RESEARCH ARTICLE

Financial incentive strategy for weight loss and maintenance of weight loss

YAHYA PASDAR[1,2], FARID NAJAFI[1,3], MITRA DARBANDI[1], SHAHAB REZAEIAN[1,4], PARISA NIAZI[5], BEHROOZ HAMZEH[1]
[1] Research Center for Environmental Determinants of Health (RCEDH), Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran; [2] Social Development and Health Promotion Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran; [3] Cardiovascular Research center, Health Institute, 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

Summary

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) $\geq$ 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 $\pm$ 4.29 kg/m² in baseline, that reduced to 32.41 $\pm$ 3.51 kg/m² in the sixth phase, and 31.64 $\pm$ 3.71 kg/m² in the final phase (P < 0.001). At baseline, mean of percentage of body fat (PBF) was 40.77 $\pm$ 2.81 that reduced to 37.34$\pm$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 $\pm$ 13.33, 101.43 $\pm$ 57.99 and 87.40 $\pm$ 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.*

Introduction

Obesity is one of the known factors associated with an increased risk of non-communicable diseases and mortality [1]. According to the World Health Organization (WHO), obesity and overweight are the fifth leading cause of death worldwide, and a major risk factor for diabetes, cardiovascular disease, cancer, sleep apnea and poor physical health. Approximately, 44% of diabetes, 23% of ischemic heart disease, 7 to 41% of all types of cancers are related to obesity and overweight [2-5]. The prevalence of obesity and overweight in developed and developing countries is increasing and is reported more in developed countries, compared to the developing countries [6]. In 2010 estimated, obesity and overweight cause of 3.4 million deaths, 4% of years of life lost (YLL) and 4% of disability-adjusted life years (DALYs) in the world [7]. Given its ascending trend, obesity can be considered a syndrome of the modern world [8]. The financial burden imposed by obese people on the community and the health system is very high. The studies conducted in developed countries show that the annual medical cost imposed by an obese person is USD $ 1,400 higher on average compared to the cost imposed by a normal-weighing person. The results of a study by Wang Y et al. (2011) in the US and UK on the financial burden of obesity and the treatment of the diseases caused by obesity showed that the combined medical costs of treating diseases such as diabetes, stroke and heart disease are much higher than the costs of treating obesity, which happens to be the underlying factor of these diseases [6].

The use of financial incentives incorporating insights from behavioral economics has become more common in promoting healthy lifestyles in recent years [9-11]. Therefore, an external motivational source such as monetary incentives can be effective in inducing initial weight loss [12]. Nutritionists and diet therapists also recommended financial incentives to lose weight, along with diet [13, 14]. Previous studies have shown that variable reinforcement using money payments may be more effective over time than a fixed incentive, and frequent incentives are more effective than infrequent incentives for behavior change [12, 15-17]. Since that weight loss maintenance is arguably considerably more difficult, therefore, it is uncertain whether financial incentives will be effective in this issue. The present study was conducted to determine the association financial incentive strategies for weight loss on obesity women and its maintenance over 12 months.

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, fifths 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.
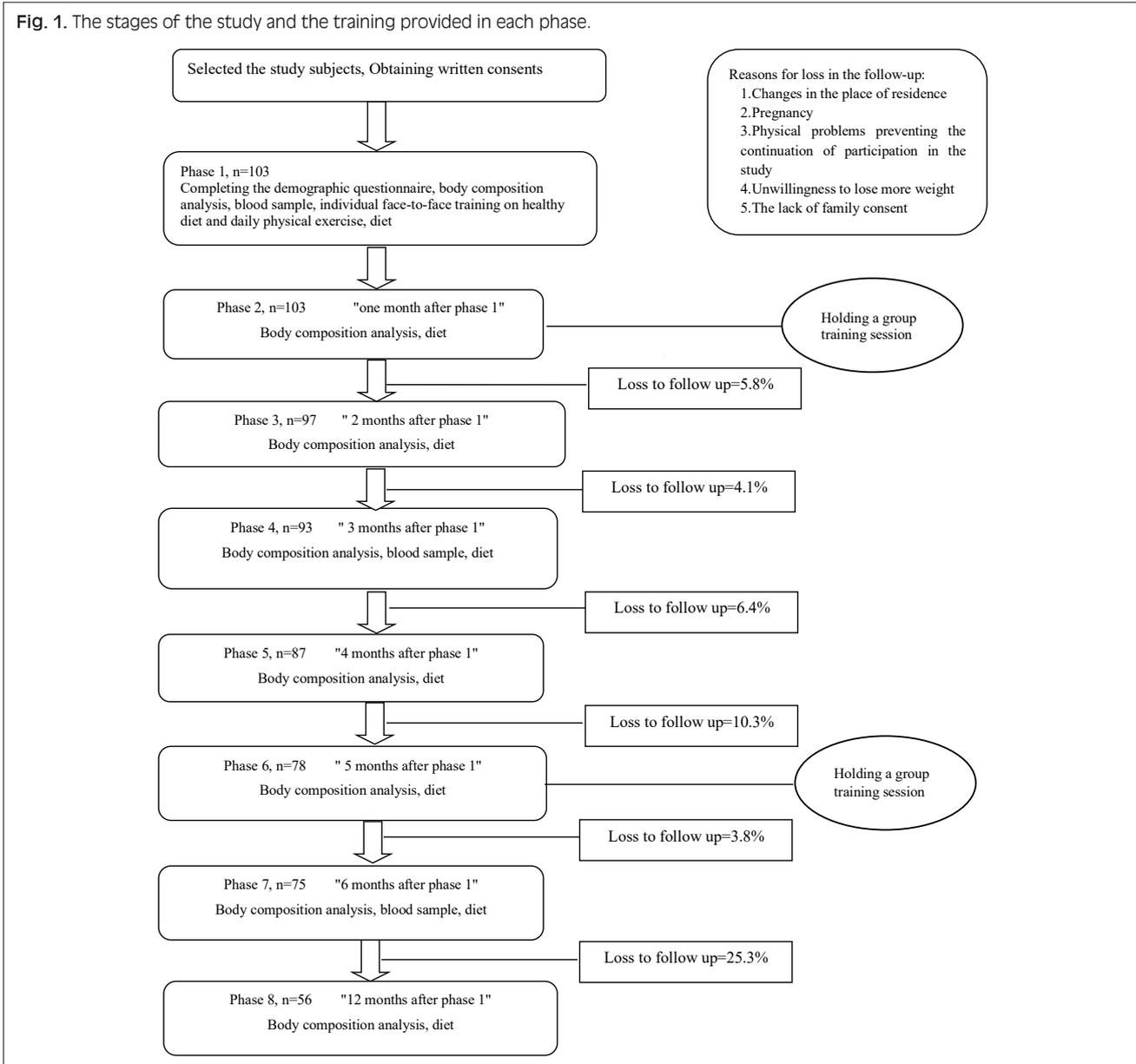
STATISTICAL ANALYSIS

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:

$$\% \text{ changes in BMI} = [(\text{BMI at phase 8 - BMI at phase 1}) / \text{BMI at phase 1}] \times 100$$

Tab. I. The types of interventions and training packages in this study.

Intervention	Procedure
Nutritional education	Providing nutritional information by booklet or monthly interval lecture on food groups, nutritional value, healthy cook, having regular meals, avoiding unhealthy eating
Low-calorie diet	At the beginning of the study, a low calorie diet (1500 calories) was given to the participants who were gradually reduced to 1200 calories at the end of the study. The designed diet consists of 3 main meals: breakfast, lunch, dinner and two snacks of morning and evening. Diet was planned by an expert nutritionist. Since the study lasted one year, availability of foods in different seasons, fruits, vegetables and foods of each season were considered in f the provided diet
Physical activity	Daily or three days a week physical activity was recommended (total 180 minutes/week)

Fig. 1. The stages of the study and the training provided in each phase.

Selected the study subjects, Obtaining written consents

Phase 1, n=103
Completing the demographic questionnaire, body composition analysis, blood sample, individual face-to-face training on healthy diet and daily physical exercise, diet

Reasons for loss in the follow-up:
1. Changes in the place of residence
2. Pregnancy
3. Physical problems preventing the continuation of participation in the study
4. Unwillingness to lose more weight
5. The lack of family consent

Phase 2, n=103   "one month after phase 1"
Body composition analysis, diet

Holding a group training session

Loss to follow up=5.8%

Phase 3, n=97   " 2 months after phase 1"
Body composition analysis, diet

Loss to follow up=4.1%

Phase 4, n=93   " 3 months after phase 1"
Body composition analysis, blood sample, diet

Loss to follow up=6.4%

Phase 5, n=87   "4 months after phase 1"
Body composition analysis, diet

Loss to follow up=10.3%

Phase 6, n=78   " 5 months after phase 1"
Body composition analysis, diet

Holding a group training session

Loss to follow up=3.8%

Phase 7, n=75   "6 months after phase 1"
Body composition analysis, blood sample, diet

Loss to follow up=25.3%

Phase 8, n=56   "12 months after phase 1"
Body composition analysis, diet

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/m^2 that reduced to 32.41 ± 3.51 kg/m^2 in the sixth phase, and reduced to 31.64 ± 3.71 kg/m^2 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)

Tab. II. Comparison of anthropometrics indices and body composition in the participants during the twelve months.

Variable	Phase 1 baseline (n = 103)	Phase 2 (n = 103)	Phase 3 (n = 97) Losses: 5.8%	Phase 4 (n = 93) Losses: 4.1%	Phase 5 (n = 87) Losses: 6.4%	Phase 6 (n = 78) Losses: 10.3%	Phase 7 (n = 75) Losses: 3.8%	Phase 8 (n = 56) Losses: 25.3%
Weight (kg)	85.86 ± 11.36	84.61 ± 11.09	83.15 ± 11.08	82.13 ± 11.24	80.98 ± 10.06	80.26 ± 9.95	79.69 ± 10.48	78.23 ± 10.83
BMI (kg/m²)	34.78 ± 4.29	34.29 ± 4.23	33.70 ± 4.37	33.29 ± 4.37	32.66 ± 3.39	32.41 ± 3.51	32.13 ± 3.77	31.64 ± 3.71
WHR	0.92 ± 0.04	0.91 ± 0.40	0.90 ± 0.04	0.90 ± 0.04	0.89 ± 0.04	0.88 ± 0.04	0.88 ± 0.04	0.88 ± 0.04
PBF	40.77 ± 2.81	40.42 ± 2.69	39.69 ± 3.00	39.61 ± 2.78	38.75 ± 2.85	38.3 ± 3.20	37.65 ± 3.66	37.34 ± 4.02
MBF (kg)	35.20 ± 6.61	34.37 ± 6.36	33.21 ± 6.50	32.73 ± 6.43	31.57 ± 5.87	30.96 ± 6.12	30.27 ± 6.51	29.46 ± 6.20
LBM (kg)	50.66 ± 5.42	50.23 ± 5.36	49.94 ± 5.28	49.40 ± 5.38	49.41 ± 4.82	49.29 ± 4.45	49.42 ± 4.81	48.77 ± 5.64
SLM (kg)	45.86 ± 4.85	45.50 ± 4.72	45.29 ± 36.9	44.79 ± 4.80	44.87 ± 4.31	44.79 ± 3.95	44.92 ± 4.29	44.37 ± 5.11
TBW(kg)	36.48 ± 3.91	36.17 ± 3.86	35.96 ± 3.80	35.56 ± 3.87	35.57 ± 3.47	35.49 ± 3.20	35.57 ± 3.46	35.12 ± 4.07
BMR (kcal)	1,258.74 ± 70.82	1,254.22 ± 70.50	1,249.88 ± 68.65	1,239.46 ± 65.95	1,241.67 ± 66.11	1,240.84 ± 60.64	1,239.74 ± 64.83	1,227.83 ± 70.79

BMI: body mass index; WHR: waist to hip ratio; PBF: percentage of body fat; MBF: mass of body fat; LBM: lean body mass; SLM: soft lean mass; TBW: total body water; BMR: basal metabolic rate.

Fig. 2. The trend of changing BMI, body weight, PBF, WHR during the follow-up period.
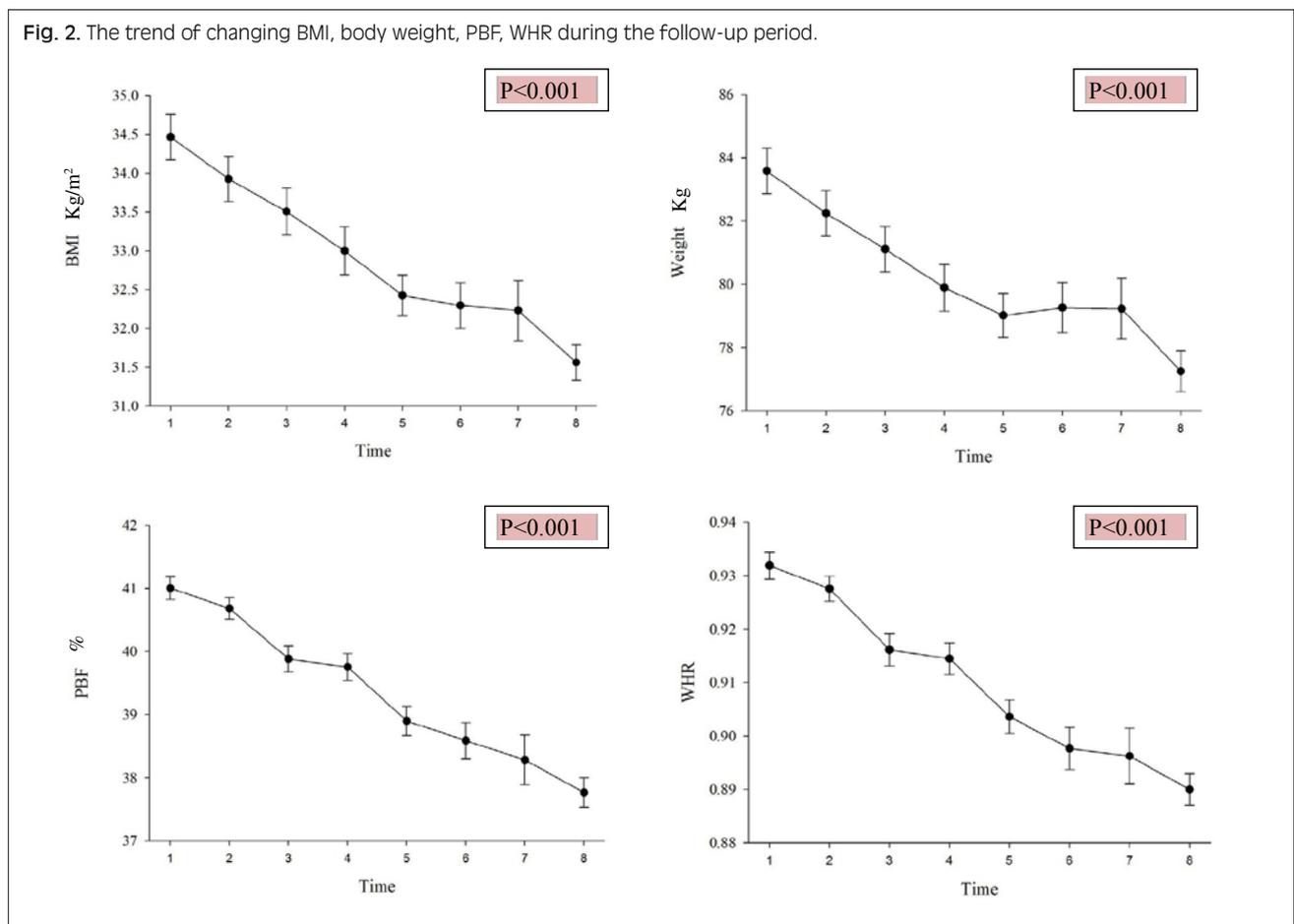
and TC (P = 0.001) decreased significantly during the follow-up. Liver enzymes (ALP, SGOT and SGPT) and FBS also had a significant decreased during the study (Tab. III).

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%

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	101.43 ± 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 ± 30.07	29.73 ± 30.79	0.014
TC	196.32 ± 38.58	158.49 ± 130.12	130.12 ± 35.34	0.001
FBS	97.28 ± 37.05	92.52 ± 10.14	90.32 ± 11.21	0.022
ALP	175.46 ± 54.56	171.71 ± 53.57	137.97 ± 46.32	0.034
SGOT	21.72 ± 8.54	18.95 ± 6.94	15.28 ± 6.04	0.052
SGPT	19.75 ± 9.45	17.32 ± 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/m^2)	-0.395	-0.432, -0.357	< 0.001	-9.52
Obesity I[a]	-0.327	-0.432, -0.220	< 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	-3.73
TBW (kg)	-0.146	-0.177, -0.114	< 0.001	-3.72
SLM (kg)	-0.152	-0.192, -0.112	< 0.001	-3.24
BMR (kcal)	-3.103	-3.550, -2.657	< 0.001	-2.45

[a] Based on body mass index; first degree obesity, second degree obesity, third degree obesity (obesity I, obesity II, obesity III).

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]. Webber et al. (2010) reported that there was no association

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.

Acknowledgements

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.

References

[1] Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The disease burden associated with overweight and obesity. JAMA 1999;282:1523-9.

[2] World Health Organization. Obesity and overweight. Available from: http://www.who.int/topics/obesity/en (accessed in May 2014).

[3] Kim SH, Despres JP, Koh KK. Obesity and cardiovascular disease: friend or foe? Eur Heart J 2016;37:3560-68. https://doi.org/10.1093/eurheartj/ehv509

[4] Mehta NK, Patel SA, Ali MK, Narayan KV. Preventing disability: the influence of modifiable risk factors on state and national disability prevalence. Health Aff (Millwood) 2017;36:626-35. https://doi.org/10.1377/hlthaff.2016.1281

[5] Kelly SP, Graubard BI, Andreotti G, Younes N, Cleary SD, Cook MB. Prediagnostic body mass index trajectories in relation to prostate cancer incidence and mortality in the PLCO cancer screening trial. J Natl Cancer Inst 2017;109:1-9. https://doi.org/110.1093/jnci/djw225

[6] Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP, Abu-Rmeileh NM, Achoki T, AlBuhairan FS, Alemu ZA, Alfonso R, Ali MK, Ali R, Guzman NA, Ammar W, Anwari P, Banerjee A, Barquera S, Basu S, Bennett DA, Bhutta Z, Blore J, Cabral N, Nonato IC, Chang JC, Chowdhury R, Courville KJ, Criqui MH, Cundiff DK, Dabhadkar KC, Dandona L, Davis A, Dayama A, Dharmaratne SD, Ding EL, Durrani AM, Esteghamati A, Farzadfar F, Fay DF, Feigin VL, Flaxman A, Forouzanfar MH, Goto A, Green MA, Gupta R, Hafezi-Nejad N, Hankey GJ, Harewood HC, Havmoeller R, Hay S, Hernandez L, Husseini A, Idrisov BT, Ikeda N, Islami F, Jahangir E, Jassal SK, Jee SH, Jeffreys M, Jonas JB, Kabagambe EK, Khalifa SE, Kengne AP, Khader YS, Khang YH, Kim D, Kimo-

koti RW, Kinge JM, Kokubo Y, Kosen S, Kwan G, Lai T, Lein-salu M, Li Y, Liang X, Liu S, Logroscino G, Lotufo PA, Lu Y, Ma J, Mainoo NK, Mensah GA, Merriman TR, Mokdad AH, Moschandreas J, Naghavi M, Naheed A, Nand D, Narayan KM, Nelson EL, Neuhouser ML, Nisar MI, Ohkubo T, Oti SO, Pe-droza A, Prabhakaran D, Roy N, Sampson U, Seo H, Sepanlou SG, Shibuya K, Shiri R, Shiue I, Singh GM, Singh JA, Skir-bekk V, Stapelberg NJ, Sturua L, Sykes BL, Tobias M, Tran BX, Trasande L, Toyoshima H, van de Vijver S, Vasankari TJ, Veer-man JL, Velasquez-Melendez G, Vlassov VV, Vollset SE, Vos T, Wang C, Wang X, Weiderpass E, Werdecker A, Wright JL, Yang YC, Yatsuya H, Yoon J, Yoon SJ, Zhao Y, Zhou M, Zhu S, Lopez AD, Murray CJ, Gakidou E. Global, regional, and nation-al prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014;384:766-81. https://doi.org/10.1016/S0140-6736(14)60460-8

[7] Bidadian M, Bahrami H. A review on present challenges in treatment of obesity. J Res Behav Sci 2013;10:757-71.

[8] Nammi S, Koka S, Chinnala KM, Boini KM. Obesity: an over-view on its current perspectives and treatment options. Nutr J 2004;3:3. https://doi.org/10.1186/475-2891-3-3

[9] Mitchell M, White L, Oh P, Alter D, Leahey T, Kwan M, Mitch-ell M, White L, Oh P, Alter D, Leahey T, Kwan M, Faulkner G. Uptake of an incentive-based mhealth app: process evaluation of the carrot rewards app. JMIR Mhealth Uhealth 2017;5:e70. https://doi.org/10.2196/mhealth.7323

[10] Ries NM. Financial incentives for weight loss and healthy be-haviours. Healthc Policy 2012;7:23-8.

[11] Amiri P, Jalali-Farahani S, Zarkesh M, Gharibzadeh S, Hedayati M, Azizi F. Behavioral interventions forweight management in overweight and obese adolescents: a comparison between a motivation-based educational program and conventional dietary counseling. Int J Endocrinol Metab 2020;18:e88192. https://doi.org/10.1001/jama.282.16.1523

[12] Volpp KG, John LK, Troxel AB, Norton L, Fassbender J, Loewenstein G. Financial incentive-based approaches for weight loss: a randomized trial. JAMA 2008;300:2631-7. htt-ps://doi.org/10.1001/jama.2008.804

[13] Williams GC, Grow VM, Freedman ZR, Ryan RM, Deci EL. Motivational predictors of weight loss and weight-loss main-tenance. J Pers Soc Psychol 1996;70:115-26. https://doi.org/10.1037//0022-3514.70.1.115

[14] Webber KH, Tate DF, Ward DS, Bowling JM. Motivation and its relationship to adherence to self-monitoring and weight loss in a 16-week Internet behavioral weight loss intervention.

J Nutr Educ Behav 2010;42:161-7. https://doi.org/10.1016/j.jneb.2009.03.001

[15] Crane MM, Tate DF, Finkelstein EA, Linnan LA. Motivation for participating in a weight loss program and financial incentives: an analysis from a randomized trial. J Obes 2012;2012:290589. https://doi.org/10.1155/2012

[16] Paloyo AR, Reichert AR, Reuss-Borst M, Tauchmann H. Who responds to financial incentives for weight loss? Evidence from a randomized controlled trial. Soc Sci Med 2015;145:44-52. https://doi.org/10.1016/j.socscimed.2015.09.034

[17] Tambor M, Pavlova M, Golinowska S, Arsenijevic J, Groot W. Financial incentives for a healthy life style and disease preven-tion among older people: a systematic literature review. BMC Health Serv Res 2016;16:426. https://doi.org/10.1186/s12913-016-1517-0

[18] https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (2018).

[19] Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics 1986;42:121-30. https://doi.org/10.2307/2531248

[20] Finkelstein EA, Linnan LA, Tate DF, Birken BE. A pilot study testing the effect of different levels of financial incen-tives on weight loss among overweight employees. J Oc-cup Environ Med 2007;49:981-9. https://doi.org/10.1097/JOM.0b013e31813c6dcb

[21] McGill B, O'Hara BJ, Grunseit AC, Bauman A, Osborne D, Lawler L, Phongsavan P. Acceptability of financial incentives for maintenance of weight loss in mid-older adults: a mixed methods study. BMC Public Health 2018;18:244. https://doi.org/10.1186/s12889-018-5136-z

[22] Faghri PD, Simon J, Huedo-Medina T, Gorin A. Perceived self-efficacy and financial incentives: factors affecting health behav-iors and weight loss in a workplace weight loss intervention. J Occup Environ Med 2017;59:453-60. https://doi.org/10.1097/JOM.0000000000000987

[23] Ananthapavan J, Peterson A, Sacks G. Paying people to lose weight: the effectiveness of financial incentives provided by health insurers for the prevention and management of overweight and obesity–a systematic review. Obes Rev. 2018;19(5):605-13. https://doi.org/10.1111/obr.12657.

[24] Yancy Jr WS, Shaw PA, Wesby L, Hilbert V, Yang L, Zhu J, Yan-cy Jr WS, Shaw PA, Wesby L, Hilbert V, Yang L, Zhu J, Troxel A, Huffman D, Foster GD, Wojtanowski AC, Volpp KG. Finan-cial incentive strategies for maintenance of weight loss: results from an internet-based randomized controlled trial. Nutr Diabe-tes 2018;8:1-11. https://doi.org/0.1038/s41387-018-0036-y