Interactive Multimedia Training in Osteoporosis Prevention of Female High School Students: An Interventional Study

Ladan Zarshenas[1], Tala Keshavarz[2], Marzieh Momennasab[3], and Nahid Zarifsanaiey[4]

[1] *Department of Nursing, Community Based Psychiatric Care Research Center, Shiraz University of Medical Sciences, Shiraz, Iran*

[2] *Department of Nursing, School of Nursing and Midwifery, Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran*

[3] *Department of Nursing, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran*

[4] *Department of E-Learning, Virtual School, Center of Excellence for E-Learning in Medical Sciences, Shiraz University of Medical Sciences, Shiraz, Iran*

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Abstract- Given the limitations of traditional teaching methods in the learning process of adolescents, this study was designed to investigate the effects of osteoporosis prevention training through interactive multimedia method on the degree of knowledge and self-efficacy of female high school students. In this interventional study which was conducted in 2016 in Fars province, Iran, 120 high school students were selected through proportional stratified sampling from schools and different classes at first, second, third, and pre-university grades. The participants were randomly divided into two groups, each containing 60 students. Educational interventions for the test group included an interactive multimedia CD, and for the control group was an educational booklet. Before and one month after the intervention the students' level of knowledge and self-efficacy was measured. The spss 19 statistical software was used, and descriptive and analytical tests were performed to analyze the data. Results showed a significant difference in self-efficacy scores after the intervention (P=0.012) with the test group obtained a higher self-efficacy score than the control group. Also, a significant increase was observed in the knowledge score of both groups after the training (P<0.001), but the knowledge score between the two groups was not statistically significant (P=0.38) after the intervention. The use of new training methods like interactive multimedia CD for public education, particular adolescents about health and hygiene is recommended.

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Keywords: Osteoporosis; Interactive multimedia training; Interventional study

Introduction

Osteoporosis is one of the fastest growing health problems in the world (1). It is estimated that every three seconds a fracture caused by osteoporosis occurs in the world (2). Statistics show that about 10 million people in America and 34 million Americans suffer from bone loss (3). This figure is expected to reach 61 million people in 2020 (4). Global prevalence of low bone density during the twenty years from 1990-2010, has become almost two-fold and decreased bone density is nearly the third source of deaths caused falling in the world (5). Bone loss among Iranians over 30 years is a growing health problem (6). In 2001, about 15% of Iran's population suffered from osteoporosis, but the percent increased to 34% in 2011. Also, 40% of Iranian women and 20% of Iranian men over 50 years old suffer from osteoporosis (7).

Seventy-five to eighty-five percent of bone formation starts with the onset of sexual maturation during adolescence, and women reach the of peak bone mass between 20-30 years of age (8). Maximum bone density in women is less than that with men, so with age; women are at greater risk of osteoporosis (9). The daily requirement of calcium is 1,300 mg per day during adolescence while teenagers, especially teenage girls do not consume enough daily calcium. Based on the primary prevention of osteoporosis, more focus should be on women, particularly teenage girls because they are at the age of bone growth and development (10).

According to the latest census in Iran, adolescents (aged 11-19 years) constitute about 12 million of the

Corresponding Author: M. Momennasab
Department of Nursing, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran
Tel: +98 71 36474252, Fax: +98 713 6474252, E-mail address: momennasab@sums.ac.ir

country's population (11).

Adolescence is a critical period in which many poor or inappropriate health behaviors in adulthood are rooted; therefore, it is important to pay attention to adolescents' health programs as the target population in health programs (12). This issue is of high importance because health and non-health behaviors shape and sustain during the adolescent period, and in general, learnability is one of the main features of this period (13). Results of Amin *et al*.,'s (2014) study showed the positive effect of training on increasing and improving knowledge, attitudes, and attention to nutritional behaviors of students in osteoporosis prevention (14).

Traditional teaching methods encourage passive learning, do not take students' individual differences and needs into consideration, and do not pay attention to problem-solving, creative thinking and other higher level cognitive skills (15,16). Therefore, many experts have stressed the need to change or supplement traditional teaching methods (17).

E-learning is an emerging approach which has overcome some of the barriers to traditional education and provides easy and flexible access to learning (18). At present, e-learning programs are based on the dynamic evaluative method in way that they make students aware of their different types of errors and encourage them to assess their own progress. Some benefits of educational multimedia include the use of multiple senses, providing sufficient examples and videos, the possibility of increasing learners' participation in the learning process, and the possibility of repeating and practicing according to individual differences until mastery is achieved (19). In several studies, the level of adolescent girls' knowledge about osteoporosis and lifestyle in order to prevent from this disease has been low (20-22). Some other studies also suggest that increased knowledge is the key to osteoporosis prevention in adolescents (23).

Given the limitations of traditional teaching methods in the learning process of adolescents as well as the importance of training health beliefs in this age period, this study examines the effects of osteoporosis prevention education by the interactive multimedia method and educational booklet on the level of knowledge and self-efficacy of the female high school students.

Materials and Methods

This is a completely randomized experimental study with a pretest-posttest design. The sample of the study included 120 female high school students in Bavanat city in Fars province located in southern Iran during 2016 academic year, selected through stratified random sampling from different classes at first, second, third, and pre-university grades. At first, schools are allocated to two test and control groups at random with 60 students in each group. The inclusion criteria had no known physical and mental illness, desire to participate in the study, familiarity and ability to work with computer, and the possibility of using CDs. On the other hand, the exclusion criteria were students' or parents' unwillingness to continue participating in the study and having experience of participating in training programs on the osteoporosis prevention.

Data collection procedure included a demographic information form, HBKQ and self-efficacy questionnaires related to osteoporosis prevention. Demographic form aimed to elicit information about age, education level of the participants and their parents, parental occupation, the number of siblings, and the family history of osteoporosis. The Healthy Bones Knowledge Questionnaire designed by Martin *et al*., contains 33 multiple-choice questions with 17 questions related to risk factors and 16 questions related to two main methods of osteoporosis prevention (calcium intake and exercising). One point is given for each correct answer. The questionnaire has a total score of 33. The reliability of the questionnaire assessed through Cronbach's Alpha was reported 0.88 by Martin *et al*., The validity of the questionnaire was also confirmed by factor analysis (24). The content and face validity of the Persian version of the questionnaire in Pour Namdar *et al*.,'s study was approved by experts, and the test-retest correlation coefficient of the questionnaire was reported as 0.84 (25).

Osteoporosis self-efficacy scale is proposed by Horan *et al*., (26) and includes two sub-categories: variables related to sports (10 questions) and variables related to calcium intake (11 questions) which measures individuals' performance in osteoporosis prevention. Each question has a Visual Analogue Scale which is exactly 100 mm in length is scored from 0 (not certain at all) to 100 (completely certain), and the scores between 0 and 100 will change per question, so the self-efficacy is obtained from the average of responses to all questions. The range of score is shown by percent and changes between the ranges of 0-100. The higher the student's score is the better performance s/he has in osteoporosis prevention (26). Cronbach's alpha coefficient of the questionnaire was based on Hutchison *et al*.,'s study was 0.94 in exercise variables subset and

0.93 in calcium consumption variables subset. The validity of the analysis was examined through factor analysis and hierarchical regression analysis (27). Cronbach's alpha coefficient of this instrument was reported 0.9 in Swaim *et al.*,'s (2008) study (28). The content and face validity of the Persian version of the questionnaire was measured and confirmed by six faculty members in two ways: content validity was reviewed and approved, and the reliability of the instrument measured by Cronbach's alpha was reported 0.7 (29).

After receiving approval from the Vice Chancellor for Research and Ethics Committee of the University, required arrangements were made with the Educational administration of Fars province. Then, the researcher started to develop appropriate content related to osteoporosis using library browsing and valid domestic and international papers. The instructional content included an introduction to osteoporosis, risk factors, benefits and barriers of calcium intake and exercise, foods with calcium and the amount of calcium needed for the body, and preventative measures to overcome osteoporosis. The researcher prepared the content of the interactive multimedia CD in collaboration with the Electronic center of the University. Accordingly, after designing and preparing the educational content by the researcher and its approval by scholar and teacher trainers of the research team, the contents were prepared according to the standard format set by the electronic center of the University to be produced (30). Thereafter, an appropriate scenario was designed on the basis of that by the researcher and was submitted to the electronic center of the University for the Production of the electronic content and evaluation. In all stages of the content production, evaluation was done by the university's Center of Excellence for E-learning. The multimedia CD was prepared in 15 interactive sections accompanied by audio, images and interesting animations, and included 9 tests with 2-3 questions. In the case of giving a correct answer to a question, the student will be guided to the next section, and in the absence of correct answers, it is possible to see the content again. In addition to providing the electronic content, a manual with the same content was designed and published.

After obtaining consent from the students, they were randomly placed into two groups. To prevent the exchange of information, students in the two groups were selected from different schools. In the test group, the electronic content was given to the students in the form of an interactive multimedia CD. Students in the control group were given a booklet about osteoporosis. Before the intervention and one month after receiving the educational content, the HBK and self-efficacy questionnaires were completed by the students. Data were analyzed using SPSS (19) by performing descriptive statistics (frequency distribution tables, mean and standard deviation) and inferential statistics (independent and paired t-test and chi-square analysis). Significant level acceptable was $P<.05$. The number of participants in this study were120 that reduced by 7% to 112 students of whom 56 students were in the group receiving the educational booklet and 56 students were in the group receiving the CD.

Ethical considerations

After obtaining permission from the University of Medical Sciences, Ethics Committee and Education administration of Fars province, sampling began from high schools in Bavanat. At the beginning of the training program, after introducing himself, the researcher explained to the students the aims of the study and the written consent was obtained from all the participants and their parents. Also, participants were assured that all information collected from them would remain confidential. After the end of the study, the control group was also given an interactive multimedia CD.

Results

The results of the demographic data showed that most of the students were second and third graders at high schools. The mean age (SD) of the students was 16.75 years (0.77) in the test group and 16.98 years (0.80) in the control group. Most of the students had no family history of osteoporosis. The majority of students had fathers with high school or lower diplomas, and also mothers were mostly housewives and had high school or lower diplomas (Table 1). By comparing the two groups by chi-square test, the Fisher test indicated a statistically significant difference in terms of the demographic characteristics before the intervention ($P>0.05$) suggesting that the two groups were similar in terms of their demographic characteristics. Similarly, the results of ANOVA test showed no significant relationship in the comparison of the demographic characteristics and HBK and self-efficacy scores.

The mean score of the self-efficacy scale in the educational booklet group increased from 106.08 (28.87) in the pretest to 120.73 (30.9) in the posttest. However, the mean scores in the CD group increased from 108.94 (35.199) to 130.48 (36.38). According to

the results of the paired t-test both educational methods significantly increased the self-efficacy scores (*P*=0.001) and also the independent t-test showed a significant difference between the two groups. (*P*=0.012). This means that training through the CD method improved students' self-efficacy scores more than the educational booklet (Table 2).

The mean scores of the HBK test scores in the control group increased from 11.37 (3.56) in the pretest to 21.34 (5.76) in the posttest. However, the mean scores in the CD group increased from 1.76 (3.70) in the pretest to 22.43 (7.26) in the posttest. According to the results of the paired t-test, both educational methods significantly increased the HBK scores (*P*=0.001) but the results of independent t-test did not show a significant difference between the two groups (*P*=0.086). This suggests that both training methods improved the students' HBK (Table 2).

Investigating the relationship between HBK and self-efficacy scores by Pearson correlation analysis showed a strong significant positive correlation between these scores (*P*=0.007). This means that with an increase (decrease) in the HBK score, the self-efficacy score also increases (decreases) (Table 4).

Table 1. Demographic characteristics of the participants of the study

		Test group	Control group	*P*
		No (%)	No (%)	
Education level of the participants	**Second**	23 (41.1)	20 (35.7)	0.57
	Third	23 (41.1)	20 (35.7)	
	Pre-university	10 (17.9)	16 (28.6)	
Education level of father	**Lower than high school diploma**	26 (46.5)	31 (55.4)	0.12
	High school diploma	15 (26.8)	15 (26.8)	
	Maste's degree or above	15 (26.8)	10 (17.9)	
Education level of mother	**Lower than high school diploma**	37 (66.1)	44 (78.5)	0.27
	High school diploma	18 (32.1)	10 (17.9)	
	Maste's degree or above	1 (1.8)	2 (3.6)	
Family history of osteoporosis	**Yes**	9 (16.1)	9 (16.1)	0.76
	No	47 (83.9)	47 (83.9)	
Father's job	**Worker**	7 (12.5)	13 (23.2)	0.39
	Employee	22 (39.3)	11 (19.6)	
	Farmer	9 (16.1)	15 (26.8)	
	Jobless or retired	3 (5.4)	2 (3.6)	
Mother's job	**Self-employed**	15 (26.8)	12 (21.4)	0.41
	Housewife	53 (94.6)	54 (96.4)	
	Employee	3 (5.4)	2 (3.6)	

Table 2. Comparison of the mean scores of efficacy in the CD and booklet groups before and after the intervention

Self-efficacy test	Before the intervention		After the intervention		Mean difference between the two stages		*P*
	Mean	SD	Mean	SD	Mean difference	SD	
CD group	108.94	35.199	130.84	36.38	21.54	41.72	0.0001
Booklet group	106.08	28.87	120.73	30.9	14.65	29.93	0.0001
P	.088		.012		.0001		--

Table 3. Comparison of the mean scores of the HBK test in the CD and booklet groups before and after the intervention

HBK test	Before the intervention		After the intervention		Mean difference between the two stages		*P*
	Mean	SD	Mean	SD	Mean difference	SD	
CD group	11.76	3.70	22.43	7.26	10.67	6.98	0.0001
Booklet group	11.37	23.56	21.34	5.76	9.97	6.60	0.0001
P	.56		.38		.086		

Table 4. The relationship between HBK scores and self-efficacy mean scores in both groups

Variable	Mean	SD	r	*P*
HBK	21.88	6.54	.255	0.007
Self-efficacy	125.60	33.95		

Discussion

The present study was conducted to investigate the effect of training osteoporosis prevention via an educational booklet and interactive multimedia CD among female students. The results showed that both methods increased the students' healthy bone knowledge and self-efficacy in this context

Self-efficacy scores increased significantly after training in both groups and the students obtained almost two-thirds of the total scores with the interactive multimedia group indicating a greater influence on the students' self-efficacy level regarding the prevention of osteoporosis. In the Kaveh *et al.*,'s (2014) study that examined the effect of educational programs about the osteoporosis prevention on students' self-efficacy in Shiraz observed a significant increase in the efficacy of the intervention group after the training (31). Fary *et al*., (2015) examined the effectiveness of e-learning programs and found a significant mean difference in the skills of the intervention group compared to the control group who were trained through the booklet after the intervention (32).

The results of a study by Mohammadrizi *et al*., (2014) that aimed to compare two training methods, that is, self-learning by CD and booklet for pregnant women indicated that training through e-learning courses was more effective that training by the booklet (33).

Likewise, patients participating in Blum *et al*.,'s (2011) study who referred for knee arthroscopy were shown to remember information for a longer time when trained by multimedia compared to the booklet (34). The reason might be the fact the features of multimedia features such as the use of pictures, sounds, music as well as interactivity of the electronic content which has a stronger effect in attracting learners' attention and concentration, and thus in the improvement of their performance. However, unlike the results obtained from the present study, in some other studies such as studies by Majidi *et al*., (2014) (35), Khoramirad *et al*., (2011) (36), Rostom *et al*., (2002) (37), and Dilles *et al*., (2011) (38), no significant difference was observed between e-learning and other educational methods. The reason may be lack of attractiveness of audio and visual effects, and the content type or the learners' low level of computer skills (35).

The results of the present study showed that training, whether electronic or via booklet, can have an impact on the students' level of knowledge regarding prevention of osteoporosis, and this result is consistent with the results of other studies. For example, Majidi (2014) administered a quasi-experimental study with a before and after training design in Guilan University of Medical Sciences to study the effects of breast self-examination through booklet and CDs on knowledge and attitudes of nursing and midwifery students, and observed that training by the use of both methods had a positive and significant effect on knowledge and attitude of students about breast self-examination (35).

Similarly, Khorami Rad's (2011) study confirmed the present findings by showing the effect of self-learning methods (CD and booklet) when training to doctors. Finally, based on the knowledge and attitude scores in both groups, they consequently considered both teaching methods as effective (36).

Findings of Temiz *et al*.,'s study conducted in 2009 is also consistent with the results of this study. In their study, they observed that the end of the term scores of both groups of students trained about engine installation through computer and books improved significantly compared to their scores before the course (39). The results of the Dilles *et al*.,'s (2011) study also indicated that self-care training of heart disease patients by computer and brochures d the participants' knowledge score in both groups, but there was no significant difference between the two groups (38).

Strong positive correlation between knowledge and self-efficacy scores in the current study indicates that by increasing people's knowledge in order to enhance self-efficacy, the first step towards promoting positive health behaviors can also be taken. Given that booklets and CDs have concise and comprehensive information about a certain subject and provide a context for learning according to the learners' desired time and place. Lack of significant difference between the effect of training by the use of CD and booklets might be due to the fact that each media has its own advantages and disadvantages. Advantages include the easier use of manuals or the possibility of taking advantage of audio and video as well as other multimedia capabilities of CDs, and disadvantages include the inability to use CD in all situations or lack of skills in using CDs. It can be

concluded that although the content of the training and characteristics of the target group may influence the application of different educational media, it is evident that compared to educational booklets, CD causes the same or higher degree of progress in increasing the knowledge and performance of learners. This can be due to the benefits of computer-based methods such as taking advantage of features such as audio and video capabilities for increasing attraction, understanding of the content, and productivity. As a result, it is recommended to apply new training methods such as interactive multimedia CD in line with the results of this study. Also, adolescents should be encouraged to use these new ways of learning for public education and specifically in the field of health because these methods can nurture and enhance adolescents' appropriate health behaviors in schools. Health care providers can also use new methods of training such as interactive multimedia in education for prevention and treatment of other diseases. Flexibility in training allows educators to decide when and from where to obtain the required educational content. Besides, health service managers can assess common plans in the field of education for the public and do further activities to promote these programs and to train health care providers based on the needs of learners.

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