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Lifestyle Interventions and Weight Control of Adolescents With Abdominal Obesity: A Randomized Controlled Trial Based on Health Belief Model

Mojgan Nourian,[1] Roya Kelishadi,[2] and Arash Najimi[3,*]

[1]Department of Nutrition, School of Nutrition and Food Science, Isfahan University of Medical Sciences, Isfahan, IR Iran
[2]Department of Paediatrics, Child Growth and Development Research Center, Faculty of Medicine, Isfahan University of Medical Sciences, Isfahan, IR Iran
[3]Medical Education Research Center, Isfahan University of Medical Sciences, Isfahan, IR Iran

[*]*Corresponding author*: Arash Najimi, Medical Education Research Center, Isfahan University of Medical Sciences, Isfahan, IR Iran. Tel: +98-311792661; +98-9133177522, E-mail: a_najimi@hlth.mui.ac.ir

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Abstract

Background: Adolescents are involved in a variety of health risk behaviors like inactivity and unhealthy diet. Furthermore, behaviors learned by adolescents will continue to adulthood.
Objectives: The current study aimed to determine the effects of lifestyle intervention on the anthropometric measurements by the health belief model (HBM) among obese adolescents in Iran.
Methods: In this parallel randomized controlled educational trial, 90 obese adolescents 12 - 18 years were selected (44 in control and 46 in the test group). The participants in the present study were selected by simple random sampling method among adolescents with obesity referred to the Isfahan cardiovascular research center, Iran. Education based on health belief model was conducted. The main components of the program were on nutrition and physical activity as two major factors in the weight control of people with obesity. Subjects in the control and intervention groups completed questionnaires at baseline (T0), end of three months of intervention (T1) and three months after the end of intervention (T2).
Results: The multivariate test results showed significant effects of interaction of time and group for knowledge scores ($F = 101.19$; $P < 0.001$), perceived susceptibility ($F = 5.01$; $P = 0.02$), self-efficacy ($F = 6.18$; $P = 0.01$) and waist circumference ($F = 5.643$; $P = 0.004$).
Conclusions: Results of this study showed that the 12-week educational intervention program using the HBM was effective to increase knowledge, perceived susceptibility and self-efficacy of the participants.

Keywords: Lifestyle, Obesity, Abdominal, Adolescent, Health Belief Model, Anthropometric, Health Behavior

1. Background

The growing rate of childhood obesity is alarming even in the developing countries. Overweight and obesity in children are associated with many acute and chronic complications and co-morbidities (1). In both children and adults, obesity leads to an increase in the incidence of cardiovascular risk factors such as high blood pressure, hypertriglyceridemia, reduced high density lipoprotein (HDL-C), and impaired glucose metabolism (2, 3). The clustering of these risk factors, related to atherosclerosis and an elevated risk of cardiovascular diseases (CVD) in adults, is referred to as metabolic syndrome (4, 5).

The prevalence of overweight in Iranian adolescents is high, an estimated prevalence of 21% (6). Parallel with the increasing prevalence of obesity in children as an epidemic and an important public health concern, the risk of metabolic syndrome will increase (7, 8). Based on the results of a national study by Kelishadi et al. (2003), prevalence of obesity in the Iranian children and adolescents was 4.5% based on centers for disease control (CDC) cut offs and prevalence of metabolic syndrome in the Iranian adolescents was about 10.3% in boys and 9.9% in girls (9). It is estimated that among the approximately 16 million students in Iran about 320,000 - 2,240,000 children and adolescents have metabolic syndrome (10).

In spite of evidences for the efficacy of educational intervention programs in behavior modifications, a limited number of studies are conducted in Iran on educational interventions among obese adolescents with metabolic syndrome components (11). Green et al. found that since there was not enough information about the knowledge and health beliefs among adolescents and young people with obesity their risks for CVD could not be accurately perceived. Therefore, it seems that adolescents with obesity should first understand the actual risks; then they could make appropriate decision about the lifestyle (12).

Educational programs are good choices to change behaviour in order to change lifestyle of adolescents (13). Theory-based health behavior change programs are

also believed to be more efficacious than those which do not employ any theories (14, 15). The health belief model (HBM), as an important model in health education programs, is applied to explain weight control behavior among adolescents and can affect components of metabolic syndrome (16). Based on this model, changes in health behaviors are predicted by perceived susceptibility, severity, benefits and perceived barriers, cues to action and self-efficacy (17).

2. Objectives

This study was conducted to evaluate the effectiveness of a focused lifestyle intervention to reduce the anthropometric measurements by the HBM among adolescents with obesity in Iran.

3. Methods

3.1. Participants

This randomized controlled educational trial was conducted in the childhood obesity research clinic of pediatric preventive cardiology department in 2013. Childhood obesity research clinic is a referral center under the supervision of Isfahan University of Medical Sciences, Isfahan, Iran.

The studied population included adolescents with abdominal obesity aged 12 - 18 years. The participants in the present study were selected by simple random sampling method from three hundred children with obesity referred from health care centers and schools to childhood obesity research clinic. The inclusion criteria were as follows: age between 12 - 18 years, being overweight or obese (body mass index in the 85^{th} - 95th percentile or $\geq$ 95th percentile for age and gender) (18), abdominal obesity (waist circumference (WC) $\geq$ 90th percentile for age and gender based on WC cut-offs for Iranian children and adolescents) (19). Those with history of any chronic diseases as diabetes, cardiovascular disease, liver or any endocrine disorders, as well as the ones on any medication use, the ones following any specific diet and/or exercise program in the six months prior to the study were not included in the study. The sample size was calculated by the following formula (alpha = 0.01, test power = 0.80)

For this study, the minimum calculated sample size was 76 participants, 38 in each group. To allow for a 25% drop-out rate during the study, 50 participants were recruited for each group. Therefore, the total number of participants was calculated 100. Oral assent was obtained from participants and written informed consent from their parents/care givers. Then they were randomly assigned to the intervention and control groups (Figure 1). Ethical approval was obtained from medical research ethics committee University Putra Malaysia and Isfahan University of Medical Sciences (UPM/FPSK/PADS/T7-MJKEticaPer/F01).

3.2. Data Collection Instruments

The knowledge instrument consisted of 13 true/false items to assess the knowledge of participants about the obesity, diet and physical activity. For every answer a score = 1 was given to the right answers and a score = 0 was given to the wrong ones. Questions which were not answered by participants were considered as wrong answers. Therefore, the possible total score for knowledge was 0 - 13.

The HBM instrument included: Perceived susceptibility (items 1 -5) to assess perceived susceptibility to obesity related diseases, perceived severity (items 6 - 9) to assess perceived seriousness of obesity- related diseases, perceived benefits (items 10 - 17) to assess perceived benefits of diet and physical activity to prevent obesity related diseases, perceived barriers (items 18 - 22) to assess perceived barriers of diet and physical activity to prevent obesity related diseases, cues to action (items 24 - 27) to assess cues to action to prevent obesity related diseases. Items were measured on 5-point Likert-type scales. A score 1 to 5 was given for each of the questions in these sections.

The self-efficacy scale included eight items (28 - 35) to measure the confidence of the subjects to follow a healthy diet and physical activity. The self-efficacy items were categorized as “No” and “Yes” responses. The choice “No” was considered as “I strongly disagree; I disagree”, the choice “Yes” was “I agree; I strongly agree”.

The knowledge and HBM tools were researcher-made questionnaires. The questionnaires were prepared based on literature search of the similar studies and then some questions were added to it, self-designed (20, 21). The validity of given questionnaires were accomplished by content and face validity methods.

The first draft of questionnaires were assessed by a panel of experts consisting of two nutritionists, two health educators and a paediatrician and then checked by a secondary school teacher for students’ understanding.

Their views were received to assess content validity and some of them were considered in the questionnaire. The questionnaire was assessed by factor analysis in 100 secondary school students who were not included in the main study. Internal consistency was done for reliability of the questionnaire (α = 0.73 and α = 0.80 for knowledge and HBM, respectively).

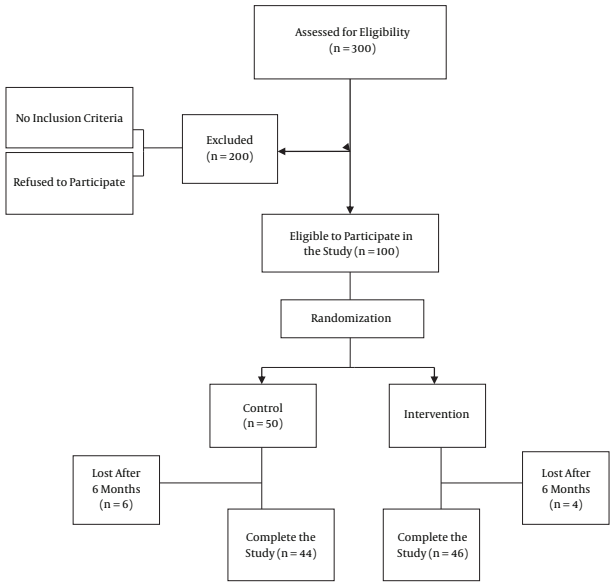

Figure 1. Study Flowchart

3.3. Anthropometric Measurements

Standing height was measured using a non-stretchable measuring tape (0.1 cm precision). Body weight was determined to the nearest 100 grams with a weighing scale (SECA 760, SECA, Hamburg, Germany). BMI was calculated as body weight in kilograms divided by the square of height in meters. BMI was categorized into overweight or obese based on the world health organization (WHO) classification. The BMI z-score was calculated using Intro-plus software. WC was measured at the largest circumference of the abdomen below the ribs and participants were classified with abdominal obesity if WC was > 90th percentile of the cut-off point for Iranian children (22).

3.4. Intervention

HBM was completed in twelve sessions and the final session provided a brief review of some important tips and a question-answer session. Each session was 60 minutes including 45 minutes presentation by the lecturer and 15 minutes question-answer. The time of small group discussion lasted to 30 minutes in some sessions based on the contents. Components and the key factors of the intervention programme and follow-up are provided in Appendix 1.

3.5. Educational Materials

The main components of the program were on nutrition and physical activity as two major factors in the weight control of people with obesity. The program focused on behavioral changes to promote changes in dietary habits and increasing the level of physical activity. Strategies used to promote behavioral changes in this program were lectures using PowerPoint presentation, self-study materials (reading materials), role playing, individual counseling to solve the problems and reminding by phone calls. HBM theory provided a framework for program development. The materials were based on the HBM and emphasized on the consequences of obesity, risk factors of obesity, importance of diet and physical activity in weight control. The study materials on obesity risk factors, obesity consequences, healthy eating and physical activity in weight control were prepared as Power Point slides, two booklets and three pamphlets by the researcher. All educational materials and components were prepared based on scientific evidence and outlines of educational intervention studies on children and adolescents with obesity and modified appropriately by the researcher.

Subjects in the control and intervention groups completed all questionnaires at baseline (T0), end of the three months intervention (T1) and three months after the end of intervention (T2), with the exception of the socio-demographic questionnaire completed only at baseline. If the children could not complete all the information in the questionnaires by themselves, they were assisted by their parents. The subjects in the intervention group were informed on the advantages of participation in the educational sessions and of the importance of completing the

sessions. Subjects in the control group received information about the times they should attend the clinic for dietary intake. The researcher and assistants also explained how they should complete the dietary questionnaire and provided an example for the subjects.

3.6. Statistical Analysis

Data were analysed using the statistical package for social science (SPSS, Version 18, Chicago. IL, USA). The independent T-test and Chi-square (χ^2) were used to compare the two study groups. Normal distribution assumption was tested by the Kolmogorov-Smirnov test. Repeated measure analysis of variance, general linear model (ANOVA, GLM) was used to assess the changes in each parameter during the study; variables that were significantly different at baseline were considered as covariate and repeated measure analysis of covariance (ANCOVA) was done.

4. Results

Mean age of the subjects in the intervention and control groups were 13.7 $\pm$ 1.8 and 13.6 $\pm$ 1.2 years, respectively (P = 0.97). There were no significant differences between the two groups regarding gender, mother's education, father's education and family history of CVD. Family history of type 2 diabetes mellitus (T2DM) in the intervention group was significantly different from that of the control group (

Kolmogorov-Smirnov tests showed that the data were distributed normally. The means of knowledge score in the control group at baseline, T1 and T2 were 7.3 $\pm$ 1.6, 11.0 $\pm$ 1.45 and 11.1 $\pm$ 1.0, respectively. There was an increase from T0 to T1 (Δ mean = +3.7 $\pm$ 0.8) and T0 to T2 (Δ mean = +3.8 $\pm$ 0.9) and the differences were significant when T1 and T2 were compared to T0 (P < 0.001). There was an increase in the score of perceived susceptibility and self-efficacy in the intervention group from T0 to T1 and from T0 to T2. The differences were significant when T1 compared to T0 (P < 0.001 and P = 0.001 respectively) and T2 compared to T0 (P = 0.001 and P < 0.001 respectively). Independent t-test also showed that the two groups were significantly different in perceived susceptibility scores at times T1 (P = 0.006) and T2 (P = 0.005). The perceived severity score changes at time T2 were compared to those of T0 and the difference was significant (P = 0.006). In the intervention group, the mean of perceived barriers scores showed an increase from T0 to T1 (Δ mean = +1.1 $\pm$ 0.05) and an increase from T0 to T2 (Δ mean = +0.4 $\pm$ 0.02) and at time T1 compared to T0 and these changes were significant (P = 0.005). There was a significant difference in perceived barriers between the two groups at time T2 (P = 0.034). For mean changes of perceived benefits and cues to action, there was no significant interaction between the time and group (Table 2).

The mean weight at T1 in the control group was 62.2 $\pm$ 16.9 kg and in the intervention group was 62.8 $\pm$ 13.5 kg. Although the weight of the subjects in both intervention and control groups decreased from T0 to T1, but the mean change was significantly different in the intervention group (P < 0.001). Also the mean weight in the intervention group decreased at T2 compared to T0 and increased in the control group but the mean change was not significantly different (P = 0.131 and P = 0.101, respectively). Mean height of the participants increased significantly at times T1 and T2 in comparison with T0 in the control and intervention groups (P < 0.001). Changes in BMI z-score of the subjects showed a significant decrease in BMI z-score in the two groups three months after intervention (T1) compared to those of the baseline (T0) (P = 0.013 in the intervention and P = 0.031 in control group). There was a significant decrease in BMI z-score after follow-up (T2) compared to that of the baseline (T0) only in the intervention group (P < 0.001). In the intervention group, the mean of WC changes were not significant (P = 0.435; P = 0.990) (Table 3).

The multivariate test results showed significant effects of interaction of time and group for knowledge scores (F = 101.19; P < 0.001), perceived susceptibility (F = 5.01; P = 0.02), self-efficacy (F = 6.18; P = 0.01) and WC (F = 5.643; P = 0.004) (Table 4).

5. Discussion

The results showed that mean changes of knowledge scores and perceived susceptibility between the groups, over time and the interaction of time and group were significant. It means that the educational program had a positive effect on increasing the knowledge and perceived susceptibility of the intervention subjects. This finding is similar to those of Dunn et al. which showed that an educational program resulted in increasing the knowledge of the subjects (23). On the other hand, the significant increase in knowledge score after the intervention program was also reported by other researchers (16, 24, 25).

By increasing the perceived susceptibility in the intervention group, they may be more motivated to change their lifestyle than the control group. Similarly, Diaz et al. showed changes in the behavior of 76 subjects with obesity aged 9 - 17 years after a lifestyle intervention based on the health belief model (26). Some other studies also found similar results. For example, Shariatjafari, et al. and Eisenmann et al. reported significant changes in the perceptions and beliefs of the subjects after the intervention (25,

Table 1. Socio-Demographic Characteristics in the Control and Intervention Groups[a]

Variable	Total (n = 90)	Control (n = 44)	Intervention (n = 46)	P Value
Age, y	13.7 ± 1.5	13.7 ± 1.8	13.6 ± 1.2	0.978
Gender				0.300
Male	40 (44.4)	22 (50)	18 (39.1)	
Female	50 (55.6)	22 (50)	28 (60.9)	
Mother's education				0.300
Illiterate	4 (4.4)	3 (6.8)	1 (2.2)	
Primary school	16 (17.8)	8 (18.2)	8 (17.4)	
Secondary school	35 (38.9)	19 (43.2)	16 (34.8)	
High school	29 (32.2)	10 (22.7)	19 (43.1)	
University	6 (6.7)	4 (9.1)	2 (4.3)	
Father's education				0.627
Illiterate	0	0	0	
Primary school	3 (3.3)	2 (4.5)	1 (2.2)	
Secondary school	15 (16.7)	8 (18.2)	7 (15.2)	
High school	51 (56.7)	22 (50)	29 (63.0)	
University	21 (23.3)	12 (27.3)	9 (19.6)	
Family history of diabetes				0.030[b]
Yes	60 (66.7)	24 (54.6)	36 (78.3)	
No	30 (33.3)	20 (45.4)	10 (21.7)	
Family history of CVD				0.501
Yes	45 (50.0)	21 (48.0)	24 (52.2)	
No	45 (50.0)	23 (52.2)	22 (47.8)	

Abbreviation: CVD, cardiovascular disease.
[a]Values are expressed as No. (%) or mean ± SD.
[b]Significant differences at P < 0.05.

27). Smalley et al. found that a majority of young people correctly identified obesity and unhealthy diet as risk factors of CVD (28). Some of the young adults and adolescents believed that heart disease prevention is important for them but they did not consider CVD as a threat (29-31). An explanation for these results may be attributed to inadequate knowledge about obesity consequences.

The current study results showed that the scores for perceived severity in the intervention group significantly increased at time T2 compared to T0, but in the control group the difference was not significant. Similar results are reported by Jagadesan et al. in India which showed that the intervention program increased the awareness of serious consequences of obesity among the adolescents (32). In contrast, other studies showed significant increase in scores of perceived severity after the educational intervention (16, 24). A possible explanation for this difference could be the difference in the age of the subjects and the design of the study.

In the current study, the increase in the scores for perceived benefits in the intervention group was greater compared to the control group but the differences were not significant. The increase in the score of perceived benefits in the control group probably was influenced by other sources of information such as media, friends and family members. The results of the current study were similar to those of the study by Calfas et al. (which showed non-significant increase in scores of perceived benefits and barriers of physical activity after a randomized controlled physical activity intervention among young adults (33). In another study, Nejad et al. reported that perceived benefits was a significant predictor of weight reduction behavior among young females with obesity (34). Scores for perceived barriers in the two groups did not show any significant changes, although there was an increasing trend. This result was consistent with the result of a study by Lovell et

Table 2. Mean ± SD of Knowledge and Health Belief Model Scores at T0 to T2 in the Two Groups (n = 90)[a]

Variable	T0	T1	T2	P[1]	P[2]
Knowledge					
Control	6.8 ± 1.6	8.2 ± 1.8	6.9 ± 1.7	0.005[b]	0.892
Intervention	7.3 ± 1.6	11.0 ± 1.45	11.1 ± 1.0	< 0.001[b]	< 0.001[b]
Perceived susceptibility					
Control	18.2 ± 4.8	18.5 ± 3.6	17.8 ± 2.8	0.668	0.642
Intervention	17.5 ± 2.3	20.4 ± 2.3	19.6 ± 2.8	< 0.001[b]	0.001[b]
P[3]	0.378	0.006[b]	0.005[b]	-	-
Perceived severity					
Control	19.0 ± 3.3	19.9 ± 2.9	19.6 ± 2.1	0.146	0.303
Intervention	19.2 ± 2.8	19.9 ± 2.5	20.5 ± 2.4	0.211	0.006[b]
P[3]	0.759	0.854	0.061	-	-
Perceived benefits					
Control	16.0 ± 2.9	16.1 ± 2.8	16.2 ± 2.2	0.827	0.591
Intervention	16.5 ± 2.1	16.7 ± 1.8	16.8 ± 2.5	0.628	0.546
P[3]	0.351	0.229	0.288	-	-
Perceived barriers					
Control	7.3 ± 2.5	8.1 ± 2.4	7.2 ± 2.3	0.117	0.964
Intervention	7.8 ± 0.2	8.9 ± 1.6	8.2 ± 1.9	0.005[b]	0.414
P[3]	0.209	0.058	0.034[b]	-	-
Cues to action					
Control	9.3 ± 2.5	9.3 ± 1.8	8.9 ± 1.9	0.999	0.409
Intervention	8.2 ± 1.1	9.0 ± 2.2	8.4 ± 2.1	0.090	0.554
P[3]	0.02[b]	0.5	0.5	-	-
Self-efficacy					
Control	4.6 ± 2.0	4.4 ± 1.7	4.2 ± 1.8	0.494	0.278
Intervention	3.7 ± 1.5	4.8 ± 1.7	4.9 ± 1.6	0.001[b]	< 0.001[b]
P[3]	0.02[b]	0.4	0.4	-	-

[a] T0, baseline; T1, end of three months intervention; T2, three months after end of intervention; P1, paired T-test for T0 and T1; P2, paired T-test for T0 and T2; P3, independent T-test for control vs. intervention group.
[b] Significant differences at P < 0.05.

al. who reported that the perceived barriers was more than the perceived benefits among female students in UK (35). Abood et al. showed that perceived barriers about exercise and consumption of fruit and vegetables decreased after intervention (36). These differences may be attributed to different sample sizes, different age groups, differences in design and differences in instruments used for data collection.

The results showed no significant difference regarding the mean scores of cues-to-action in the intervention group before and after education. It means that the subjects may not accurately rate the importance of a cue to behavior promotion and the intervention program did not have an effect on cues-to-action of the participants. The findings of the current study were similar to those of the study by Kip et al. which showed that contrary to expectations from HBM, young adults who learned that a family member experienced a heart attack or stroke were not more likely to initiate weight loss or physical activity (37). The mean score of perceived self-efficacy in this study significantly increased in the intervention group. It means that subjects in the intervention group were more confident after the educational program to change their dietary habits and physical activity level to promote a

Table 3. Mean ± SD of Anthropometric Measurements From T0 to T2 (n = 90)[a]

Variable	T0	T1	T2	P1	P2
Weight, kg					
Control	62.4 ± 17.4	62.2 ± 16.9	63.7 ± 16.5	0.773	0.101
Intervention	64.1 ± 13.5	62.8 ± 13.5	63.3 ± 13.6	< 0.001[b]	0.131
P3	0.604	0.849	0.886	-	-
Height, cm					
Control	152.4 ± 11.5	153.5 ± 11.2	155.4 ± 11.5	0.012[b]	< 0.001[b]
Intervention	153.8 ± 8.4	155.2 ± 8.4	156.9 ± 8.6	< 0.001[b]	< 0.001[b]
P3	0.513	0.427	0.489	-	-
BMIa z-score					
Control	2.0 ± 0.6	1.9 ± 0.7	1.9 ± 0.8	0.031[b]	0.112
Intervention	1.9 ± 0.4	1.8 ± 0.7	1.7 ± 0.6	0.013[b]	< 0.001[b]
P3	0.752	0.653	0.288	-	-
WCb, cm					
Control	98.0 ± 11.7	99.8 ± 11.5	101.7 ± 10.3	0.002[b]	< 0.001[b]
Intervention	101.8 ± 8.3	101.4 ± 8.5	102.1 ± 8.9	0.658	0.621
P3	0.085	0.448	0.820	-	-

Abbreviations: BMI, body mass index; WCb, waist circumference.
[a]T0, baseline; T1, end of three months intervention; T2, three months after end of intervention; P1, Paired T-test for T0 and T1 p-value; P2, Paired T-test for T0 and T2 p-value; P3, Independent T-test for control vs. intervention group.
[b]Significant differences at P < 0.05.

Table 4. Comparison of Knowledge, Health Belief and Anthropometric Measurement Mean Scores Within and Between the Groups From T0 to T2 (n = 90)

Variable	Time		Group		Time × Group	
	F	P Value	F	P Value	F	P Value
Knowledge	94.23	< 0.001[a]	39.21	< 0.001[a]	101.19	< 0.001[a]
Perceived susceptibility	6.53	0.012[a]	4.73	0.032[a]	5.01	0.028[a]
Perceived severity	3.74	0.028[a]	0.98	0.325	0.86	0.425
Perceived benefits	0.33	0.721	2.65	0.107	0.01	0.986
Perceived barriers	5.16	0.008[a]	10.54	0.002[a]	0.15	0.858
Cues to action	2.41	0.093	6.03	0.016[a]	1.057	0.350
Self-efficacy	0.32	0.570	0.01	0.925	6.18	0.015[a]
Weight (kg)	3.342	0.071	0.302	0.584	3.151	0.080
Height (cm)	2.542	0.083	2.459	0.121	0.319	0.574
BMIa z-score	0.249	0.780	0.186	0.668	1.301	0.275
WC (cm)	3.088	0.048[a]	1.688	0.200	5.643	0.004[a]

Abbreviation: BMI, body mass index.
[a]Significant differences at P < 0.05.

healthy lifestyle. The findings are consistent with those of Shariatjafari et al. which showed that the educational intervention significantly increased the self-efficacy of subjects (25). These findings are also similar to the results of other studies which showed that by increasing the level of knowledge, the self-efficacy of the subjects will also in-

crease (38). In the current study an increase in the self-efficacy score in the intervention group may be attributed to an increase in knowledge of the subjects. This is in contrast to the results of the study by Olander et al. who found that a majority of techniques did not have obvious effects on physical activity self-efficacy (39).

In the current study, the mean weight and BMI z-score significantly decreased in the intervention group at times T1 and T2 compared to those of T0. The increase in WC over time was significantly greater for the control subjects compared with the intervention group. The results of previous intervention studies targeting adolescents show larger effects, although these results may not be comparable because of differences in the sample population (26). The results of the current study were in accordance with the effects of two methods of nutritional intervention on weight loss in children with obesity. The mean value of children's BMI decreased significantly (10). This finding is also consistent with those of the previous studies showing reductions in weight by a 12-week program in children and their families which promoted healthy lifestyle changes, waist circumference and BMI reductions (40). Furthermore, the current study supports other findings by Waling et al. on the effect of a family-based intervention on anthropometric in children with overweight and obesity (41). In a study by Reinehr et al. the lifestyle intervention was associated with a significant improvement of WC (4). In summary, the changes in the anthropometric data suggest that a more intensive intervention program in nutrition and physical activity might achieve more significant outcomes. Furthermore, the subjects in the intervention group had higher WC compared with the control group at baseline. Therefore, subjects in the intervention group may have persistent weight problems and may face many difficulties to lose weight.

The strengths of the present study include the use of randomized clinical trial as the best method to design an intervention study. Besides, it was the first time that this study was conducted in Iran on adolescents with obesity by HBM framework. Moreover, the study subjects participated in the educational classes designed to improve their ability to change their lifestyle by group discussions, which may provide peer support for behavior changes.

The current study had several limitations. As with most studies of this kind, the duration of the present study was short to induce the significant changes in anthropometric measurements. Another limitation was that all analyses were performed on both genders since there were no significant differences in the proportion of girls and boys between the two groups of the study. Finally, results of the present study suggest that longer duration and more different ways of education are needed to have significant behavioral changes in this age group. These findings are useful for further community based intervention to plan and mange obesity in children and adolescents.

Supplementary Material

Supplementary material(s) is available here.

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Footnote

Authors' Contribution: Mojgan Nourian and Roya Kelishadi contributed in the conception of the work, conducting the study, revising the draft, approval of the final version of the manuscript and agreed for all aspects of the work; Arash Najimi contributed in the acquisition, analysis and interpretation of data, approval of the final version of the manuscript and agreed for all aspects of the work.

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