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Original Article

Effectiveness of educational program based on Trans-Theoretical model in prevention of osteoporosis in women

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ABSTRACT

Objectives: osteoporosis is one of the main causes of disability and mortality in older adults. Bone mass and density decreased slowly over time, and the most symptoms cannot be seen until the first fracture occurs. The purpose of this study is to investigate The Effectiveness of educational program based Trans-Theoretical Model (TTM) in prevention of osteoporosis in women. Study Design: quasi experimental study. Methods: This study was conducted on 160 patients (80 experimental and 80 control), who were registered under the health centers in Fasa City, Fars Province, Iran were selected in 2016. A questionnaire consisting of demographic information, TTM constructs was used to measure nutrition and walking performance for prevention of osteoporosis before, 6 months after intervention and 12 months later. Bone mineral density (BMD) was recorded at the lumbar spine and femur before and 12 months later intervention. Data were analyzed using SPSS22 via chi-square test, independent t-test, Mann-Whitney -Wilcoxon test and Repeated Measurement ANOVA at significance level of 0.05. Results: According to the results, the experimental group showed a significant increase in the pros, cons, self-efficacy, processes of change, nutrition and walking performance compared to the control group six months and one year after the intervention. 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. Conclusion: Applying the TTM Model is very effective for developing an educational program for prevention of osteoporosis in women. Hence, this model can act as a framework for designing and implementing educational interventions for the osteoporosis prevention.

Keywords: Bone Mineral Density, Trans-Theoretical Model, Nutritional Status, Walking, Osteoporosis, Women.

Introduction

Nowadays, osteoporosis is considered a complex health issue and has been called the silent disease of the century. It is an asymptomatic disease and painless, unless there is a fracture. This disorder may have a profound irreparable physical and psychological harm and financial costs on patients and families [1]. The first 10 year of the 21st century was entitled as Bone and Joint Decade (BJD) by the United Nations and the World Health Organization which concerns Bone and Joint disease such as osteoporosis in worldwide [2].

The prevalence of osteoporosis and the rate of fractures are much higher in postmenopausal women than in older men. [3] So that, about 200 million women worldwide suffer from the disease [4]. Bone mass percentage in women in all age groups is significantly less than men of the same age and race [5]. One of two women and one in five men over 50 years-old experiences vertebral fracture in their lifetime both of which lead to significant morbidity and mortality [6]. In a study in Fars province, prevalence of osteopenia and osteoporosis in a population based on T-score for spinal cord segments was recorded respectively as 42% and 24% in the back segments, 46% and 10% in the femoral neck, and 48% and 6% in the entire femur [7]. The burden osteoporosis is significant, and the costs of treatment illnesses related to osteoporosis are high [8]. If effective preventive measures don't enhance constantly, it is

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predicted that the cost of osteoporotic fractures in the USA before the year 2040 increases to 200 billion dollars [9]. The results of the studies indicate that exercise along with adequate intake of calcium, and vitamin D has an important effect in reducing the rate of loss of bone density and BMD improvement [10].

Osteoporosis is completely preventable and curable. An important point in preventing osteoporosis is to correct thinking, lifestyle and daily habits in order to improve the quality and efficiency of individuals [11]. One of the most important global health goals is increasing the number of women trained for osteoporosis [12].

Most Scholars believe that the effectiveness of health education and behavior change programs depends largely on the use of models and theories of health education [13]. Prochaska's Trans-theoretical Model (TTM) is one of the health education models that can be used to change behavior at the individual level. The most important elements of this model include the Stages of Change, Decisional Balance, and Self-efficacy. Based on Stages of Change, change occurs in five stages: Pre-contemplation, Contemplation, Preparation, Action, and Maintenance as fallows.

1) Pre-contemplation: the stage where people do not have physical activity or do not want to have physical activity in the next 6 months;
2) Contemplation: people want to change behavior in the next 6 months;
3) Preparation: people want to change behavior in the next 30 days;
4) Action: People have been doing the behavior for more than a day or less than six months; and
5) Maintenance: people have been able to continue doing the desired behavior for over six months [13-15].

One of the fundamental assumptions of the present model is the possibility of relapse to previous behavior in any of the above steps [15]. People need various interventions at any stage, and this categorization of stages enables us to use appropriate interventions for each stage. Another feature of this model is its emphasis on the individual's assessment of the pros and cons of behavior change (Decisional Balance) [16], which is important for progress in the stages of behavior change [17]. Another component of this model is self-efficacy, which refers to the person confidence in the ability to do a certain behavior without relapse [13, 18]. This component plays a pivotal role in behavior change and in going to the next stage of change in this process [17]. Finally, this model interprets a change of behavior as an event and does the evaluation of behavior based on explicit behavior in the end points. Therefore, balancing osteoporosis preventive behaviors such as engaging in regular physical activity and diet that - unlike simple single-stage behaviors- requires continuity in behavior, lends itself well to the use of models with various smaller stages of change [19]. Kaveh et al studied the effectiveness of TTM on increasing physical activity to prevent osteoporosis among students [20]. Malekshahi et al also showed the effectiveness of this model in increasing physical activity and proper diet in order to prevent osteoporosis among women aged 30 to 50 years [21]. According to what mentioned above, this study aimed to determine the application of TTM to women's nutritional and physical activity behaviors for the prevention of osteoporosis.

Materials and Methods

This quasi-experimental prospective study was carried out in 2016. The sample included 160 women over 30 years covered by health centers in Fasa, Iran. Therefore, among the six urban health centers in Fasa, two centers were randomly selected (A center as experimental group and a center as the control group). Simple random sampling was done in each health center according to the numbers assigned to family health records of mothers covered by the center. The subjects were then invited, and the objectives of the study were explained for them. The inclusion criteria for this study stated that participants would be women over 30 years of age covered by health centers in Fasa. They were not diagnosed with rheumatoid disease, mental illness, fracture, digestive disorders, and food allergies. They also consented to participate in the study. Exclusion criteria omitted women with disabilities, diseases, and problems such as early osteoporosis.

The sample size was determined based on a previous study by Ghaffari in which the mean calcium intake in the groups under study before and after the intervention was 813.31 ± 264.75 mg and 1096.61 ± 590.21 mg respectively [22]. Based on the above study and the amount of B =0.90, α =0.05, S1=264.75, S2=590.21, 1μ=813.31, 2μ= 1096.61, a size of 55 people was estimated for each group. Finally, 80 participants were selected for each group. After selecting the experimental and control groups, the pre-test questionnaire was completed by both groups, and the subjects' bone density values were measured and recorded in the bone densitometry center of Fasa.

DEXA (Dual Energy X-Ray Absorptiometry) method was used by densitometer Hologic device to determine BMD between the lumbar vertebrae L1 to L4. The densitometry data included BMD in the lumbar spine and in the femur and were analyzed based on the criteria and T-score cutoff value for osteoporosis as defined by the World Health Organization. Educational intervention for experimental group included 12 sessions of 55-60 minutes of lecture, group discussion, questions and answers, as well as materials such as posters, pamphlet, videos, and PowerPoints. The first training session focused on introducing osteoporosis, and its signs, symptoms and diagnosis. In the second and third sessions, a 50-year-old woman suffering from osteoporosis and fractures was invited to explain about the disease and its risk factors, symptoms, diagnosis, and complications to the subjects (as dramatic relief through role-playing and personal memories). The fourth and fifth sessions focused on the role of nutrition in the prevention of osteoporosis, pros and drawbacks of diets, proper nutrition model, decision-making, planning and scoping, self-efficacy in the diet according to the proposed model, and recording the

activities in the specified form. The sixth and seventh sessions stressed the role of exercise, proper exercise, the role of walking and its importance, benefits and barriers to walking and decision to do the activity, determining the type of walking, self-efficacy in walking, and recording the walking activity in the specified form. The eighth and ninth sessions were held in the presence of a family member for each subject and stressed the role of the family in adopting, facilitating, and providing appropriate food for patients and helping them through the stages of change for walking. In the tenth session, subjects were divided into groups of 5-6 individuals and the role of supporting groups and friends as facilitator in adopting osteoporosis preventive behaviors was explained. In addition, the subjects cooperated to prepare food containing calcium. For the eleventh session, a walking meeting was held in a park and the importance of walking and how to record the activities was described. In the twelfth session, the content taught in previous sessions was reviewed and a training manual was given to the subjects. Six months after the intervention, both experimental and control groups completed the questionnaire. To maintain and improve the activities of individuals in the experimental group, they were sent educational text messages about osteoporosis once a week. They also attended follow-up training sessions once a month. Twelve months after the intervention, the questionnaires were answered (by both experimental and control groups), and BMD measurements were carried out and recorded. The data collection instrument included demographic items (age, BMI, job, number of deliveries, breastfeeding, smoking, history of osteoporosis in the family, history of special diseases, and history of bone densitometry), Stages of Change, Perceived Self-efficacy, Change Processes, Decisional Balance (pros and cons), nutritional performance, and walking. The instrument was developed according to studies [1, 20-23]. Stages of Change contained five yes/no questions. Perceived Self-efficacy included five items with five-point Likert scale (not confident, somewhat confident, confident, fairly confident, and very confident, rated 1-5 respectively). The mean scores were calculated for individuals. The scores ranged from 5 to 25. The decisional balance, including pros and cons aspects of walking and diet was measured via five items for pros with the score range of 5 to 25; and four items for cons with a five-point Likert scale (strongly disagree, disagree, no opinion, agree, and strongly agree) and the related mean scores were calculated for the subjects. The score range for this component was from 4 to 20. Change processes were measured via 10 five-point Likert-scale items (1=Never. 2=Rarely. 3=Sometimes. 4=Often. 5=Very Often) each measuring one process. Then the mean scores on this component were calculated for individuals. The score range was 10 to 50 [11, 14]. Nutritional performance was measured via 10 items asking about the type and amount of food a person consumed during the last week (score between 0 and 14). Walking performance was measured via 7 questions about the duration and type of walking (light, medium and heavy) in the last week based on the given guidelines (score between 0 and 21). Action was measured on the basis of recorded activities in the form of self-reporting [23]. The validity of the questionnaire items was confirmed based on the item impact score of higher than 0.15 and CVR of higher than 0.78. To determine the face validity, a list of developed items was piloted to 30 women aged over 30 years with similar demographic and socio-economic characteristics to the study population. In order to determine the content validity, the opinions of twelve specialists and experts (outside the research team) in the field of health education and health promotion (10 people), orthopedics (one person), and vital statistics (one person) were used. The necessary items were selected and maintained based on Lawshe's table (based on the number of evaluators, i.e. 0.56 for 12 persons). The calculated values in this study for the majority of items were higher than 0.70. Cronbach's alpha reliability of the research instrument was 0.85. The Cronbach's alpha was also acceptable for Self-efficacy (α=0.79), Pros (α=0.78), Processes of Change (α=0.77), and Cons (α=0.77). Given that the value of Cronbach's alpha for each of the components and constructs studied in this study was larger than 0.70, the reliability of the instrument was confirmed.

For ethical considerations, the approval of the Fasa University of Medical Sciences and Fasa Health Center, as well as the written consent of all women participating in the study was obtained. The participants received explanations regarding the objectives, importance and necessity of the study and were assured that their information would remain confidential. The collected data were analyzed via SPSS version 22 using Chi-square, independent samples t-test, Mann-Whitney, Wilcoxon, and Repeated Measures ANOVA at a significance level of 0.5.

Results

The mean age of the women in the experimental and control groups was 45.54 ± 5.8 and 46.23 ± 5.10 years, respectively. The mean BMI was 22.13±3.28 for the experimental group and 22.75±3.11 for the control group. The average number of women deliveries for the experimental group was 2.61 ± 1.25 and 2.53 ± 1.16 for the control group. The results of Chi-square test revealed no significant difference between the two groups regarding the demographic variables as occupation (p=0.512), educational level (p=0.215), marital status (p=0.113), history of osteoporosis in the family (p=0.313) and history of bone densitometry (p=0.131).

Descriptive findings on stages of change among the groups in three phases of measurement can be seen in Table 1. However, more progress is observed in the experimental group.

Table 1. Descriptive findings on stages of change among the groups in three phases of measurement

Groups	Pre-intervention		Six month after intervention		12 month after intervention	
	Experimental	Control	Experimental	Control	Experimental	Control

Stages of change	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Pre-contemplation	12 (%15)	16 (%20)	1 (%1.25)	14 (%17.50)	1 (%1.25)	12 (%15)
Contemplation	48 (%60)	50(%62.50)	10 (%12.50)	45(%56.25)	5 (%6.25)	46(%57.50)
Preparation	11 (%13.75)	8 (%10)	35 (%43.75)	12 (%15)	23 (%28.75)	12 (%15)
Action	8 (10)	5 (%6.25)	27 (%33.75)	8 (%10)	35 (%43.75)	8 (%10)
Maintenance	1 (%1.25)	1 (%1.25)	7 (%8.75)	1 (%1.25)	16 (%20)	2 (%2.50)

Table 2 shows the mean of constructs processes of change, self-efficacy, and pros and cons during 6 months, and 12 months after intervention. T-test has shown that processes of change, self-efficacy, and the pros have significant changes ($P < 0.001$).

Table 2. The Mean and Standard Deviation of Trans-theoretical Constructs at Pre-intervention, 6 Months, and 12 Months After Intervention in experimental and Control Groups

Trans-theoretical Construct	Before Intervention	6 Months After Intervention	12 Months After Intervention	P Value
Cons				
experimental Group	16.20±2.21	13.21 ±2.05	9.11 ±2.06	**0.001**
Control Group	15.55±2.67	14.92±2.33	13.36±2.24	**0.09**
T test	0.310	0.001	0.001	
Pros				
experimental Group	10.15±2.34	16.24±2.61	21.35±2.06	**0.001**
Control Group	11.21±2.11	12.10±1.95	12.85±2.04	**0.112**
T test	0.122	0.001	0.001	
Self-efficacy				
experimental Group	7.24±4.11	13.65±9.25	20.55±9.88	**0.001**
Control Group	6.77±5.66	7.00±5.59	8.25±3.65	**0.521**
T test	0.512	0.001	0.001	
Processes of change				
experimental Group	15.21±4.12	28.12±4.52	39.20±4.22	**0.001**
Control Group	16.32±4.81	18.25±4.65	19.13±4.50	**0.234**
T test	0.185	0.001	0.001	

The t test showed that nutrition and walking had no significant differences in both groups before the intervention. However, a significant increase is seen after intervention in the experimental group. Table 3 shows the relevant data in this regard.

Table 3. Comparison of women nutrition means score and walking in prevention of osteoporosis at pre intervention, 6 months and 12 months after intervention in experimental and control groups

variable		Before Intervention (Means ±SD)	6 month after Intervention (Means ±SD)	12 month after Intervention (Means ±SD)	P-value
Nutrition Performance	experimental Group	4.50±1.56	7.80±1.94	12.34±1.65	**0.001**
	Control Group	4.94±2.01	5.34±1.79	6.01±1.22	**0.84**
	T test	0.240	0.001	0.001	
Jogging Performance	experimental Group	6.84±3.21	11.92±3.64	18.95±1.64	**0.001**
	Control Group	6.92±2.64	7.25±2.24	8.36±2.44	**0.214**
	T test	0.190	0.001	0.001	

Comparison of the BMD T-score in the lumbar spine and femur before and 12 months after intervention showed that before the intervention, there was no significant difference in both group. 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. The value of the hip BMD T-Score in the intervention group increased while it decreased in the control group (Table 4).

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

	Experimental		Control		P-value
	Mean	SD	Mean	SD	
Spine					
Pre- intervention	0.116	1.116	0.114	1.161	0.351
12 months later	0.320	1.41	0.072	1.485	0.033

Hip					
Pre- intervention	-0.214	1.118	-0.221	1.135	0.312
12 months later	-0.092	1.092	- 0.271	1.120	0.421

Discussion

The results of the study showed that one of the key ways to prevent osteoporosis in communities is the community-based interventions with using behavior change models such as TTM. The findings showed that subjects in the experimental group had significant progress in the stages of change compared to the control group 6 months and 12 months after the intervention. Similarly, Kaveh et al showed a significantly better progress from the Pre-contemplation to Action and Maintenance stages compared to the control group [20]. The study conducted by Solhi on pregnant women also showed a significant progress of the subjects from the early to higher stages [24]. Findorff et al carried out a study based on the model of stages of change on 272 women aged 70 years old. The intervention was conducted over 28 weeks with 1-year follow-up. In the post-test, 83% of experimental group and only 17% of the control group stepped into Action and Maintenance stages [25].

Results of the present study showed that an educational intervention based on TTM increased Self-efficacy among female subjects in the experimental group in the areas of diet and walking behavior. Swim et al showed that Self-efficacy was significantly associated with osteoporosis preventive behaviors among women, and that improving women's Self-efficacy to ensure adequate calcium intake and increase useful exercise can prevent osteoporosis among them [26]. Results by Pirzade et al [27], Manley [28], and Khani Jeihooni [29] are consistent with that of this study.

After the educational intervention, the experimental group showed a significant increase in pros, but a decrease in cons. Therefore, the Decisional Balance was toward positive change. Several studies have shown the direct or indirect effects of pros on physical activity and diet (Calcium intake) [27, 30]. Gorely showed that reducing cons can move people from Contemplation to Action [31]. According to Kim, cons can play an important role in Self-efficacy [32].

The mean score of change processes in the experimental group increased significantly more than the control group after the intervention. This result of the present study is consistent with that of Kirk [15], Kaveh et al [20] and Pirzade et al [27].

Based on our results, an educational intervention based on Trans-theoretical Model showed a significant improvement in diet and walking performance in the experimental group. In the same line, in a study conducted on 100 female students, Wafaa Hassan et al found a significant increase in calcium intake and exercise by the subjects after the intervention [33]. Torshizi et al showed that the physical activity of subjects in both experimental and control groups was not ideal before training, but after the TTM-based education for the experimental group, significant differences were reported [34]. Shojaeizadeh showed that calcium intake has increased significantly in the second stage of change, but reduced in the third stage (three months after the intervention) [35]. The positive effect of TTM on increasing physical activity has been confirmed in several studies [4, 15, 20, 27, 36, 37].

Twelve months after the intervention, the experimental group gained a higher amount of T-Score for lumbar spine and hip compared to the pre-test, but this value reduced in the control group. Similarly, Polinski et al's study showed a significant relationship between the components of TTM and BMD [38]. Zhao et al showed that exercise and calcium intake positively affected BMD [39]. In Jessup's study, the effects of exercise on BMD, balance and Self-efficacy of older women were assessed. The results showed that the experimental group's BMD in the femur and balance significantly improved compared with the control group, but a significant difference in self-efficacy of the two groups was not found [40].

Conclusion

The results indicated the effectiveness of the intervention and the necessity of planning educational interventions in order to increase osteoporosis preventive behaviors. As a result of TTM-based education, a significant improvement in the target variables in the experimental group, and in turn, their activities for the prevention of osteoporosis as well as their BMD improved. Given the sensitivity and vulnerability of women and the role of social supports in their stages of behavior change, there is a need to provide solutions via proper planning to prevent osteoporosis. Holding educational programs for individuals, families, physicians, and other health care providers, as well as educational programs on radio and television is essential. One limitation of this study is that the findings are for women referring to health centers in Fasa and cannot be generalized to all women as well as to other communities. Another limitation is that the subjects' performance on prevention of osteoporosis was measured via self-reporting.

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Competing interests

None declared.

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