly over the 12-month, P = 0.052 and P = 0.005, respectively.

Conclusions. Financial incentives can effectively help to weight loss and maintenance of weight, and improve lipid profiles; blood sugar and liver enzymes. The use of motivational factors with proper training (diet and physical activity) will have a better result.
Methods

Participants
This quasi-experimental study was conducted on 103 women with body mass index (BMI) ≥ 30 kg/m², in Kermanshah, Iran. Kermanshah is one of the provinces of Iran with about 1,000,000 populations in the western region of Iran. The sample size was calculated as 103 based on previous studies [12]. Participants were randomly selected from two health centers based on the list of women clients. The two centers were located in slum areas of the city; and all participants had a similar socioeconomic status. Including criteria were obese women (BMI ≥ 30 kg/m²) and age over 30 years. Exclusion criteria were pregnant women, experienced unsuccessful attempt for weight reduction and serious to weight loss.

Measurements
Demographic characteristics such as age, education, marital status were collected using questionnaire and filled by an expert interviewer. Body composition such as weight, BMI, Mass of Body Fat (MBF), Percentage of Body Fat (PBF), Soft Lean Mass (SLM), Total Body Water (TBW), Body Impedance, Body Protein, Minerals, Lean Body Mass, and Waist to Hip Ratio (WHR) were measured using Bio-Impedance Analyzer BIA (Inbody Avis 333) with precision of 100 gr. The height of the subjects was measured with BSM 370 (Biospace Co, Seoul, Korea) with precision of 1 cm. Obesity and overweightness were defined according to the WHO criteria. BMI ≥ 30 indicated an obese individual [18], with the formula; BMI = weight (kg) / height² (m).

Lipid profiles, liver enzymes and fasting blood sugar were measured 3 times during the study (phase 1, phase 4 and phase 7). For collection of the blood sample, after 8-12 hours of fasting, blood samples were collected from the ante-brachial vein. Serum and plasma samples were centrifuged and stored in aliquots in cryotubes at -80°C until analyzed.

Follow-up assessments, interventions and participant’s education
The study consisted of eight phases and participants were followed-up for 12 months. Participants were given training packages for daily physical activity and diet at baseline (Tab. I). Physical activity package included 45 minutes of walking at least three times per week. Given their physical state and since some of them had back pain and knee pain, heavier physical exercise was not recommended. Given follow-up 12 months, a seasonal diet was developed for all the subjects for every season. Due to weight loss in the previous phase, they were given a new diet in each phase. We explained face-to-face to participants at least 30 minutes about the use of physical activity and diet packages.

Incentive
Money payment for losing weight was incentive intervention in this study. The participants received local currency for each 3% of weight reduction in the first phase equal to $ 30, in the second $ 50, in the third $ 70 and in the fourth, fifth and sixth phases $ 100. After the end of sixth phase, participants had to maintain their weight constant for the next 6 months. Then in phase seven (after 12 months of follow-up included 6 months of weight loss and 6 months of maintaining weight) body composition was measured again, and people who were stable in weight were encouraged [Fig. 1].

Primary outcome measurements
Primary outcome measurements weight and loss BMI will be the primary outcome measure. This will be assessed using the Bio-Impedance Analyzer BIA (Inbody Avis 333).

Secondary outcomes
Secondary outcomes included weight maintenance, decreased lipid profile, fasting blood glucose, and improving liver enzymes after the intervention.

Statistical analysis
The descriptive data (mean and standard deviation for the quantitative variables and frequency and percentage for the qualitative variables) pertaining to each phase of the study were analyzed in SPSS-21 at a confidence interval of 95%. The generalized estimating equation (GEE) model was used to determine the changes in the variables over time, since the changes in each phase were dependent on the previous phase. In other words, there is a correlation between the measurements during the follow-up [19]. The following equation was used to measure the changes in the variables over the 12 months of the follow-up; for example, the changes in BMI were calculated as:

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\%\text{ changes in BMI} = \frac{\left(\text{BMI at phase 8} - \text{BMI at phase 1}\right)}{\text{BMI at phase 1}} \times 100
\]
Results

Overall, 103 women were evaluated in the base line stage, with an average age of 39.74 ± 5.70 years (min = 30 year, max = 53 year). About 97 (94.2%) women were married and the rest were single or divorced. 30 (29.13%) people were illiterate, 59 (%57.28) of participants less than diploma and 14 (13.59%) persons were diploma, 96.3% were housewives. All participants were from the suburbs of the city and therefore, they were similar in terms of socio-economic status. They had a low income level. In the women studied, the average number of children was 2.86 ± 1.49 (min = 0 year, max = 6). 37.6% of women had chronic diseases including type 2 diabetes, cardiovascular disease, hyperlipidemia or hypertension. The average physical activity (walking) was 140 ± 60 minutes per week.

Participants lost to follow-up during the 12 months of study for the participants differed in each phase. In the first phase, participants’ mean BMI was 34.78 ± 4.29 kg/m² that reduced to 32.41 ± 3.51 kg/m² in the sixth phase, and reduced to 31.64 ± 3.71 kg/m² in the final phase and after 12 months of follow-up. The mean of weight was 85.86 ± 11.36 kg in the first phase and 78.23 ± 10.83 kg in the final phase. The mean WHR in the first and final phase was 0.92 ± 0.04 and 0.88 ± 0.04, respectively. The mean of SLM reduced by about 1 kg during the follow-up, but the mean of MBF reduced by more than 6 kg (Tab. II). Figure 2 shows the descending trend of weight, BMI, PBF and WHR during the one-year follow-up.

Average Triglyceride in the first, fourth and seventh phases were 128.57 ± 13.33, 101.43 ± 57.99 and 87.40 ± 57.59 mg/dl, respectively, which shows a decreasing trend (P = 0.003). Also, LDL-C (P = 0.006)

Fig. 1. The stages of the study and the training provided in each phase.
and TC (P = 0.001) decreased significantly during the follow-up. Liver enzymes (ALP, SGOT and SGPT) and FBS also had a significant decreased during the study (Tab. III).

The analysis of the GEE model after adjusting the effect of age showed significant reductions in all components of the body composition during the 12-month follow-up. The biggest share of the 9.52% reduction in BMI of the body composition during the 12-month follow-up. The biggest share of the 9.52% reduction in BMI of the body composition during the 12-month follow-up.
reduction in BMI and 8.52\% reduction in weight over time belonged to the first degree obesity (obesity I), which showed reductions of 6.61 and 6.45\%. In fact, after each phase, a significant mean reduction of 0.395 units in the BMI was observed during the follow-up, making for a total of 9.05 units of change from the start to the end of the study. The reduction in MBF was more significant than the reduction in the other components (Tab. IV).

**Discussion**

This study showed the positive effect of financial incentives on weight loss and maintenance of weight in obese women. The average BMI decreased by almost 3 units using monetary incentives over the 12-month follow-up of obese women. The average weight of the participants decreased about 8 kg over the 12-month. The other components of body composition, including WHR, PBF, MBF and LBM, also showed a descending trend in the follow-up period.

A study in the United States (2012) reported that in obese individuals $ 5 per 1\% weight loss has been rewarded, at the end of the study, the group that received the financial incentives had more weight loss, but weight loss was not significantly different between the two groups [15]. In a randomized controlled trial study in the United States, subjects with BMI > 30 were divided into three groups and followed for 16 months. They had a control group and in exchange for weight loss, financial incentives were given to two groups, Lottery cash was given to a group and the other group received investment savings accounts. The results showed that in the two groups that received encouragement, weight loss was higher compared to the control group [12].

A study in Finland examining the effect of different levels of financial incentives on weight loss, one group had control and gave the other two groups $ seven and $ 14 for weight loss, respectively. Individuals in the seven-dollar group lost 1.35 kg of weight, the 14-dollar group had a 2.11 kg weight loss and the control group (without financial incentives) had a 0.9 kg weight loss [20].

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**Tab. III.** Comparison of lipid profiles and liver enzymes and blood sugar in the participants during the twelve months.

| Biochemical factors | Phase 1 baseline (n = 103) | Phase 4 (n = 93) | Phase 7 (n = 75) | P-value |
|---------------------|-----------------------------|-----------------|-----------------|---------|
| Triglyceride        | 128.57 ± 13.33              | 101.45 ± 57.99  | 87.40 ± 57.59   | 0.003   |
| LDL-C               | 92.27 ± 90.93               | 99.28 ± 40.76   | 84.20 ± 67.00   | 0.006   |
| HDL-C               | 37.50 ± 35.60               | 39.72 ± 50.07   | 29.75 ± 50.79   | 0.014   |
| TC                  | 196.52 ± 58.58              | 158.49 ± 130.12 | 130.12 ± 35.34  | 0.001   |
| FBS                 | 97.28 ± 57.05               | 92.52 ± 10.14   | 90.52 ± 11.21   | 0.022   |
| ALP                 | 175.46 ± 54.56              | 171.71 ± 53.57  | 157.97 ± 46.52  | 0.054   |
| SGOT                | 21.72 ± 8.54                | 18.95 ± 6.94    | 15.28 ± 6.04    | 0.052   |
| SGPT                | 19.75 ± 9.45                | 17.52 ± 7.94    | 11.81 ± 5.60    | 0.005   |

LDL-C: low-density lipoprotein–cholesterol; HDL-C: high-density lipoprotein–cholesterol; TC: total cholesterol; FBS: fasting blood sugar; ALP: alkaline phosphatase; SGOT: serum glutamic oxaloacetic transaminase; SGPT: Serum glutamic-pyruvic transaminase.

**Tab. IV.** Change of body composition after financial incentives over time using generalized estimating equations adjusted for age and physical activity.

| Variable | B     | 95\% CI          | P-value | % change from baseline |
|----------|-------|------------------|---------|-----------------------|
| BMI (kg/m²) | -0.395 | -0.432, -0.357   | < 0.001 | 9.52                  |
| Obesity I | -0.327 | -0.422           | < 0.001 | 6.61                  |
| Obesity II | -0.210 | -0.245, -0.173   | < 0.001 | 1.23                  |
| Obesity III | -0.278 | -0.350, -0.206   | < 0.001 | 1.22                  |
| Weight (kg) | -0.972 | -1.066, -0.878   | < 0.001 | 8.52                  |
| Obesity I | -0.876 | -1.141, -0.612   | < 0.001 | 6.45                  |
| Obesity II | -0.550 | -0.634, -0.461   | < 0.001 | 3.00                  |
| Obesity III | -0.700 | -0.883, -0.516   | < 0.001 | 0.16                  |
| WHR      | -0.006 | -0.66, -0.005    | < 0.001 | -4.37                 |
| PBF      | -0.494 | -0.542, -0.446   | < 0.001 | -8.41                 |
| MBF (kg) | -0.769 | -0.836, -0.703   | < 0.001 | -16.30                |
| LBM (kg) | -0.202 | -0.246, -0.159   | < 0.001 | -7.53                 |
| TBW (kg) | -0.146 | -0.177, -0.114   | < 0.001 | -5.72                 |
| SLM (kg) | -0.152 | -0.192, -0.112   | < 0.001 | -5.24                 |
| BMR (kcal) | -3.105 | -3.550, -2.657   | < 0.001 | -2.45                 |

\* Based on body mass index; first degree obesity, second degree obesity, third degree obesity (obesity I, obesity II, obesity III).
between motivational intervention and weight loss [14]. Other studies with different designs have shown the positive effect of financial incentives on weight loss [21-23]. The differences between the results of the studies can be due to the duration of the incentives, the financial value of the incentives, the level of economic-social status of participants and the sample size.

In addition to losing weight, another goal of the present study was to maintain weight, which was evaluated in the second six months of the follow-up and showed a positive result. After six months (24 weeks) of weight loss, participants were able to maintain their weight constant in the second 6 months of the study that was a very valuable finding. The study by Yancy et al. (2018) showed lottery-based and direct monetary incentives provided no additional benefit for weight loss maintenance [24]. The result of this goal can be relevant to the duration of the follow-up. Therefore, further studies need to be done to show how long a fallopian is appropriate for the optimal outcome of a motivational intervention for weight loss. Although the present study and similar studies have confirmed financial incentives as an appropriate motivational strategy for weight loss, but this strategy can only have a considerable effect on low-income people and those who do not have a source of personal income, especially housewives [16].

During the 12-month follow-up, MBF decreased by 6 kg and SLM by 1 kg. Lipid profiles, Liver enzymes and FBS also showed a significant decrease during the study. This finding demonstrates the positive impact of training packages on physical activity and diet. Therefore, the use of motivational factors along with appropriate training will produce better results.

Loss to follow-up was one of the limitations of this study. Maybe, if participants received more encouragement, they were more likely to lose weight and stay in the study. Having no control group was another limitation. The strength of this study was a relatively long follow-up period.

Conclusions

Finding of this study showed the positive impact of financial incentives on weight loss and maintenance of weight in obese women. The average BMI decreased by almost 3 units using monetary incentives over the 12-month follow-up of obese women. The average weight of the participants decreased about 8 kg over the 12-month. The other components of body composition, including WHR, PBF, MBF and LBM, also showed a descending trend in the follow-up period. This study showed the positive effect of physical activity training regimens on weight loss. Because, the most weight loss was due to fat mass and the least to SLM. Therefore, using motivational factors along with appropriate training will produce better results.

Performing similar interventions on a larger scale can help reduce the burden of chronic disease. More money as a financial incentive may increase people’s motivation to lose weight and make intervention more effective.

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The research was approved by the Ethics Committee of Kermanshah University of Medical Sciences under the code (KUMS.REC. 1394.484). All the participants were provided oral and written informed consent. The study protocol was registered in the Iranian Registry of Clinical Trials (IRCT) with the registration number of IRCT20120525009856N8 at 2020-02-25. We wish to thank all of the women who participated in this study.

Conflicts of interest statement

The authors declare no conflict of interest.

Authors’ contributions

Conceptualization: YP and MD; methodology: SHR and FN; acquisition of data: PN and MD; formal analysis: SHR and MD; interpretation of data: FN; writing - original draft: MD and YP; writing - review and editing: YP, FN, BH, MD, SHR and PN; supervision: YP; project administration: MD. All authors have read and agreed to the submitted version of the manuscript.

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