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Effects of an Osteoporosis Prevention Program Based on Health Belief Model Among Females

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Background: Several studies reported the efficacy of osteoporosis prevention interventions in improvement of people's preventive behaviors. However, there are reports that the interventions were not successful in altering osteoporosis health beliefs and preventive behaviors.
Objectives: The current study aimed to assess the effect of a program based on health beliefs model (HBM) on females' health beliefs and performances about osteoporosis preventive behaviors.
Patients and Methods: This quasi-experimental study was conducted on 120 patients registered in two healthcare centers of Fasa, Fars Province, Iran in 2014. A questionnaire including demographic information and HBM constructs was employed to measure the females' beliefs regarding nutrition and walking performance in prevention of osteoporosis bone mineral density (BMD) measured at the lumbar spine and femur before, immediately after the intervention, and six months after the intervention. Data were analyzed using Chi-square, independent samples t-, Mann-Whitney U tests and repeated measures ANOVA.
Results: Immediately and six months after the intervention, a significant increase was found in the intervention group's health beliefs, nutrition, and walking performances to prevent osteoporosis. Six months after the intervention, lumbar spine BMD T-score increased to 0.127 ± 0.061 in the intervention group but reduced to -0.043 ± 0.059 in the control group. Also, hip BMD T-score increased to 0.125 ± 0.088 in the intervention group, but decreased to -0.028 ± 0.052 in control group.
Conclusions: The current study showed the effectiveness of HBM in adoption of nutrition and walking behaviors as well as the increase of bone density to prevent osteoporosis.

Keywords: Nutritional Status; Walking; Health Belief Model

1. Background

Osteoporosis is a disease characterized by decreased bone density and loss of bone microstructure which can lead to an increased risk of fracture (1). Females are eight times more at risk of osteoporosis than males (2). Bone mass in females is significantly less than that of the males of the same age and race (3). In both sexes, the peak bone mass is achieved by the age of 30 years and then, the bone mass gradually decreases with the age increase (4). In a meta-analysis study in Iran, the overall prevalence of osteoporosis in lumbar spine was 17% and that of osteopenia was 35% (5).

It is shown that positive changes in lifestyle such as exercise and adequate intake of calcium and vitamin D can prevent or delay osteoporosis by reducing the rate of bone density loss and improving the people's bone mineral density (BMD) (6-8). Accordingly, the world health organization (WHO) set a goal to increase the number of females trained regarding osteoporosis prevention (9). Identifying the factors affecting behavior makes this change easier. Therefore, if osteoporosis should be prevented, it is essential to use the models that identify the factors affecting people's behavior.

Using health belief model (HBM) might help people change their behavior through understanding the disease entity, their susceptibility, and benefits, barriers, and cues to action and self-efficacy (10) in turning to healthy behaviors (10).

Several studies were conducted on osteoporosis-preventing interventions using the HBM and reported its efficacy in improvement of people's preventive behaviors (11, 12). However, Drieling et al. and Ziccardi et al. used this model to prevent osteoporosis and reported that the interventions were not successful in altering osteoporosis health beliefs and preventive behaviors (13, 14).

2. Objectives

The current study aimed to assess the effect of implementing a program based on HBM on improvement of osteoporosis preventive eating behaviors and physical activity among adult females.

3. Patients and Methods

3.1. Study Design and Participants

This quasi-experimental study was conducted on 120 females aged 30 to 50 years old referring to healthcare centers of Fasa, Fars province, Iran in 2014. Among the six urban healthcare centers of Fasa, two centers were randomly selected, as intervention and the control groups. Simple random sampling was used at the healthcare center based on the number of health records of the households covered by the centers. The subjects of each group were then invited to a special meeting in the healthcare centers. The inclusion criteria were being in the age range of 30 - 50 years old, covered by one of the two healthcare centers, no disability, no known rheumatoid disease, mental illness, or a genetic early osteoporosis, lack of fractures, and signing a consent letter to participate in the study. The exclusion criteria were a subject's decision to withdraw from the study and absence of more than 2 educational sessions. Figure 1 presents the study flow chart.

Sample size was estimated based on a previous study by Ghaffari et al. in which the mean and standard deviation of calcium intake before and after the study were 813.31 ± 264.75 mg and 1096.61 ± 590.21 mg in the study groups, respectively (15). Then, based on the mentioned study and considering $\beta = 0.90$, $\alpha = 0.05$, $S1 = 264.75$, $S2 = 590.21$, $\mu1 = 813.31$, and $\mu2 = 1096.61$, 55 subjects were estimated to be needed in each group. However 60 subjects were recruited in each group to compensate the possible attrition.

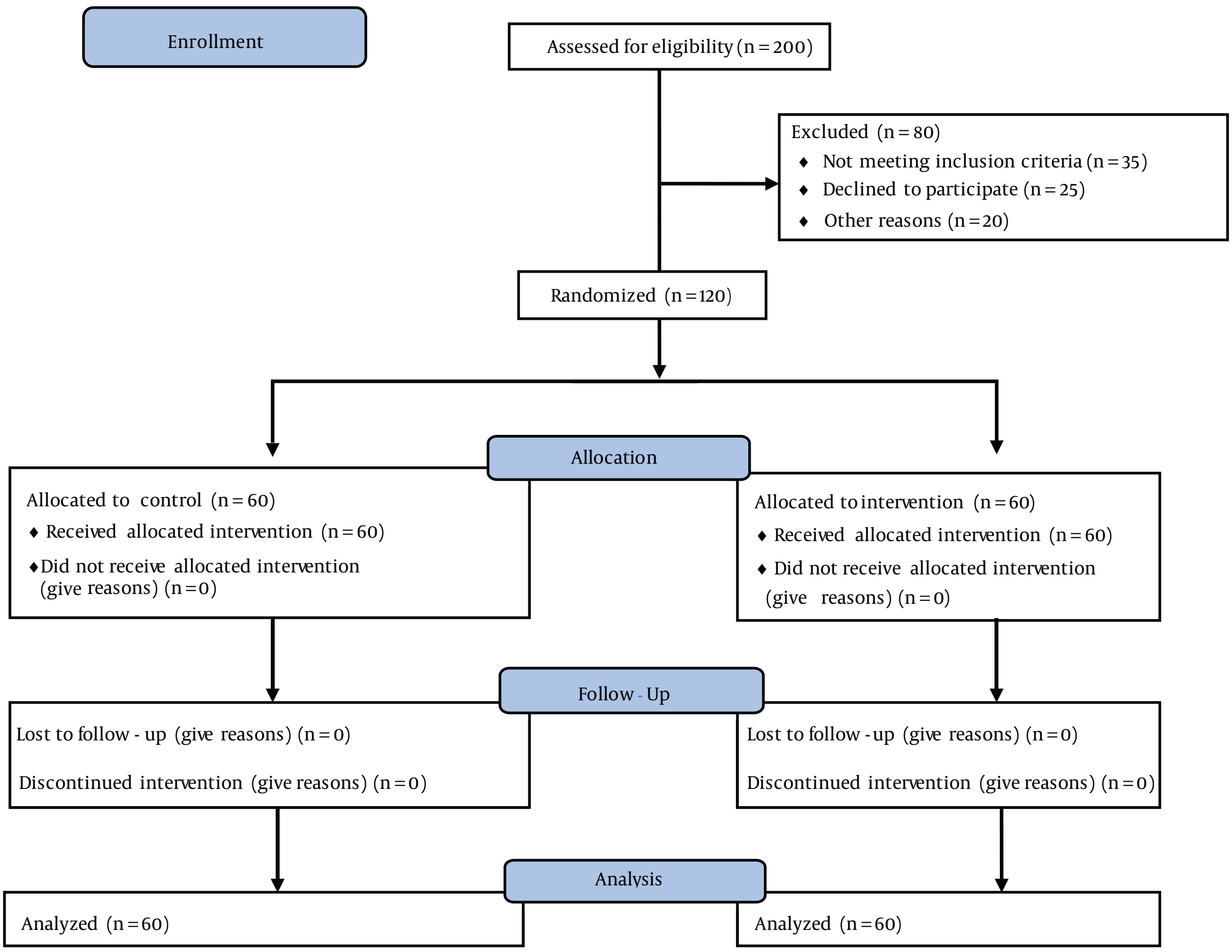

Figure 1. Flow Chart of the Study

3.2. Instruments

The study data were collected using a three-part instrument. The first part consisted of questions on demographic characteristics such as age, body mass index (BMI), education level, marital status, occupation, delivery times, breastfeeding, smoking, history of osteoporosis in the family, history of other co-morbidities (i e, thyroid disorders, diabetes, cancer, and immunodeficiency diseases) and history of performing a BMD examination. The second section, with 56 items, was based on HBM structure including knowledge of osteoporosis (23 items), perceived susceptibility or females' opinion about chances of getting osteoporosis (4 items), perceived severity and complications of osteoporosis (6 items), perceived benefits of osteoporosis preventive behaviors such as physical activity and calcium intake (8 items), perceived barriers to physical activity and consumption of calcium-rich foods (7 items), self-efficacy in performing exercises, and observing proper diet (4 items), external cues to action including resources such as family and friends, doctors and health workers, mass media, books and magazines, internet, and other patients with osteoporosis who encouraged the subjects towards osteoporosis prevention behaviors (1 item), and internal cues to action such as fear of suffering from complications of osteoporosis and a sense of inner peace following preventive behaviors (3 items). All items, except for cues to action, are responded on a 5-point Likert scale ranging from strongly disagree (= 1) to strongly agree (= 5). Scores of questions on external cues to action are calculated as cumulative frequency.

The third section consisted of questions on nutritional performance and exercise (i.e. walking). Performance questions consisted of 14 questions on the type and amount of food consumed in the week before the test (scored from 0 to 14). Exercise questions included 7 questions on the duration and type of walking (easy, moderate and heavy) in the week before the test based on the received guidelines (scored from 0 to 21). The subjects' performance was assessed via self-report method.

To evaluate the validity of the questionnaire items, the impact index item higher than 0.15 and content validity ratio above 0.79 were considered and based on the exploratory factor analysis, they were classified into nine factors. In order to determine the content validity, twelve specialists, and professionals (outside the research team) in the field of health education and health promotion (n = 10), orthopedic (n = 1), and biostatistics (n = 1) were consulted. Then, according to the Lawshe table, items with a content validity ratio (CVR) higher than 0.56 were considered acceptable and retained for the subsequent analysis (16).

To assess the reliability of the instrument, a cross-sectional study was conducted on 401 females aged 30 to 50 years old referring to healthcare centers of Fasa. Then, the reliability of the instrument was assessed using the internal consistency method. The overall Cronbach's alpha was 0.87. Moreover, the Cronbach's alpha was 0.86 for knowledge, 0.71 for perceived susceptibility, 0.82 for perceived severity, 0.79 for perceived benefits, 0.82 for perceived barriers, 0.79 for self-efficacy, and 0.77 for Cues to action.

3.3. Intervention

At the beginning of the study, the pre-test questionnaire was administered to the two groups. Illiterate subjects answered the questionnaire through self-report. However, an expert research assistant interviewed the illiterate subjects and recorded their answers in the questionnaire. Then, all subjects were referred to Fasa bone densitometry center and their bone density of L1 to L4 vertebrates and femoral neck was measured using Hologic machine using Dual Energy X-Ray Absorptiometry (DEXA) method. The densitometry data was collected according to the World Health Organization T-Score values.

In the intervention group, the educational program was presented by the authors and five public health experts trained for the study before starting the intervention. The training sessions were held in the health center. The intervention included eight educational sessions of 55 - 60 minutes. Each session included a combination of lectures, group discussion, questions, and answers, showing posters, short videos, and PowerPoint displays. Moreover, educational pamphlets were given to the participants at the end of the last session. The details of the training sessions are presented in Table 1. To preserve and enhance the activity of the experimental group, weekly educational text messages on osteoporosis were sent to them through short message system. They also attended monthly sessions so that the researchers could follow-up their activities.

Table 1. The Details of the Training Sessions

Sessions	Details
First session	Introduction to osteoporosis and its symptoms, complications and diagnosis.
Second session	A 55-year-old female diagnosed with osteoporosis and had a fracture was invited as a model and talked to the subjects about osteoporosis and its risk factors, symptoms, complications, and diagnosis with the help of a physician
Third and fourth sessions	The role of nutrition in preventing osteoporosis, benefits and barriers of diet, following dietary recommendations, self-efficacy in observing proper diet, and recording activities in the specified forms
Fifth and sixth sessions	The role of exercise, and appropriate exercises; the role and importance of walking, its benefits, barriers types, and self-efficacy, and recording the duration of walking in specified forms
Seventh session	The session was held with the presence of at least one family member and the role of family members in making, facilitating, and providing suitable food, walking program, and BMD testing was explained
Eighth session	The previous sessions were reviewed and the subjects were provided with educational pamphlets

Immediately after the intervention, both groups answered the questionnaire again. Moreover, six months later, the questionnaire was completed by both groups and the subjects underwent BMD tests and the results were recorded. No attrition occurred in the study groups. The control group did not receive any training and was only invited to the special sessions to fill out the questionnaires. However, due to ethical considerations, a training session on osteoporosis was held for this group after the completion of the study.

3.4. Ethical Considerations

The study was approved by the Ethics Committee of Tarbiat Modares university, Tehran, Iran (number: 522523, code: 2351006). The study objectives and procedures were explained to the subjects and their written informed consents were obtained. Data confidentiality of the individuals was observed during the study.

3.5. Statistical Analyses

Data analysis was carried out through SPSS version 13. Demographic variables of the two groups were compared using Chi-square test. Repeated measures analysis of variance was used to compare the participants mean scores of knowledge, nutrition, and walking performance in the three consecutive measurements. Moreover, Bonferroni post hoc test was used to assess the difference between the participants mean scores in different measurements. In addition, independent samples t-test was used to compare knowledge, nutrition, and jogging performance mean scores of the two groups. Mann-Whitney U test was also used to compare the T-Score of lumbar spine and femur of the two groups. Significance was set at $P < 0.05$.

4. Results

Tables 2 and 3 show the subjects demographic data. No significant difference was observed between the two groups regarding the demographic data.

Table 2. Frequency Distribution of the Subjects in Terms of Demographic Information- Qualitative Variables

Variables	Experimental Group [a]	Control Group [a]	P Value (T-Test)	CI: 95%
Age	41.75 ± 5.4	41.77 ± 5.43	0.748	-1.97 - 1.94
BMI	22.44 ± 3.30	22.27 ± 3.05	0.855	-0.98 - 1.32
Number of deliveries/subject	2.57 ± 1.47	2.50 ± 1.19	0.532	-0.42 - 0.55

[a] Values are presented as mean ± SD.

Table 3. Frequency Distribution of the Subjects in Terms of Demographic Information-Quantitative Variables [a]

Variables	Control Group	Experimental Group	P Value
Occupation			0.673
Employed [b]	10 (16.71)	12 (20)	
Housewife	50 (83.33)	48 (80)	
Educational level			0.771
Illiterate and Primary school	11 (18.32)	16 (26.60)	
Secondary school	22 (36.73)	17 (28.32)	
High school	17 (28.3)	18 (30)	
College	10 (16.7)	9 (15)	
Marital status			0.88
Single	12 (20)	14 (23.33)	
Married	48 (80)	46 (76.77)	
Breast feeding			0.769
No	54 (90)	53 (88.33)	
Yes	6 (10)	7 (11.7)	
Smoking			0.315
No	60 (100)	59 (98.3)	
Yes	0 (0)	1 (1.7)	
History of osteoporosis in the family			0.378
No	52 (86.77)	55 (91.73)	
Yes	8 (13.33)	5 (8.3)	
History of a special disease			0.769
No	53 (88.33)	54 (90)	
Yes	7 (11.77)	6 (10)	
History of bone densitometry			0.543
No	53 (88.33)	55 (91.77)	
Yes	7 (11.77)	5 (8.33)	

[a] Data are presented as No. (%).
[b] Employees working anywhere.

Before the intervention, no significant difference was observed between the two groups in terms of knowledge (P = 0.358), perceived susceptibility (P = 0.827), perceived severity (P = 0.196), perceived benefits (P = 0.707), perceived barriers (P = 0.293), self-efficacy (P = 0.965), internal cues to action (P = 0.262), nutrition (P = 0.481), and walking performance (P =0.999). However, immediately after the intervention and six months later, the experimental group showed a significant increase in all of the foregoing subscales (P < 0.001) except for the perceived barriers that significantly decreased compared to that of the control group (Tables 4) (P < 0.001).

Six months after the intervention, the value of lumbar spine BMD T-Score in the experimental group increased to 0.127 ± 0.061, while in the control group it decreased to -0.043 ± 0.059 (P = 0.413). The value of the hip BMD T-Score in the intervention group increased to 0.125 ± 0.088 while it decreased to -0.028 ± 0.052 in the control group (P = 0.420) (Table 5).

Distribution of the external cues to action for osteoporosis is presented. The number of used cues, especially those of the family and friends, increased immediately and six months after the intervention compared to before the intervention (Table 6).

Table 4. Comparing the Participants Mean Scores of Knowledge, HBM Components Nutrition and Walking Performance Regarding Osteoporosis Prevention [a]

Variable	Experimental Group (N = 60)			Control Group (N = 60)			P Value
	Pre-Test	Post-Test	Six Months Later	Pre-Test	Post-Test	Six Months Later	
Knowledge	7.65 ± 2.36	10.82 ±17.30	18.33 ± 2.25	8.07 ± 2.58	8.67 ± 2.50	7.17 ± 2.59	< 0.001
Perceived susceptibility	22.7 ± 2.31	10.50 ± 2.65	15.82 ± 2.28	7.13 ± 1.84	7.65 ± 1.71	8 ± 1.80	< 0.001
Perceived severity	9.73 ± 2.34	13.23 ± 3.54	19.92 ± 4.31	9.22 ± 1.99	9.83 ± 1.95	10.35 ± 2.05	< 0.001
Perceived benefit	13.53 ± 3.76	18.65 ± 4.72	28.60 ± 5.01	13.30 ± 2.98	14.17 ± 2.85	14.98 ± 3.01	< 0.001
Perceived barrier	26.50 ± 4.01	20.82 ± 4.02	13.55 ± 3.95	25.70 ± 4.28	24.60 ± 4.40	23.80 ± 4.46	< 0.001
Self-efficacy	7.68 ± 1.90	10.93 ± 2.37	15.87 ± 2.60	7.67 ± 2.18	8.80 ± 2.19	9.40 ± 2.47	< 0.001
Internal cues to action	5.57 ± 1.91	7.15 ± 1.91	12.25 ± 1.46	5.93 ± 1.65	6.35 ± 1.70	7.53 ± 1.56	< 0.001
Nutrition performance	4.80 ± 1.87	7.75 ± 1.87	11.78 ± 1.49	5.05 ± 2	5.40 ± 1.79	5.55 ± 1.67	< 0.001
Jogging performance	6.93 ± 3.44	11.83 ± 3.31	18.72 ± 2.17	6.93 ± 2.52	7.85 ± 2.38	8.45 ± 2.47	< 0.001

[a] The values are presented as mean ± SD.

Table 5. The Mean T-Score of Lumbar Spine and Femur in the Subjects [a]

Variables	Experimental Group	Control Group	P Value [b]
Spine			
Pre-intervention	0.118 ± 1.254	0.108 ± 1.220	0.973
Six months after the intervention	0.245 ± 1.248	0.065 ± 1.228	0.413
Paired t-test P value	< 0.001	< 0.001	
Hip			
Pre-intervention	-0.240 ± 1.108	-0.222 ± 1.114	0.935
Six months after the intervention	-0.115 ± 1.087	- 0.250 ± 1.107	0.42
Paired t-test P value	< 0.001	< 0.001	

[a] The values are presented as mean ± SD.
[b] Comparison between experimental and control (Mann-Whitney test).

Table 6. Distribution of External Cues to Action Regarding Osteoporosis Prevention [a]

Variables	Experimental Group (N = 60)			Control Group (N = 60)			P Values		
	Pre-Test	Post-Test	Six Months After the Intervention	Pre-Test	Post-Test	Six Months After the Intervention	Pre-Test	Post-Test	Six Months After the Intervention
Physicians and health personnel	16 (26.66)	17 (28.33)	20 (33.33)	15 (25)	16 (26.66)	16 (26.66)	0.22	0.25	0.046
Families and friends	15 (25)	26 (43.33)	29 (48.33)	15 (25)	14 (23.33)	14 (23.33)	0.301	0.01	0.035
Books	9 (15)	5 (8.33)	2 0.033)	10 (16.66)	9 (15)	10 (16.66)	0.245	0.230	0.225
Journals and publications	8 (13.33)	4 (6.66)	2 (0.033)	9 (15)	9 (15)	8 (13.33)	0.115	0.120	0.131
Mass media	9 (15)	5 (8.33)	3 (5)	8 (13.33)	10 (16.66)	9 (15)	0.312	0.420	0.540
Patients	1 0.016)	1 (0.016)	2 (0.033)	2 (0.033)	1 (0.016)	1 (0.016)	0.841	0.521	0.733
Internet	2 (0.033)	2 (0.033)	2 (0.033)	1 (0.016)	1 (0.016)	2 (0.033)	0.651	0.425	0.535

[a] Data are presented as No. (%).

5. Discussion

The intervention used in the study could significantly increase mean scores of knowledge about osteoporosis in the experimental group, which was consistent with results of Ghaffari et al. (15) and Winzenberg et al. (17) who trained middle school girls and premenopausal females on osteoporosis prevention. The slight increase of knowledge mean score in the control group can be attributed to the participants' access to other sources of information.

The present study showed that the intervention could significantly affect the subjects' beliefs regarding osteoporosis in all domains of the HBM. Consequently, the participants' mean scores of perceived susceptibility, severity of the problem, benefits of the preventive behaviors and self-efficacy in osteoporosis prevention significantly increased. These findings showed that the intervention had positive effects on the subjects' beliefs about the importance of change behavior regarding osteoporosis prevention. Moreover, the intervention could significantly reduce the subjects' mean score in the domain of perceived barriers. This finding showed that the intervention induced this belief in the participants that it is possible to change behavior regarding osteoporosis prevention and adopt proper diet and exercise programs. Several previous studies confirmed that implementing training programs could significantly affect people's beliefs regarding osteoporosis and its prevention (12, 18-22). However, Tussing et al. (18) and Sanaeinasab et al. (23) reported that the perceived severity of the osteoporosis did not significantly improve after osteoporosis prevention education. Moreover, Jessup et al. (24) reported that exercise did not significantly affect the levels of self-efficacy regarding osteoporosis prevention in older women. However, the current study results along with the majority of previous studies signifies the urgent need to implement community based interventions to educate people on the dangers of osteoporosis in their lives and especially in adulthood.

In the present study, although the mean score of internal cues to action increased in both groups, this increase was more sensible in the intervention group. This is in agreement with the result of the research by Khorsandi et al. (20). Although changes in the intervention group can be attributed to the intervention, in the case of the control group the changes might be attributed to their frequent confrontation to the test and an increase in internal motivations to change behavior and information seeking. The results also showed an increase in external cues immediately and six months after the intervention. It seems that the increase in the internal cues of action made the subjects use more external supportive resources that mostly included the family, friends, physicians, and healthcare workers. External cues of action are social factors included in HBM and refer to perceived social pressures leading to performing or not performing a behavior. These external and internal cues led the subjects towards osteoporosis prevention behaviors. This implies the effectiveness of external cues as the source of information, support for eating and walking behaviors, and providing the necessary resources and guidance for bone density assessment.

The mean scores of nutrition and exercise performances in the intervention group significantly increased compared to those of the controls both immediately and six months after the intervention. It indicates the positive effects of education on subjects performance regarding osteoporosis preventive behaviors. Hazavehei et al. also reported an increase in walking and calcium intake in the intervention group after the education (12). In a study by Bhurosy et al. using the HBM on 189 people aged ≥ 40 years could significantly increase the calcium intake of the study participants (25). Similar findings were also reported by Jung et al. who trained young females through targeted messages (26).

Six months after the intervention, the value of the thigh and lumbar spine T-Score increased in the experimental group, while it reduced in the control group. Huang et al. investigated the effectiveness of an osteoporosis prevention program based on HBM among females in Taiwan. The results showed increases in perceived benefits, self-efficacy, knowledge and BMD in the intervention group (27). Specker et al. reported that exercise and calcium intake can improve bone density in the growth age (28). Similar findings were reported by Jessup et al. who studied the effects of exercise on bone density in the elderly (24). The improvements in bone T-score and BMD confirm that positive changes in knowledge and health beliefs of the participants could result in positive effects in bone density as an objective measure for the efficacy of the intervention.

The current study selected two separate healthcare centers as intervention and control to prevent the possible contact between the participants. However, some hidden contacts might have occurred between the participants in the two groups that were not under the control of the research team.

In conclusion, the current study confirmed the positive effects of training according to HBM on females' knowledge and beliefs about osteoporosis and its prevention. Consequently, subjects' performances in preventive behaviors and BMD improved. The results of the current study showed the importance of education regarding osteoporosis in females and revealed that policy makers should integrate osteoporosis prevention programs similar to those of the current study in the routine programs provided in all healthcare centers. Such programs, if implemented regularly, might positively affect the people's health behavior and life style especially regarding osteoporosis prevention. The current study was implemented only in females as they are more at risk of osteoporosis. However, similar studies are suggested to be implemented in males because osteoporosis is a prevalent risk for all in the community especially due to the sedentary life style of the people as a consequence of the industrialization of the society. Socioeconomic factors are also important variables that were ignored in the current study and should be addressed in future studies.

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Authors' Contributions

Ali Khani Jeihooni, Alireza Hidarnia, Mohammad Hossein Kaveh and Alireza Askari: designing, data collection and writing the manuscript; Ebrahim Hajizadeh: designing, data collection, statistical analysis and writing the manuscript.

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