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The Effect of a Lifestyle Modification Education on Adiposity Measures in Overweight and Obese Nonalcoholic Fatty Liver Disease Patients

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ABSTRACT

Background: Obesity is increasingly associated with nonalcoholic fatty liver disease (NAFLD) and weight loss through a combination of dietary modifications and increased physical activity is a primary goal of therapy in this disease. Therefore, this study was conducted to evaluate the effects of a lifestyle modification education on adiposity measures, physical activity, and total calorie intake in overweight and obese NAFLD patients.

Methods: During 8 weeks, 82 obese patients were randomly assigned into either an intervention group ($n = 41$) receiving a lifestyle modification education or to a control group ($n = 41$) receiving usual care. Total calorie intake, physical activity, and body composition indices were measured before and after the intervention.

Results: Thirty-six patients in intervention group and 33 in control group completed the study. The analysis of body composition variables did not show any significant reduction for percent of body fat, abdominal circumference, waist to hip ratio, visceral fat area, age matched of body, and soft lean mass (SLM) of the trunk ($P > 0.05$). On the other hand, a significant reduction in weight, body mass index, mass of body fat (MBF), SLM, and MBF of the trunk was observed after 2 months of intervention compared to the controls ($P < 0.05$). A significant reduction was observed in total calorie intake of intervention group as compared to the control group. Physical activity status did not show any significant improvements after 2 months of intervention.

Conclusions: Our lifestyle modification education and its guidelines could be used in obese patients with NAFLD to improve their body composition measurements and to lose weight. This could result in significant long-term benefits in NAFLD patients.

Keywords: Adiposity, lifestyle, nonalcoholic fatty liver, physical activity

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INTRODUCTION

The increasing rate of obesity incidence and prevalence has been warning in recent years.[1] On the basis of the current trend, by 2030, about 20% of world population will be obese.[2] The implications of this increasing trend are clear since obesity is associated with various systemic diseases including diabetes, high blood pressure, heart disease, and nonalcoholic fatty liver disease (NAFLD).[3]

NAFLD, as one of the most common causes of liver disease worldwide, has increased proportionately together with the rise in obesity.[3] The prevalence of NAFLD in obese patients is reported to be up to 80%.[4] NAFLD is associated with the metabolic syndrome and its related conditions such as hypertension, hyperlipidemia, insulin resistance, and abdominal adiposity.[5]

Insulin resistance due to obesity appears to be central to the pathogenesis of NAFLD. Thus, treatment should be focused on a weight loss strategy.[3] Currently, no agents with proven safe and sustainable weight loss results in terms of improved biochemical profiles and a regression of steatohepatitis and fibrosis exists in the market.[3] Therefore, a combination of dietary amendments and higher level of physical activity is thought to have significant long-term benefits.[6] In 2009, fifty patients with NAFLD were enrolled in an uncontrolled trial in order to reduce calorie intake and had 3 h/week light aerobic activity. The results revealed a significant reduction in body mass index (BMI).[7] Another intervention has been done in 2014 among postmenopausal overweight and obese Indian women by calorie restriction, improvement of dietary content and recommendation to increase physical activity, which resulted in significant decrease in BMI and waist circumference.[8] However, more studies are warranted to provide answers regarding the best diet and exercise regimen for NAFLD patients. Thus, the current study was conducted to examine the weight reducing effects of a lifestyle modification education on adiposity measures included weight, BMI, lean body mass (LBM), soft lean mass (SLM), mass of body fat (MBF), percent of body fat (PBF), abdominal circumference (AC), waist to hip ratio (WHR), visceral fat area (VFA), age-matched of body (AMB), MBF of the trunk and SLM of the trunk. In addition, calorie intake and physical activity. The results could be used as effective preventive and therapeutic strategies toward reducing the burden of obesity and NAFLD.

METHODS

Study design and participants

Of 327 patients who were invited to fatty liver research center (Isfahan, Iran) and assessed for eligibility, 82 patients met the inclusion criteria and were enrolled in this intervention. The presence of NAFLD was confirmed by an expert physician in our department based on the results of liver sonography (presence of steatosis) and laboratory tests (aspartate aminotranferase and alanine aminotransferase more than 31 mg/dl).[9] This study was approved and performed under the guidelines of the research ethics committee of Isfahan University of Medical Sciences (Ethic code; 393583) and also registered in Iranian Registry of Clinical Trials (registration number; IRCT2016071211763N24). Moreover, a written informed consent was obtained from all subjects. All 82 participants were randomly assigned into two groups using blocked randomization method and were matched based on confounding factors included age, sex, and education level to take lifestyle modification program (n = 41) or to take usual care (n = 41). Randomization was carried out using computer-generated random numbers. Thirty-six patients in intervention group and 33 of controls completed the study. The characteristics of participants are shown in Table 1.

The inclusion criteria were age 20–50 years; BMI ≥25; no use of alcohol and the exclusion criteria were missing more than two out of eight sessions; weight loss during the last 6 months; special dietary or physical activity regimens, menopause or pregnancy before or during intervention; use of medications with known effects on weight, for example, drugs acting on central nervous system, thyroid supplements, diuretics, and selective serotonin reuptake inhibitors or specialized weight loss agents such as orlistat or any herbal weight loss preparations; psychosocial disorders such as bulimia nervosa, anorexia nervosa, drug abuse, significant clinical depression or under psychiatric care; other diseases such as renal and hepatic disease, malignancy, thyroid disorder, psychosis, and autoimmune diseases.

Procedure and assessment of variables

Patients in the intervention group attended eight sessions of lifestyle modification education based on healthy eating guidelines during 2 months in which food pyramid, my plate, and each food group in exchange list were expanded and explained for them. Also bad and good choices in each group were explained. Participants were encouraged to consume more fruits and vegetable, low fat dairy, complex carbohydrates, white meat and fish and avoid the intake of unhealthy fats and refined carbohydrates. Moreover, one session was allocated to physical activity and regular 30–60 min exercise during at least 5 days of the week was recommended [Table 2]. On the other hand, the controls were followed up for 2 months and were asked to follow usual care which included usual dietary recommendations.

Physical activity was evaluated using 3-day physical activity records completed for 3 consecutive days in the beginning and at the end of the study. Participants were

Table 1: Baseline characteristics of participants

Variables	Intervention group ($n=36$)	Control group ($n=33$)	*P*
Age (year)	49.45±1.46	48.23±1.63	0.58[a]
Educational level (%)			
Illiterate	11.4	18.4	0.49[b]
Elementary	50.0	28.9	
Diploma	25.0	31.6	
University education	13.6	21.1	
Gender male/female (%)	27.3/72.7	36.8/63.2	0.35[b]
Weight (kg)	82.82±1.93	85.69±2.14	0.98[a]
BMI (kg/m^2)	32.27±0.66	32.12±0.67	0.66[a]

Data are presented as mean±SE, [a]Resulted from independent *t*-test, [b]Resulted from Chi-square test. BMI=Body mass index, SE=Standard error

Table 2: Lesson plan of nutrition education based on health belief model

Session	Session title	Content
1	NAFLD	Definition, risk factors, sign and symptoms of NAFLD An overview of dietary guidelines for NAFLD patients Weight loss plan and strategies
2	Food groups	Introducing food guide pyramid and my plate Explaining bread, cereal, rice and pasta group and healthy choices Explaining meat, poultry, fish, dry beans, eggs and nuts group and healthy choices
3	Food groups	Explaining fruit group and healthy choices Explaining vegetable group and healthy choices Explaining milk, yogurt and cheese group and healthy choices
4	Food groups	Explaining fat, different types of fat and healthy choices
5	Food groups and treatment	Explaining fiber, different types of fiber and its benefits in NAFLD A brief explanation of medical treatment of NAFLD
6	Food groups	Explaining sugar, sweets and sugar sweetened products and their relation to NAFLD
7	Food groups and exchange list	Explaining of exchange list and summarization of food groups
8	Physical activity and review	Explaining the importance of physical activity alongside with healthy dietary pattern All of the sessions material reviewed and summarized

NAFLD=Nonalcoholic fatty liver disease

asked to record all of their activity during 2 weekdays and on weekend day. Then, all of the activity get a relevant metabolic equivalents of task (MET) points and the overall score calculated by dividing it on 24 (hours of a day).[10]

Dietary information was collected by 3-day food records and an average of 3-day calorie intake was calculated by nutritionist 4 software (First Databank, Hearst Corp, San Bruno, CA, USA). Three-day food records were completed by participants during 2 week days and a weekend day in the beginning and at the end of intervention.

Body Composition Analyzer Model ioi 353 (Jawon, Seol, Korea) was used to estimate weight, BMI, AC, WHR, PBF, MBF, LBM, SLM, VFA, AMB, SLM of trunk and MBF of trunk. The device employs bio-electrical impedance analysis (BIA) method and eight electrodes are placed on hands and feet, and then measure body composition using an experimentally derived algorithm. Furthermore, height was measured using a stadiometer (Seca, Hamburg, Germany) with 0.1 cm accuracy without shoes. Anthropometric measurements were performed by a trained personnel in the fatty liver Institute in the morning with an empty stomach.

Statistical analysis

Quantitative and qualitative data were presented as mean ± standard error and frequency (percentage), respectively. Normality of quantitative variable was assessed using Kolmogrov–Smirnov test and Q-Q plot. Nonnormal data were subjected to logarithmic transformation. Qualitative data were compared between two groups using Chi-square test. Within group analysis based on quantitative data was conducted using paired samples *t*-test. Between group analysis was performed using analysis of covariance based on after intervention values, adjustment was made for baseline values and energy intake. SPSS version 21 (SPSS Inc., Chicago, IL, USA) software was used for statistical analysis.

RESULTS

There were two participants in the control group and one in the intervention group who decided to follow an especial weight-loss plan during our intervention, these individuals were excluded from the study. On the other hand, two participants of the intervention group were excluded because of recurrent lumbar disk, which made them unable to follow the coarse. Moreover, six patients in control group and two in the intervention group did not continue the study for unknown reasons. The final data analysis included 36 patients in education group and 33 in the control group [Figure 1].

The baseline characteristics, including age, gender, educational level, weight, and BMI of participants in two groups were similar and there were no significant differences in the baseline characteristics between the two groups, as shown in Table 1.

The results of our lifestyle modification intervention are: Weight, BMI, MBF of the trunk, and energy intake showed a strong significant reduction after 2 months

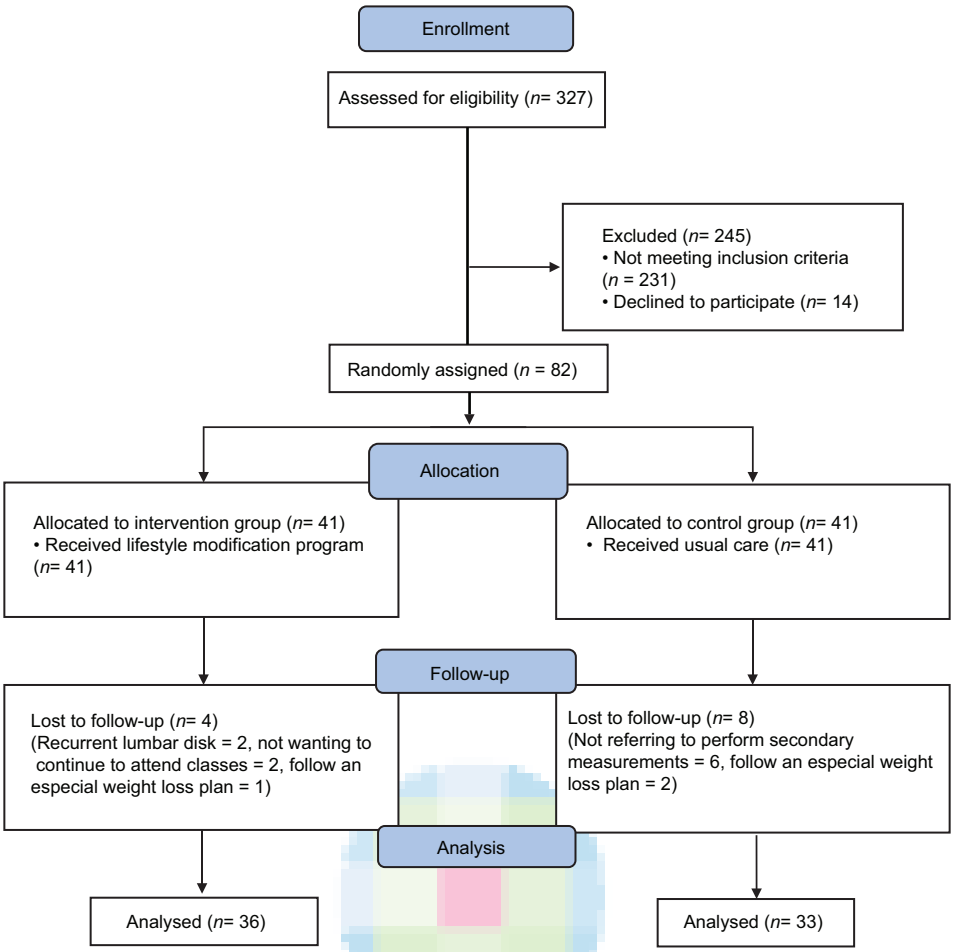

Figure 1: Flow diagram of the study

in intervention group ($P < 0.001$). Furthermore, significant reduction was observed in the intervention group compared to control group. For PBF, SLM, LBM, AC, WHR, VFA, AMB and physical activity variables significant improvement was observed in the intervention group; however, no significant differences were observed between two groups. For SLM of trunk, no significant differences were observed within or between groups [Table 3].

DISCUSSION

The 2-months of lifestyle modification education in the present study resulted in significant reduction in weight, BMI, MBF, SLM, and MBF of the trunk in overweight patients with NAFLD. Since the physical activity level of patients did not change significantly it could be concluded that these improvements in body composition variables could be only the result of the reduction in total calorie intake.

There was a statistically significant reduction in anthropometric measurements except for AC and WHR in the study group when compared to control group. A recent study in 2016 revealed the beneficial effects of lifestyle modification on weight, after 3 and 6 months of intervention in type 2 diabetic patients.[11] Another trial in 2014 showed a significant reduction in weight and BMI after 3 months of intervention same as our study, but it also showed a significant reduction in WHR contrary to our study.[12] The probable reasons for insignificant results regarding WHR could be the short period of intervention and insignificant change in physical activity level as well. In 2014, a 4-months intervention was done in low income hispanic women which resulted in significant reduction of WHR alongside with elevation of physical activity level, but it did not show any significant differences for weight and BMI.[13] This could be the answer to our hypothesis about insignificant reduction of WHR.

In our study, the variables which shown fat mass included: MBF, PBF, and MBF of the trunk which were only PBF stayed insignificant after intervention. In 2014, another same study repeated our results, which were revealed a reduction of fat mass and trunk fat mass but not fat-free mass after 3 months of intervention.[14] Macfarlane *et al.* in 2016 showed a significant reduction in fat mass after 10 weeks of intervention, but this result did not repeat

Table 3: Results of within group and between groups comparison

Variables	Intervention group ($n=36$)		P^a	Control group ($n=33$)		P^a	P^b
	Before	After		Before	After		
Weight (kg)	82.82±1.93	81.05±1.96	<0.001	85.69±2.14	85.05±2.15	0.09	0.02
BMI (kg/m^2)	32.27±0.66	31.54±0.65	<0.001	32.12±0.67	31.91±0.68	0.14	<0.001
PBF (%)	38.56±0.99	37.85±0.95	<0.001	35.96±0.98	35.87±0.98	0.77	0.23
MBF (kg)	32.07±1.26	30.81±1.22	<0.001	30.64±98	30.28±0.93	0.21	0.03
MBF trunk (kg)	16.46±0.65	15.73±0.63	<0.001	15.68±0.50	15.51±0.48	0.23	<0.001
SLM (kg)	46.09±1.17	45.70±1.20	0.02	50.20±1.71	49.97±1.77	0.55	0.07
SLM trunk (kg)	23.04±0.56	22.92±0.57	0.18	25.74±1.00	24.89±0.85	0.25	0.94
LBM (kg)	50.74±1.26	50.26±1.29	<0.001	55.04±1.83	54.76±1.89	0.49	0.72
AC (cm)	97.28±1.23	95.49±1.28	<0.001	100.24±1.37	98.86±1.50	0.1	0.53
WHR	0.95±0.00	0.94±0.00	<0.001	0.97±0.01	0.95±0.01	0.16	0.76
VFA (cm^2)	172.83±7.75	159.88±7.74	<0.001	180.81±10.55	170.90±9.56	0.22	0.5
AMB (year)	54.69±1.77	54.33±1.77	<0.001	51.87±1.78	51.81±1.72	0.8	0.36
Physical activity (MET)	34.15±0.60	37.05±0.63	<0.001	33.69±0.72	41.28±8.38	0.37	0.6
Energy (kcal)	2281.04±111.20	1668.63±85.47	<0.001	2631.51±161.57	2348.39±83.01	0.05	<0.001

Data are presented as mean±SE, [a]Resulted from paired sample *t*-test, [b]Resulted from ANCOVA, Adjustment was made for before intervention values and calorie intake (except energy). BMI=Body mass index, PBF=Percent of body fat, MBF=Mass of body fat, SLM=Soft lean mass, LBM=Lean body mass, AC=Abdominal circumference, WHR=Waist to hip ratio, VFA=Visceral fat area, AMB=Age matched of body, ANCOVA=Analysis of covariance, MET=Metabolic equivalents of task, SE=Standard error

for LBM.[15] The possible answer for insignificant change in LBM could be the tools of measurements. In our study, we used a BIA. BIA was only being able to detect changes in fat mass when compared to dual-energy X-ray absorptiometry (DXA), which is used to measure total body composition and fat content. On the other hand, BIA overestimate LBM and underestimate fat mass in comparison with DXA.[14,15] VFA is referred to visceral fat, which is stored in the abdominal cavity. VFA showed a significant reduction in the intervention group but when it compared to control group did not stay significant. In 2013, Takihata *et al*. showed a significant reduction in VFA after 6 months of intensive lifestyle modification. On the other hand, it stated that VFA associated with NAFLD and also is affected by not only weight reduction but also unknown factors. It should be the reason of insignificant reduction in VFA alongside with a short period of intervention.[16]

The last variable which was extracted from body composition analysis and did not show a significant reduction, was AMB that refers to biologic age. Based on recent studies, biologic age is correlated with physical activity and exercise capacity, which were expressed as MET.[17] Hence, insignificant change in physical activity which was calculated as MET could be the reason of insignificant reduction in AMB level.

The results of our study showed a significant reduction in weight, independent of physical activity level. A recent study exactly showed our result in which weight loss after 52 weeks of lifestyle modification did not show significant correlation with physical activity.[18]

Our study had some limitations including the small sample size, short period of intervention and absent of the follow-up period after the end of lifestyle modification education.

CONCLUSIONS

Based on the results of this trial, clear differences in body composition variables and calorie intake were revealed after lifestyle modification education. It means that changing the lifestyle could have resulted in remarkable changes in anthropometric measurements. A lifestyle modification program and its guidelines could be used in NAFLD patients with obesity, in order to improve their body composition measurements and lose weight. With this in mind, further studies and more trials are needed to draw a firm conclusion about the connection between lifestyle modification and body composition variables.

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Conflicts of interest
There are no conflicts of interest.

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