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The Effect of a Prevention Program Based On Health Belief Model on Osteoporosis

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ABSTRACT

Background: Osteoporosis is one of the most common metabolic bone diseases. The purpose of this study was to investigate the effect of a prevention program based on health belief model on osteoporosis among women.

Methods: In this quasi-case study, 120 patients (60 cases and 60 control), registered under the health centers in Fasa City, Fars Province, Iran were selected in 2014. A questionnaire consisting of demographic information, Health Belief Model (HBM) constructs was used to measure nutrition and walking performance for prevention of osteoporosis before, immediately after the intervention and six months later. Bone mineral density (BMD) was recorded at the lumbar spine and femur before and six months after intervention. Data were analyzed using SPSS19 via chi-square test, independent *t*-test, and Repeated Measures ANOVA at significance level of 0.05.

Results: Immediately and six months after the intervention, the case group showed a significant increase in the knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, internal cues to action, nutrition and walking performance compared to the control group. Six months after the intervention, the value of lumbar spine BMD T-Score in the case group increased to 0.127, while in the control group it reduced to -0.043. The value of the Hip BMD T-Score in the intervention group increased to 0.125 but it decreased to -0.028 in the control group.

Conclusions: This study showed the effectiveness of knowledge, walking and diet on bone mass by HBM model. Hence, these models can act as a framework for designing and implementing educational interventions for the osteoporosis prevention.

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Introduction

Osteoporosis is a disease characterized by decreased bone density and or loss of bone microstructure, which can lead to an increased risk of fracture[1]. Women are 8 times more at risk of osteoporosis than men[2] so that, about 200 million women worldwide suffer from the disease[3]. Bone mass in women in all age groups is significantly less than that of men of the same age and race[4]. Peak bone mass is achieved by age 30 and then the bone mass gradually decreases with the increase in age[5].

In a meta-analysis study in Iran, the overall prevalence of osteoporosis in the lumbar spine was 0.17% and that of osteopenia was 0.35%[6]. In Fasa, southwest Iran, 34.1% of the women had osteoporosis[7]. Exercise and adequate intake of calcium and vitamin D have a significant effect on reducing the rate of bone density loss and improving BMD[8].

Osteoporosis is preventable and an important point in preventing the disease is to modify thinking, lifestyle, and daily habits in such a way that improve the quality of life and efficiency of individuals[9]. Thus, teaching preventive behaviors such as physical activity and correct nutrition as a simple and efficient method can help us prevent the disease and promote and maintain our health. One of the most important WHO goals is to increase the number of women trained in the area of osteoporosis[10].

In line with such a purpose, identifying factors affecting behavior change can make changes easier. Therefore, in order to investigate factors affecting the adoption of osteoporosis preventive behaviors among women, it is essential to use models that identify factors affecting behavior. Based on Health Belief Model (HBM), people change their behavior when they understand that the disease is serious, otherwise they might not turn to healthy behaviors[11]. The structures of the HBM model include perceived severity, perceived

susceptibility, perceived benefits, perceived barriers, modifying variables, cues to action and self-efficacy[11].

Perceived susceptibility was used to evaluate women's perception about the extent to which they are at risk of osteoporosis. Furthermore, their perceived severity of osteoporosis complications was measured. The sum of these two factors is the women's perceived threat of the disease. The perceived benefits and barriers that refer the individual's analysis about the benefits of adopting preventive behaviors of osteoporosis, such as diet and walking and about potential barriers to preventive behaviors of osteoporosis were investigated. These, alongside women's perceived ability to carry out preventive behaviors; their cues to action (the incentives that affect women within and outside the family, such as friends, doctors, health care providers, media and educational resources). Their fear of osteoporosis complications and their sense of inner peace as a result of seeking preventive behaviors are factors affecting women's decision to comply with preventive behaviors of osteoporosis.

This study aimed to measure HBM constructs regarding eating behaviors and physical activity in the prevention of osteoporosis among women.

Methods

The quasi-experimental, prospective intervention study was conducted in 2014. The participants includes 120 women 30 to 50 yr old covered by health centers of Fasa, southwest Iran. Among the six urban health centers of Fasa, two centers were randomly selected as a center of the case group, and another for the control group. Simple random sampling was used at health center based on the numbers of health records of the mothers covered by the centers. The subjects were then invited to a meeting at a health center. They were explained about the study and the related purposes and their written informed consents were obtained.

The inclusion criteria were women 30 to 50 yr old covered by health centers of Fasa, willing to participate in the study. The exclusion criteria were women with disability, diseases and problems that prevented them from participating in the study.

After selecting the case and control groups, the pre-test questionnaire was administered to two groups. These people were present from the beginning to the end study. Women's education by researchers and five public health experts was done. Training sessions were held in the Hall Health Center.Participants did not know whether or not they were affected by osteoporosis.

Next, to measure bone density, the subjects 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 was collected based on the WHO T-Score values.

The intervention for the case group included eight educational sessions of 55 to 60 min of speech, group discussion, questions and answers, as well as posters and educational pamphlets, film screenings and powerpoint displays.

Immediately after the intervention, both groups completed the questionnaire. To preserve and enhance the activity of the case 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. Six months later, the questionnaire was completed by both groups and the subjects underwent BMD tests.

The questionnaire used in this study was developed based on the health belief model. The questionnaire included the following parts:

The first part included demographic questions, including age, BMI (Body Mass Index calculated as weight in kilograms divided by height in meters squared (kg/m^2). BMI provides a reliable indicator of body fatness for most people and is used to screen for weight categories that may lead to health problems)[12], education level, marital status, occupation, times of delivery, breastfeeding, smoking, history of osteoporosis, history of osteoporosis in the family, history of a special disease (Any disease other than osteoporosis, such as thyroid disease, diabetes, cancer, and immunodeficiency diseases) and history of BMD(Bone mineral density).

The second section included questions on the structures of the health belief model. Questions included 23 questions on knowledge; 4 questions on perceived susceptibility (the women's opinion about chances of getting osteoporosis); 6 questions on perceived severity (about complications due to osteoporosis); 8 questions on perceived benefits (about the benefits of preventive behaviors of osteoporosis, such as physical activity and calcium intake); 7 questions on perceived barriers (including barriers to physical activity and consumption of calcium-rich foods), 4 questions on self-efficacy (including the ability to do exercises and observe proper diet); 1 question on external cues to action (resources including family and friends, doctors and health workers, mass media, books and magazines, internet and other patients with osteoporosis that encourage the subjects towards prevention behaviors of osteoporosis); and 3 questions on internal cues to action (including the fear of suffering from complications of osteoporosis and a sense of inner peace following preventive behaviors); all questions are based on the standard 5-point Likert scale ranging from strongly disagree to strongly agree (scores of 1 to 5). Scores of questions on external cues to action are calculated as cumulative frequency.

The third section consists of questions on nutritional performance and exercise, i.e. walking. performance questions consist of 10 questions about the type and amount of food consumed during the past week (score from 0 to 14). Exercise questions include 7 questions on the duration and type of walking (easy, moderate and heavy) during the last week based on received guidelines (score from 0 to 21). The subjects' performance was assessed via self-report method.

To evaluate the validity of the questionnaire items, the item effect size 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 face validity, a list of the items was checked by 30 women of 30 to 50 with demographic, economic, social and other characteristics similar to those of the targeted population. In order to determine the content validity, twelve specialists and professionals (outside the team) in the field of

health education and health promotion (n=10), orthopedic (n = 1), and biostatistics (n = 1) were consulted. Then, based on the Lawshe's table, items with a higher CVR value (than 0.56 for 12 people) were considered acceptable and were retained for subsequent analysis. The calculated values in this study for the majority of items were higher than 0.70.

The overall reliability of the instrument based on the Cronbach's alpha, was 0.87. 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, 0.77 for cues to action. Since the alpha values calculated for each of the structures studied in this research were higher than 0.7, the reliability level of the instrument was considered acceptable.

The conceptual framework of the proposed model is illustrated in Figure 1.

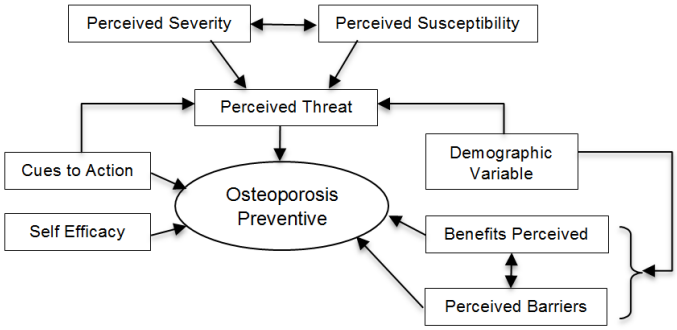

Figure 1: Conceptual framework of this study

Ethical considerations performed by obtaining from the Ethics Committee of Tarbiat Modares University. The aims and importance of the study were explained to the subjects and their written consent were obtained. The participants were assured that the information would remain confidential. Data analysis was carried out through SPSS 19 (Chicago, IL, USA) using chi-square test, independent *t*-test and Repeated Measurement Anova at significance level of 0.05.

Results

The mean age of women participated in the study was 41.75 ± 5.4 yr in the case group, and 41.77 ± 5.43 yr old for the control group. The mean BMI was 22.44±3.30 for the case group and 22.27±3.05 for the control group. The average number of women deliveries for the case group was 2.57 ± 1.47 and 2.50 ± 1.19 for the control group. The above parameters did not show a significant difference between the two groups based on the independent *t*-test. Table 1 shows the demographic data. Based on the chi-square test, there was no significant difference between the two groups in education level (P=0.771), marital status (P=0.880), occupation (P=0.673), breastfeeding (P=0.769), smoking (P=0.315), history of osteoporosis in the family (P=0.378), history of special diseases (P=0.769) and records of bone densitometry (P=0.543).

Before the intervention there was no significant difference 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) and nutrition (P=0.481) and walking performance (P=0.999). However, immediately after the intervention and six months later, the case group showed a significant increase compared to the control group in all of the foregoing scales except for perceived barriers (P<0.001). On structural barriers, the case group showed a significant decrease compared to the control group (Tables 2 and 3) (P<0.001).

Table 1: Frequency distribution of the subjects in terms of demographic information

	Control		Intervention		
Variables	**Number**	**Percent**	**Number**	**Percent**	***P* value**
Occupation					0.673
Employed	10	16.7	12	20.0	
Housewife	50	83.3	48	80.0	
Educational level					0.771
Illiterate	2	3.3	2	3.3	
Primary	9	15.0	14	23.3	
Secondary	22	36.7	17	28.3	
High school	17	28.3	18	30.0	
College	10	16.7	9	15.0	
Marital Status					0.880
Single	6	10.0	8	13.3	
Married	48	80.0	46	76.7	
Divorced	2	3.3	3	5.0	
Widowed	4	6.7	3	5.0	
Breastfeeding					0.769
No	54	90.0	53	88.3	
Yes	6	10.0	7	11.7	
Smoking					0.315
No	60	100.0	59	98.3	
Yes	0	0.0	1	1.7	
History of Osteoporosis in the Family					0.378
No	52	86.7	55	91.7	
Yes	8	13.3	5	8.3	
History of a special disease					0.769
No	53	88.3	54	90.0	
Yes	7	11.7	6	10.0	
History of bone densitometry					0.543
No	53	88.3	55	91.7	
Yes	7	11.7	5	8.3	

Table 2: Comparison between the mean scores of participants' knowledge, Health Belief Model components

	Intervention (n=60)			Control (n=60)			
Variables	**Mean**	**SD**	***P* value**	**Mean**	**SD**	***P* value**	***P* value**
Knowledge							
Pre-intervention	7.65	2.36	Ref.	8.07	2.58	Ref.	0.358
Post-intervention	10.82	17.3	0.001	8.67	2.50	0.001	0.001
Six months later	18.33	2.25	0.001	7.17	2.59	0.001	0.001
Perceived Susceptibility							
Pre-intervention	22/7	2.31	Ref.	7.13	1.84	Ref.	0.827
Post-intervention	10.50	2.65	0.001	7.65	1.71	0.001	0.001
Six months later	15.82	2.28	0.001	8.00	1.80	0.001	0.001
Perceived Severity							
Pre-intervention	9.73	2.34	Ref.	9.22	1.99	Ref.	0.196
Post-intervention	13.23	3.54	0.001	9.83	1.95	0.001	0.001
Six months later	19.92	4.31	0.001	10.35	2.05	0.001	0.001
Perceived Benefit							
Pre-intervention	13.53	3.76	Ref.	13.30	2.98	Ref.	0.707
Post-intervention	18.65	4.72	0.001	14.17	2.85	0.001	0.001
Six months later	28.60	5.01	0.001	14.98	3.01	0.001	0.001
Perceived Barrier							
Pre-intervention	26.50	4.01	Ref.	25.70	4.28	Ref.	0.293
Post-intervention	20.82	4.02	0.001	24.60	4.40	0.001	0.001
Six months later	13.55	3.95	0.001	23.80	4.46	0.001	0.001
Self-efficacy							
Pre-intervention	7.68	1.90	Ref.	7.67	2.18	Ref.	0.965
Post-intervention	10.93	2.37	0.001	8.80	2.19	0.001	0.001
Six months later	15.87	2.60	0.001	9.40	2.47	0.001	0.001
External Cues to Action							
Pre-intervention	5.57	1.91	Ref.	5.93	1.65	Ref.	0.262
Post-intervention	7.15	1.91	0.001	6.35	1.70	0.001	0.001
Six months later	12.25	1.46	0.001	7.53	1.56	0.001	0.001

Table 3: Comparison of mean scores of nutrition and walking performance regarding osteoporosis prevention

Variables	Experiment			Control			*P* value
	Mean	SD	*P* value	Mean	SD	*P* value	
Nutrition Performance							
Pre-intervention	4.80	1.87		5.05	2.00		0.481
Post-intervention	7.75	1.87	0.001	5.40	1.79	0.001	0.001
Six months later	11.78	1.49	0.001	5.55	1.67	0.001	0.001
Jogging Performance							
Pre-intervention	6.93	3.44		6.93	2.52		0.999
Post-intervention	11.83	3.31	0.001	7.85	2.38	0.001	0.001
Six months later	18.72	2.17	0.001	8.45	2.47	0.001	0.001

Comparison of bone mineral density T-score in the lumbar spine (*P*=0.965) and femur (*P*=0.928) in women before and six months after intervention showed that before the intervention, there was no significant difference between the case group and the control group in this regard. Six months after the intervention, the value of lumbar spine BMD T-Score in the case group increased to 0.127, while in the control group it reduced to -0.043 (*P*=0.427). The value of the hip BMD T-Score in the intervention group increased to 0.125 while it decreased to -0.028 in the control group (*P*=0.502) (Table 4).

Table 5 shows the distribution of external cues to action for osteoporosis, before, immediately after and six months after the intervention. The number of cues used, especially family and friends, immediately after the intervention and six months after the intervention increased as compared to before the intervention.

Table 4: The mean T-Score of lumbar spine and femur in women

Variables	Experiment		Control		*P* value
	Mean	SD	Mean	SD	
Spine					
Pre-intervention	0.118	1.254	0.108	1.220	0.965
Six months later	0.245	1.248	0.065	1.228	0.427
Hip					
Pre-intervention	-0.240	1.108	0.222	1.114	0.928
Six months later	-0.115	1.087	0.250	1.107	0.502

Table 5: Distribution of external cues to action regarding osteoporosis prevention

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

Discussion

This study showed that a key prevention method for osteoporosis is that of community-based intervention strategies using behavior change models such as the health belief model. There were significant differences between mean scores of knowledge before, immediately after and six months later the intervention in the case group. The knowledge scores in this group increased significantly after the intervention. This is consistent with results of Ghaffari et al.[13], Winzenberg et al.[14] and Wafaa Hassan et al.[15]. Although the mean score of knowledge significantly increased in the control group as well, there is a significant difference between the mean scores of knowledge of the two groups. 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.

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 Tussing et al.[16], Dohney et al.[17] and Ghaffari et al.[13].

After intervention the perceived severity of the casegroup significantly increased compared to the control group. This is consistent with results of Khorsandi et al.[18] and Hazavehei et al.[19]. However, the perceived severity in Tussing et al.[16] and Sanaei Nasab et al.[20] showed no significant increase after the intervention.

The mean scores for perceived benefits showed a greater increase in the casegroup than in the control group immediately after and six months after the intervention. Ebadi Fard Azar et al.[21] 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 Mehrab Beik et al. on the prevention of osteoporosis among women with low socioeconomic status, perceived benefits showed a significant increase after the intervention[22]. 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 six months after intervention for the casegroups. 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 Anderson et al.[23] and Khorsandi et al.[18], perceived barriers of the study population regarding calcium intake and physical activity decreased after intervention.

The mean scores of self-efficacy in the present study showed that before the intervention, both groups had lower ability to control diet and walk. After the intervention, the mean score of self-efficacy increased significantly in the case group. This is consistent with tprevious findings[10,16,24], but is inconsistent with those of Jessup et al.[25].

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 six 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 resources and guidance people need to assess bone density. The mean score for the internal cues to action significantly increased after the intervention in the case group compared to the control. This is consistent with results of Khorsandi et al.[18] and Ebadi Fard Azar et al.[21].

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. Immediately after and six months 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. also reported an increase in walking and calcium intake in the intervention group after the intervention[19]. In a study by Wafaa Hassan et al. 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[15]. This is consistent with previous study on the effects of physical activity education in prevention of osteoporosis among women 40 to 65 yr old based on trans-theoretical model[3].

The study by Tarshizi et al. showed that the subjects' physical activity levels before the training was not appropriate. However, by applying the HBM training in the case group, a significant difference was observed in this area[26]. In another study [22], a significant difference was reported between the level of physical activity after the intervention in the case 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[22]. The results of this study are consistent with previous studies[18,21,27]. 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[28].

Six months after the intervention, the value of lumbar spine BMD T-Score in the case group increased to 0.127, while in the control group it reduced to -0.043. The value of the thigh BMD T-Score in the intervention group increased to 0.125 while it decreased to -0.028 in the control group. Huang 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[29]. Exercise and calcium intake improved bone density[30].

Jessup, in a research on the effects of exercise on bone density, balance and self-efficacy in older women, showed that in the case 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[25].

The results show the effectiveness of the intervention program and the importance of educational interventions to improve osteoporosis prevention behaviors. The 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. Cognitive psychologists have warned that the human memory is fallible and thus the reliability of self-reported data is tenuous on some items[31].

Conclusions

The importance of ongoing investigations epidemiologic and education about osteoporosis in women reveals that policy makers should consider as a priority health-related field. 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.

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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Conflict of interest statement

No conflict of interest.

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