Original Article

Access this article online

Quick Response Code:

Website: www.jehp.net

DOI: 10.4103/jehp.jehp_1515_20

Promotion of osteoporosis-preventive behaviors in adolescents: Application of protection motivation theory

Somayyeh Khazaeian, Fariba Shahraki Sanavi[1], Hossein Ansari[2], Fatemeh Mirshekari[3]

Department of Midwifery, Pregnancy Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran, [1]Health Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran, [2]Department of Biostatistics and Epidemiology, School of Health, Health Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran, [3]Department of Midwifery, School of Nursing and Midwifery, Zahedan University of Medical Sciences, Zahedan, Iran

Address for correspondence:
Dr. Somayyeh Khazaeian, Department of Midwifery, Pregnancy Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.
E-mail: m_khazaiyan@yahoo.com

Received: 30-11-2020
Accepted: 20-02-2021
Published: 31-12-2021

Abstract:

BACKGROUND: Osteoporosis is considered a health problem that can be simply prevented by lifestyle modifications in adolescence. Therefore, this study was conducted to investigate the effects of protection motivation theory (PMT)-based training on osteoporosis-preventive behaviors in female high school students in Zahedan, Iran.

MATERIALS AND METHODS: The present quasi-experimental study was performed on 240 female high school students who were selected by a multistage sampling technique in Zahedan in 2019–2020. To collect the data, a multipart questionnaire was distributed among the participants in three stages, namely at the baseline, immediately, and 2 months after the intervention. This instrument consisted of demographic information, socioeconomic status, knowledge, PMT constructs, and preventive behaviors. The intervention group was subjected to educational content. The collected data were analyzed in SPSS software (version 22) by descriptive and analytical tests (i.e., Chi-square, independent *t*-test, and ANOVA).

RESULTS: Based on the results, the intervention and control groups showed no significant difference in terms of the mean score of knowledge, theoretical constructs, and preventive behaviors at the baseline ($P > 0.05$). However, the two groups were significantly different in terms of the mentioned variables immediately and 2 months after the intervention ($P = 0.001$). Mean score of preventive behaviors, the two groups also demonstrated a significant difference (i.e., calcium intake, physical activity, and sunlight exposure) 2 months after the intervention, compared to before the intervention. ($P = 0.001$).

CONCLUSION: The findings of the present study were indicative of the PMT effectiveness, which can, therefore, be used as a framework for designing educational programs regarding osteoporosis prevention.

Keywords:

Adolescents, education, osteoporosis, protection motivation theory

Introduction

Osteoporosis, or porous bone, is a chronic bone disease characterized by decrements in bone mass, which heightens the risk of fracture in the affected individuals.[1,2] This disease is a silent epidemic of the present age that develops gradually and asymptomatically, presenting as bone fractures if left without any preventive or therapeutic measures.[3] The disease develops when osteoclasts (bone removal) outnumber osteoblasts (bone formation)[4] manifesting such disorders as short stature, kyphosis, chronic pain syndrome, and low back pain, reducing quality of life and performance in the affected patients.[5]

At present, this disease has become one of the most important health problems

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Khazaeian S, Sanavi FS, Ansari H, Mirshekari F. Promotion of osteoporosis-preventive behaviors in adolescents: Application of protection motivation theory. J Edu Health Promot 2021;10:469.

which stand higher than all types of cancers in terms of mortality rate.[6] According to the statistics, women are more susceptible to osteoporosis; in this regard, females constitute 22% of affected patients in Europe[7] and 80% of cases in every 25 million patients in the US.[8] Asian women are reported to have lower bone mineral density due to their specific body weight and anatomical structure. Accordingly, it has been estimated that by 2050, more than half of all the worldwide incidence of hip fractures will occur in Asia.[9]

Based on the National Osteoporosis Prevention, Diagnosis, and Therapy Program, in Iran, 50% and 70% of males and females aged more than 50 years suffer from osteoporosis, respectively. Moreover, according to this program, approximately 2.5 million Iranian postmenopausal women are at the risk of bone fractures.[10-12] However, this disease can be prevented most appropriately by early changes in lifestyle habits, such as proper nutrition, regular physical activity, and sunlight exposure, especially during adolescence.[13]

Adolescence is considered a period during which an individual achieves a reasonable stage of cognitive development. Most of the healthy and unhealthy behaviors are shaped at this age and spread to the rest of life. As educability is one of the significant characteristics of youngsters, it can be regarded as a valuable factor for promoting preventive behaviors at this age.[14] The importance of osteoporosis prevention is highlighted in girls owning to the fact that not only are they more likely to be infected but also these people are future mothers; therefore, their health condition can affect the health status of their family.[15]

Behaviorists believe that model-based curriculum development plays an essential role in raising people's awareness and beliefs regarding health behavior.[16,17] Protection motivation theory (PMT) is one of the educational theories, stating that fear can affect protection motivation through self-efficacy constructs, response efficiency, response cost, rewards, perceived sensitivity, and perceived severity. In this model, it is assumed that the acceptance of a recommended health behavior against health risks is a direct consequence of motivation to protect oneself[18] [Figure 1]. In this respect, the results of studies performed in this field are indicative of the importance of theoretical constructs in predicting preventive behaviors.[19-21]

According to the literature, adolescent girls' level of health knowledge and practice toward the osteoporosis risk factors is not acceptable. Moreover, the amount of calcium intake per day, physical activity, and sun exposure is not adequate in this population.[8,22-24] Therefore, investments in the implementation of educational and health-care programs on osteoporosis prevention are considered fundamental for this group. Regarding this, the present study was conducted to determine the effects of PMT-based training on osteoporosis-preventive behaviors in female high school students.

Materials and Methods

Study design and setting

This quasi-experimental study was performed on female high school students in Zahedan, Iran, from October 2019 to February 2020. Based on the geography, the city was divided into four clusters of north, south, east, and west using the probability sampling method. Afterward, a list of public high schools in two districts with comparable households in terms of socioeconomic status was prepared. A total of ten high schools (i.e., five high schools in each of the intervention and control groups) were randomly selected using the Randomizer software. In the next stage, the sample size in each high school was determined by the quota sampling method.

Study participants and sampling

The sample size was calculated as 240 cases with 95% confidence, power of 0.80%, and a dropout rate of 10% based on a study performed by Shobeiri *et al*.[25] All eligible students were entered into the study according to the inclusion criteria. Finally, among this population, 240 cases (i.e., 120 individuals in each group) were randomly selected using the Randomizer software [Figure 2].

Tenth-grade high school girls, the female high school students who did not have a debilitating physical or mental illness and any treatment regimen (e.g., malabsorption syndrome, osteomalacia, rickets, depression, and anorexia mental), corticosteroids, calcium supplements or Vitamin D, and no previous participation in osteoporosis prevention educational programs were included in the study. However, those who were not willing to participate in the study or were absent in at least one of the training sessions were excluded from the research.

Data collection tool and technique

The data were collected through a questionnaire consisting of four sections, covering demographic and economic information (n = 8), knowledge (n = 15), protection motivation constructs (n = 54), and preventive behaviors (n = 26). The section related to the protection motivation constructs entailed items related to self-efficacy (n = 7), response cost (n = 6), fear (n = 8), response efficiency (n = 7), reward (n = 6), perceived sensitivity (n = 7), perceived intensity (n = 7), and protection motivation (n = 6). Furthermore, the section

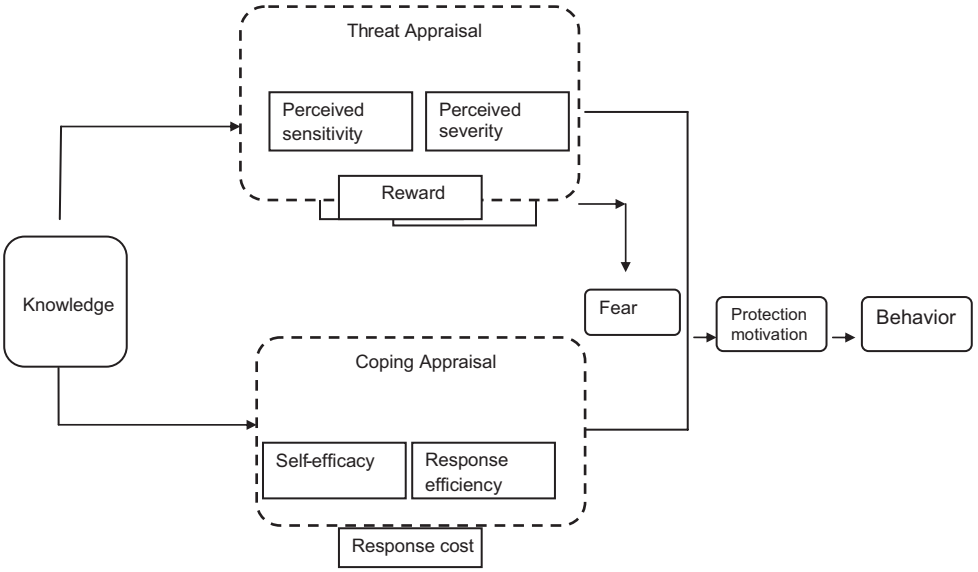

Figure 1: Protection motivation theory

covering preventive behaviors consisted of data related to physical activity ($n = 7$), sunlight exposure ($n = 2$), and proper nutrition ($n = 17$).

Different Likert scale scorings were applied for each section of the questionnaire. In this regard, the items in Section 1 were scored on a two-point Likert scale (i.e., having knowledge = 2 and lacking knowledge = 1). Section 2 was rated on a five-point Likert scale (ranging from strongly disagree = 1 to strongly agree = 5). Furthermore, preventive behaviors (calcium intake, sunlight exposure, physical activity) were included in section 4. In the calcium intake subsection, the daily calcium intake of <650, 650–1300, and >1300 mg were scored as 3, 2, and 1, which were representative of highly unfavorable, unfavorable, and favorable nutritional status, respectively.

In the subsection of sunlight exposure, daily sun exposure of 15–30 min, weekly sun exposure of 15–30 min, and lack of sun exposure during the week, respectively, rated like 1, 2, and 3, indicating favorable, unfavorable, and highly unfavorable amount of sunlight exposure, respectively. The International Physical Activity Questionnaire Self-Administered-Short Form was also used to measure physical activity. In this subsection, the physical activity levels <600, 600–3000, and >3000 METs-min/week were scored as 3, 2, and 1, respectively, representing low, moderate, and high levels of the amount of physical activity, respectively.[8,26-28]

The validity and reliability of the mentioned standard questionnaires have been confirmed by previous researchers. The level of participants' knowledge was assessed based on a questionnaire developed by Afrasiabi *et al*., with confirmed content validity and test–retest reliability ($r = 0.87$).[8] Considering the preventive behaviors related to proper nutrition and sunlight exposure, a questionnaire designed by Mahmoodi *et al*. was used with a test–retest validity of 0.75.[27]

The impact on participation and autonomy questionnaire was completed in the physical activity subsection. The validity and reliability of this instrument have been confirmed in 12 countries, including Iran with the obtained Cronbach's alpha coefficient of 0.70 as reported by Moghaddam *et al*.[29] The protection motivation questionnaire applied in this study was also reported to have acceptable concurrent validity and subtest correlation ($r = 0.75 - 0.96$).[26,30] Although all questionnaires were standard, their reliability was examined again, rendering the Cronbach's alpha coefficients ranging from 0.72 to 0.94.

To implement the intervention, the intervention group was divided into small 10 groups of 12 participants. The educational content was presented in four 60-minute sessions, twice a week for two weeks. The presentation was in the form of lectures, questions and answers, group discussions, PowerPoint, and photos. The educational content included the definition of osteoporosis, preventive measures, health misconceptions, high-risk groups, physical activity training, sunlight proper use, possible barriers to the consumption of calcium-containing foods, proper nutrition, and diet.

The content of the training course was developed according to the results of intervention and osteoporosis-preventive programs performed in Iran and other countries [Table 1]. This content was then approved by five faculty members, and its simplicity, fluency, and comprehensibility were confirmed based on the ideas of five high school students. The educational

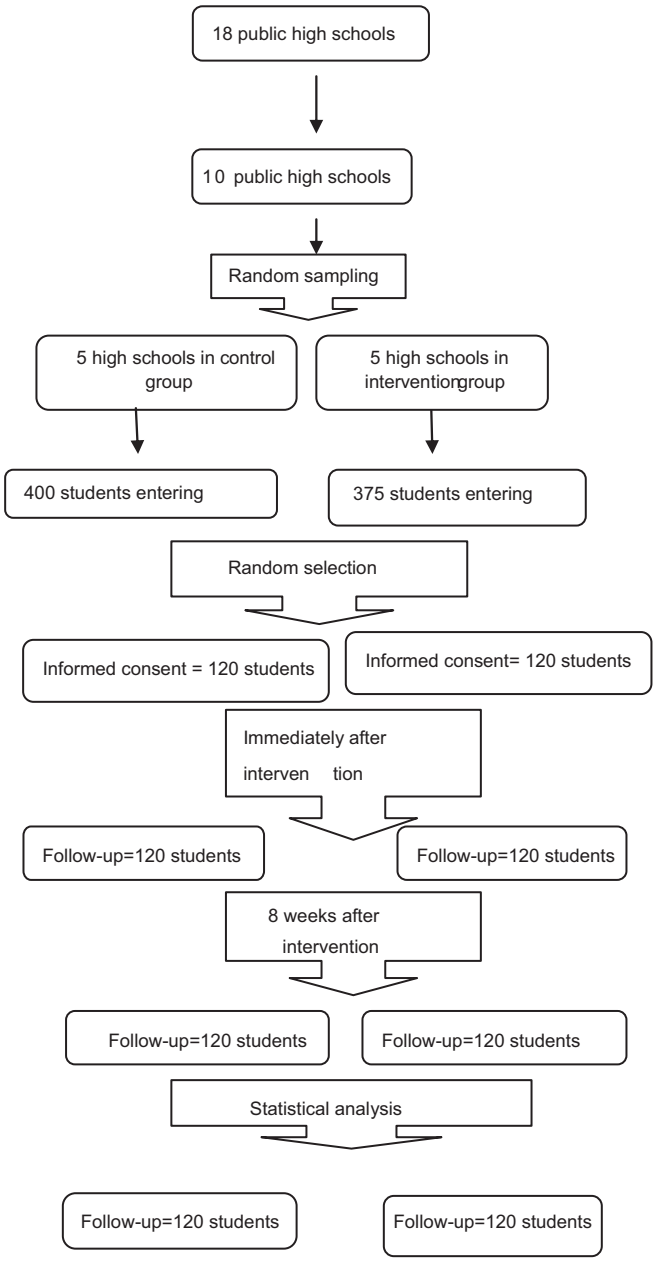

Figure 2: Flowchart of the study design

course was delivered in the form of group discussions, PowerPoint presentations, photos, and short videos.

At the end of the sessions, an educational booklet was provided to the research units. The questionnaires of knowledge and PMT constructs were filled out by the students in both the groups at the baseline, immediately, and 8 weeks after the intervention. The control group completed two questionnaires consecutively after a 1-week interval. The promoting preventive behavior questionnaire was completed before and 8 weeks after the intervention.

Ethical consideration

To comply with ethical considerations, informed consent was obtained from all participants and their parents in both the groups. Moreover, research units were ensured about the confidentiality terms. Another point was that after the fulfillment of the research, the educational pamphlet was distributed among the participants of the control group. The study was approved by the Research Ethics Committee of Zahedan University of Medical Sciences with the ethics code of IR.ZAUMS.REC.1398.142.

Data analysis

The collected data were analyzed in SPSS Statistics software, Version 24 (IBM Corp., Armonk, NY, USA) using descriptive and analytical tests, including the Chi-square test, independent *t*-test, and ANOVA. In addition, Kolmogorov–Smirnov test was used in order to check the normality of the variables.

Results

A total of 240 female high school students participated in the present study. The mean ages of the intervention and control groups were 15.43 ± 0.529 and 15.42 ± 0.492 years, respectively. Regarding the employment status of the mothers of the participants in the intervention and control groups, 68.33% (n = 82) and 70% (n = 84) of them were homemakers, respectively. With respect to the fathers, 64.14% (n = 77) and 61.66% (n = 74) of them were employees, respectively.

Considering the economic status, the majority of the families in the intervention (n = 69) and control (n = 65) groups belonged to the middle class (57.7% and 54.16%, respectively). In this respect, the economic and employment conditions, calculated by the Chi-square test, showed no significant difference between the two groups ($P > 0.05$). Moreover, the mean score of knowledge and PMT constructs, measured by independent *t*-test, was not significantly different between the two groups before the intervention ($P < 0.001$).

Due to the significance of Mauchly's test and nonfulfillment of the sphericity assumption to the knowledge score and theoretical constructs, the Greenhouse–Geisser epsilon correction was applied using the univariate method. According to this method, a significant difference was observed regarding the effects of knowledge ($P = 0.001$, df = 1.10), perceived sensitivity ($P = 0.001$, df = 1.68), perceived intensity ($P = 0.001$, df = 1.91), response efficiency ($P = 0.001$, df = 1.86), self-efficacy ($P = 0.001$, df = 1.13), response cost ($P = 0.001$, df = 1.92), reward ($P = 0.001$, df = 1.95), fear ($P = 0.001$, df = 1.87), and protection motivation ($P = 0.001$, df = 1.79) over time.

In addition, there was a significant interaction between the groups and time in relation to knowledge ($P = 0.001$, df = 1.10), perceived sensitivity ($P = 0.001$, df = 1.68),

Table 1: Educational activities and timetable of educational sessions in the intervention group

Session	Variables	General purpose	Specific objectives
1	Perceived, severity	At the end of the session, learners believe that the health threat posed by osteoporosis s is serious	The learner can explain the complications of osteoporosis in group (knowledge)
			The learner can ask questions about ways to prevent osteoporosis (emotional)
			The learner can actively participate in the discussion (emotional reaction)
2	Perceived, sensitivity, fear	At the end of the session, learners think that are susceptible to osteoporosis	The learner can define osteoporosis in the presence of other learners
			The learner can describe two cases of the importance of considering osteoporosis
			The learner can refer to two of the symptoms of osteoporosis
			The learner can refer to all groups exposed to osteoporosis
			The learner can determine the most vulnerable group.
			The learner can protect herself from the risk of osteoporosis The learner one can ask questions about ways to prevent osteoporosis
			The learner believe that if they get sick, they will depend on others to do their daily chores
3	Perceived reward, cost	At the end of the session, learners judge the costs of doing the protecting behavior rather than the nondoing of the protective behavior. Learners can understand the rewards received because of doing protective behaviors toward not doing so	Learners can calculate the cost of buying calcium-rich foods, compared with costs imposed by osteoporosis treatment. The learner can explain the importance of a calcium-rich diet
			The learner can explain the changes in the diet that contains calcium
			The learner can provide solutions regarding access to calcium-containing products
			The learner can explain food and calcium-based drinks to other nonnutrients (beverages, tea, coffee, etc.) (knowledge)
			The learner can explain to his/her family the importance of using calcium-containing foods (knowledge)
			The learner can actively participate in the discussion (emotional reaction)
			The learner can explain the benefits of exercise
4	Perceived self-efficacy, response efficiency	At the end of the session, learners will believe that they can successfully perform the proposed behavior	The learner believes that (s) he can include foods rich in calcium in his/her diet
			The learner believes that (s) he can stop eating foods that prevent the absorption of calcium.
		At the end of the session, learners believe that it is possible to prevent osteoporosis by taking foods containing calcium, physical activity, and expose to sunlight	The learner believes that (s) he can consume foods rich in calcium even if his/her family does not want to consume these foods.
			The learner believes that (s) he can have adequate physical activity expose to sunlight for 10-15 min daily
			The learner believes that (s) he can prevent osteoporosis by eating foods rich in calcium
			The learner believes that consuming foods rich in calcium could lead to better health status in old age
			The learner believed that it would be possible to eat well food habits in his family by consuming foods rich in calcium

perceived intensity (P = 0.001, df = 1.79), response efficiency P = 0.001, df = 1.86), self-efficacy (P = 0.001, df = 1.13), response cost (P = 0.001, df = 1.92), reward (P = 0.001, df = 1.95), fear (P = 0.001, df = 1.87), and protection motivation (P = 0.001, df = 1.79).

The results of intergroup tests were indicative of the significant effect of this training course on the mean scores of knowledge and constructs of PMT [Table 2]. Furthermore, the outcomes of the study revealed an improvement in the adoption of preventive behaviors, including calcium intake, physical activity, and sunlight exposure, 2 months after the educational intervention. In this regard, the mentioned variables were significantly different, compared to those in the control group [Table 3].

Discussion

Based on the results of the present study, the mean score of students' knowledge in the intervention group increased significantly over time, compared to that in the control group. This increase was prominent, especially immediately after the intervention. The researcher could not find out any studies investigating the students' knowledge about osteoporosis prevention based on PMT. Therefore, similar studies were used to gather the necessary background literature.

In this regard, Mousaviasl *et al*. and Gammage *et al*. reported an increase in the mean score of adolescents' knowledge regarding osteoporosis after educational intervention based on the health belief model.[13,31] The results of the mentioned studies are in agreement with those of the present research. These consistent results are indicative of the important role of education using active learning and its tremendous impact on students' awareness.

These findings provide strong evidence regarding the necessity of raising students' knowledge of osteoporosis

Table 2: Comparison of knowledge score and protection motivation theoretical constructs between the research groups at three evaluation stages

Time	Variable	Mean±SD		MD (95% CI)	*P**	Eta effect size
		Intervention group (*n*=120)	Control group (*n*=120)			
Knowledge	Before intervention	17.68±2.34	17.65±2.60	0.25 (−0.605-0.655)	0.938	0.729**
	Immediately after intervention	26.80±1.80	17.63±2.61	9.16 (8.59-9.73)		
	8 weeks after intervention	25.94±1.75	17.73±2.79	8.20 (7.61-8.80)		
Perceived sensitivity	Before intervention	21.55±2.64	20.58±2.42	0.867 (0.139-1.79)	0.645	0.782**
	Immediately after intervention	29.68±2.09	19.13±2.56	10.55 (9.61-11.40)		
	8 weeks after intervention	32.38±2.20	19.08±2.80	13.30 (12.44-14.17)		
Perceived severity	Before intervention	19.75±3.40	19.18±3.22	0.575 (−0.30-1.45)	0.197	0.689**
	Immediately after intervention	27.58±2.83	18.02±3.11	9.56 (8.61-10.51)		
	8 weeks after intervention	39.16±2.73	18.53±3.317	11.63 (10.70-12.56)		
Response efficiency	Before intervention	20.82±2.75	20.14±2.97	0.10 (−0.63-0.83)	0.787	0.794**
	Immediately after intervention	32.19±2.55	16.92±3.21	15.26 (14.41-16.11)		
	8 weeks after intervention	29.92±2.53	17.32±3.18	12.60 (11.78-13.43)		
Self-efficacy	Before intervention	19.93±2.82	19.04±2.63	0.89 (−0.18-1.96)	0.103	0.681**
	Immediately after intervention	31.45±2.20	19.04±2.81	12.40 (11.39-13.42)		
	8 weeks after intervention	29.48±2.33	19.10±3.04	10.37 (9.30-11.44)		
Response cost	Before intervention	24.23±2.63	23.12±2.54	0.03 (−0.62-0.69)	0.921	0.575**
	Immediately after intervention	14.02±3.30	21.56±3.98	−7.53 (−8.52-−6.54)		
	8 weeks after intervention	13.35±3.45	22.44±4.23	−10.09 (−11.07-−9.10)		
Reward	Before intervention	24.26±2.64	24.03±2.77	0.22 (−0.46-0.91)	0.521	0.471**
	Immediately after intervention	16.67±2.62	22.04±3.59	−5.37 (−6.17-−4.57)		
	8 weeks after intervention	13.95±2.89	22.59±3.68	−8.64 (−9.48-−7.80)		
Fear	Before intervention	21.12±3.311	20.80±3.03	0.317 (−0.49-1.12)	0.440	0.789**
	Immediately after intervention	32.61±2.39	17.22±3.75	15.38 (14.42-16.34)		
	8 weeks after intervention	29.71±2.47	17.17±3.59	12.54 (11.56-13.51)		
Motivation protection	Before intervention	19.82±1.95	20.24±2.31	−0.42 (−1.09-0.24)	0.213	0.456**
	Immediately after intervention	28.93±1.26	20.70±2.01	8.22 (7.51-8.93)		
	8 weeks after intervention	26.54±1.34	21.24±2.52	5.30 (4.61-5.98)		

*Independent-samples *t*-test, ***P*<0.001. Repeated measures analysis of variance. MD=Mean difference, CI=Confidence interval, SD=Standard deviation

Table 3: Distribution frequency of research groups according to performance before and 8 weeks postintervention

Variable	Performance	Before intervention		*P**	8 weeks postintervention		*P**
		Intervention group, *n* (%)	Control group, *n* (%)		Intervention group, *n* (%)	Control group, *n* (%)	
Calcium intake	Favorable	29 (24.2)	17 (14.2)	0.091	86 (71.7)	15 (12.5)	<0.001
	Unfavorable	19 (15.8)	16 (13.3)		27 (22.5)	25 (20.8)	
	Highly unfavorable	72 (60)	87 (72.5)		7 (5.8)	80 (66.7)	
Sunlight exposure	Favorable	21 (17.5)	12 (10.2)	0.163	87 (72.5)	21 (17.5)	<0.001
	Unfavorable	86 (71.7)	89 (74.2)		29 (24.2)	83 (69.2)	
	Highly unfavorable	13 (10.8)	19 (15.8)		4 (3.3)	16 (13.3)	
Physical activity	High	6 (5)	4 (3.3)	0.183	9 (7.5)	4 (3.3)	<0.001
	Moderate	37 (30.8)	26 (21.7)		73 (60.8)	30 (25)	
	Low	77 (64.2)	90 (75)		38 (31.7)	86 (71.7)	

*Chi-square test

by means of providing them with persistent education based on health models and theories. These educational courses need to be sponsored by the government, health-care providers, and health-care educators, who play a key role in health education at schools.

In the present study, the mean score of perceived sensitivity and perceived severity in the intervention group increased after the educational intervention. Likewise, in a study performed by Mohammadi *et al*., an increase was reported in the mean score of sensitivity and perceived severity after the implementation of educational intervention in women of reproductive age.[32] Moreover, the positive role of educational interventions in the perceived sensitivity of adolescents in smoking prevention was emphasized in a study carried out by Thrul *et al*.[33] Although these results are consistent with those of the present study, in a study conducted by Ansari *et al*., no significant training effect was observed regarding the perceived sensitivity of male

students to influenza prevention.[34] The reason for this discrepancy can be related to the effects of gender and the type and importance of disease on people's perception.

The findings of another study showed that the intervention group had an increase in the mean score of self-efficacy after the educational intervention, compared to the control group. Furthermore, Thrul *et al*. revealed that self-efficacy was the strongest construct in the prevention of smoking in adolescents;[33] Karimy *et al*., quoting Bandura, considered self-efficacy the most important precondition for changing health behavior; accordingly, they pointed to the strong effect of self-efficacy on health behaviors.[35] In the present study, the students gained confidence in their ability to adopt disease-preventive strategies after finding out about the simplicity and cost-efficiency of these approaches.

The increase observed in the mean score of response efficiency in the intervention group after the educational intervention was indicative of the positive effect of training on this variable. It can be concluded that students would attempt to change their behavior as soon as they come to believe that preventive behaviors are effective in reducing and eliminating the risk of disease. Nonetheless, it should be also noted that modifying and sustaining a behavior need appropriate training over time and providing suitable conditions for healthy behavior stability. The results are consistent with the results of other studies, such as Okuhara *et al*., Mohammadi *et al*., and Soltani *et al*.[32,36,37]

Our results also revealed a decrease in the mean scores of response costs and rewards after the educational intervention in the intervention group. These results are in line with those of the study Mohammdi *et al*. This indicates that women, after reducing perceived barriers (financial cost), increased their motivation to engage in preventive behavior.[32] These results are in line with those of the study conducted by Thrul *et al*., showing that adolescents' motivation to adopt smoking-preventive behaviors would increase as a result of understanding the barriers and reducing the costs.[33] Our results are also consistent with those obtained by Maseudi *et al*. reporting the effectiveness of reduced response cost in increasing the intention to adopt skin cancer-preventive behaviors in students following education.[38]

The results also indicated that students' understanding of the ineffectiveness of perceived barriers (i.e., time and financial cost) in preventive behaviors makes them more motivated to adopt these measures. Moreover, it was revealed that receiving less internal and external rewards for maladaptive behaviors (i.e., nonprevention) leads to a higher possibility of preventive behavior execution.

In the present study, it was aimed to familiarize the students with the risk factors leading to adopting risky behaviors resulting in osteoporosis development to motivate this group to refrain from such behaviors, thereby protecting them against this disease. Based on the results of the current study, a significant difference was observed in the mean score of fear in the intervention group, compared to that in the control group after the intervention.

Khiyali *et al*. revealed that by increasing fear, women's motivation and intention to perform Pap smear as a preventive measure of cervical cancer would increase.[39] In another study carried out by Maseudi *et al*., it was shown that the increased fear in students enhanced their intention of adopting protective behaviors with regard to sunlight exposure.[38]

According to the studies, as soon as students feel threatened with a harmful vulnerable health threat, they develop a fear of getting sick. As a result, they feel capable of and motivated to modifying the suggested improper behaviors. In the present study, the findings indicated a significant increase in the mean score of protection motivation in the intervention group following the educational intervention. This finding was indicative of the effectiveness of this theory in preventing osteoporosis in the intervention group. It should be noted that the results of this study are in agreement with those obtained by Morowatisharifabad *et al*.,[40], Hadi[21] and Maseudi *et al*.[38]

It was revealed that training osteoporosis-preventive behaviors (i.e., calcium intake, physical activity, and sunlight exposure) had a positive effect in the intervention group 2 months after the intervention. In this regard, the participants had low physical activity before the intervention; however, following the intervention, physical activity reached a moderate level in about half of the cases as a result of the increase in the perceived sensitivity.

These results are consistent with those obtained by Mousaviasl *et al*. and Mahmoodi *et al*., They reported an increase in the mean score of students' physical activity post intervention and an increase in physical activity behavior in women of reproductive age after a health belief model-based intervention in their studies.[13,27] Also Sanaeinasab *et al*. and Morseth *et al*. and Jeihooni *et al*.[41-43] reported that education had a significant effect on increasing physical activity behavior in students after intervention. Contrary to the findings of the present study, Kasper *et al*. reported an optimal level of physical activity in adolescents before the intervention.[24] The reason for this discrepancy could be the attitude toward physical activity and lack of equipped sports grounds for females.

The students investigated in this study could not have proper physical activities owing to the cultural differences and religious prejudices prevalent in the region under research despite their increased sensitivity toward this issue as a result of receiving education. The results of the current study showed a significant difference between the intervention and control groups in terms of sunlight exposure after the educational intervention. This finding is in line with the results of the studies investigating adolescents.[13,23]

In addition, although the calcium intake of three-quarters of the participants in the intervention group was at a highly unfavorable level before the intervention, due to the increase in mean self-efficacy, a favorable condition was observed in this variable in almost half of the participants after the intervention. This result is in line with that of Shobeiri *et al*. reporting an increase in calcium intake in women after the intervention.[25]

However, the results of the present study are not consistent with those obtained by Shojaeizadeh *et al*., revealing a decrease in calcium intake in the healthy participants 3 months after the implementation of the health belief model-based intervention.[44] The discrepancies among the results of studies are indicative of the involvement of various factors in the nutritional status, such as age (playing an important role in educability), economic and social status, and indigenousness of some diets. Finally, it can be concluded that education alone does not effectively change or maintain behavior. Therefore, it is vitally important to choose the right strategy for training life-preventing behaviors, especially for adolescents, which were considered in this study. This study is the selection of the minimum appropriate sample size to evaluate behavior change based on valid books. The results of this study can be effective in designing and implementing subsequent interventions to promote health, quality of life and prevent osteoporosis, which has been a silent epidemic of the present age. According to the important role of the family in promoting health through lifestyle changes, research can be conducted at the family level as the target community.

Limitation and suggestion

The limitations of the current study were the lack of long-term follow-up to determine the persistence of health behavior in students. Moreover, since the data were collected based on a self-administered questionnaire, the results would be effective in case the students have provided accurate answers. It is suggested for institutionalization behavioral changes in this age group; health and educational officials should design appropriate interventions and provide coherent planning to provide the students and their parents with persistent education inducing behavior modifications.

Conclusion

The results of the present study revealed that designing and implementing educational programs based on a health model (e.g., PMT) can have a significant effect on the level of students' knowledge and performance. Accordingly, following the educational course, the students understood the severity and sensitivity of the issue and decreased financial and nonfinancial costs (i.e., time and effort) and maladaptive behavior rewards. Moreover, they witnessed an increase in their confidence and ability level to adopt preventive behaviors. As a result, they attained enhanced motivation to perform self-care behaviors and preventive strategies. Nevertheless, given the short-term persistence of the effect of education (disappearing after a few months), to institutionalize behavioral changes in this age group, health and educational officials should design appropriate interventions and provide coherent planning to provide the students and their parents with persistent education inducing behavior modifications.

Acknowledgments

This article was derived from a master's thesis of midwifery of Zahedan University of Medical Sciences. The authors, hereby, extend their gratitude to the Vice-Chancellor's Office for Research and the School of Nursing and Midwifery at Zahedan University of Medical Sciences, the District Department of Education, and the school heads, teachers, and students who helped conduct this study sincerely contributed to this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Moradnejad S, Montazeri A, Sadeghi R, Tol A, Yekaninejad MS, Mohebbi B. The effectiveness of educational intervention to improve health promoting behavior on prevention of osteoporosis among women: Application of BASNEF model. J Hayat 2020;26:309-326.
2. El-Tawab SS, Saba EK, Elweshahi HM, Ashry MH. Knowledge of osteoporosis among women in Alexandria (Egypt): A community based survey. J Egypt Rheumatol 2016;38:225-231.
3. Schneyer CR, Lopez H, Concannon M, Hochberg MC. Assessing population risk for postmenopausal osteoporosis: A new strategy using data from the Behavioral Risk Factor Surveillance System (BRFSS). J Bone Miner Res 2008;23:151-158.
4. Pietschmann P, Mechtcheriakova D, Meshcheryakova A, Föger-Samwald U. Immunology of osteoporosis: A mini-review. Gerontology 2016;62:128-137.
5. Larijani B, Tehrani MM, Hamidi Z, Soltani A, Pajouhi M. Osteoporosis, global and Iranian aspects. Iran J Public Health 2004;33:1-17.
6. Chan CY, Mohamed N, Ima-Nirwana S, Chin KY. A review of knowledge, belief and practice regarding osteoporosis among

adolescents and young adults. Int J Environ Res Public Health 2018;15:17-27
7. Sharifi N, Majlessi F. Self-empowerment of female students in prevention of osteoporosis. Glob J Health Sci 2016;9:7
8. Afrasiabi S, Gashmard R, Malchi F, Rabiee Z, Bagherzadeh R, Hosein Nezhad A, *et al*. Evaluation of knowledge, attitude and performance of high school girls about osteoporosis in 2011. Iran J Obstet Gynaecol Infertil 2016; 18:20-28.
9. Lau EM. The epidemiology of osteoporosis in Asia. Inter Bone Mineral Soci 2009;6:190-193.
10. Ghaffari M, Tavassoli E, Esmaillzadeh A, Hasanzadeh A. The effect of education based on health belief model on the improvement of osteoporosis preventive nutritional behaviors of second grade middle school girls in Isfahan. Health Serv Res 2011;6:714-23.
11. Sahib M. Psychometric properties and assessment of the Osteoporosis Health Belief Scale among the general Arabic population. Patient Prefer Adherence 2018;12:223-232.
12. Zhang YP, Xia RY, Zhang B, Zhang F, Zhao XS, Zhang LL, *et al*. Gender differences on osteoporosis health beliefs and related behaviors in non-academic community Chinese. J Community Health 2014;39:545-551.
13. Mousaviasl S, Alijani Renani H, Gheibizadeh M, Saki Malehi A. The effect of education based on the health belief model onosteoporosis prevention behaviors in female high school students. Jundishapur J Chronic Dis Care 2016;5.
14. Afifi M. Anemia in pregnancy at south sharqiya health centers, Oman. J Egypt Public Health Assoc 2003;78:39-54.
15. Babatunde OT, Himburg SP, Newman FL, Campa A, Dixon Z. Theory-driven intervention improves calcium intake, osteoporosis knowledge, and self-efficacy in community-dwelling older Black adults. J Nutr Educ Behav 2011;43:434-440.
16. Glanz K, Rimer BK, Viswanath K. Health Behavior and Health Education: Theory, Research, and Practice. US John Wiley & Sons; 2008.
17. El Dib R, Silva EM, Morais JF, Trevisani VF. Prevalence of high frequency hearing loss consistent with noise exposure among people working with sound systems and general population in Brazil: A cross-sectional study. BMC Public Health 2008;8:151.
18. Cismaru M. Using Protection Motivation Theory to Increase the Persuasiveness of Public Service Communications; SIPP Public Policy Paper 2006.
19. Helmes AW. Application of the protection motivation theory to genetic testing for breast cancer risk. Prev Med 2002;35:453-462.
20. Hodgkins S, Orbell S. Can protection motivation theory predict behaviour? A longitudinal test exploring the role of previous behaviour. J Psychol Health 1998;13:237-50.
21. Hadi L, Morowatisharifabad M , Fallahzadeh H. Study of determinants of lung cancer protective behaviors in Esfahan steel company workers based on protection motivation theory J TOLOO E BEHDASHT. 2015;16:67-80.
22. Menshadi F, Azari A, Kuhpayeh Zadeh J, Ghasemi M. Knowledge, attitude and practice of osteoporosis among a group of Iranian adolescent females. J Modern Rehabilit 2009;2:47-54.
23. Hossien YE, Tork H, El-Sabeely AA. Osteoporosis knowledge among female adolescents in Egypt. Am J Nurs 2014;3:13-17.
24. Kasper MJ, Garber M, Walsdorf K. Osteoporosis knowledge and beliefs in college females. J Med Sci Sports Exerc 2006;38:52-53.
25. Shobeiri F, Hesami E, Khodakarami B, Soltanian A. Effect of counseling on preventive behaviors of osteoporosis in women referred to health centers in Hamedan, Iran in 2015. J Educ Community Health 2014;2:51-57.
26. Seyd Abadi Z, Mohammadi M, Mehri A, Akrami R. Development and psychometric assessment of nutritional preventive treatment of osteoporosis in women based on protection motivation theory. Sci J Ilam Uni Med Sci 2017;25:24-33.
27. Mahmoodi M, Salehi L. To evaluate of efficacy of education based on health belief model on knowledge, attitude and practice among women with low socioeconomic status regarding osteoporosis prevention. Iran J Epidemiol 2011;7:30-37.
28. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, *et al*. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-1395.
29. Moghaddam MB, Aghdam FB, Jafarabadi MA, Allahverdipour H, Nikookheslat SD, Safarpour S. The Iranian version of international physical activity questionnaire (IPAQ) in Iran: Content and construct validity, factor structure, internal consistency and stability. World Appl Sci J 2012;18:1073-1080.
30. Horan M, Kim K, Gendler P, Froman R, Patel M. Development and evaluation of the Osteoporosis Self-Efficacy Scale. Res Nurs Health j 1998;21:395-403.
31. Gammage KL, Francoeur C, Mack DE, Klentrou P. Osteoporosis health beliefs and knowledge in college students: The role of dietary restraint. Eat Behav 2009;10:65-67.
32. Mohammadi M, Mehri A, Hashemian M, Abadi ZS, Mohammadi S. Investigating the effect of educational intervention based on protection motivation theory on osteoporosis preventive nutritional behaviors in women of reproductive age referring to Healthcare Centers in Sabzevar, Iran. bjms 2020;19:254-261.
33. Thrul J, Stemmler M, Bühler A, Kuntsche E. Adolescents' protection motivation and smoking behaviour. Health Educ Res 2013; 28:683-691.
34. Ansari MA, Gharlipour Z, Mohebi S, Sharifirad GR, Rahbar A. Effect of education based on the protection motivation theory on preventive behaviors of influenza A among high school students in Qom City. qmusj 2019;13:22-33.
35. Karimy M, Gallali M, Niknami S, Aminshokravi F, Tavafian S. The effect of health education program based on Health Belief Model on the performance of Pap smear test among women referring to health care centers in Zarandieh. Jahrom Med J 2012;10:53-59.
36. Okuhara T, Okada H, Kiuchi T. Predictors of staying at home during the COVID-19 pandemic and social lockdown based on protection motivation theory: A cross-sectional study in Japan. Healthcare (Basel) 2020;8:1-23.
37. Soltani N, Tahmasebi R, Haghighatjoo S, Noroozi A. Effective factors of seat-belt use in front seat passenger on urban trips of bushehr: Application of protection motivation theory. ijhehp 2019;7:220-230.
38. Maseudi GR, Hosseini EO, Mirzaei R, Shahrakipour M, Hosseini SA. The effect of education based on protection motivation theory on the harmful effects of solar rays on male students. J Health Educ Health Promo 2015;2:322-330.
39. Khiyali Z, Ghahremani L, Kaveh MH, Keshavarzi S. The effect of an educational program based on protection motivation theory on pap smear screening behavior among women referring to health centers in Fasa. J Educ Community Health 2017;3:31-37.
40. Morowatishari fabad M, Abdolkarimi M, Asadpour M, Fathollahi MS, Balaee P. The predictive effects of protection motivation theory on intention and behaviour of physical activity in patients with type 2 diabetes. Open Access Maced J Med Sci 2018;6:709-714.
41. Morseth B, Emaus N, Jørgensen L. Physical activity and bone: The importance of the various mechanical stimuli for bone mineral density. A review. Norsk Epidemiol 2011;20:173-178.
42. Sanaeinasab H, Tavakoli R, Karimizarchi A, Amini ZH, Farokhian A, *et al*. The effectiveness of education using the health belief model in preventing osteoporosis among female students. East Mediterr Health J 2014;19 Suppl 3:S38-44.
43. Jeihooni AK, Askari A, Kashfi SM, Khiyali Z, Kashfi SH, Safari O, *et al*. Application of health belief model in prevention of osteoporosis among primary school girl students. Int J Pediatr 2017;5:6017-6029.
44. Shojaeizadeh D, Asadi M, Lashgarara B. Application of health belief model in prevention of osteoporosis in volunteers of Khorramabad city health centers, Iran. J Health Serv Res 2012;8:183-192.