



## ORIGINAL RESEARCH PAPER

# Application of the Health Belief Model for Osteoporosis Prevention among Middle School Girl Students, Garmsar, Iran

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## A B S T R A C T

**Introduction:** Osteoporosis is a serious metabolic bone disorder that often results in hip fracture and is usually asymptomatic in its initial stages. Since the majority of bone formation occurs during childhood and adolescence, it is important to begin primary prevention at an early age, although the optimal way for instilling this preventive behavior in youth has not yet been defined. The purpose of this study was to assess the effectiveness of a health education intervention based on the Health Belief Model (HBM) in reducing the risk of osteoporosis development in female adolescents.

**Methods:** The study population consisted of 206 female students from the middle schools of the city of Garmsar, Iran. The students were randomly assigned to one of three groups. Students in Group I, the experimental group, participated in two health education sessions of one hour, based on components of the HBM. Students in Group II took part in the traditional didactic health education curriculum on osteoporosis. Group III students had no specific educational program for osteoporosis prevention. Data were collected at three points: before the intervention, immediately after the intervention, and one month after the intervention. The data-gathering instrument was a validated and reliable questionnaire (67 questions) that was developed based on the following HBM domains: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and health behavior action for osteoporosis prevention).



**Results:** Group 1's pre-tests, post- tests and one month follow up tests revealed a significant increase in the students' mean scores in the domains of knowledge (about osteoporosis) ( $p<0.001$ ), perceived susceptibility ( $p<0.001$ ), perceived severity ( $p<0.001$ ), and perceived benefits of reducing risk factors ( $p<0.001$ ), as well as taking health action ( $p<0.001$ ). The mean scores of Group II only improved significantly in the domains of knowledge and perceived susceptibility ( $p<0.001$ ). Group III showed no significant changes.

**Discussion and Conclusion:** The findings of this study support the feasibility of a health education program based on HBM to induce behavior change for osteoporosis prevention in middle school females.

**Key words:** Health Belief Model, middle school girl students, osteoporosis prevention, health education program

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## Introduction

Osteoporosis is a clinically-silent disease in its early stages. It can lead to hip and spine fractures later in life. According to the National Osteoporosis Association of America in 1999, 28.5 million people in the U.S., of whom 89% are women, had osteoporosis in the USA. Also, 10 million people in the U.S. were categorized as having low bone mass, exposing them to the risk of osteoporosis and osteopenia (Mark & Link, 1999; National Osteoporosis Foundation, 2006).

There are no specific statistics in Iran about the prevalence of osteopenia, osteoporosis and related fractures (Gharibdoust, 2003; Larijani et al., 2005). However, Larijani, in a 2005 study of osteoporosis rates in Iran, reported an estimated 7 million of the 70 million people in Iran were at risk for fractures. Also, the Research Center for Endocrinology and Metabolism of the Tehran University reported that in the subgroup of people who are more than 50 years old, 70% of the women and 50% of the men are suffering from osteoporosis or osteopenia (Larijani, 2005).

Since bone density decreases with age, special consideration should be given to preventing this disease. Prevention of osteoporosis can be implemented at any age. However, because 40 to 45% of bone mass develops in early adulthood, prevention is most effective if done in childhood and adolescence (American Academy of Orthopedic Surgeons, 2004; Madhoo et al., 2007.; Weaver, 2000). In addition, if people develop and commit to lifestyles that support strong bones when they are adolescents or young adults, they increase the likelihood that they will have healthy bones throughout their lives (Bachrach, 2001).

Measures, such as high calcium diet and exercise among adolescents, have been very effective in preventing osteoporosis, particularly among women (Madhoo et al., n.d.; Pfister, 1993; Galler & Derman, 2001). If people develop and commit to lifestyles that support strong bones when they are adolescents or young adults, they increase the likelihood that they will have healthy bones throughout their lives (Bachrach, 2001). However, helping young people develop a healthy lifestyle is a major challenge.

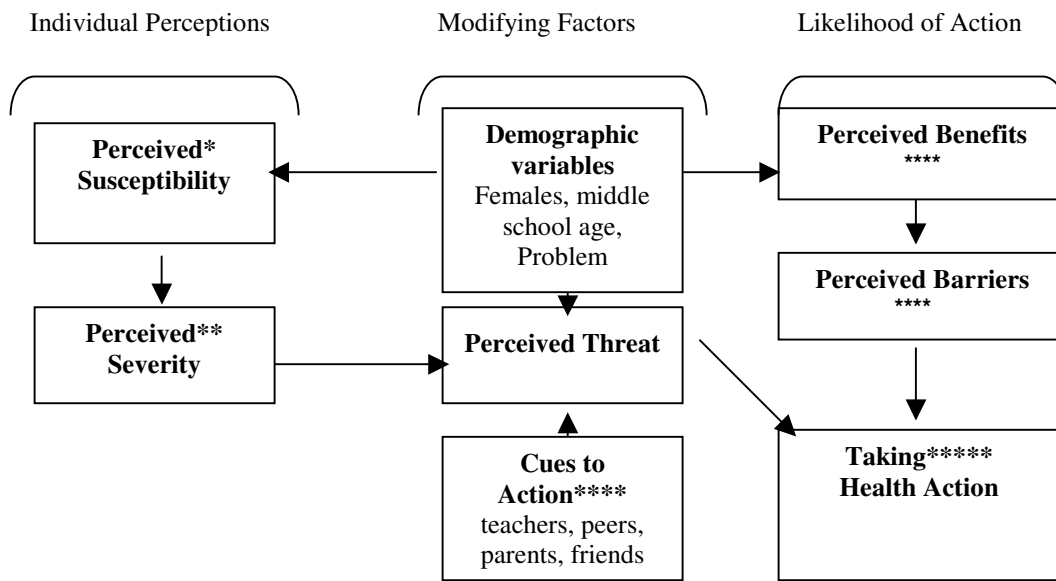
The Health Belief Model (HBM) is one of the most widely used frameworks for trying to understand health behavior. Developed in the 1950s by Godfrey Hochbaum, (1958) and Irwin Rosenstock (1974), and Rosenstock & Kirscht (1974), the model has been used successfully for many decades to promote health behaviors such as seat belt use and the use of health screening (Becker, 1974; Heidarinia, 2002). HBM is based on the premise that people are most likely to take health-related action (e.g., eat a healthy diet), if they feel that by doing so they can avoid a negative health condition. The model asserts that to plan a successful educational intervention, the individual or group's perceived susceptibility (e.g., to osteoporosis); perceived severity of the condition and its



consequences; perceived benefits in taking certain actions to reduce risk; perceived barriers (e.g., costs of the advised action) and cues to action (strategies for activating the “readiness” to undertake health actions) are required.

HBM is based on the domains of perceived susceptibility (to disease), perceived severity, perceived threat, perceived barriers, perceived benefits, cues to action and health action (Becker, 1974). Knowledge of all of these factors is believed to be vital to the planning process for successful educational interventions (Figure 1). The HBM framework was developed in the 1950s by Hochbaum (1958 & 1992), and Rosenstock (1974 & 1991) as a model for health educators. Use of this model has resulted in effective programs in which individuals experienced changes in beliefs of individuals that lead to an increase in healthy behaviors (Heidarinia, 2002; Becker, 1974).

This paper describes the results of a study that examines whether the application of the HBM can be used effectively to change the perception of middle school girls about their risk for developing osteoporosis and lead to a change in behavior for prevention of this disease later in life.



- \***Perceived Susceptibility:** students' belief that they are susceptible to osteoporosis when they have an inactive lifestyle.
- \*\***Perceived Severity of osteoporosis:** Knowledge and beliefs of the consequences of having osteoporosis, including bone fractures and disability.
- \*\*\***Cues to Action:** Advice from family members and friends, encouragement of students by teachers, and group discussion and workshops on the subject of osteoporosis.
- \*\*\*\***Perceived Benefits and Barriers:** Improvement of musculoskeletal strength, the possession of good self-esteem and a sense of well being, and prevention of low back pain and obesity.
- \*\*\*\*\* **Taking Health Action:** Increasing nutritional intake of calcium, engaging in routine physical activity, and ensuring that there is sufficient routine exposure to sunlight to prevent osteoporosis.

**Figure 1- Theoretical model of relationships using the Health Belief Model**



## Methods

Two-hundred-and-six (206) second form middle school female students from all nine middle schools in the city of Garmsar, Iran, participated in this experimental study. Each of the nine classes was randomized to one of three equal-sized groups.

During a two-week period, students in Group I (N=76), the HBM Group, received two one-hour-long educational intervention sessions based on the HBM conceptual framework process (Figure 1). According to this model, the health education planning included goals and objectives based on Individual Perceptions (perceived susceptibility and severity), Modifying Factors (perceived threat and cues to action), and Likelihood of Action (perceived benefits and barriers and taking health action) that influenced osteoporosis preventive behavior among the students (Becker, 1974). The educational methods used included short lectures, slide shows, group discussion and role-playing activities designed by the investigators and school administrators. In order to create a teachable moment and a "perceived threat", a 42 year-old female volunteer with osteoporosis, who had experienced 2 bone fractures as a result of the disease, participated in the group discussion. She described her unhealthy habits related to nutrition and physical activity that might have contributed to her condition. The teaching materials (a poster, a booklet, and a pamphlet) were based on the pre-test data analysis of the students' needs.

Students in Group II (N=60), the Traditional Education Group, received the traditional, mostly didactic health education curriculum on osteoporosis routinely offered to middle school students in this region. Researchers were present at these educational sessions to document the use of the routine pedagogical methods. Students in Group III (N=60), the Control Group, did not have an educational intervention related to osteoporosis prevention.

The study was conducted after human subject approval was obtained. The data gathering instrument was a two-part questionnaire; one part was used to obtain the demographic characteristics of the participants and the other to determine responses to questions organized by the domains of the HBM: knowledge, perceived threat (perceived susceptibility and perceived severity), benefits, barriers, cues to action, and healthy behavior action for osteoporosis prevention.

The reliability test-retest coefficient on second-form students for the questionnaire was 0.77. The content validity of the questionnaire was determined by a panel of reviewers consisting of college professors in health education. Nineteen (19) multiple-choice questions were used to assess students' knowledge. Fourteen (14) items were used to assess the students' perceived threat, that is, their perceived susceptibility to having osteoporosis and their perception of the severity of the condition. Response options were "absolutely yes", "no", and "do not know. To assess the students' perceptions of benefits and barriers students were asked to respond to 23 items. Response options were "yes" and "no". The students' behavior (taking health action) related to the osteoporosis prevention was assessed using 3 items (physical activity, intake of milk products, amount of exposure to sun. The criteria for taking health action were as follows: physical activities of 20 to 30 minutes duration, more than three times a week; drinking more than 2 glasses of milk or its products (daily calcium intake more than 1300 mg) per day by report; and experiencing more than 15 to 30 min. daily of direct exposure to the sun.

The students completed the questionnaires on three separate occasions (pre intervention, post intervention, and at one month follow-up) to evaluate the effectiveness of the educational interventional program. The students were informed that all data obtained from the questionnaires were to be used without personal identifiers and were, therefore, confidential. All questionnaire administrators and students were blinded to the conditions of this study.



The Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Descriptive statistics, including frequencies, percentages, measures of central tendency and variance were calculated for each item. Analysis of variance (ANOVA), *T*-test, and Kruskal-Wallis test were used to identify differences among the groups, pre- and post- test as well as comparing variables such as knowledge, perceived susceptibility and severity, perceived benefits and barriers and taking health action of three groups in pre, post and follow-up in each group.

## Results

In this study, 206 middle school female students from Garmsar with a mean age of 14.34 (SD=0.6) years fully cooperated with the researchers. Table 1 compares the 3 groups' mean scores in knowledge and in the HBM domains of perceived susceptibility, severity, barriers and benefits, immediately before, immediately after and one month after the intervention. The ANOVA test indicated that for each of the HBM domains the differences among the three groups were significant only at post and follow-up testing ( $p<0.001$ ). The mean scores of the Group I students improved significantly on post-test and follow-up testing across all five domains, compared with pretest scores. Group II students improved significantly in the domains of knowledge and perceived susceptibility, but not in the other three domains. For Group III, the control group, no significant changes were found between testing times.

Table 2 shows the health action taken related to the nutritional behavior of the three groups before, immediately after, and one month after the intervention. It appears that before intervention the nutritional behavior for the calcium intake among the groups could be classified primarily as "very poor" (calcium intake less than 650 mg) by self report (76.3%, 66.7% and 64.3 % respectively). After the intervention, the percentage of Group I students who remained in the "very poor" category of calcium intake declined significantly (to 26.3%). In contrast, 65.0% of Group II students and 67.1% of Group III students remained in the "very poor" category at the same testing points.

Table 3 shows that before the intervention there was no significant difference between the groups ( $p=0.22$ ) in terms of physical activity. At that time more than 42% of the students were in the "not acceptable" category defined as less than 20-30 minutes of physical activities fewer than three times per week. As a result of the intervention, the percentage of Group I students who had "acceptable" physical activity increased significantly (50%) compared with students in Groups II and III (21.7%, 31.4 % respectively). Also, one month after intervention, the regular physical activity of students in Group I (34.2%) was consistent compared to the regular physical activity of students in Groups II and III (15% and 27.1%).

Table 4 shows the health action taken for the sun exposure behavior of the three groups before, immediately after and one month after the intervention. Before the intervention, the sun exposure of the majority of the students (81.6% in Group I, 70% in Group II and 82.9% in Group III) was in the unacceptable category (weekly less than 15 to 30 minutes). After the intervention, the percentage of students in Group I who were in the "acceptable sun exposure" category increased significantly (from 9.2% to 26.3%) compared to the percentage of students in Groups II (from 10% to 6.7%) and Group III (from 7.1% to 2.9%) who were in the acceptable category. One month after the intervention a greater percentage of Group I students (11.8%) was in the acceptable category than were students in Group II (6.7%) and Group III (2.9%).

**Table 1: Comparison of means scorers of the students' knowledge and Perceived Susceptibility, Severity, Barriers and Benefits about osteoporosis in the 3 groups studied pre, post and follow up intervention.**

Health Belief Model (HBM) Components Variables	(HBM) Group *** N=76			Traditional Education Group ** N=60			Control Group N=70			ANOVA Test Results		
	Pre- test Mean (SD)	Post- test Mean (SD)	Follow up Test Mean (SD)	Pre- test Mean (SD)	Post- test Mean (SD)	Follow up Test Mean (SD)	Pre- test Mean (SD)	Post- test Mean (SD)	Follow up Test Mean (SD)	Pre- test p=	Post- test p=	Follow up Test p=
Knowledge	49.44 (13.59)	91.82 (8.48)	85.52 § (12.80)	47.71 (12.92)	59.91 ✕ (14.17)	55.96 Φ (15.16)	45.93 (13.16)	44.88 (12.24)	47.89 (14.28)	0.282	0.000*	0.000*
Perceived Susceptibility	65.71 (10.78)	93.49 (7.55)	85.59 § (12.80)	62.68 (13.06)	68.98 ✕ (14.54)	65.83 (15.67)	66.90 (13.29)	68.17 (13.23)	66.42 (13.78)	0.141	0.000*	0.000*
Perceived Severity	64.34 (19.27)	98.94 (4.18)	96.44 § (9.60)	65.16 (17.80)	66.33 (21.23)	62.66 (18.67)	62.71 (19.70)	64.57 (21.51)	63.57 (20.78)	0.752	0.000*	0.000*
Perceived Benefits	62.67 (32.88)	91.98 ✕ (19.86)	91.02 Φ (20.27)	51.51 (34.12)	56.66 (38.43)	53.63 (36.81)	61.81 (38.13)	59.74 (34.00)	62.07 (34.88)	0.132	0.000*	0.000*
Perceived Barriers	8.77 (12.38)	2.41 ✕ (6.20)	4.27 Φ (11.01)	12.08 (16.04)	10.22 (14.67)	12.63 (14.26)	9.4 (14.60)	10.23 (11.45)	10.11 (13.14)	0.378	0.000*	0.000*

\*= ANOVA test result: significant difference between the groups.

\*\*=ANOVA test result: significant difference between the pre-, post- and follow-up (p<0.05) only on knowledge and Perceived Susceptibility

\*\*\*= ANOVA test result: significant difference between the pre-, post- and follow-up (p<0.05) on all the HBM components variables

§: Tukey test result: significant difference between the pre- and post test; post test and follow-up; pretest, and follow-up (p<0.05).

✕: Tukey test result: significant difference between the pre and post test (p<0.05)

Φ: Tukey test result: significant difference between the pre and follow-up test (p<0.05)

**Table 2: Comparison of the students' taking nutrition behavioral action for osteoporosis prevention in the 3 groups studied during pre, post and follow up intervention.**



Time of measurement	Level of daily Ca <sup>++</sup> intake during the study	Health Belief Model Group** N=76		Traditional Education Group N=60		Control Group N=70		Kruskal-Wallis test result p value
		n	%	n	%	n	%	
Before the intervention	Acceptable (A)	0	0	1	1.7	0	0	0.244
	Almost acceptable (AA)	18	23.7	19	31.7	25	35.7	
	Not acceptable (NA)	58	76.3	40	66.7	45	64.3	
After the intervention	Acceptable (A)	7	9.2	1	1.7	0	0	0.000*
	Almost acceptable (AA)	49	64.5	20	33.3	23	32.9	
	Not acceptable (NA)	20	26.3	39	65.0	47	67.1	
One month after the intervention	Acceptable (A)	3	3.9	1	1.7	1	1.4	0.002*
	Almost acceptable (AA)	38	50	16	26.7	20	28.6	
	Not acceptable (NA)	25	46.1	43	71.7	49	70	

\*=significant difference between the groups

\*\*=Freidman test result: significant difference between the Pre, post and follow-up

A: daily Ca intake more that 1300 mg

AA: daily Ca intake between 650 to 1300 mg

NA: daily Ca intake less that 650 mg

**Table 3: Comparison of the students' taking physical activity behavioral action for osteoporosis prevention in the 3 groups studied during pre, post and follow up intervention.**

Time of measurement	Level of students weekly physical activity	Health Belief Model Group** N=76		Traditional Education Group N=60		Control Group N=70		Kruskal-Wallis test result p- value
		n	%	n	%	n	%	
Before the intervention	Acceptable (A)	20	26.3	15	25	23	32.9	0.220
	Almost acceptable (AA)	18	23.7	9	15	17	24.3	
	Not acceptable (NA)	38	50	36	60	30	42.9	
After the intervention	Acceptable (A)	38	50	13	21.7	22	31.4	0.001*
	Almost acceptable (AA)	28	36.8	16	26.7	15	21.4	
	Not acceptable (NA)	10	13.2	31	51.7	33	47.1	
One month after the intervention	Acceptable (A)	26	34.2	9	15	19	27.1	0.001*
	Almost acceptable (AA)	36	47.4	21	35	17	24.3	
	Not acceptable (NA)	14	18.4	30	50	34	48.6	

\*=significant difference between the groups

\*\*=Freidman test result: significant difference between the pre-, post -and follow-up

A: 20 to 30 min. exercising, more than three times a week

AA: 20 to 30 min. exercising, three times a week

NA: 20 to 30 min. exercising, less than three times a week



**Table 4: Comparison of the students' taking expose to the sun behavioral action for osteoporosis prevention in the 3 groups studied during pre, post and follow up intervention**

Time of measurement	Level of students' exposure to the sun	Health Belief Model Group** N=76		Traditional Education Group N=60		Control Group N=70		Kruskal-Wallis test result
		n	%	n	%	n	%	p - value
Before the intervention	Acceptable (A)	7	9.2	6	10	5	7.1	0.188
	Almost acceptable (AA)	7	9.2	12	20	7	10	
	Not acceptable (NA)	62	81.6	42	70	58	82.9	
After the intervention	Acceptable (A)	20	26.3	4	6.7	2	2.9	0.001
	Almost acceptable (AA)	18	23.7	11	18.3	6	8.6	
	Not acceptable (NA)	38	50	45	75	62	88.6	
One month after the intervention	Acceptable (A)	9	11.8	4	6.7	2	2.9	0.005
	Almost acceptable (AA)	19	25	9	15	8	11.4	
	Not acceptable (NA)	48	63.2	47	78.3	60	85.7	

\*=significant difference between the groups

\*\*=Freidman test result: significant difference between the pre-, post- and follow-up

A: daily 15 to 30 min. expose to the sun

AA: weekly 15 to 30 min. expose to the sun

NA: weekly less than 15 to 30 min. expose to the sun

# Discussion

In this study a health education program based on the HBM appears to have been more effective in changing the behaviors of female adolescents to reduce risk for osteoporosis than was traditional didactic health education or “no” education about osteoporosis prevention. The results of the study showed that prior to the intervention, all elements of HBM were below average in the three groups. After the intervention, students in Group I showed significant improvement for all three types of behavior assessed, students in Group II showed a slight improvement in these behaviors, while students in Group III showed no improvement. This supports our hypothesis that a health education program based on the HBM combined with non traditional pedagogic methods for teaching, can be effective in promoting the adoption of behaviors by adolescent girls to prevent osteoporosis.

Knowledge and perceived susceptibility to disease are considered to be motivating factors for behavior change (Abood et al., 2003). In a 2004 study on 1065 women of 16 to 72 years of age, Drozdowska et al. found that 50% of the study population believed that osteoporosis was a minor health problem and 53% thought it was a curable disease (2004). In another study on 60 women aged 18 to 25, 14% thought that they were not at a risk of osteoporosis and 65% thought osteoporosis was a disease of women only more than 70 years of age (Madhoo et al., n.d.). These results are consistent with the perceptions of students in our study at the time of the pretest. It suggests that the students did not engage in prevention behavior because of lack of knowledge of the consequences of failing to act or lack of “perceived susceptibility” to the disease.

Many young females from a variety of cultures have low calcium intake (Barr, 1994). The majority of students (more than 76%) in our study admitted that they ingested less than 670 mg of calcium daily before the study intervention. After the intervention, 50% (a total of 74% of the students) of the students in Group I increased their calcium intake to between 650 and 1300 mg of calcium daily. One month later 54% of the students in Group I had contained to keep their calcium intake at this level. Again, these results suggest that behavioral change (increased ingestion of calcium in the diet) is related to greater knowledge and perceived susceptibility to disease (osteoporosis).

A study conducted by Kelishadi and colleagues in 2001 in Isfahan, Iran, targeting middle and high school students, showed that most of the girls did not have suitable physical activity, consistent with our pretest findings. More than 42% of the girls in our study had less than 20 to 30 minutes of physical activity three times a week before intervention. After the intervention, the number of students in Group I who averaged at least 20-30 minute-periods of exercise per week increased from 50 % to 89%. In addition to demonstrating the effectiveness of the intervention, these findings also suggest that on a policy level, the two hours a week of physical education currently offered in middle schools in Iran are not providing sufficient physical activity for these students to meet the needs for osteoporosis prevention.

Our study is unique in that it assessed self reports of three types of disease prevention before and after three different educational interventions, across five domains of the HBM. In our study, we used all components of HBM (perceived susceptibility, severity, benefits, and barriers) to better understand the components of the process of changing behavior to prevent disease and how educational interventions can influence each of these components. As a result of this study, we postulate that all components of the HBM are equally essential to inducing behavior change.

There were several limitations to this study. First, the same questionnaire was used on each of the three testing points, thus possibly impacting the test validity. Second, the way in which we assigned interventions to the different groups could have impacted the internal and external validity of the study design, and ultimately biased our evaluation. One further limitation includes the fact that there is no longitudinal follow-up and students were tested only one month after the intervention.

It is paradoxical that, as health researchers and educators become increasingly aware of the importance of good habits in nutrition and physical activity in the prevention of a variety of chronic diseases, children and adolescents are adopting lifestyles that act



counter to these. Diets in many developing as well as industrialized countries are moving towards foods that are poor in calcium and minerals, and children gravitate to television and computer games in place of outdoor games and sports. In order to reverse this trend, it is necessary to actively promote healthy behaviors and lifestyles to adolescents. School health education programs are critical opportunities for facilitating healthy lifestyles for youth. The HBM is one approach to school health education that is effective in producing at least short-term behavior change in efforts to prevent osteoporosis. Further studies to assess whether or not this educational approach leads to sustained behavioral change are warranted.

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