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# Effectiveness of education based on family-centered empowerment model on health-promoting behaviors and some metabolic biomarkers in elderly women: A stratified randomized clinical trial

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## Abstract:

**OBJECTIVE:** The purpose of family-centered care interventions is to enhance the abilities of family members in certain areas that overcome the barriers to health and well-being. The purpose of the present research was to determine the effect of education based on family-centered empowerment model on health-promoting behaviors and some serum metabolic indicators in elderly women.

**MATERIALS AND METHODS:** In this stratified randomized controlled trial, 60 elderly women aged 60 years and older referring to elderly-friendly health centers in Tabriz-East Azerbaijan were divided randomly into intervention and control groups in 2019. Intervention group received a family-centered healthy lifestyle intervention once a week for 10 sessions and the control group received the routine care. The mean score of health-promoting behaviors using the Health Promoting Lifestyle Profile-II questionnaire, glycemia and serum lipid profile, liver and renal function, 25-hydroxy Vitamin D, and calcium serum levels were assessed before the intervention, 2 and 6 months after the intervention through SPSS/version 23 using independent *t*-test, ANCOVA, and repeated measure analysis.

**RESULTS:** The ANCOVA test showed a significant increase in total lifestyle score in the intervention compared to the control group, 2 (adjusted mean difference [aMD]: 13.7; 95% confidence interval [CI]: 5.6–21.8) and 6 months (aMD: 17.2; 95% CI: 7.7–26.7) after education. The score of the nutrition and health responsibility domains significantly increased two ( $P < 0.05$ ) and 6 months ( $P < 0.001$ ) after the intervention in the intervention group compared to control. In both groups, serum levels of total cholesterol, low-density lipoprotein cholesterol, urea, and creatinine showed a significant decrease, and high-density lipoprotein cholesterol and calcium levels showed a significant increase ( $P < 0.05$ ).

**CONCLUSION:** A healthy lifestyle education based on family-centered empowerment model increased the total lifestyle score. So, it is recommended as an effective educational approach to improve the health of elderly.

## Keywords:

Biomarkers, elderly women, family-centered empowerment model, health promoting behaviors

## Introduction

The age of 65 years old has been accepted as a definition of aging in the most

developed countries; however, the United Nations uses the age of over 60 years old to refer to the elderly. The World Health

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Organization classifies aging as follows: young elderly aged 60–74 years old, elderly aged 74–90 years old, and old elderly aged over 90 years old.<sup>[1]</sup> Aging is one of the most raised phenomena in recent years in the field of global health.<sup>[2]</sup> Currently, the population aging has now become a global phenomenon.<sup>[3]</sup> The population aging is occurring at an unprecedented rate in every region of the world.<sup>[4]</sup> Reducing overall fertility, on the one hand, and improving lifestyles, health care, and life expectancy, on the other hand, have raised the phenomenon of aging in societies.<sup>[1,5]</sup> According to the World Health Organization reports, in 2000, there were 600 million elderly people all over the world. This rate will be reached 1.2 billion by 2025 and 2 billion by 2050, and the population under the age of 15 and over the age of 60 will be equal for the first time in 2050; this means 21% of the total population.<sup>[1]</sup> The general census in 1996 showed that 6.26% of the Iranian population was over 60 years old. This rate reached 7.26% in the 2006 census and is projected to increase to 11.5% by 2026.<sup>[1,6]</sup>

Although the increase in the elderly population has been considered a success in social, economic, development, and health policies, it is a major challenge in the present era.<sup>[1]</sup> The health and well-being needs of the elderly are very important due to their rapid population growth.<sup>[5]</sup> Preventing the function reduction and maintaining independence in the elderly has been recognized as the most important national priority as well as the key policy for the elderly health care in the United States.<sup>[7]</sup>

Nutritional status and physical activity are very important issues in promoting physical and mental health, reducing the symptoms of depression and anxiety, life satisfaction and improving the quality of life of people, especially the elderly.<sup>[8,9]</sup> Elderly people suffer from obesity and diseases such as diabetes, metabolic syndrome, colon cancer, breast cancer, high blood pressure, dyslipidemia, cardiovascular disease, depression, and other chronic diseases due to lack of physical activity in daily life and poor nutrition.<sup>[10,11]</sup>

Health promotion is needed for the whole population, but the elderly are often overlooked as health audiences. Since the family base is a place where health behaviors are usually learned, developed, maintained, and changed, targeting the family system (instead of the individual) is an option to improve the health of individuals, families, and communities.<sup>[12]</sup> The purpose of family-centered care interventions is to enhance the abilities of family members in certain areas that overcome the barriers to health and well-being, because they will not be able to overcome barriers without enhancing their capabilities. In this model, one of the family members participates in all stages of work.<sup>[13]</sup> Family-centered empowerment

model is an Iranian model that has been developed based on Bandura learning theory to improve the health status of people with chronic disease.<sup>[14]</sup> It was proposed by Roshan *et al.* in 2014 to prevent a chronic disease called iron deficiency anemia in adolescent girls.<sup>[15]</sup>

There is no study based on researchers' searching on the effect of family-centered empowerment model on health-promoting behaviors and serum indicators associated with common chronic diseases in old age in Iran. Given the importance and necessity of preventing disability in old age,<sup>[16]</sup> the purpose of this study was to determine the effect of educational intervention based on family-centered empowerment model compared to routine care on health-promoting behaviors and some metabolic indicators consisted of glycemia and serum lipid profile, liver and renal function, 25-hydroxy Vitamin D (25(OH) D), and calcium serum levels in older women.

## Materials and Methods

This study is a randomized controlled trial stratified based on health-care centers with a parallel design and was conducted in 2019. The statistical population was the eligible elderly women over 60 years old who had a health record in the one of the fifth elderly-friendly health-care center of Tabriz. The inclusion criteria were the tendency to participate in the study, having a health record in the old friendly health-care centers of Tabriz, having literacy, being over 60 years old, having an active family member to attend education sessions with the educating person, being female, and the ability to do independently everyday activities. The exclusion criteria were participating in other similar studies, following a specific diet (e.g., vegetarians), the occurrence of severe stressors such as the death of first-degree relatives over the past 3 months, banning any exercise according to the doctor's instructions, having neurological defects (stroke-Parkinson's disease and paralysis) and known psychological disorders, acute cardiovascular disorders (acute myocardial infarction, acute heart failure, and uncontrolled hypertension) based on the patient's statement and health record, having chronic uncontrollable diseases (such as advanced diabetes and malignancies), acute and chronic kidney disease, parathyroid, thyroid disease, as well as unwillingness to continue during the research, as well as decline to participate during the study.

The G\*POWER (version 3.1.2: Franz Faul, Universitat Kiel, Germany) software was used to determine the sample size. Poordehkordoi *et al.*<sup>[17]</sup> studied the effect of family-centered intervention on the variables of quality of life, general health, mental health, physical health, and social performance. Maximum sample size (related to

social performance variable) was calculated considering  $m_1 = 50.35$ ,  $m_2 = 73.21$ ,  $Sd_1 = 25.27$ , and  $Sd_2 = 15.50$ , two-tail test, 95% confidence level (CI), 95% power,  $n = 25$ . A total of 30 people were estimated given the 20% drop in the final sample for each group.

$$n = \frac{\left( Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^2 (\delta_1^2 + \delta_2^2)}{(\mu_1 - \mu_2)^2}$$

A total of sixty qualified elderly women were selected by the convenient sampling method and divided into intervention and control groups using random blocking after the approval of the study in the Regional Ethics Committee (IR.TBZMED.REC.1397.112) and registration in the Iranian Registry of Clinical Trials (IRCT20161126031087N2) and obtaining the necessary permissions. Allocation sequence was determined using Random Allocation Software through 4 and 6 block sizes with a 1:1 allocation ratio. Matte closed envelopes numbered one to sixty were used to conceal the allocation. Therefore, none of the participants, researchers, and statistical analysts was informed of the type of received intervention before the allocation to the groups. The sequence of allocation was determined based on random blocking by the person noninvolved in the study. The first person who entered the study was given envelope number 1, the second person was given envelope number 2, and this process continued until the end of sampling. Blinding was not possible after individuals were assigned to the study groups due to the nature of the study.

During the in-person visit, comprehensive information was initially provided about the reasons for conducting the research, the benefits, methods, and confidentiality of the information, and a consent form was obtained. Then, participants completed demographic information and Health Promoting Lifestyle Profile II (HPLP2) questionnaire in a private space in the presence of the researcher. The anthropometric indicators were measured. Moreover, 5 cc of blood sample was taken during the first visit of the participants after about 12 h of fasting between 9 and 10 o'clock the morning. The blood sample was poured into jelly tubes without anticoagulant material and centrifuged for 10 min in 3000 rpm after transfer to a laboratory. These serums were kept at 70°C until measurements.

The educational booklet was prepared by the researcher with the help of health experts and health care providers in accordance with the educational content of the elderly-friendly centers, and the content validity was approved by the professors. In the intervention group, health-promoting behaviors were taught through the

family-centered empowerment model during weekly 45-min sessions for 10 weeks.<sup>[18,19]</sup> At the beginning of each session, the researcher reviewed the previous contents for 10 min, and then, the intended contents were taught. The control group received no further education, but the routine care and training by elderly friendly centers, including healthy nutrition, exercise and physical activity training, free prescription of Vitamin D3 pearl, blood pressure, diabetes, blood lipid profile control.

HPLP2, the anthropometric indices, and blood pressure were evaluated 8 weeks and 6 months after the end of the intervention blood sampling was also performed again to re-evaluate serum biochemical indices after 6 months.

The education program was provided to the control group in a session in the form of a booklet after completing the education program.

The data collection instruments in this study include the checklist of inclusion and exclusion criteria, demographic-anthropometric information questionnaire, and HPLP2 questionnaire. This questionnaire is set in six behavioral dimensions consisted of nutrition (12 questions), physical activity (seven questions), spiritual growth (nine questions), health responsibility (23 questions), stress management (6 questions), and interpersonal relationships (13 questions). Statements have been designed based on the Likert scale from 1 to 4 (never = 1, sometimes = 2, often = 3, always = 4) and all questions are positive.<sup>[20]</sup>

Determining the reliability of the instrument was performed on twenty people with pretest and posttest. Cronbach's alpha coefficient for total health-promoting behaviors was as much as 0.92. The coefficient was as much as 0.76, 0.71, 0.84, 0.89, 0.82, and 0.85 for the subscales of nutrition, physical activity, spiritual growth, health responsibility, stress management, and interpersonal relationships, respectively. Intraclass correlation coefficient (95% CI) = 95.0 (0.92–0.97).

The body mass index (BMI) formula was calculated by dividing person's weight in kilograms to squared height in meters.

Serum biochemical indicators include fasting blood sugar, triglycerides, total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and calcium were measured through the spectrophotometric method with Alcyon 300 device using Pars Azmoon kit and 25(OH) D was measured through ELISA method using Monobind kit. The serum level of fasting insulin was measured by the ELISA method using the Monobind kit to determine

the insulin resistance. Then, the Homeostasis Model Assessment-Insulin Resistance index (HOMA-IR), which is the biological response to exogenous and endogenous insulin, was calculated as follows:

HOMA-IR:  $\text{fasting insulin (mIU/L)} \times \text{fasting glucose (mg/dL)} / 405$ .

At the beginning of the study, 8 weeks and 6 months after the intervention, laboratory tests were conducted by the one experienced laboratory technician and with the same device. The devices were calibrated before testing.

### Lifestyle education by family-centered empowerment model

Four executive steps have been designed for step by step implementing of family-centered empowerment models that are coherent and cohesive. The steps are as follows: perceived threat, problem solving, educational participation, and evaluation.

The educational sessions were conducted by the researcher in the form of lectures, discussions, questions, and answers, as well as the presentation of an educational booklet and poster [Table 1].

The results were analyzed using SPSS version 23 (IBM SPSS Statistics, IBM Corporation, Chicago, IL) software at a significance level of 0.05. The normal distribution of the data was determined by Kolmogorov-Smirnov test. Comparisons were performed in two groups using independent *t*-test, and one-way ANOVA, Chi-square test, Chi-square by trend, and Fisher's exact test. To compare the score of health-promoting behaviors and its domains, anthropometric indicators, blood pressure, and serum biomarkers between the study groups, the independent *t*-test was used before the intervention. ANCOVA test and ANOVA with repeated measurements were used after intervention at different

times (8 weeks and 6 months after the intervention) adjusted the baseline scores.

## Results

A total of 60 elderly women aged 60 and older participated in the study from January 2019 to November 2019. Finally, 58 participants (29 people in each group) were analyzed [Figure 1]. The mean age of the individuals was 63.6 in the intervention group and 64.4 years in the control group. There was no significant difference between the two groups in terms of individual-social characteristics ( $P < 0.05$ ) [Table 2].

There was no significant difference between intervention and control groups in terms of the total score of health-promoting behaviors in between group analysis at baseline ( $P < 0.05$ ). However, there was a significant increase in intervention compared to control 2 months (adjusted mean difference [aMD]: 13.7; 95% CI: 5.6–21.8) and 6 months (aMD: 17.2; 95% CI: 7.7–26.7) after education. A significant increase was observed in the mean score of nutrition and health responsibility domains in the intervention group compared to the control group 8 weeks ( $P < 0.05$ ) and 6 months ( $P < 0.001$ ) [Table 3].

Total cholesterol, LDL-C, urea, and creatinine serum levels decreased significantly in both groups. HDL-C and calcium levels showed a significant increase ( $P < 0.05$ ) [Table 4].

There was no statistically significant difference in weight between the intervention and control groups before the intervention and 8 weeks after the intervention, but the difference was significant 6 months after the intervention ( $P = 0.017$ ). The BMI did not differ significantly before the intervention between intervention and control group, but the difference was significant 8 weeks ( $P = 0.033$ ) and 6 months ( $P = 0.005$ ) after the intervention. The difference was not significant

**Table 1: Educational sessions**

Educational sessions	Educational program
First session	Familiarity with members, statement of goals, introduction of educational intervention, etc.,
Second session	Education by the researcher in the field of nutrition
Third session	Reviewing the contents of the previous session, education in the field of physical activity and spiritual growth
Fourth session	Reviewing the contents of the previous session, education in the field of health responsibility
Fifth session	Reviewing the contents of the previous session, education in the field of stress management and interpersonal relationships
Sixth session	Problem-solving step (group discussion)
Seventh session	Problem-solving step (group discussion)
Eighth session	Based on the educational participation step (the topics discussed in the previous sessions were transferred to other family members through the elderly in the presence of the researcher)
Ninth session	Based on the educational participation step (the topics discussed in the previous sessions were transferred to other family members through the elderly in the presence of the researcher)
Tenth session	Summary of sessions and assessment of the model



**Table 2: Demographic characteristic of elderly women among study groups**

Variable	Intervention (n=29), n (%)	Control (n=29), n (%)	P
Age (years)			
60-65	22 (73.3)	24 (80.0)	0.069 <sup>§</sup>
66-71	8 (26.7)	3 (10.0)	
72-78	0	3 (10.0)	
Mean (SD) <sup>†</sup>	63.6 (2.9)	64.4 (4.7)	0.431 <sup>*</sup>
Marriage			
Married	25 (83.3)	18 (60.0)	0.103 <sup>§</sup>
Single	0	1 (3.3)	
Widow	5 (16.7)	10 (33.3)	
Divorce	0	1 (3.3)	
Job			
Housewife	26 (86.7)	21 (70.0)	0.251 <sup>§</sup>
Working at home	0	2 (6.7)	
Retired	4 (13.3)	7 (23.3)	
Income			
Equal	17 (56.7)	18 (62.1)	0.829 <sup>†</sup>
Outcome > income	13 (43.3)	9 (30.0)	
Income > outcome	0	3 (10.0)	
Education			
Elementary	20 (66.7)	12 (40.0)	0.163 <sup>†</sup>
Secondary	4 (13.3)	4 (13.3)	
High school	4 (13.3)	10 (33.3)	
University	2 (6.7)	4 (13.3)	
Habitation			
Personal	28 (93.3)	28 (93.3)	1.00 <sup>§</sup>
Rental	2 (6.7)	1 (3.3)	
Homeland	0	1 (3.3)	
Live with children (yes)	17 (56.7)	18 (62.1)	0.792 <sup>§</sup>
Available in patient to children (yes)	27 (90.0)	25 (86.2)	0.706 <sup>§</sup>
Access to children support (yes)	25 (83.3)	22 (75.9)	0.532 <sup>§</sup>
Use of Vitamin D supplements (yes)	20 (66.7)	26 (86.7)	0.125 <sup>§</sup>
Systolic blood pressure (mmHg) <sup>†</sup>	119/0 (12.2)	121.5 (12.9)	0.443 <sup>*</sup>
Diastolic blood pressure (mmHg) <sup>†</sup>	74.2 (8.7) <sup>†</sup>	78.2 (9.8) <sup>†</sup>	0.085 <sup>*</sup>

Intervention=Education based on family-centered empowerment model, Control=Routine care for elderly at health centers. All variables have been reported based on n (%) except for those marked by<sup>†</sup>. Which reported as mean (SD), <sup>\*</sup>Independent t-test, <sup>†</sup>Chi-square, <sup>§</sup>Fisher's exact test, <sup>†</sup>Chi-square by trend. SD=Standard deviation

in other anthropometric indicators include waist and waist-to-hip ratio [Table 5].

## Discussion

The effect of education based on the family-centered empowerment model on health-promoting behaviors and some serum metabolic biomarkers in older women was investigated in this study for first time. The results showed that the total mean score of health-promoting behaviors of intervention group was significantly higher than the control group, 2 and 6 months after the intervention (routine care). The cardiovascular and metabolic risk factors such as the mean of weight and BMI decreased significantly compared to the routine care group. In both groups, serum levels of total cholesterol, LDL, urea, and creatinine showed a significant decrease, and HDL-C and calcium levels showed a significant increase,

although the difference between the groups was not statistically significant.

Health promoting lifestyle includes six dimensions of health responsibility, physical activity, nutrition, spiritual growth, interpersonal relationships, and stress management.<sup>[21]</sup> Providing and promoting health is one of the basic needs of all people, and the implementation of health promotion behaviors is the most important and effective factor in maintaining and improving the health of the elderly. Evidence has shown that exercise, quitting smoking, limiting alcohol consumption, participating in learning activities, and integrating into society can help them to control many diseases and reduce their loss of functional capacity, which improves their quality of life and life expectancy.<sup>[22]</sup>

An intervention study was conducted in Shahrekord, Iran, with a family-centered empowerment model to investigate the quality of life of the elderly. The mean score

**Table 3: Mean scores of health promoting lifestyle of elderly women among study groups**

Variable	Mean (SD)		Adjusted differences (95% CI)	P
	Intervention (n=29)	Control (n=29)		
<b>Total score (70-280)</b>				
Baseline	196.8 (26.8)	208.2 (31.1)	-	0.133 <sup>¶</sup>
8 weeks after intervention	220.4 (19.5)	214.7 (27.8)	13.7 (5.6-21.8)	0.001 <sup>§</sup>
6 months after intervention	224.0 (23.7)	214.8 (27.5)	17.2 (7.7-26.7)	0.001 <sup>§</sup>
Adjusted differences (95% CI)	27.5 (18.0-36.9)	5.7 (-0.2-11.6)		
P	<0.001	0.057		
<b>Nutrition (12-48)</b>				
Baseline	35.0 (4.7)	36.5 (5.3)	-	0.249 <sup>¶</sup>
8 weeks after intervention	39.1 (4.0)	37.4 (5.4)	2.7 (0.7-4.6)	0.010 <sup>§</sup>
6 months after intervention	40.4 (3.8)	37.7 (5.2)	3.7 (1.7-5.7)	<0.001 <sup>§</sup>
Adjusted differences (95% CI)	5.4 (3.6-7.1)	1.2 (-0.3-2.7)		
P	<0.001	0.200		
<b>Physical activity (7-28)</b>				
Baseline	16.6 (4.5)	17.1 (4.2)	-	0.637 <sup>¶</sup>
8 weeks after intervention	18.9 (3.6)	17.9 (5.0)	1.5 (-0.5 to 3.4)	0.132 <sup>§</sup>
6 months after intervention	18.6 (4.6)	18.1 (5.4)	0.9 (-1.5-3.2)	0.472 <sup>§</sup>
Adjusted differences (95% CI)	2.0 (0.1-4.0)	1.0 (-0.5-2.6)		
P	0.014	0.259		
<b>Spiritual growth (9-36)</b>				
Baseline	31.2 (5.1)	33.6 (3.0)	-	0.069 <sup>¶</sup>
8 weeks after intervention	33.7 (2.6)	34.3 (2.9)	0.13 (-1.3-1.6)	0.853 <sup>§</sup>
6 months after intervention	33.9 (3.0)	34.4 (2.7)	0.09 (-1.3-1.5)	0.897 <sup>§</sup>
Adjusted differences (95% CI)	2.7 (0.9-4.5)	0.8 (-0.4-1.9)		
P	0.004	0.171		
<b>Health responsibility (23-92)</b>				
Baseline	54.6 (11.4)	59.9 (15.8)	-	0.212 <sup>¶</sup>
8 weeks after intervention	63.5 (9.3)	60.3 (14.2)	7.7 (4.0-11.4)	<0.001 <sup>§</sup>
6 months after intervention	64.7 (9.2)	60.0 (14.5)	9.2 (5.1-13.4)	<0.001 <sup>§</sup>
Adjusted differences (95% CI)	10.1 (6.7-13.6)	0.1 (-3.2-3.4)		
P	<0.001	0.860		
<b>Stress management (6-24)</b>				
Baseline	17.8 (3.5)	18.9 (3.7)	-	0.169 <sup>¶</sup>
8 weeks after intervention	19.3 (2.5)	19.6 (3.4)	-0.30 (-1.9-1.3)	0.708 <sup>§</sup>
6 months after intervention	21.1 (7.8)	19.7 (3.6)	1.2 (-2.2-4.5)	0.484 <sup>§</sup>
Adjusted differences (95% CI)	3.3 (0.02-6.7)	0.8 (-0.6-2.2)		
P	0.070	0.346		
<b>Interpersonal relationships (13-52)</b>				
Baseline	41.4 (7.4)	43.2 (7.7)	-	0.420 <sup>¶</sup>
8 weeks after intervention	45.8 (4.7)	45.2 (5.0)	1.5 (-0.7-3.6)	0.176 <sup>§</sup>
6 months after intervention	45.3 (5.1)	45.0 (6.2)	0.72 (-1.9-3.6)	0.587 <sup>§</sup>
Adjusted differences (95% CI)	3.9 (1.3-6.5)	1.8 (-0.5-4.1)		
P	0.001	0.099		

Higher score higher lifestyle. <sup>¶</sup>Independent t-test, <sup>§</sup>ANCOVA adjusted for baseline. Patient within group analysis with repeated measure (using sphericity, or greenhouse in case of significant Mauchly test). SD=Standard deviation, CI=Confidence interval

of quality of life in the intervention group was significantly higher than before the implementation of the program, while this change in control group was not statistically significant. Although the results were consistent with the present study, it investigated the quality of life.<sup>[17]</sup> In another study by Hosseini *et al.* in Tehran (Iran), the physical activity and health responsibility subscales got minimum scores among health-promoting behaviors.<sup>[23]</sup> The mentioned study is somewhat in line with our results but it was a cross-sectional study.

Similar results with the present study were obtained following health promoting education programs for the elderly,<sup>[24,25]</sup> which are consistent with the results of the present study. However, they were designed according the other educational approach.

In the current study, the education program significantly reduced the risk of cardiovascular and metabolic diseases (average weight and BMI). Decreased serum levels of total cholesterol, LDL, urea, and creatinine

**Table 4: Mean scores of serum levels of metabolic biomarkers of elderly women among study groups**

Biomarker	Mean (SD)		Adjusted differences (95% CI)	P
	Intervention (n=29)	Control (n=29)		
<b>FBS (mg/dL)</b>				
Baseline	101.4 (17.0)	110.4 (1.2)	-	0.183 <sup>¥</sup>
8 weeks after intervention	101.4 (12.6)	110.7 (40.4)	-0.5 (-9.5-8.6)	0.917 <sup>§</sup>
6 months after intervention	96.6 (12.9)	105.1 (24.9)	-3.1 (-9.9-3.7)	0.364 <sup>§</sup>
P	0.039	0.312		
<b>HOMA-IR</b>				
Baseline	3.4 (1.6)	3.0 (1.2)	-	0.441 <sup>¥</sup>
8 weeks after intervention	3.0 (1.2)	3.1 (1.4)	-0.4 (-1.1-0.3)	0.257 <sup>§</sup>
6 months after intervention	2.9 (1.3)	3.1 (1.5)	-0.4 (-1.2-0.3)	0.249 <sup>§</sup>
P	0.087	0.965		
<b>Insulin (µU/mL) fasting</b>				
Baseline	13.3 (6.1)	11.0 (5.5)	-	0.138 <sup>¥</sup>
8 weeks after intervention	11.9 (5.3)	11.7 (5.1)	-1.6 (-4.2-1.0)	0.215 <sup>§</sup>
6 months after intervention	11.9 (5.5)	11.2 (5.7)	-1.3 (-4.1-1.5)	0.355 <sup>§</sup>
P	0.161	0.779		
<b>Total cholesterol (mg/dL)</b>				
Baseline	245.6 (51.3)	229.0 (70.4)	-	0.334 <sup>¥</sup>
8 weeks after intervention	225.7 (5.2)	200.6 (46.5)	17.1 (2.4-31.8)	0.023 <sup>§</sup>
6 months after intervention	195.3 (36.0)	187.7 (42.5)	3.1 (-15.9-22.0)	0.749 <sup>§</sup>
P	<0.001	0.001		
<b>LDL-C (mg/dL)</b>				
Baseline	171.2 (49.7)	159.5 (59.5)	-	0.426 <sup>¥</sup>
8 weeks after intervention	154.1 (34.9)	128.3 (44.1)	20.4 (3.9-36.9)	0.016 <sup>§</sup>
6 months after intervention	122.3 (31.5)	106.4 (36.8)	12.7 (-3.9-36.9)	0.130 <sup>§</sup>
P	<0.001	<0.001		
<b>HDL-C (mg/dL)</b>				
Baseline	38.9 (11.4)	38.7 (9.9)	-	0.969 <sup>¥</sup>
8 weeks after intervention	41.2 (10.3)	42.3 (9.0)	-1.1 (-4.7-2.4)	0.516 <sup>§</sup>
6 months after intervention	44.4 (10.1)	46.9 (9.8)	-2.6 (-6.1-0.8)	0.132 <sup>§</sup>
P	<0.001	<0.001		
<b>Triglyceride (mg/dL)</b>				
Baseline	162.1 (75.3)	167.0 (73.2)	-	0.827 <sup>¥</sup>
8 weeks after intervention	152.1 (64.5)	150.0 (72.4)	5.3 (-32.9-43.6)	0.781 <sup>§</sup>
6 months after intervention	143.5 (61.4)	168.9 (75.2)	-22.0 (-51.4-7.4)	0.139 <sup>§</sup>
P	0.293	0.382		
<b>25 (OH) Vitamin D (ng/mL)</b>				
Baseline	53.0 (22.8)	57.0 (25.6)	-	0.663 <sup>¥</sup>
8 weeks after intervention	61.4 (22.4)	54.9 (26.7)	7.0 (-11.9-25.9)	0.461 <sup>§</sup>
6 months after intervention	56.7 (21.5)	64.6 (22.7)	-6.1 (-24.6-12.3)	0.507 <sup>§</sup>
P	0.549	0.363		
<b>Calcium (mg/dL)</b>				
Baseline	9.5 (0.6)	9.5 (0.5)	-	0.695 <sup>¥</sup>
8 weeks after intervention	9.9 (0.4)	10.0 (0.4)	-0.2 (-0.4-0.02)	0.073 <sup>§</sup>
6 months after intervention	9.9 (0.4)	9.8 (0.6)	0.2 (-0.1-0.4)	0.251 <sup>§</sup>
P	0.005	<0.001		
<b>ALT (U/L)</b>				
Baseline	17.5 (7.8)	15.9 (6.9)	-	0.523 <sup>¥</sup>
8 weeks after intervention	14.6 (6.6)	12.6 (5.0)	1.3 (-2.9-5.6)	0.546 <sup>§</sup>
6 months after intervention	17.7 (7.9)	15.1 (3.6)	1.8 (-2.2-5.8)	0.367 <sup>§</sup>
P	0.316	0.004		
<b>AST (U/L)</b>				
Baseline	23.8 (8.6)	22.9 (9.5)	-	0.732 <sup>¥</sup>
8 weeks after intervention	22.7 (10.5)	18.2 (6.5)	4.1 (-3.9-12.2)	0.308 <sup>§</sup>

Contd...

**Table 4: Contd...**

Biomarker	Mean (SD)		Adjusted differences (95% CI)	P
	Intervention (n=29)	Control (n=29)		
6 months after intervention	22.8 (7.9)	22.2 (8.0)	0.2 (-3.0-3.3)	0.920 <sup>§</sup>
P	0.850	<0.001		
Urea (mg/dL)				
Baseline	31.8 (6.4)	30.1 (8.3)	-	0.584 <sup>¥</sup>
8 weeks after intervention	30.0 (7.2)	26.7 (4.9)	3.0 (0.6-5.4)	0.016 <sup>§</sup>
6 months after intervention	27.2 (6.3)	26.3 (5.8)	1.1 (-2.0-4.2)	0.485 <sup>§</sup>
P	<0.001	0.002		
Creatinine (mg/dL)				
Baseline	1.1 (0.2)	1.0 (0.16)	-	0.562 <sup>¥</sup>
8 weeks after intervention	1.0 (0.16)	1.0 (0.18)	0.06 (-0.03-0.2)	0.180 <sup>§</sup>
6 months after intervention	0.85 (0.15)	0.80 (0.12)	0.04 (-0.02-0.1)	0.210 <sup>§</sup>
P	<0.001	<0.001		

<sup>¥</sup>Independent t-test, <sup>§</sup>ANCOVA adjusted for baseline. Patient within group analysis with repeated measure (using sphericity, or greenhouse in case of significant mauchly test). SD=Standard deviation, CI=Confidence interval, FBS=Fasting blood sugar, HOMA-IR=Homeostasis model assessment of insulin resistance, LDL-C=Low-density lipoprotein cholesterol, HDL-C=High-density lipoprotein cholesterol, AST=Aspartate transaminase, ALT=Alanine transaminase

**Table 5: Mean score of anthropometric indicators of elderly women among study groups**

Variable	Mean (SD)		Adjusted differences (95% CI)	P
	Intervention (n=29)	Control (n=29)		
Weight (kg)				
Baseline	74.9 (11.4)	73.8 (10.5)	-	0.700 <sup>¥</sup>
8 weeks after intervention	72.8 (11.7)	73.5 (10.6)	-0.7 (-1.8-0.4)	0.231 <sup>§</sup>
6 months after intervention	74.0 (11.7)	73.6 (10.9)	-1.2 (-2.1-0.2)	0.017 <sup>§</sup>
Body mass index (kg/m)				
Baseline	30.7 (3.9)	29.8 (3.8)	-	0.360 <sup>¥</sup>
8 weeks after intervention	30.1 (4.0)	29.9 (3.8)	-0.7 (-1.4--0.1)	0.033 <sup>§</sup>
6 months after intervention	30.3 (3.9)	29.8 (4.1)	-0.6 (-0.2--1.0)	0.005 <sup>§</sup>
Waist (cm)				
Baseline	97.9 (8.0)	95.6 (9.6)	-	0.311 <sup>¥</sup>
8 weeks after intervention	95.1 (8.5)	97.0 (9.2)	-1.9 (-4.9-1.1)	0.211 <sup>§</sup>
6 months after intervention	89.6 (17.8)	90.0 (25.0)	-0.4 (-11.8-11.1)	0.946 <sup>§</sup>
Hip/waist				
Baseline	0.87 (0.05)	0.87 (0.06)	-	0.975 <sup>¥</sup>
8 weeks after intervention	0.87 (0.05)	0.88 (0.07)	-0.02 (-0.05-0.01)	0.277 <sup>§</sup>
6 months after intervention	0.84 (0.16)	0.82 (0.22)	0.01 (-0.09-0.12)	0.819 <sup>§</sup>

<sup>¥</sup>Independent t-test, <sup>§</sup>ANCOVA adjusted for baseline. SD=Standard deviation, CI=Confidence interval

and increased levels of HDL-C and calcium in both intervention and control groups are some of the interesting results of this study.

Previous studies have shown that regular physical activity and exercise can prevent the risk of cardiovascular disease in adults and increase HDL levels. Considering that a 1% reduction in blood cholesterol reduces cardiovascular disease as much as 2%, both physical and chronic activities can reduce the triglycerides and blood cholesterol.<sup>[26]</sup> Other benefits of physical activity include reducing the risk of hip and vertebral fractures, increasing bone strength by more calcium absorption of the bones in the presence of Vitamin D, and weight control by reducing body and blood fat.<sup>[27,28]</sup>

In line with the results of the present study, the results of previous studies suggest that comprehensive interventions

including health education and nutrition affect the lifestyle of at risk people for diabetes Type 2, and cardiovascular disease by decreasing the BMI score, blood pressure, fasting glucose, glycated hemoglobin, and FINDRISK score in the studied groups.<sup>[29]</sup> Furthermore, the effectiveness of a multimodel, community-based, and culture-based behavioral intervention program significantly reduced hemoglobin A1c levels, diabetes-related quality of life, self-efficacy, adherence to a diabetes management regimen, and health literacy in the educated group.<sup>[30]</sup> Two above studies were conducted on elderly people with Type 2 diabetes and cardiovascular diseases using other educational approaches. Family-centered education in current study was effective similar to the above approaches on elderly people without uncontrolled diseases.

Another similar study investigated the consequences of lifestyle-based behavioral intervention on overweight in



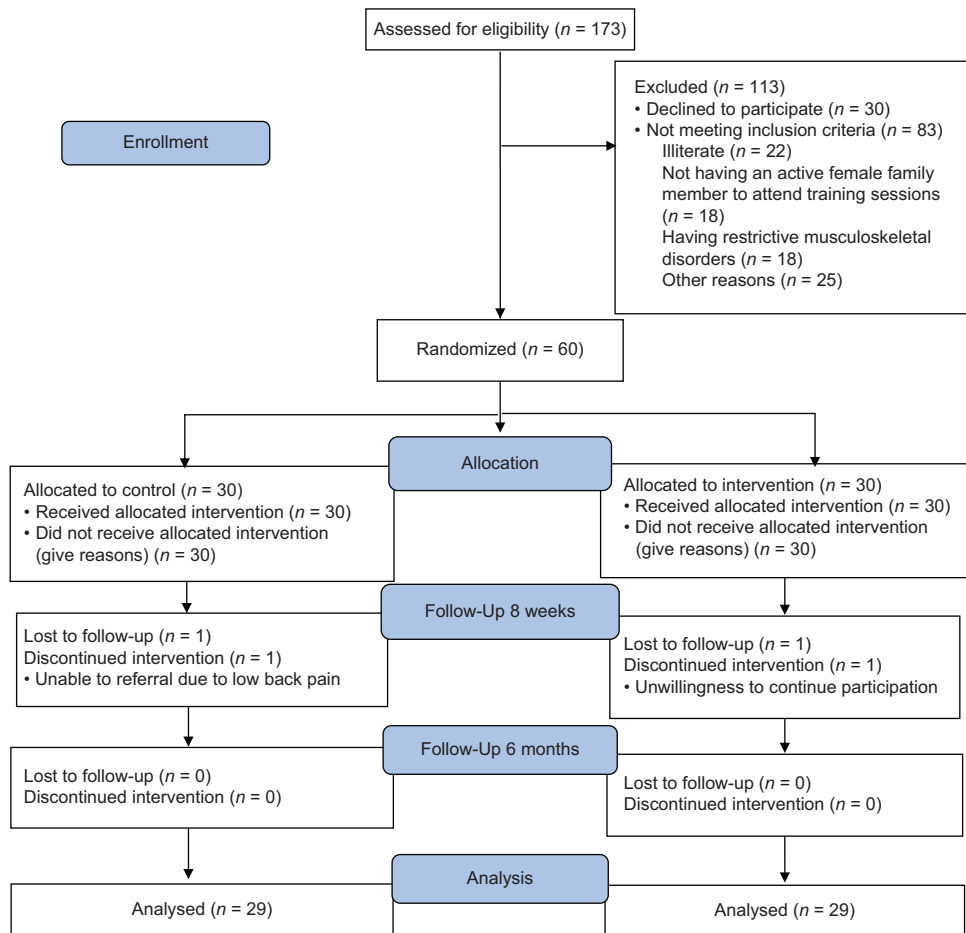


Figure 1: Flow diagram of the progress through the phases of the randomized controlled trial

women aged 35–64 years old. The results showed that proper eating habits, waist circumference and women's physical activity, and awareness of heart disease in the intervention group have significantly improved compared to the control group. This indicates that the high level of attendance in classes and participation in individual education and counseling sessions supports the possibility and acceptance of lifestyle behavior intervention.<sup>[31]</sup> The results of these studies are consistent with the present study.

Health education is an integral part of public health as well as foundation for the development and promotion of health. Family members as a supporter have definitely important role in the illnesses and health problems. The family members' relationship makes the health of each member effective in the health of other members and the whole family. Therefore, programs that focus on the performance of the elderly with a family-centered approach are very important and they should be considered.

The main strengths of the present research were the mutual trust between the researcher and the participants and so the great interest and sense of responsibility to participate in all training sessions by the elderly as well as the very

sincere cooperation of the health-care personnel in all five health-friendly centers. The limitations of this research were the existence of differences in the level of literacy and also cultural, social, and economic differences between the participants in five health centers that was effective on providing interventions and training. The research setting was limited to elderly-friendly centers that cannot be generalized to all elderly people in Tabriz. Therefore, we suggest conducting similar research in all health-care centers. Implementing and evaluating this educational approach on both gender as well as on people with life-style related diseases seem to be beneficial. Moreover, to make significant changes in all domains and metabolic indicators, long-term family-centered interventions are proposed.

## Conclusion

The study showed that education based on the family-centered empowerment model had a positive effect on the total score of health promoting behaviors and some of its dimensions. Most indicators of serum metabolic status improved in both groups, but the difference between the two groups was not significant. Based upon the results, this educational model seem benefic

in the studied elderly women. So, it is recommended implementation of this educational approach for improving life style and the health of older women.

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### Conflicts of interest

There are no conflicts of interest.

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