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The effect of education based on based health belief model on osteoporosis and bone mineral density among women

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Abstract
Osteoporosis is a systemic skeletal disorder characterized by reduction of one mass, deterioration of bone structure, increase of bone fragility, and fracture risk increment. The purpose of this study was to investigate the effect of an educational program based on Health Melief Model (HBM) onosteoporosis and Bone Mineral Density (BMD) in women. In this quasi-experimental study, 160 participants registered with the health centers. 80 participants were randomly divided into the experimental and control groups. In order to measure the efficacy of nutrition and walking performance for prevention of osteoporosis, a questionnaire consisting of demographic information and HBM constructs was used before, immediately after the intervention, and 12 months following the intervention. BMD was recorded at the lumbar spine and femur before and 12 months following the intervention. Compared to the control group,the experimental group showed a significant increase in their knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, internal cues to action, nutrition, and walking performance immediately and one year after the intervention. Twelve months following the intervention, the value of lumbar spine and hip BMD T-Score in the experimental group increased, while in the control group it reduced. This study revealed the effect of knowledge, walking, and diet on bone mass based on HBM model. Hence, these models can act as a framework for designing and implementing educational interventions in order to prevent osteoporosis.

Keywords: Bone Mineral Density, Health Belief Model, Nutritional Status,Walking, Women

Introduction
Osteoporosis is the most frequent pathological cause of skeletal weakening, characterized by a concomitant reduction in bone mass and/ or loss of bone microstructure, which can lead to an increased risk of fracture [1]. Although the risk of osteoporotic fracture can be reduced by timely diagnosis of bone mineral loss using densitometry and implementation of a specific antiresorptive therapiesor anabolic treatment [2], osteoporosis remains underdiagnosed and undertreated [3-6]. Given the importance of osteoporotic fractures to public

health, national health services have been recommending more widespread availability of bone densitometry to identify those women most at risk for osteoporotic fractures [7]. Bone mineral density is considered to be the standard measure for the diagnosis of osteoporosis and the assessment of fracture risk. The majority of fragility fractures occur in patients with bone mineral density in the osteopenic range [8].

Osteoporosis prevalence is higher in females than males[9].So that, will affect more than 10 million women by 2020 if efforts to prevent it are ineffective[10].

Pourhashem in his study conducted that the overall prevalence rate of osteoporosis was 32.1% in at least one measurement sites (28.5% in lumbar and 14.5% in femoral region) [11].

A study carried out in Fasa demonstrated that 34.1% of the women had osteoporosis [12]. The findings of different studies suggest that exercise and adequate intake of calcium and vitamin D have a significant effect on reducing the rate of bone density loss and improving Bone Mineral Density (BMD) [13]. Knowledge in the areas of risk factors of osteoporosis, exercise, and calcium supplementationhave been very effective in preventing osteoporosis [14].

In line with such a purpose, identifying factors affecting behavior change can make changes easier. There fore Identifying factors affecting behavior change can make changes easier. Therefore, investigating factors affecting the adoption of osteoporosis preventive behaviors among women, using models that identify factors affecting behavior, is necessary. Researchers have used such models to change their subjects' behavior. Among the models effective in health education and promotion are the Health Belief Model (HBM) [15].

A common reason for non-compliance to osteoporosis prevention is the erroneous belief that osteoporosis is not serious. According to HBM, people are most likely to make health behavior changes when they perceive that the disease is serious [16].

The structures of the HBM model include perceived severity, perceived susceptibility, perceived benefits, perceived barriers, modifying variables, cues to action, and self-efficacy [17].

Considering what said above, this study aims to measure HBM constructs regarding eating behaviors and physical activity on bone density in the prevention of osteoporosis among women.

Method

This quasi- experimental, prospective intervention research was conducted during 2015. The population of this study includes 160 women >30 years old covered by health centers of Fasa city, Fars province, Iran. Among the six urban health centers of Fasa, two centers were randomly selected one for the experimental group, and one center for the control group. Based on the numbers of health records of the mothers registered by the centers, simple random sampling was held at health center. The participants were then invited fora meeting in the health centers. They were informed about the study and the related purposes, and their written informed consents were obtained.

Inclusion criteria were as follows: women >30 years old covered by health centers of Fasa, lack of rheumatoid disease and mental illness, lack of fractures, lack of digestive disorders and food allergies, and consent to participate in the study.

Women with disability, diseases, and problems (such women with genetic early osteoporosis) that prevented them from participating in the study were excluded from the study.

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 [17]. Then, based on the mentioned study and considering β= 0.90, α= 0.05, S1= 264.75, S2= 590.21, μ1= 813.31, and μ2= 1096.61, 55 participants were recruited for each group. However, 5 more participants were recruited in each group to compensate the possible attrition.

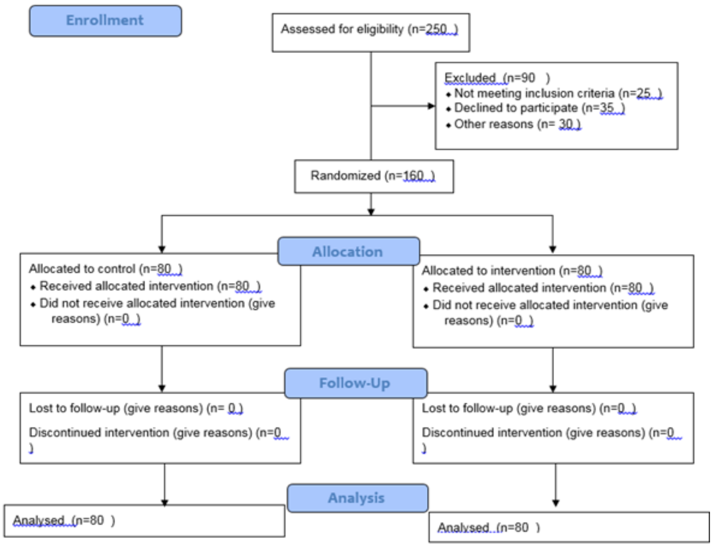

Figure 1 *Presents the study flow diagram*

Selecting the experimental and control groups, the pretest questionnaires were distributed to two groups. Next, to measure bone density, the participants were sent to Fasa bone densitometry center. After testing, the results were recorded. Bone density was measured by Hologic machine using DEXA (Dual Energy X-Ray Absorptiometry) method in L1 to L4 bones. The densitometry data including bone density in lumbar spine and femoral neck were collected based on the World Health Organization's T-Score values.

The intervention for the experimental group included eight educational sessions of 55 to 60 minutes of speech, group discussion, questions and answers, as well as posters and educational pamphlets, film screenings and power point displays, conducted by researchers and five public health experts who underwent training in the hall health center.

The educational content of the training sessions included introduction to osteoporosis and its signs, complications, diagnosis, the role and importance of nutrition and the role of exercise in preventing osteoporosis, and the role of family members in making, facilitating,and providing suitable food and walking program.

Immediately after the intervention, both groups completed the questionnaire. To preserve and enhance the activity of the experimental group, weekly educational text messages about osteoporosis were sent to them and they attended monthly training sessions so that the researchers can follow-up their activities. Twelve months later, the questionnaire was re-completed by both groups (experimental and control) and the participants underwent BMD tests.The results were recorded. The control group did not receive any training. However, due to ethical considerations, a training session on osteoporosis was held for this group after the the study.

The data collection instrument which was completed by the women under the study. This instrument was developed based on the Khani Jeihooni's and hazavehei's studies [18-19].

Data analysis was carried out through SPSS-19. 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 $p<0.05$.

Results

The mean age of the women in the experimental and control groups was 46.66 ± 6.2 and 45.96 ± 5.94 years, respectively. The mean BMI was 22.36 ± 3.25 for the experimental group and 22.30 ± 3.14 for the control group. The average number of women deliveries for the experimental group was 2.55 ± 1.36 and 2.52 ± 1.11 for the control group. The results of chi-square test revealed no significant difference between the two groups regarding the demographic variables (Table 1).

Table 1 *Frequency distribution of the participants in terms of demographic information*

Variable	Control group		Experimental group		p-value
	N	%	N	%	
Occupation					0.640
Employed	15	18.75	17	21.25	
Housewife	65	81.25	63	78.75	
Educational level					0.652
Illiterate	7	8.75	5	6.25	
Primary	13	16.25	14	17.50	
Secondary	25	31.25	23	28.75	
High school	20	25	22	27.50	
College	15	18.75	16	20	
Marital Status					0.777
Single	5	6.25	6	7.50	
Married	61	76.25	60	75	
Divorced	6	7.50	5	6.25	
Widowed	8	10	9	11.25	
Breastfeeding					0.651
No	72	90	74	92.50	
Yes	8	10	6	7.50	
Smoking					0.648
No	78	97.50	79	98.75	
Yes	2	2.50	1	1.25	
History of osteoporosis in the family					0.355
No	68	85	65	81.25	
Yes	12	15	15	18.75	
History of a special disease					0.590
No	67	83.75	62	77.50	
Yes	13	16.25	18	22.50	
History of bone densitometry					0.611
No	69	86.25	71	88.75	
Yes	11	13.75	9	11.25	

According to Table 2 a significant difference were observed between the two groups regarding the mean scores of HBM, knowledge, nutrition, and walking after the intervention.

Comparison of bone mineral density T-score in the lumbar spine (p=0.635) and femur (p=0.752) in women before and 12 months after the intervention showed that before the intervention, there was no significant difference between the experimental group and the control group in this regard. 12 months after the intervention, the value of lumbar spine BMD T-score in the experimental group increased, while in the control group it reduced (p=0.041). The value of the hip BMD T-score in the intervention group increased while it decreased in the control group (p=0.459) (Table 3).

Table 2 *Comparison between the mean scores of participants' knowledge, HBM components and of nutrition and walking performance regarding osteoporosis prevention*

Variable	Experimental (N =60)			Control (N =60)			p-value [b]
	Mean	SD	p-value [a]	Mean	SD	P-value [a]	
Knowledge							
Pre- intervention	6.24	3.31		7.05	2.11		0.638
Post- intervention	11.24	3.25	<0.001	9.34	2.24	<0.001	<0.001
12 months later	18.54	2.22	<0.001	8.85	2.39	<0.001	<0.001
Perceived Susceptibility							
Pre- intervention	7.98	2.31		7.85	1.25		0.545
Post- intervention	11.21	2.24	<0.001	8.01	1.32	<0.001	<0.001
12 months later	17.82	2.11	<0.001	8.32	1.45	<0.001	<0.001
Perceived Severity							
Pre- intervention	8.98	2.32		9.11	1.45		0.230
Post- intervention	15.32	2.66	<0.001	9.35	1.25	<0.001	<0.001
12 months later	21.42	5.01	<0.001	10.64	2.28	<0.001	<0.001
Perceived Benefit							
Pre- intervention	12.22	2.81		13.14	2.35		0.581
Post- intervention	19.61	3.98	<0.001	15.05	2.56	<0.001	<0.001
12 months later	30.11	4.24	<0.001	15.85	3.28	<0.001	<0.001
Perceived Barrier							
Pre- intervention	27.14	4.15		26.85	4.25		0.487
Post- intervention	19.32	4.32	<0.001	25.35	4.32	<0.001	<0.001
12 months later	11.20	3.65	<0.001	23.88	4.45	<0.001	<0.001
Self –efficacy							
Pre- intervention	8.24	2.25		8.65	2.19		0.681
Post- intervention	18.33	2.85	<0.001	9.56	2.19	<0.001	<0.001
12 months later	25.28	2.62	<0.001	10.45	2.47	<0.001	<0.001
Internal Cues to Action							
Pre- intervention	5.25	1.25		5.65	1.36		0.336
Post- intervention	8.15	1.35	<0.001	6.31	1.28	<0.001	<0.001
12 months later	13.24	1.39	<0.001	6.99	1.38	<0.001	<0.001
Nutrition Performance							
Pre- intervention	5.22	1.34		5.08	2.11		0.645
Post- intervention	8.14	1.35	<0.001	5.61	1.87	<0.001	<0.001
12 months later	12.32	1.79	<0.001	6.15	1.86	<0.001	<0.001
Walking Performance							
Pre- intervention	7.01	3.15		6.84	2.22		0.322
Post- intervention	12.22	3.22	<0.001	7.94	2.32	<0.001	<0.001
12 months later	19.01	2.38	<0.001	8.18	2.58	<0.001	<0.001

P-value [a]: Comparison with first evaluation (RM ANOVA – Bonferroni post hock)
P-value [b]: Comparison between experimental and control group (t test for evaluation and Mann-Whitney for difference).

Table 3 *The mean T-score of lumbar spine and femur in women*

	Experimental		Control		p-value[c]
	Mean	SD	Mean	SD	
Spine					
Pre- intervention	0.124	1.132	0.112	1.124	0.635
12 months later	0.312	1.138	0.078	1.520	0.041
Hip					
Pre- intervention	-0.236	1.212	-0.244	1.140	0.752
12 months later	-0.104	1.110	- 0.282	1.214	0.459

Table 4 *Distribution of external cues to action regarding osteoporosis prevention*

		Before intervention			Immediately after intervention			12 months after the intervention		
Variables		Experiment	Control	p-value	Experiment	Control	p-value	Experiment	Control	p-value
Physicians and health personnel	yes	30	28	0.681	35	30	0.211	50	30	0.190
	no	30	32		25	30		10	30	
Families and friends	yes	20	16	0.412	45	18	0.112	55	20	0.045
	no	40	44		15	42		5	40	
Books	yes	15	13	0.626	20	15	0.222	28	16	0.111
	no	45	47		40	45		32	44	
Journals and publications	yes	12	15	0.911	14	17	0.721	20	16	0.412
	no	48	45		46	43		40	44	
Radio and television	yes	25	20	0.724	27	18	0.120	35	21	0.090
	no	35	40		33	42		25	39	
Patients	yes	4	7	0.725	8	8	0.433	20	9	0.235
	no	56	53		52	52		40	51	
Internet	yes	3	4	0.355	10	6	0.101	15	7	0.010
	no	57	56		50	54		45	53	

Table 4 shows the distribution of external cues to action for osteoporosis, before, immediately after and 12 months after the intervention. The number of cues used, especially family and friends, immediately after the intervention and 12 months after the intervention increased as compared to before the intervention.

Discussion

This article describes a program of osteoporosis prevention that of community-based intervention strategies using HBM. Based on the results, there were significant differences between mean scores of knowledge before, immediately after and 12 months later the intervention in the experimental group. The knowledge scores in this group increased significantly after the intervention. The significant increase in the women' knowledge among the intervention group after the health education program was similar to results of El-Sayed et al. [20], Sanaeinasab et al. [21], Abushaikha et al. [22], Abd El Hameed et al. [23], Kutsal et al. [24], Ghaffari et al. [17], Winzenberg et al. [25] and Wafaa Hassan et al.[26]. The increase in knowledge and other constructs can be the participants' access to information as well as their participation in the training course held by the Fasa health center about diseases and health issues for women and health volunteers. The increase in knowledge score in the intervention group is significant and deserves consideration. This success of osteoporosis education program recommends for adopting such education program on future osteoporosis education programs.

There was a significant difference between perceived susceptibility of the two groups six months after the intervention. This can be attributed to the effects of the intervention on the subjects' perceived susceptibility. In other words, after the intervention, most women believed they were at risk for osteoporosis. This is consistent with results of Piaseu et al. [27], Tussing et al. [28], Dohney et al. [29] and Ghaffari et al. [17].

After intervention the perceived severity of the experimental group significantly increased compared to the control group. This is consistent with results of Khorsandi et al. [30] and Hazavehei et al. [19]. However, the perceived severity in Tussing et al. [28] and Sanaeinasab et al. [21] showed no significant increase after the intervention. So that, the osteoporosis education program did emphasize the visible severity of osteoporosis with images and markers pointing out looking frail and disfigured, having a hunch back, and being shorter in height.

The mean scores for perceived benefits showed greater increase in the experimental group than in the control group immediately after and 12 months after the intervention. Ebadi Fard Azar et al. [31] showed that the construct of perceived benefits of physical activity in the intervention group significantly increased after training, but this was not true for the control group. This is consistent with the findings of the present study. In the study by Mehrabbeik [32] on the prevention of osteoporosis among women with low socioeconomic status, perceived benefits showed a significant increase after the intervention. The increase in the perceived benefits can be the result of an emphasis in training on walking and diet, physical and psychological benefits of walking and the role of nutrition in preventing osteoporosis.

The results of this study showed no significant difference between the two groups before intervention in terms of barriers. However, the difference was significant in immediately and 12 months after intervention for the experimental groups. In other words, the educational interventions significantly reduced barriers to proper diet and walking and thereby reduced the risk of osteoporosis. In the study of Franko et al. [33] and Khorsandi et al. [30], perceived barriers of the study population regarding calcium intake and physical activity decreased after intervention. According to Ziccardi et al. [34] study, these barriers were possibly belief-based and were reduced by education.

The mean scores of self-efficacy in the present study showed that before intervention, both groups had low ability to control diet and walk. After the intervention, the mean score of self-efficacy increased significantly in the experimental group. This is consistent with the results of Seldak et al. [15], Tussing et al. [28] and Piaseu et al. [27], but is inconsistent with those of Jessup et al. [35].

External cues of action are social factors included in the HBM and refer to perceived social pressures leading to doing or not doing a behavior. These external cues alongside internal ones led the women towards osteoporosis prevention behaviors. In this study, external cues for the subjects included family, friends, doctors, and health workers. In immediately after and 12 months after the intervention external cues increased. They have an influential role as a source of information and support for eating and walking behaviors and for providing resource and guidance people need to assess bone density. The mean score for the internal cues to action significantly increased after intervention in the experimental group compared to the control. This is consistent with results of Khorsandi et al. [30] and Ebadi Fard Azar et al. [31].

In this study, before the intervention, there was no significant difference between the mean score of women on osteoporosis prevention behaviors and both groups had low performance in maintaining proper diet and walking. After the intervention, the mean performance score of the women in the intervention group significantly increased compared to controls. This shows the positive effects of the education on women's performance. Hazavehei et al. [19] also reported an increase in walking and calcium intake in the intervention group after the intervention. In a study by Wafaa Hassan et al.[26] on 100 female students using the HBM, the students' performance on calcium intake and exercise after the intervention showed a significant increase compared to before. This is consistent with Shirazi's study [10] on the effects of physical activity education in prevention of osteoporosis among women 40 to 65 years old based on trans-theoretical model.

The study by Tarshizi et al. [36] showed that the subjects' physical activity levels before the training was not appropriate. However, by applying the HBM training in the experimental group, a significant difference was observed in this area. In the study by Mehrabbeik [32], a significant difference was reported between the level of physical activity after the intervention in the experimental and control group. This is consistent with the present study but no significant difference was observed between the mean daily calcium and vitamin D intake before and after training. The intake levels were unsatisfactory.The results of this study are consistent with results of Khorsandi et al. [30] and Ebadi Fard Azar et al. [31]. Shojaezadeh 's study [37] showed that there was a significant increase in calcium intake in the second phase, but in the third stage (three months after the intervention) calcium intake decreased.

12 months after the intervention, the value of lumbar spine and hip BMD T-Score in the experimental group increased, while in the control group it reduced. In a study, Huang et al. [38] investigated the effectiveness of an osteoporosis prevention program among women in Taiwan based on the Health Belief Model and the three factors of knowledge, self-efficacy and social support. The results showed that in the intervention group, perceived barriers and benefits improved significantly. Self-efficacy and knowledge variables also increased because of the training program. BMD improved in the intervention group, while it reduced in the control group. Jessup et al. [35], in a research on the effects of exercise on bone density, balance and self-efficacy in older women, showed that in the experimental group, compared to the control group, BMD in the femur and balance improved significantly. However, no significant change was observed in self-efficacy in both groups.

In a study, Kemmler et al. [39] investigated the effect of exercise on bone mineral density in 100 women came to the conclusion that in the exercise group compared with the control group increased bone mineral density and mass loss hip and femoral neck decreased topic areas.

In a study of Egbunike et al. [40] to the effect 12-week program of exercise on BMD femoral neck, BMD significantly increased.

The results show the effectiveness and the importance of educational interventions to improve osteoporosis prevention behaviors. Results of the education based on the health belief model showed that people with higher mean scores on these constructs performed better in activities for the prevention of osteoporosis and had better bone density.

The limitations related to this research project include its sampling method. Simple random sampling is selecting research participants on the basis of being accessible to the researcher. Another concern about such data centers on whether subjects are able to accurately recall past behaviors.

Conclusions

The results of this study, the importance of ongoing investigations epidemiologic and education about osteoporosis in women reveals that policy makers should consider as a priority health-related field. The results of this study showed that although the belief Health can enhance the knowledge, perceived susceptibility, understanding the risks of disease and interests and obstacles to the proper conduct of the preventive role Most important, but it seems to change Behavior, especially long-term behaviors and the behaviors that Socioeconomic factors are interdependent, and failure to sort these issues should also be considered.

The result obtained from this study can be concluded that providing educational programs in this regard for family members, physicians and other health personnel and offering training programs in radio and television broadcasting is essential. Further studies should have more comprehensive interventions on the structures of calcium intake benefits and barriers and use other behavioral change theories. It is advised that researchers explain social and behavioral barriers in calcium intake in different cultural contexts.

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Contribution

Study design: AKhJ, SMK, ZKh
Data collection and analysis: AKhJ, HJ, SHK
Manuscript preparation: AKhJ, SMK, ZKh,HJ, SHK

Conflicts of Interest

"The authors declare that they have no competing interests."

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