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Improvement of osteoporosis-related behaviors in female students based on trans theoretical model

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Abstract:

BACKGROUND: Osteoporosis is one of the major problems associated with aging and is more common among women than men. This study was designed to modify osteoporosis-related behaviors in female students based on the transtheoretical model (TTM).

MATERIALS AND METHODS: This quasi-experimental study was conducted on female secondary school students. The sample size was determined 100 by using Altman's nomogram, including 50 cases and 50 controls. Participants were completed the Demographic Information and Osteoporosis-Related Behavior Questionnaire based on TTM. Evaluation of the data showed that each participant was at what stage of change in physical activity and preventive dietary behavior of osteoporosis. The content of the training package was designed, and for the intervention group, 2-h training sessions were held weekly by the instructor in accordance with the stage of change for 2 months, and the booklet was provided with the appropriate contents of the stage of change. Three months after the completion of training, the questionnaires were completed by intervention and control groups. Statistical analysis was performed using SPSS 23 software.

RESULTS: Concerning the stages of change in physical activity and nutrition, a significant difference was before and after the intervention in the intervention group ($P < 0.001$), while no significant difference was observed in the control group. After the intervention, there was a significant difference in the self-efficacy and some subconstruct of processes of change, but there wasnot a significant difference in the decisional balance.

CONCLUSION: Educational intervention based on TTM has been successful in achieving the goal of modifying osteoporosis-related behaviors in female students. The results of this study can be used by health planners to plan and implement health promotion interventions that will undoubtedly help reduce the burden of disease.

Keywords:

Health promotion, nutrition, osteoporosis, physical activity, self-efficacy

Background

Osteoporosis is a systemic skeletal disease associated with a decrease in bone density that results in an increased risk of bone fractures and susceptibility to fracture.[1] Osteoporosis is one of the major problems associated with aging and is more common among women than men.[2,3] The US Preventive Services Task Force estimates that during each women's and man's lifetime, the odds of fractures due to osteoporosis are one in two and one in five, respectively.[4] Among European women, the lifetime probability of a hip fracture is 7%–25%, and major osteoporotic fractures are nearly 50% at the age of 50.[3]

The direct medical costs of osteoporosis are estimated to be $12.2–$17.9 billion per year globally.[4]

There are no specific statistics in Iran about the prevalence of osteopenia, osteoporosis,

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and related fractures.[5,6] However, according to the results of a meta-analysis, one of the most common problems in people over 30 years of age, especially among women in Iran, is osteoporosis and osteopenia. It was also estimated that the prevalence of osteoporosis was 19% in Iranian postmenopausal women.[7]

The prevention of osteoporosis should be prioritized as bone density decreases with age. The beginning of the prevention of osteoporosis is useful at any age. It is much more effective, however, to begin preventing osteoporosis in childhood and adolescence because 40%–45% of bone mass is formed at this age.[6] The most important measures to prevent osteoporosis include increasing effective physical activity, smoking cessation, and getting enough calcium and Vitamin D in the diet.[8] Educational programs are very effective for understanding the risk factors and ways to prevent osteoporosis and reduce the risk of developing the disease in later stages of life.[9]

To make a prevention research more effective and improve their application, preventive interventions must be conducted in a theoretical framework.[10] The transtheoretical model (TTM) is used to develop health interventions in research and services and evaluate their effectiveness.[11] TTM was developed by Procheska and includes stages and processes of change.[12] Stages of change divide people into five stages, depending on their level of readiness to change behavior. Processes of change that divided into behavioral processes and experimental processes include the elements needed to change one's behavior and how one's behavior changes at each stage.[13] Cognitive processes are used in the early stages of change and behavioral processes in the final stages of change.[14]

Another construct found in TTM is self-efficacy, which is self-confidence in a situation[15] and refers to one's perceived ability to perform a task. Decisional balance is another construct in TTM which focuses on advantages and disadvantages of behavior change[14] TTM has been applied to manage and change behaviors related to physical activity intervention,[14,16,17] smoking cessation[18] and eating habits.[11] While this model has not been used so far to modify the risk factors associated with osteoporosis; therefore, this study was designed to modify osteoporosis-related behaviors in female students based on TTM.

Materials and Methods

This field trial study was conducted on female secondary school students in Firozabad city, southeast Iran, in 2019. The sample size was determined 100 by using Altman's nomogram, including 50 cases and 50 controls. Two-stage cluster sampling was used, and two schools of Taha and Farhangian were selected randomly. Subjects were randomly selected from 11th grade students in the experimental field A (23 students) and B (27 students) from Taha High School for intervention group and 11th grade students in the experimental field A (24 students) and B (26 students) from Farhangian high school for controls. Inclusion criteria included female students from 15 to 18 years old and single, and exclusion criteria included dissatisfaction with the study, possible transfer from the school, and a family history of osteoporosis.

Data collection tools included Demographic Information and Osteoporosis-Related Behavior Questionnaire based on TTM. To design the Osteoporosis-Related Behavior Questionnaire based on TTM, 12 articles were selected after extensive searching; identification of the construct was made by regular review of the scientific literature utilizing the opinions of the experts. Then, the questions related to each construct were designed, and necessary changes were made to the writing and ordering of questions and appropriate scoring. To determine the validity, the questionnaire was given to eight experts in related fields, and the corrections were made to the questionnaire and approved. To assess the reliability, the questionnaire was randomly distributed among 20 high school female students in Firozabad city and was collected after completion. Sample participants at this stage of the study will not participate in the next stages. The obtained data were entered into the Statistical Package for the Social Sciences (SPSS) version 21.0 [IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.], and Cronbach's alpha was calculated for the questionnaire. Cronbach's alpha was calculated for self-efficacy 0.79, decisional balance 0.73, consciousness-raising 0.82, dramatic relief 0.74, environmental reevaluation 0.67, self-reevaluation 0.8, counter conditioning 0.72, social liberation 0.81, helping relationships 0.66, reinforcement management 0.85, self-liberation 0.65, stimulus control 0.73, total behavior change constructs 0.9, and total questionnaires 0.87. The reliability of the questionnaire was confirmed as the Cronbach's alpha value >0.7 is good as internal consistency.

After obtaining written consent from the participants, they were completed the Demographic Information and Osteoporosis-Related Behavior Questionnaire based on TTM. A review of the information obtained revealed each of the participants was located at what stage.

Evaluation of the data revealed the distribution of participants in the stages of change in physical activity and preventive dietary behavior of osteoporosis. Therefore, the intervention group was divided according to the stage of change, and educational intervention was

done for each group. The content of the training package was designed based on a comprehensive study and collaboration of health education and promotion and medical professionals. For the intervention group, 2-h training sessions were held weekly (eight sessions) by the researcher for 2 months; The training included: Familiarity with osteoporosis, the risks, and complications of osteoporosis, the importance of preventing osteoporosis, osteoporosis prevention methods and risk factors and controllable risk factors. Strategies used include guided mastery experience, modeling, social persuasion, life skills training, group discussion, and counseling, group members, feedback to each other, a public exercise program, and pay attention to the impact of exercise and appropriate nutritional behaviors on life. Finally a booklet was provided with the appropriate contents of the stage of change. Three months after completion of training, the Osteoporosis-Related Behavior Questionnaire based on TTM was completed after obtaining written consent by intervention and control groups. A training program for osteoporosis prevention was conducted for the control group after completing the research.

The Kolmogorov–Smirnov test showed that the data did not follow the normal distribution. Statistical analysis was performed using SPSS 23 software for descriptive tests, Chi-square, Mann–Whitney, Wilcoxon, and Friedman tests.

Results

Results of the Chi-square test showed no significant difference between the intervention and control groups in any of the demographic variables. The median family income in the intervention and control groups were 60% and 68%, and those with good family income were 40% and 32%, respectively (P = 0.4). None reported poor family income levels.

There was a significant difference in the self-efficacy construct between the intervention and control groups as a result of the intervention, but the decisional balance construct did not show such a difference in the intervention outcome. Furthermore, the ten substructures related to processes of change did not show the significant difference before intervention in the intervention and control groups. In contrast, after the intervention there was a significant difference in the subconstructs of consciousness-raising, dramatic relief, environmental reevaluation, social liberation, reinforcement management and self-liberation between the two groups. Also, a significant difference was observed in the self-efficacy construct and the subconstructs of consciousness-raising, dramatic relief, environmental reevaluation, social liberation, helping relationships, reinforcement management, self-liberation and stimulus control before and after the intervention in the intervention group, while no significant difference was observed in the control group [Table 1].

The results showed that 78% of the participants in the experimental group were in the pre-operative (pre-contemplation, contemplation, and preparation) phase of stages of change in physical activity before training, which decreased to about 42% after training; similarly, the number of people in operation and maintenance increased from 22% to 58%. The results also showed a significant difference before and after the intervention in the intervention group ($P < 0.001$), while no significant difference was observed in the control group. Concerning the stages of change in nutrition, the results also showed that 50% of the subjects in the experimental group were in the pre-operative (pre-contemplation, contemplation, and preparation) phase before training, which decreased to about 14% after training; similarly, the number of people in operation and maintenance increased from 50% to 86%. The results also showed a significant difference before and after the intervention in the intervention group ($P < 0.001$), while no significant difference was observed in the control group [Table 2].

Discussion

The results suggest TTM training has been very effective in improving the self-efficacy of female students in relation to osteoporosis preventive behaviors. According to the findings of this study, the Kaveh study showed the effect of osteoporosis education program on increasing the self-efficacy score of university students.[14] Sharma study in high school girls also showed that calcium self-efficacy had a significant indirect effect on calcium intake.[19] In the TTM, self-efficacy is one of the main constructs of the model and seems to be one of the main factors in the progress of the intervention group in the stages of change in physical activity and nutrition from pre-operative to operation and maintenance stages. Interestingly, there was a correlation between self-efficacy and processes of change in the intervention and control groups before and after the intervention. Finnell *et al*. concluded that individuals' self-efficacy in moving to higher stages gradually increased,[20] which is consistent with the results of the present study.

Educational intervention could not significantly change the decisional balance. Therefore, the progress of the intervention group in the stages of change in physical activity and nutrition from pre-operative to operation and maintenance stages cannot be attributed to the decisional balance construct. The focus of the decisional balance construct is on the importance of one's Pros and Cons perceptions of the consequences of behavior or behavior change.[21,22]

Table 1: Comparison of self-efficacy, decisional balance and processes of change in intervention and control groups (before and after intervention)

Variables	Median (range)		*P**
	Intervention	Control	
Self-efficacy			
Before intervention	21 (10)	20 (12)	0.51
After intervention	22 (8)	20.5 (15)	0.04
*P***	0.005	0.63	
Decisional balance			
Before intervention	39 (17)	39 (20)	0.41
After intervention	40 (29)	39 (14)	0.31
*P***	0.97	0.69	
Consciousness-raising			
Before intervention	10 (11)	10 (12)	0.36
After intervention	12 (10)	10 (10)	<0.001
*P***	<0.001	0.71	
Dramatic relief			
Before intervention	12 (10)	11 (9)	0.08
After intervention	12 (8)	12 (12)	0.01
*P***	0.01	0.23	
Environmental reevaluation			
Before intervention	12.5 (12)	13 (9)	0.45
After intervention	13 (6)	12 (12)	0.01
*P***	0.01	0.13	
Self-reevaluation			
Before intervention	16.5 (12)	17 (12)	0.31
After intervention	17 (10)	15.5 (12)	0.15
*P***	0.61	0.12	
Counter conditioning			
Before intervention	14.5 (15)	14.5 (13)	0.79
After intervention	15 (13)	14 (14)	0.81
*P***	0.38	0.21	
Social liberation			
Before intervention	20 (16)	20 (17)	0.99
After intervention	22 (16)	20.5 (17)	0.004
*P***	0.004	0.86	
Helping relationships			
Before intervention	15 (12)	15 (11)	0.39
After intervention	16 (11)	15 (11)	0.12
*P***	0.001	0.87	
Reinforcement management			
Before intervention	24 (14)	24 (14)	0.76
After intervention	25.5 (11)	24 (18)	0.006
*P***	0.001	0.73	
Self-liberation			
Before intervention	19 (16)	19 (15)	0.65
After intervention	21 (14)	19 (13)	0.001
*P***	<0.001	0.37	
Stimulus control			
Before intervention	19 (19)	18 (18)	0.97
After intervention	20 (16)	19 (15)	0.26
*P***	0.01	0.17	

*Mann-Whitney *U*-test, **Wilcoxon test

The intervention does not appear to have produced significant changes in perceptions of superiority over the barriers of behavior in participants. Kroll considered the decisional balance equilibrium to have two benefits and barriers in students' sporting behaviors that were inadequate,[23] which could be correlated with the results of the present study. Furthermore, Krigel *et al*. indicated the decisional balance exercise in accordance with previous versions of motivational interviewing may be counterproductive, and caution should be exercised in using it.[24] However, some studies based on the TTM have reported conflicting results; Alinia *et al*. in the study on the application of the TTM in adolescent girl sport,[25] Di Noia and Prochaska in the application of the TTM in Nutrition and Diets,[26] Flemming study in measuring perceived pros and cons of organ donation[21] Ivey survey in characteristics in stages of change and decisional balance among smokers[27] shown the effectiveness of decisional balance constructs.

After the intervention, there was a significant difference between the intervention and control groups in most of the processes of change constructs related to the cognitive or experimental processes. This difference was observed in consciousness-raising, dramatic relief, environmental reevaluation, and social liberation. Since cognitive processes are used in the early stages of change,[14] these findings are consistent with the results of moving through the stages of change and show that the progress of intervention group individuals in cognitive processes have helped to move them from pre-operative to operation and maintenance stages. However, the results showed that only in the two constructs of reinforcement management and self-liberation related to behavioral processes, after the intervention, there was a significant difference between the intervention and control groups. However, according to the findings of the study of Romain both empirical and behavioral processes are similarly associated with behavior change[28] and according to Plotnikoff's findings, the role of behavioral processes in predicting the transfer of individuals during the stages of change is greater and higher than the cognitive or experimental processes.[29] Behavioral processes are used more often in the final stages of change,[14] and it seems that there is a need for more accurate training programs to sustain behavior and prevent return.

A comparison of movement in stages of change of physical activity and nutrition showed a significant difference in the intervention group, while no significant difference was observed in the control group. This significant progress in the stages of change in intervention group participants compared to the control group can be attributed to the impact of the educational intervention designed based on the TTM. Procheska found that applying the stages of change for multiple behaviors was more useful than applying the model for only one behavior, which in the present study also improved

Table 2: Comparison of stages of change in physical activity and nutrition before and after the intervention (intervention and control groups)

Stages	Intervention group		*P**	Control group		*P**
	Before intervention, *n* (%)	After intervention, *n* (%)		Before intervention, *n* (%)	After intervention, *n* (%)	
Physical activity						
Precontemplation	8 (16)	1 (2)	<0.001	0 (0)	3 (6)	0.73
Contemplation	25 (50)	14 (28)		28 (56)	24 (48)	
Preparation	6 (12)	6 (12)		11 (22)	10 (20)	
Action	2 (4)	12 (24)		6 (12)	6 (12)	
Maintenance	9 (18)	17 (34)		5 (10)	7 (14)	
Total	50 (100)	50 (100)		50 (100)	50 (100)	
Nutrition						
Precontemplation	6 (12)	0 (0)	0.001	3 (6)	5 (10)	0.2
Contemplation	9 (18)	4 (8)		10 (20)	6 (12)	
Preparation	10 (20)	3 (6)		6 (12)	6 (12)	
Action	6 (12)	18 (36)		10 (20)	10 (20)	
Maintenance	19 (38)	25 (50)		21 (42)	23 (46)	
Total	50 (100)	50 (100)		50 (100)	50 (100)	

*Friedman test

multiple behaviors after the intervention[30] Nigg's study shows that changes in stage of change require efforts to improve self-efficacy and decisional balance.[31]

One of the models of health education and health promotion that can be used at the individual level for behavior change is Procheska's theoretic model.[32] Lach *et al*.,[33] Di Noia and Prochaska[34] and Purnarani *et al*.[35] studies have emphasized the efficacy of the TTM model in modifying individuals' behaviors. One possible reason for the similarity of the results of the present study with other studies is that individuals move from inactive to active stages because of educational intervention. As a result, perceived barriers to the desired behavior decrease, and perceived benefits increase. Finally, the decision-making process is facilitated.

Limitations

There were some problems in cooperating student and the support of education managers to conduct research.

Suggestions

The present study focuses on individual-related factors by applying TTM, so it is recommended to identify external barriers to behavior change and modify them in future studies. Given the complexity of TTM and its multiple constructs, it is suggested that future studies focus on one part of the model and then compare their impact on the overview studies.

Conclusion

Educational intervention based on TTM has been successful in achieving the goal of modifying osteoporosis-related behaviors in female students. Given the importance of osteoporosis among women, early prevention of this disease in adolescence through promoting healthy lifestyles should be a priority for health systems. Therefore, the results of this study can be used as a suitable strategy by health planners to plan and implement health promotion interventions to reduce the future burden of disease.

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Conflicts of interest

There are no conflicts of interest.

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