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The effect of educational intervention based on the theory of planned behavior aimed at mothers on osteoporosis prevention behaviors in lower secondary school female students

Fatemeh Shahmohamadi, Meimanat Hoseini, Mahsa Matbouei, Malihe Nasiri[1]

Department of Community Health Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [1]Department of Basic Sciences, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Address for correspondence:
Dr. Meimanat Hoseini, Department of Community Health Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Niyayesh Complex, Niyayesh Cross-Section, ValiAsr St, Tehran, P.O. Box 1919973361, Iran. E-mail: meimanathosseini@yahoo.com

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Abstract:

BACKGROUND: Osteoporosis is mainly characterized by a low bone mineral density and a sharp architectural and biomechanical deterioration in bone tissue required to maintain bone homeostasis. The theory of planned behavior (TPB) can be considered as one of the leading theories when designing an evidence-based intervention. This study was carried out based on the TPB to determine the effect of an educational intervention aimed at mothers on the prevention of osteoporosis in female students.

MATERIALS AND METHODS: A total of seventy mothers of lower secondary school students in Tehran, Iran, participated in this experimental study which was conducted in 2019–2020. The participants were randomly assigned to two groups, namely experimental and control groups. Based on the TPB, a demographic and a researcher-made questionnaire consisting of five sections were used in order to collect data. The validity and reliability of the questionnaires were confirmed before data collection. Four 45–60 min training programs were delivered to the subjects using the TPB. Data were collected before, immediately after, and 1 month following the training program. Finally, IBM SPSS Statistics 21 was used for statistical analysis.

RESULTS: No significant difference was observed in terms of attitude, subjective norms, perceived behavioral control, behavioral intention, and osteoporosis prevention-related behavior between the experimental and control groups before proceeding with the intervention ($P > 0.05$). However, the mean scores of attitude, subjective norms, perceived behavioral control, behavioral intention, and behavior were significantly higher in the experimental group compared to those of the control group following the educational intervention ($P < 0.05$).

CONCLUSION: It can be concluded that such interventions based on the TPB can, in fact, produce a significant effect on osteoporosis prevention-related behaviors. Thus, it can serve as a useful model for planning educational interventions.

Keywords:

Education, osteoporosis, prevention, theory of planned behavior

Introduction

Osteoporosis is primarily characterized by a low bone mineral density and a sharp biomechanical and architectural deterioration in bone tissue required to maintain bone homeostasis.[1] The disease has no symptoms for early detection, so it is often too late by the time a bone fracture occurs.[2] Due to the potentially devastating

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consequences following bone fractures, osteoporosis is considered a serious condition and a major public health issue. Moreover, osteoporosis is widely regarded as the primary cause of fractures worldwide and a pressing global health concern since it can lead to further disability and early mortality.[3] Osteoporotic fractures can lead to lasting physical, mental, psychological, and social impairments and place a large economic burden on the health-care system.[4] An estimated 200–400 thousand cases of fractures occur annually in Iran, of which osteoporosis is the leading cause by some considerable margin.[5] The national incidence rate of osteoporosis in Iranian women and men is estimated to be 32.4% and 9.4%, respectively. In a study conducted by Sanaeinasab *et al*. in 2009, it was indicated that 49.6% of the Iranian female population under 50 years of age has low bone mass, while the incidence rate of osteoporosis in the general population was at 22.2%.[6] It is reported that, due to demographic changes and an aging population, the prevalence of osteoporosis and osteoporotic fractures will increase substantially in the near future.[4] Thus, raising awareness about the risk factors associated with osteoporosis can serve as an effective preventive measure to combat the disease.[1] As a complex multifactorial disorder, the treatment and preventive measures for osteoporosis and osteoporotic fractures should also be regarded as a multistage and multifactorial process.[7] In addition, preventive measures have been put into practice for all four stages of the disease,[3] where education plays a crucial role.[8] Compelling evidence suggests that an increase in bone density by undergoing lifestyle changes may reduce the incidence rate of osteoporosis.[2] Therefore, weight-bearing exercises including climbing up and down the stairs, running, aerobics, swimming, and isometric exercises for at least 30 min a day; a proper diet or a supplement regimen rich in adequate amounts of calcium and vitamin D; smoking cessation; and maintaining a low-to-moderate consumption of alcohol and caffeine are the primary preventive measures in the fight against osteoporosis.[9] It is well proven that there is a clear correlation between bone growth during childhood and bone health in older age.[3] In other words, bone mass steadily increases by the age of 20–30 years; once reaching peak density, bones adapt themselves to the varying biomechanical demands. Furthermore, bone remodeling occurs in response to calcium homeostasis as well as hormonal factors, diseases, and therapeutic treatments.[7] Consequently, failure to prevent the disease at an early age can lead to bone loss and osteoporotic fractures in the aging population. Moreover, recent studies have shown that women are 4 times more likely than men to develop osteoporosis.[1] Community health nurses are able to reduce health-care costs by educating the public about disease prevention.[10] In addition, educating parents before the onset of irreversible complications and dangerous side effects in the child can prevent or minimize the complications of the disease.[11] A number of studies have proposed that educational interventions aimed at parents are highly effective.[12] Health education can serve as a means to learn how individuals or groups of people behave and if deemed necessary, change their current behavior with a more healthy one in order to develop effective programs. This role of education determines the role of models and theories in behavioral sciences in health education.[13] The overall efficacy of educational intervention highly depends on the proper application of behavioral science theories. The theory of planned behavior (TPB) is regarded as one of the leading theories when designing an evidence-based intervention.[14] This theory is widely applied to enhance the understanding of health-related behaviors.[15] The TPB basically states that an individual's behavioral intentions predict their behavior, and behavioral intention, in turn, can be shaped by attitude toward the behavior, subjective norm, and perceived behavioral control. Attitude represents an individual's preferences or willingness to respond to a psychological intention with a favorable or unfavorable appraisal. Similarly, individuals' perceived norms are based on their beliefs about acceptable behavior in their group or community. Numerous studies have also indicated that a sense of self-control over any given behavior plays an important role in behavioral intention and behavior.[16] The TPB has been applied to a large number of studies including the evaluation of the status and predictors of hypertension preventive nutritional behaviors that found that hypertension preventive nutritional behaviors were significantly correlated with attitude, perceived behavioral control, and behavioral intention.[17] According to Taghdisi *et al*. after the educational intervention, the mean scores of attitude, subjective norms, perceived behavioral control, behavioral intention variables, and fruits and vegetables were significantly higher in the intervention group when compared to the control group.[14] The results of the study by Pooreh and Hosseini Nodeh. suggested that, in the nutrition section, attitude, subjective norm, perceived control, and behavioral intention significantly increased. About physical activity, except subjective norm, the mean score of the attitude, perceived control, and behavioral intention revealed a significant difference between two groups.[18] Shirvani *et al*. also found that the model explained 77% and 17% of intention and behavior variance. Subjective norms and intention were the strongest predictors of intention and behavior, respectively.[19] However, not a single TPB-based study was found in the literature, in which the likely effect of an educational intervention aimed at mothers on the prevention of osteoporosis in female students was investigated. Therefore, the high prevalence and associated complications of osteoporosis in Iran, as well as the pivotal role of parents in providing basic care for

their children indicated the need to carry out the present study. Thus, this study was conducted based on the TPB to determine the effect of an educational intervention aimed at mothers on the prevention of osteoporosis in female students.

Materials and Methods

Study design and setting

An experimental study was conducted in 2019–2020 in Tehran, in which the subjects were randomly assigned to two groups, namely, experimental and control groups.

Study participants and sampling

Multistage random sampling was used where the total number of Tehran all-female high schools was determined by an inquiry from one of the researchers to the Tehran Department of Education. A complete list of the abovementioned high schools was then prepared, of which two high schools in the 18th district were randomly selected using a random number table. The high schools were subsequently assigned to the experimental and control groups by tossing a coin. Then, a total of 35 lower secondary school students was randomly selected from each high school. The mothers of the selected students were then invited through a text message sent by the principal in order to attend the training program. At the initial session, mothers were formally invited to participate in the study, informed about the primary objectives, and assured that the collected information would be anonymous and remain confidential. Each mother was then assigned a code to be written at the top of the questionnaire at every stage of data collection. The questionnaires were distributed among the experimental and control groups in the pretest stage. Training programs were subsequently delivered to the experimental group once the pretest stage had been completed. The postintervention questionnaires were collected and reviewed following the conclusion of the training programs, of which the incomplete ones were removed. Finally, 33 participants remained in the experimental group, whereas 33 questionnaires with similar codes were randomly selected as the control group. The educational intervention was completed in the form of group training programs, in which the experimental group was divided into two groups consisting of 17 and 18 individuals. Four 45–60 min training programs were held within the period of a month for each experimental subgroup at classrooms equipped with a video projector and whiteboard. A number of group teaching methods including lecture-type presentation, questions and answers, and group discussion were employed using various teaching aids such as slides, video projector, markers, and whiteboards. During the intervention period delivered to the experimental group, no intervention was given to the control group. The educational content of the present study on osteoporosis prevention based on the TPB included sections on attitude, subjective norms, perceived behavioral control, behavioral intention, and behavior using credible reference books, articles, and sources. Furthermore, three faculty members of the School of Nursing and Midwifery and two officials in the Tehran Department of Education were asked to assess the validity of the educational content which was subsequently approved following the application of expert assessment. A range of topics was covered and discussed during the educational intervention. During the first session, the purpose statement of the educational program, bone anatomy and physiology, and its functions, the importance of education of adolescent students for preventing osteoporosis were addressed. At the second session, osteoporosis as a serious condition, symptoms, complications, and the prevalence of osteoporosis was discussed, and a positive attitude was reinforced toward osteoporosis prevention by raising awareness. During the third session, various methods for osteoporosis prevention and the importance of self-efficacy (perceived control), family, and associates (subjective norm) in osteoporosis prevention were revealed. At the fourth session, previous lectures were reviewed and summarized in order to influence behavioral intention and carry out osteoporosis prevention behaviors. Furthermore, an educational pamphlet and a video were presented to teachers and students (friends and classmates) in order to strengthen the subjective norms at the first session. In addition, another educational pamphlet was presented to the control group once the questionnaires were completed at the last stage.

Data collection tool and technique

A demographic information questionnaire containing questions about age, level of education and occupation of parents, head of household, number of family members, and history of osteoporosis in the family, as well as a researcher-made osteoporosis prevention questionnaire based on the TPB consisting of several sections on attitude, subjective norms, perceived behavioral control, behavioral intention, and behavior were used in order to collect data. This researcher-made questionnaire on osteoporosis prevention was developed based on the TPB, credible scientific sources, similar studies,[20-23] and using the International Physical Activity Questionnaire. Moreover, this questionnaire consisted of 5 sections with a total of 33 items. The attitude about osteoporosis prevention had ten items; subjective norms (beliefs and undue pressure from family, friends, and relatives) in the context of osteoporosis prevention had six items; perceived behavioral control (an individual's perception about the ease or difficulty of performing a given behavior) in the context of osteoporosis prevention had

seven items; behavioral intention for the prevention of osteoporosis had five items; and osteoporosis prevention behaviors (physical activity report, consumption of milk in the diet, sunlight exposure, and refraining from caffeinated beverages and Vitamin D supplement) had five items. Moreover, reverse scoring was used for several items in the attitude and perceived behavioral control sections. The 5-point Likert scale was then employed (on a continuum from strongly agree to strongly disagree) with a direct-scoring system as follows: "Strongly agree" = five, "Agree" = four, "Neither agree nor disagree" = three, "Disagree" = two, "Strongly disagree" = one, and a reverse-scoring system for the rest. The face and content validity were assessed to evaluate the validity of the questionnaire in this study. Thus, the questionnaire was given to ten family members and their remarks were taken into consideration in order to determine the face and content validity of the questionnaire. Then, ten faculty members of Shahid Beheshti University of Medical Sciences School of Nursing and Midwifery were asked to assess the face and content validity of the questionnaire where their remarks were taken into consideration. Furthermore, the content validity ratio (CVR) and content validity index (CVI) were calculated for the questionnaire.

The CVR generated for each item was compared to the table of critical values for the CVR where items with CVR values meeting the minimum value required were retained in the questionnaire.[24]

$$\mathrm{CVR} = \frac{n_e - \frac{n}{2}}{\frac{n}{2}}$$

In the present study, the items having a minimum CVR of 0.62 were retained based on the Lawshe table and a panel of ten experts. The lowest obtained CVR for the items in the questionnaire was determined at 0.4 where the item with that CVR was removed and others were retained. The CVI was established by the panel of experts based on the extent to which the items are representative of the entire domain the questionnaire seeks to measure. Thus, the panel of experts was asked to rate the relevance of each item on a scale of 1–4. The CVI of the questionnaire items ranged from 0.82 to 0.97, and thus all the items were retained. In order to determine the reliability of the questionnaire, the Cronbach's alpha coefficient and test–retest reliability were measured to determine the internal consistency and stability, respectively. Therefore, the Cronbach's alpha coefficient was ranged from 0.74 to 0.82 in a pilot study carried out among thirty mothers of students outside the research sample in order to determine the internal consistency of the questionnaire. Furthermore, the questionnaires were completed by thirty mothers of students outside the research sample in two stages with an interval of at least 14 days, and the correlation coefficient was calculated using the Intraclass Correlation Coefficient which ranged from 0.89 to 0.91. Data were collected before, immediately after, and 1 month following the training program. Finally, IBM SPSS Statistics 21 (SPSS Inc., Chicago, IL) was used for statistical analysis. As a result of the study objectives, descriptive statistics and absolute and relative frequency distribution were used for data analysis, while various statistical tests including Mann–Whitney U test, Chi-squared test, Sphericity test, Greenhouse–Geisser correction, repeated measures ANOVA, and two independent sample *t*-test were employed to assess the relationship between variables where a $P < 0.05$ is statistically significant.

Ethical considerations

This study was conformed to the national Code of Ethics with the following registration number: IR.SBMU.PHARMACY.REC.2019.139. Moreover, permission to enter the research field was obtained from a person in authority before data collecting. The participans in both groups were informed about the purpose and method of data collection, and informed written consent was acquired from all participants. Study participation was voluntary, and participants can leave the study at any time. The survey was carried out anonymously using different code numbers and the personal information of the participants was excluded from collection.

Results

The mean ± standard deviation of students' age in the experimental and control groups were 13.36 ± 1.06 and 13.70 ± 1.21 years, respectively [Table 1]. No significant difference was observed in mean age between the experimental and control groups based on the conducted two independent sample *t*-test ($P > 0.05$). A number of sample demographic information are presented in Table 1.

No significant difference was observed between the level of education and number of family members using the Mann–Whitney U-test. Furthermore, no significant difference was observed in the two groups between the head of household and history of osteoporosis when the Chi-squared test was applied ($P > 0.05$). Therefore, the groups were identical in terms of these variables, while the monthly family income of the control group was significantly lower than that of the experimental group ($P < 0.05$). Moreover, no significant difference was observed in the two groups between the level of education and employment status of mothers and fathers when the Chi-squared test was employed ($P > 0.05$). However, the employment status of fathers was

Table 1: Demographic information of lower secondary school female students in the experimental and control groups in 2019-2020

Variable	Frequency (%)		χ^2	*P*
	Experimental group	Control group		
Grade				
Seventh	20 (60.6)	14 (42.4)	0.43	0.514
Eighth	0	7 (21.2)		
Ninth	13 (39.4)	12 (36.4)		
Head of household				
Father	32 (97.00)	33 (100)	1.40	0.999
Mother	1 (3.00)	0		
Number of family members (persons)				
Three	10 (30.03)	10 (30.3)	0.18	0.672
Four	18 (54.5)	13 (39.4)		
Five	4 (12.2)	8 (24.3)		
Six or more	1 (3.00)	2 (6.00)		
Monthly family income				
Meet basic needs	18 (54.5)	9 (27.3)	5.08	0.044
Less than basic needs	15 (45.5)	24 (72.7)		
Family history of osteoporosis				
Yes	7 (21.2)	10 (30.3)	0.05	0.839
No	24 (72.7)	17 (51.5)		
Don't know	2 (6.1)	6 (18.2)		

significantly different in the experimental and control groups ($P < 0.05$). The linear regression method was applied to ensure that the employment status of fathers and monthly family income would not affect the family attitude before proceeding with the intervention. The effect of these two factors was taken into account as Sphericity in the model which was later revealed that they fail to affect the overall score of family attitude in terms of osteoporosis prevention ($P < 0.05$). No significant difference was observed in the two groups between the mean attitude score, subjective norms, perceived behavioral control, mothers' behavioral intention, and students' behavior before the educational intervention when the two independent sample *t*-test was applied ($P > 0.05$). However, the difference in the scores of the abovementioned variables was significant between the two groups immediately after and 1 month following the training program ($P < 0.05$) [Table 2].

Discussion

The results obtained in this study indicated that the TPB-based educational intervention has, in fact, led to a change in attitude, subjective norms, perceived behavioral control, and behavioral intention of mothers, as well as a behavioral change in students as reported by their mothers. Furthermore, an increase in the mean score of attitude toward osteoporosis prevention behavior immediately after and 1 month following the TPB-based educational intervention in the experimental group in comparison with the control group reveals the effectiveness of such intervention on mothers' attitude toward osteoporosis prevention. This finding is consistent with that of the studies conducted by Mazloomy-Mahmoodabad *et al*. in 2017,[13] Taghdisi *et al*. in 2016,[14] and Pooreh and Hosseini Nodeh in 2015.[18] It is rather evidently clear that the stronger the attitude, the greater its effect on behavior. Based on the findings, it seams a change in attitude can cause a change in behavior if the result occurs as an outcome of education. In the present study, educating mothers about osteoporosis prevention behaviors lead to a positive attitude toward such behaviors, which, in turn, this change in attitude as a way to strengthen the osteoporosis prevention behaviors in students is particularly valuable. Thus, osteoporosis prevention behavior can be influenced by an increase in attitude score.

In this study, subjective norms, as yet another structure of the TPB, used to predict behavior. Given that subjective norms are mainly concerned with the perception of social pressure exerted on a person to perform a task, and they are highly effective factors that illustrate the influence of others on an individual displaying a behavior,[25] the findings of the present study on subjective norms showed that, after the intervention, the mean score of mothers' subjective norms in the experimental group after education was significantly increased. Based on which, it is expected that subjective norms are effective in changing the behavior of mothers and their children. In this study, subjective norms considered as important factors in behavioral change when performing an educational intervention. In addition to educating mothers, efforts have been made in the present study to

Table 2: Comparison of the theory of planned behavior-based structural model in the experimental and control groups prior to, immediately, and 1 month following the educational intervention

Variable	Phase	Mean±SD		*P*
		Experimental group	Control group	
Attitude	Before	77.57±8.83	74.17±7.28	0.05
	Immediately after	92.20±6.08	75.30±9.03	0.05
	1 month after	92.80±5.68	74.40±7.68	0.05
Subjective norms	Before	71.09±10.90	71.09±4.56	0.05
	Immediately after	74.93±9.54	70.20±5.95	0.05
	1 month after	79.61±8.30	69.63±6.23	0.05
Perceived behavioral control	Before	57.58±16.11	56.38±14.33	0.05
	Immediately after	65.37±13.90	55.63±14.31	0.05
	1 month after	66.67±13.62	54.87±14.36	0.05
Behavioral intention	Before	88.13±11.07	89.52±8.27	0.05
	Immediately after	96.84±5.99	89.14±8.64	0.05
	1 month after	98.23±3.90	87.63±9.52	0.05
Behavior	Before	66.36±19.17	52.57±7.19	0.05
	Immediately after	69.10±19.66	54.39±8.82	0.05
	1 month after	87.57±15.91	51.81±10.88	0.05

SD=Standard deviation

strengthen the subjective norms of teachers and students by providing them with an educational pamphlet and a video on osteoporosis prevention. Similarly, it was indicated in a study carried out by Shirvani *et al*. in 2015 examining the primary determinants of physical activity in Iranian military spouses based on the TPB that subjective norms are the strongest predictors of intention and behavior.[19] Furthermore, Jalambadani, Borji, and Delkhosh stated in a 2018 study aimed at determining the effect of a TPB-based education on the iron supplement in pregnant women that the mean score of subjective norms increased significantly in the experimental group after proceeding with the intervention ($P < 0.05$).[26] Similar results were stated in a study by Taghdisi *et al*. in 2016, in which the effectiveness of an educational intervention on the subjective norms was shown.[14]

In the present study, an increase in the level of perceived behavioral control could be a deciding factor in the implementation of a behavior. The findings of this study expressed that the mean score of mothers' perceived behavioral control in the experimental group was significantly increased once the intervention was completed. Moreover, the results obtained in a study carried out by Jalambadani *et al*., in 2018, showed a significant difference between the experimental and control groups in terms of perceived behavioral control scores after completing an iron supplement intervention in pregnant women ($P < 0.05$).[26] In yet another study conducted by Pooreh and Hosseini Nodeh in 2015, the positive effect of a TPB-based educational intervention on perceived behavioral control in hypertension preventive self-care behaviors was observed.[18]

Behavioral intention, as another structure of the TPB, was considered during the educational intervention in this study. Behavioral intention is regarded as the most powerful predictor of behavior in the TPB. In essence, while intentions are clearly necessary, they are often not sufficient. Thus, the more desirable attitudes or subjective norms are and the higher perceived behavioral control is, the stronger an individual's intention to perform the desired behavior should be.[27] In addition, a high level of intention can have optimal effects on increasing the likelihood of engaging in a given behavior. Therefore, one can certainly deduce that the significant changes that occurred in attitude, subjective norms, and perceived behavioral control in the experimental group in terms of osteoporosis prevention have led to a significant increase in behavioral intention to prevent osteoporosis. The results obtained in this study are consistent with those of other studies conducted by Taghdisi *et al*. in 2016,[14] Sarayloo *et al*. in 2019,[28] Mazloomy-Mahmoodabad *et al*. in 2017,[13] and Taghipour *et al*. in 2019.[29]

The increase in the mean score of osteoporosis prevention behavior in the experimental group immediately after and 1 month following the educational intervention can be viewed as a confirmation of the effect of the TPB-based educational intervention on students' osteoporosis prevention behavior due to significant changes in other structures of the theory, namely, mothers' attitude, subjective norms, perceived behavioral control, and intentional behavior. Therefore, this finding can emphasize the critical role of mothers in changing their child's behavior. Based on the TPB, one can state that the primary reason for such behavior is the behavioral intention. Furthermore, intention, in turn, is also influenced by attitudes, subjective norms, and perceived behavioral control, while their summation determines performance or behavior.[27]

Limitation and recommendation

Investigating on osteoporosis prevention behavior using a valid model in students and the involvement of mothers in changing child behavior was one of the strengths of the present study. Measuring participants' osteoporosis prevention behavior was the limitation of this study since children's behavior was self-reported by their mothers and researchers were not able to directly observe the subjects' behavior.

Based on the findings of the research, it is suggested that since the performing such interventions in schools can lead to a significant increase in osteoporosis prevention behaviors during adolescence, which, in turn, can contribute to bone health in adulthood, educational planners, and educators should pay more attention to this issue and deal with training these behaviors and skills.

Conclusion

The results obtained in this study revealed the effectiveness of the TPB-based educational intervention aimed at mothers on osteoporosis prevention in female students. In other words, it was shown based on the obtained results that the TPB-based educational intervention was effective for all structures including attitude, subjective norms, perceived behavioral control, behavioral intention, and osteoporosis prevention behavior that have led to a significant change in the mothers' attitude, subjective norms, perceived behavioral control, and behavioral intention which have ultimately promoted osteoporosis prevention behaviors in students.

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Conflicts of interest

There are no conflicts of interest.

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