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The impact of health promotion model and self efficacy based education intervention on women's knowledge, beliefs and clinical outcomes regarding osteoprosis prevention

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***Abstract*---**Osteoporosis causes almost 9 million fractures worldwide each year, accounting for considerable costs to health care systems and substantial disability and mortality of women .Few studies to date have applied the HBM framework to study the role of knowledge, self-efficacy, and health beliefs in osteoporosis-related preventive behaviors among women. Aim of the study was to determine the impact of health promotion model and self-efficacy based education intervention on women's knowledge beliefs and clinical outcomes regarding osteoporosis prevention. The research design quasi experimental design was utilized. Setting: It was conducted at ante-natal and rheumatoid clinics at Beni-Suef University Hospital, Egypt. Sample: A convenient sample included 128 women divided into control and study groups. Tools of data collection: Four data collection tools were used: I) Structured interview questionnaire, II) Osteoporosis knowledge assessment sheet (OKAT), II) Osteoporosis health belief scale (OHBS) IV) Factor loadings for the osteoporosis self-efficacy scale (OSES). The results: Showed that; There was a highly significant difference existed between the two groups regarding their knowledge, beliefs and their self-efficacy post intervention which in turn lead to better clinical outcomes among study group versus control group with P<0.001. Conclusion: Health promotion model based educational intervention had a statistical significant positive effect on increasing women's knowledge, beliefs & better clinical outcomes to prevent osteoporosis. Recommendations: Health providers should focus more extensively on the health promotion and more high-quality research with comprehensive design.

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Introduction

Osteoporosis or silent disease (porous bone) is a global health issue that increases the fragility of the bone .It is the most frequent pathological causes of skeletal weakening characterized by a concomitant reduction in bone mass and loss of bone microstructure , as a result of low bone mass density and deterioration of the micro architectural particularly of the hip, spine, wrist, and shoulder which can lead to an increased risk of fracture and decreases the quality of life of the individuals in physical, social, psychological, and economical aspects and increasing the risk for morbidity and mortality (Kanis, 2019)&(Shuler, et al. 2018)

From birth to adulthood, our bones develop and grow until, in our early 20s, they reach what is called peak bone mass – the time when the bones are at their strongest, densest and least likely to fracture. Throughout life, bone is constantly being renewed, with new bone replacing old bone- and this helps to keep our skeleton strong. But for people with osteoporosis, more and more bone is lost and not replaced. This means that the bones gradually become brittle and more likely to break. Although the risk of osteoprosis fracture can be reduced by timely diagnosis of bone mineral loss using densitometry and implementation of a specific antiresorptive therapy or anabolic treatment, osteoprosis remains under diagnosed and under treated (Briançon, et al.2017) & (Delmas, et al.2017).

Porous bone affects more than 75 million people worldwide and causes more than 8.9 million fractures annually, resulting in an osteoporotic fracture every 3 second (National Osteoporosis Foundation, 2018). Osteoprosis prevalence is higher in females than males. So that, will affect more than 10 million women by 2020, if efforts to prevent it are ineffective. Around the world, one in three women and one in five men over the age of fifty will suffer a broken bone due to osteoporosis (International Osteoprosis Foundation, 2020).

By being aware of osteoporosis and which factors could place you at risk, you can make sure that you get diagnosed and treated as soon as possible. The World Health Organization (WHO,2019) indicates that risk factors for osteoporosis include age, sex, long-term glucocorticoid use, secondary osteoporosis, genetics, prior fragility fracture, low body mass index (BMI), smoking, excess alcohol consumption, sedentary lifestyle, having a diet lacking calcium and Vitamin D, nulliparous, late menarche, and early menopause (Jeihooni, et al. 2015) & (Khoshnood, et al. 2019).

So the findings of different studies suggests that exercise and adequate intake of calcium and vitamin D have a significant effect on reducing the rate of bone density loss and improving bone mineral density (BMD) . Knowledge in the area of risk factors of osteoprosis, exercise and calcium supplementation have been very effective in preventing osteoporosis bone mineral density is considered to be the standard measure for the diagnosis of osteoprosis and the assessment of fracture risk (Kelley & Kelley, 2019).

Health promotion model (HPM) is the most commonly used theory as evidence-based and cost-effective approach in educational intervention. Changing lifestyle or understanding the reasons for people's osteo-protective behaviors depending on their individual and social factors is a complex situation. The HPM assumes that individual's perceptions of their health plays an essential role in changing osteo-protective behaviors and reducing the risk of osteoporosis throughout their life span (Dempster, 2018), (Jeihooni, et al. 2015) & (Zhang, et al. 2018).

We therefore decided to use health promotion and education program (HPEP) in the present study. The HPM was developed in the early 1950s and updated in the 1980s, which is a conceptual framework used to understand health behavior and possible reasons for non-compliance with recommended health action (Pender, 2010) & (Wei, et al. 2015).

The underlying major components of the model; perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, self-efficacy, and motivation factors. In addition to health promotion movements initiated by the WHO Ottawa Charter in the mid1980s, have become major pillars of health promotion reform worldwide and the WHO set a goal to increase the number of females trained regarding osteoporosis prevention. Several studies have also shown positive impacts of HPM on modifying health behaviors (Al-Otaibi, 2015), (Edmonds, et al. 2012) (Elsabagh, et al. 2015) (Evenson & Sanders, 2016) (Sanaeinasab, et al. 2019).

In line with such a purpose, identify factors affecting behavior changes can make changes easier. Therefore, investigating factors affecting the adoption of osteoprosis preventive behaviors among women, using models is necessary. Researchers have used such models to change their subjects behavior .A common reason for noncompliance osteoprosis prevention is the erroneous belief that osteoprosis is not serious. According to (HPM), people are most likely to make health behavior changes when they perceive that the disease is serious. Considering what said above, this study aims to measure HPM constructs regarding eating behaviors and physical activity on bone density in the prevention of osteoporosis among women (Samia, et al.2018).

Significance of the study

Women's lighter, thinner bones and longer life spans are some of the reasons why they are a key target group in preventive intervention for osteoporotic fractures. They start losing bone at a younger age (about 10 years earlier) and at a faster rate than men. Women are also four times more likely than men to develop osteoporosis and two times more likely to have osteopenia compared to men. The risk for osteoporosis related fracture is 50% for women after the age of 50 (especially during the first 5 years after menopause), while this rate is 20% for men (Tuzun, et al. 2016) & (El Miedany, et al. 2020).

As silent, preventable and modifiable in nature, women need to be aware of the risk of osteoporosis and engage early counseling strategies from adolescence to pre-menopausal prior to an irreversible period of declining bone mass. Pourhashem, et al. (2018) in his study conducted that the overall prevalence rate

of osteoprosis was 32, 1% in at least one measurement site (28,5% in lumbar and 14,5 % in femoral region) . A study carried out in Fasa university of medical sciences, demonstrated that 34, 1% of the women had osteoporosis. The findings of different studies suggest that exercise and adequate intake of calcium and vitamin D have a significant effect on reducing the rate of bone density loss and improving Bone Mineral Density (BMD) Knowledge in the areas of risk factors of osteoprosis, exercise, and calcium supplementation have been very effective in preventing osteoprosis (Hernlund, et al. 2017) & (Nobakht,et al.2019).

The prevalence of osteoporosis is relatively high amongst the Egyptian population and is associated with a wide range of risk factors and medical conditions .Based on different studies, carried out in Egypt, it has been estimated that the prevalence of osteoporosis in Egypt has been rated at 28.4% in women and 21.9% in men, whereas 53.9% of women and 26% of men had osteopenia (Kutsal, et al., 2020).

In rural areas of Upper Egypt, the prevalence of osteoporosis in postmenopausal women was even higher reaching up to 47.8%, whilst in another study carried out at the Trauma Unit of Assiut University Hospital, Egypt, the prevalence of osteoprosis was high (74.9%) in patients admitted with hip fractures .Such high prevalence highlights the magnitude of the problem in terms of public health and the importance of having up-to-date guidelines for the management of osteoporosis in Egypt .The treat-to-target approach has been recently suggested as a useful strategy to osteoporosis management (Winzenberg,2019).

In spite of the finding that osteoporosis awareness has increased in the last 20 years with the introduction of several effective pharmaceutical agents for treating those at high risk, it was rated as moderate amongst Egyptian women particularly with regards to its risk factors, preventive measures and consequences (Elliott, Seals & Jacobson, 2017).

Operational definitions

- **Clinical outcomes:** In the context of the current study clinical outcomes refers to laboratory investigations including (Calcium, Vit D& bone mineral density (BMD)) that will be measured using CBC.

Aim of the study:

The study was aimed to determine the impact of health promotion model and self-efficacy based education intervention on women's knowledge, beliefs and clinical outcomes regarding osteoprosis prevention.

Research hypothesis:

H1: Women who engage in educational intervention based on health promotion model demonstrate higher level of knowledge about risk factors and preventive measures of osteoporosis than those who don't engage.

H2: Women who engage in in educational intervention based on health promotion model demonstrate stronger health beliefs and self-efficacy regarding osteoporosis than those who don't engage.

H3: Women who engage in in educational intervention based on health promotion model affect better clinical outcomes (BMD, vitamin D& Ca ionized) levels a year later than those who don't engage.

Materials and Methods

Research design:
A quasi-experimental research design (pre/post-test) control, and study group. It is used for establishing the cause-and-effect relationship between an independent and dependent variable.

Setting:
This study was conducted at rheumatoid and ante-natal clinics which is located at the ground floor of outpatient building. It starts from 8 am to 1 pm. at Beni-Suef University Hospital, in Beni Suef city, Egypt, in October 2020.

Subjects:
A convenient sample of 128 women were included in the study inclusion criteria; (Women aged 20 to 55 years old, free from physical and cognitive disability, lack of fractures, lack of digestive disorders ,food allergies, and have the consent to participate in the study). Such women with genetic early osteoporosis especially (hyper-parathyroidism, rickets, rheumatoid and osteomalacia) must be excluded from this study.

Tools of data collection:
Data were collected using the following four tools;
Tool (I):- Structured interview questionnaire sheet: It compromised three parts: **Part one;** Demographic characteristics of the women**,** which included name, age, marital status, educational level, regular menses, exposure to sunlight and smoking ,etc.. **(13 Items)**. **Part two;** Women's medical related data, which included previous family history of osteoprosis, history of: hormonal therapy, fracture, performing any physical activity, history of being diagnosed with osteoprosis, etc… **(19 Items). Part three;** Laboratory investigation**,** which included BMD, vitamin D and calcium (Ca ionized) **(3 Items)**.

Tool (II):- Osteoporosis knowledge assessment sheet (OKAT):- Which was translated and culturally adapted from the original OKT, (Kim, et al. 1991) & (Hsieh, et al. 2014). It was concerned with measuring the knowledge of women and covers the core of osteoporosis-related knowledge, included questions with a list of characteristics and asked whether the items are more or less likely to affect a person's chance of getting osteoporosis, e.g. (Osteoporosis increased risk of bone fractures, etc…), explore knowledge regarding the relationship between exercise and osteoporosis, e.g. (type of physical activity is beneficial for osteoporosis, etc..) and test knowledge regarding the relationship between calcium intake and osteoporosis, e.g. (adequate calcium intake can be achieved from two glasses of milk a day, etc…) **(19 Items).**

- Each item was scored either (0) for incorrect answer or (1) for correct answer. The sum of correct responses to all questions produces the total score range from **(0: 19)**.

Scoring system: The overall Knowledge scores was considered either satisfactory (if 60% or more) or unsatisfactory (if less than 60%). This OKAT can be useful in further follow up studies to measure the effectiveness of the preventable education programs.

Tool (III):- Osteoporosis health belief scale (OHBS) which was originally developed by (Kim, et al.1991) and has been translated into Arabic, adapted, and validated by the researchers .It was used to assess women's health belief about osteoporosis .The scale includes **(25 items)** divided into seven domains: Perceived susceptibility to osteoporosis e.g. (your chances of getting osteoporosis are high, etc..), perceived seriousness of osteoporosis**.** e.g.(the thought of having osteoprosis is scares, it would be very costly if you got osteoporosis, etc..),perceived benefits of exercise and calcium intake. e.g.(regular exercise prevent problem that can occur, etc..), perceived benefits of calcium& vitamin D intake . e.g.(you feel like you are not strong enough to exercise regularly, ,etc..) **(25 items)**.
-Each question is graded on four-point likert scale ranging from **(1 - 4)** in which 1 (strongly disagree) & 4 (strongly agree).
Scoring system: The sum of all scores ranges (25-100). The overall scores was considered either satisfactory (if 60% or more) or unsatisfactory (if less than 60%).

Tool (IV):- Factor loadings for the Osteoporosis Self Efficacy Scale (OSES) which was originally developed by (Kim, et al.1991) and has been translated into Arabic, adapted and validated by the researcher .It was used to measure confidence for adopting behavior change regarding to exercise. (9 items),calcium intake(6 items) and vitamin D (5 items) .Women are asked, "If they were recommended that you do any of the following, how confident or certain would you be that you could:" and then presented with a list of examples such as: "Do exercises even if they are difficult" and "obtain foods that give an adequate amount of calcium even when they are not readily available ,eat vitamin D rich food on regular basis, etc.. women then respond yes or no **(20 Items).**
Scoring system: Each item was scored either (0) for no or (1) for yes. The sum of responses to all items produces the total score range from **(0: 20)**. The overall scores was considered high (if 75% or more), moderate (if 50% to less than 75%) or low (if less than 50%).

Validity and Reliability

Content validity was tested by a jury of 5 experts in the fields of Obstetric and Newborn Health Nursing & Medical-Surgical Nursing. The experts revised the tools for clarity, relevancy, comprehensiveness, simplicity and applicability; minor modifications were done and the final form was developed. To ensure the validity of tool I translation, the back-translation technique was used. Testing reliability of the proposed tools was estimated using Chronbach's Alpha test to measure the internal consistency of the tools. It was found that Chronbach's Alpha test for the tool I was 0.91, for Tool II was 0.86, for tool III 0.73 and for tool IV 0, 89 which reflects reliable tools.

Pilot Study

A pilot study was carried out on 10% of the women before data collection to test the applicability and feasibility of the tools and to make necessary modifications before conducting the main study. Women who were included in the pilot study were excluded from the study sample.

Ethical Considerations

Ethical approval was granted from the responsible authorities of the faculty of Nursing at Beni-Suef University after an explanation of the purpose of the study. Official permission was obtained from Beni-Suef University Hospital administrative authority providing the details about the nature of the study. Informed consent was obtained from the women before starting the data collection procedure to explain the purpose of the study. Women were assured that their participation is voluntary and they had the right to withdraw from the study at any time without penalty. They were assured that anonymity and confidentiality of information were protected. Ethics, values, culture, and beliefs were respected.

Field of work or Data collection (Procedure):
The procedure of data collection in the current study was implemented through the following phases:-

Assessment and planning phase
The researchers reviewed the related literature and prepared the used instruments to collect data; Instruments selected for the reliability assessment were the OHBS and the OKAT having reviewed the relevant literature (Hassan &Bashour, 2013). In addition, permission was taken from the women and the hospital administration to start the study.

Implementation phase:

1- Data were collected during the period from the first of November 2019 to the end of October 2020. The researcher divided the subject into two groups (study and control group). All women visit the ante natal and rheumatoid outpatient clinic of Beni-suef University Hospital who met the inclusion criteria were enrolled in this study. Quasi experimental study design was used in which each woman was interviewed as her own control to reduce the errors arising from the variance between women. This method prevents bias related to psychological and physical factors, reduces variability, and minimizes subject-to-subject variation. This is because woman's feeling, perception and expression can be affected by physical, environmental, psychological, social, cultural, and personal factors. Therefore, comprehensive women's knowledge assessments were performed by the researcher who visited the previously mentioned settings two times a week, using different sessions.
2- During the first session, the researchers explained the nature and purpose of the study and took oral consent from women who fulfilled the study criteria. The researcher interviewed both study and control group using tools of data collection (I, II, III and IV) to obtain baseline data (pretest), then divided each group into four equal groups (16 woman for each). If women could not

read or write the researchers helped them and noted their response in their sheets.

3- During the same session the researchers explained the health promotion program for the study group included four educational sessions of 55 to 60 minutes of speech, group discussion, questions and answers, as well as posters and educational pamphlets, film screenings and power point displays, conducted by researchers. The educational content of the training sessions included introduction to osteoporosis and its signs, complications, diagnosis, the role and importance of nutrition and the role of exercise in preventing osteoporosis, and the role of family members in making, facilitating, and providing suitable food and walking program. Immediately after the intervention, the study group completed the questionnaire (I, II, III and IV) (posttest) .To preserve and enhance the activity of the study group, they attended training sessions monthly for at least one year, so that the researchers can follow-up their activities and women underwent BMD tests and the results were recorded.
4- Every woman in the study group was provided the booklet that was developed by the researchers with detailed information on knowledge and practice about osteoporosis.
5- The control group did not receive any training, however due to ethical considerations, a training session on osteoporosis was held for this group after the study.

Evaluation phase

The evaluation was implemented after the end of program for all women in the study and control group by using the same tools to identify the change in the level of knowledge and practice.

Booklet

The booklet was also an instructional tool giving information on osteoporosis management by the researchers in the light of the literature on the subject. The content of the HPM based on education program was comprised of four components (perceived sensitivity, severity, benefits, barriers, a cue action, and self-efficacy practices); (a) orientation and introduction to the program, (b) general information about osteoporosis (include definition of osteoporosis, prevalence, and controllable risk factors; symptoms, complications, diagnosis, and treatment of osteoporosis),(c) preventive measures (including improving calcium intake through low fat food selections), and (d) initiating exercise activities. The duration of the HPM was 2 hr. presented via (lecturing, question-and-answer, pamphlets, flow-charts, booklet, video, slides and discussion method). The education program was planned face to face by researchers using small groups (approximately = 16 women), on four sessions. Within the framework of the HPM, each woman in the study group was provided telephone counseling to start and continue osteo-protective behaviors after the education for follow-up. It is worth noting that the educational materials were distributed to and discussed with the women in the control group after intervention, to meet the research ethics and to protect the rights of women in the control group.

Statistical design

The collected data were analyzed using statistical package for social sciences (SPSS 22.0) for descriptive statistics in the form of frequencies and percentages for categorical variables. Means and standard deviations were used for continuous variables. Pearson correlation coefficient (*r*) was used for measuring the correlation between numerical variables. Student *t* tests were used for measuring the differences in mean scores before and after program implementation. Chi square tests were used for measuring differences for categorical variables. The statistical significance were set at (P<0.05).

Limitations of the study

- Participants were recruited from only one study site; therefore, the results cannot be generalized to other populations.
- Sometimes the sessions were extended due to noise and other individuals' interruption.

Results

Table (1): Demographic characteristic of the study subjects

Items	Study Group (n=64)	Control Group (n=64)	X^2	P-Value
	N (%)	N (%)		
Age: – Less Than 20 – 20-30 – 30-40 – 40-50 – More Than 50 Mean ± SD	 12(18.75) 14(21.87) 21(32.81) 4(6.25) 13(20.32) 34.92 ± 2.43	 9(14.06) 15(23.43) 22(34.37) 8(12.50) 10(15.64) 36.54 ± 3.39	0.597	0.963
Marital Status: – Single – Married – Divorced – Widow	 8(12.50) 46(71.87) 6(9.37) 4(6.26)	 5(7.81) 42(65.62) 9(14.06) 8(12.51)	0.102	0.992
Education: – Not Educated – Basic – Intermediate – High	 6(9.37) 16(25) 12(18.75) 30(46.88)	 8(12.5) 14(21.87) 9(14.06) 33(51.57)	0.447	0.978
Occupation: – Governmental – Craft – Not Working	 13(20.31) 9(14.06) 42(65.63)	 16(25) 7(10.93) 41(64.07)	0.572	0.751
Residence: – Urban – Rural	 21(32.81) 43(67.19)	 23(35.93) 41(64.07)	0.139	0.835
Puberty Age:				

– 13-15 – 16 or More	47(73.43) 17(26.57)	43(67.18) 21(32.82)	0.041	0.840
Menstruation: – Regular – Irregular	 61(95.31) 3(4.69)	 59(92.18) 5(7.82)	 0.533	 0.465
Breast Feeding: – Yes – No	 35(54.68) 29(45.32)	 33(51.56) 31(48.44)	 0.631	 0.811
Pregnancy No: – No – 1-3 – 3-5 – more than 5	 13(20.31) 31(48.43) 15(23.43) 5(7.83)	 10(15.62) 34(53.12) 13(20.31) 7(10.95)	 0.031	 0.985
Exposure To Sunrays: – Yes – No	 61(95.31) 3(4.69)	 60(93.75) 4(6.25)	 0.151	 0.697
Smoking : – Yes – No	 0(0.0) 64(100)	 0(0.0) 64(100)	 -	 -

Note: No statistics are computed for smoking because it is a constant.

Table 1 illustrates the subjects' demographic characteristics.
The mean age was (34.92 ± 2.43) for the study group and (36.54 ± 3.39) for the control group. The majority of subjects in both groups were married (71.87% and 65.62%) respectively.
Using chi-square test for comparing study and control group indicated a non-statistically significant difference in terms of the demographic characteristics before the intervention (P>0.05) suggesting that the two groups were similar.

Table (2): Health status of the study subjects

Items	Study Group (n=64)	Control Group (n=64)	X^2	P-Value
	N (%)	N (%)		
History of Osteoporosis: – Yes – No	 30(46.88) 34(53.12)	 33(51.56) 31(48.44)	 0.281	 0.96
Hormones: – Yes – No	 18(28.12) 46(71.88)	 16(25) 48(75)	 0.039	 0.843
Previous Injury: – Yes – No	 28(43.75) 36(56.25)	 31(48.44) 33(51.56)	 0.010	 0.920
Previous Fracture: – Yes – No	 16(25) 48(75)	 14(21.88) 50(78.12)	 0.174	 0.676
Physical Activities: – Yes	 11(17.19)	 15(23.44)	 0.037	 0.848

– No	53(82.81)	49(76.56)		
Medication/Supplements: – Yes – No	 15(23.44) 49(76.56)	 16(25) 48(75)	0.043	0.837
Previous Knowledge: – Yes – No	 7(10.93) 57(89.07)	 10(15.62) 54(84.38)	0.610	0.435
Previous Diagnosis: – Yes – No	 15(23.44) 49(76.56)	 13(18.75) 51(81.25)	0.015	0.945
Diagnostics Tests: – Yes – No	 6(9.38) 58(90.62)	 10(15.62) 54(84.38)	0.035	0.965
Osteoporosis Treatment: – Yes – No	 3(4.68) 61(95.32)	 2(3.12) 62(96.88)	0.208	0.648

Table 2 shows the health status of subjects. About half of study and control groups had history of osteoporosis (53.12%, 48.44%) respectively. The majority of both groups had no hormonal therapy (71.88%, 75%) respectively. Using chi-square test for comparing study and control group indicated a non-statistically significant difference in terms of the health status before the intervention (P>0.05) suggesting that the two groups were similar.

Table (3): Comparison of the mean scores of knowledge before and after the intervention

Knowledge (OKAT)	Before Intervention	After Intervention	Mean Difference	T-Value	P-Value
	Mean ± SD	Mean ± SD			
Study Group	8.48 ± 1.95	14.55 ± 2.38	6.07	-19.02	0.000
Control Group	8.12 ±2.03	10.32 ±2.65	2.20	1.344	0.184
P-Value	0.136	0.000			

Table 3 shows the comparison between the mean scores of knowledge before and after the intervention in both groups. The mean scores of knowledge in the study group largely increased from (8.48 ± 1.95) to (14.55 ± 2.38), while the mean score of knowledge in control group slightly increased from (8.12 ±2.03) to (10.32 ±2.65). According to the results of paired sample t tests, the differences in the mean scores of knowledge in study group were significant (***p***=0.000), while in control group were not significant (***p***=0.184). The results of independent sample t tests, showed that difference in mean scores of study and control groups before intervention was not significant (***p***=0.136) while after intervention it was significant (***p***=0.000).

Table (4): Comparison of the mean scores of beliefs before and after the intervention

Beliefs (OHBS)	Before Intervention Mean ± SD	After Intervention Mean ± SD	Mean Difference	T-Value	P-Value
Study Group	30.64 ± 4.23	70.01 ± 10.30	39.37	-30.128	0.000
Control Group	29.42 ±5.84	31.95 ± 6.54	1.53	-1.049	0.298
P-Value	0.744	0.000			

Table 4 shows the comparison between the mean scores of subjects' beliefs before and after the intervention in both groups. The mean scores of beliefs in the study group largely increased from (30.64 ± 4.23) to (70.01 ± 10.30), while the mean score of beliefs in control group slightly increased from (29.42 ±5.84) to (31.95 ± 6.54). According to the results of paired sample t tests, the differences in the mean scores of beliefs in study group were significant (***p***=0.000), while in control group were not significant (***p***=0.298). The results of independent sample t tests, showed that difference in mean scores of study and control groups before intervention was not significant (***p***=0.744) while after intervention it was significant (***p***=0.000).

Table (5): Comparison of the mean score of self-efficacy before and after the intervention

Self-Efficacy (OSED)	Before Intervention Mean ± SD	After Intervention Mean ± SD	Mean Difference	T-Value	P-Value
Study Group	7.79 ± 1.47	14.40 ± 2.77	6.61	-50.040	0.000
Control Group	8.25 ± 2.89	9.54 ± 1.97	1.29	0.263	0.793
P-Value	0.065	0.031			

Table 5 shows the comparison between the mean scores of subjects' self-efficacy before and after the intervention in both groups. The mean scores of self-efficacy in the study group largely increased from (7.79 ± 1.47) to (14.40 ± 2.77), while the mean score of self-efficacy in control group slightly increased from (8.25 ± 2.89) to (9.54 ± 1.97). According to the results of paired sample t tests, the differences in the mean scores of self-efficacy in study group were significant (***p***=0.000), while in control group were not significant (***p***=0.793). The results of independent sample t tests, showed that difference in mean scores of study and control groups before intervention was not significant (***p***=0.065) while after intervention it was significant (***p***=0.031).

Table (6): Correlation between knowledge, beliefs and self-efficacy

	Knowledge	Beliefs	Self-Efficacy
	r (P-Value)	*r* (P-Value)	*r* (P-Value)
Knowledge		0.43 (0.001*)	0.53 (0.000*)
Beliefs			0.32(0.042*)

Table 6 summarizes the correlations between knowledge, beliefs and self-efficacy. Using Pearson correlation coefficients, there were significant correlations between all variables.

Table (7): Correlation between clinical outcomes and subjects' knowledge, beliefs and self-efficacy

	Knowledge	Beliefs	Self-Efficacy
	r (P-Value)	*r* (P-Value)	*r* (P-Value)
Calcium Level	0.32(0.004*)	0.41(0.002*)	0.05(0.564)
Vit. D Level	0.21(0.006*)	0.39(0.003*)	0.03(0.953)
BMD	0.024(0.456)	0.029(0.652)	0.12(0.523)

Table 7 summarizes the correlations between clinical outcomes and subjects' knowledge, beliefs and self-efficacy. Using Pearson correlation coefficients, there were significant correlations between calcium and vit.D levels and subjects' knowledge and beliefs while other variables were not significant.

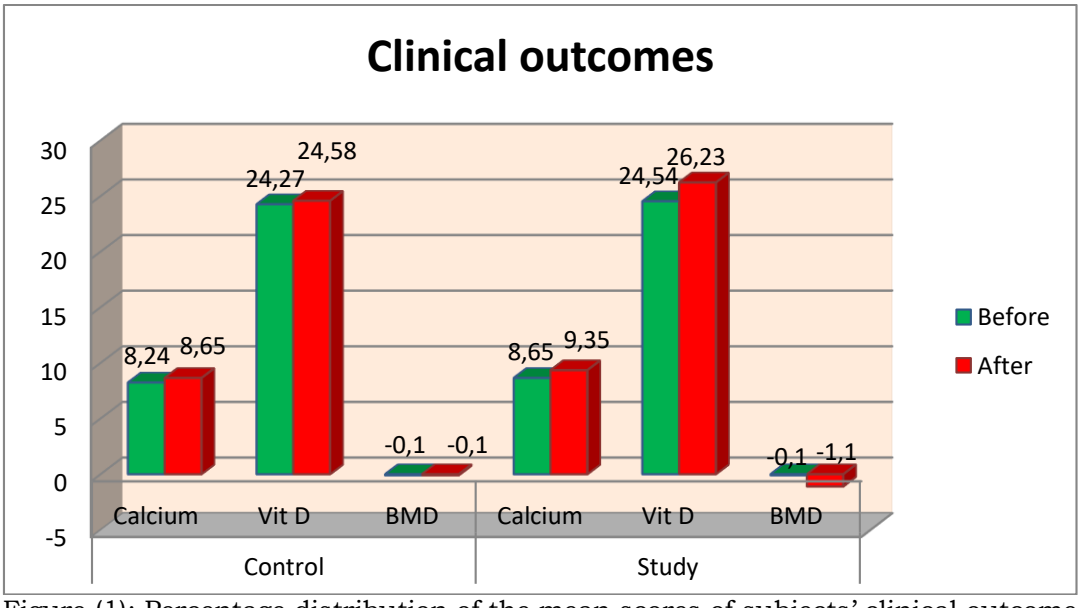

Figure (1): Percentage distribution of the mean scores of subjects' clinical outcome before and after the intervention through program phases

Figure 1 illustrated the percentage distribution of the mean scores of subjects' clinical outcome before and after the intervention between two groups. The differences among control group regarding calcium, vitamin D and BMD were not

statistically significant. On the other hand the differences among study group were statistically significant for calcium (P=0.002) and vitamin D (P=0.001) while for BMD were not statistically significant.

Discussion

Osteoporosis causes almost 9 million fractures worldwide each year, accounting for considerable costs to health care systems, and contributing to substantial disability and mortality for women with osteoporosis .The burden of osteoporosis may be greater in developing countries, including the Middle East where most of Arab women live. One can argue that women in the Arab world may be more borne to osteoporosis for obvious cultural and social reasons such as greater number of pregnancies, longer lactation, low physical activity and potentially lower vitamin D due to both in adequate exposures to sunlight as well as dress style, and possibly reduced vitamin D and calcium intake .With this note, we have only selected women in our sample, assuming that reliability check for men should not be different (Sayed-Hassan and Bashour, 2013) & (John& Kibusi, 2020)

Several population-based studies have now demonstrated an increased risk of osteoporosis and fracture (Evelyn, et al .2018).Despite an increasing number of studies illuminating the biology underlying bone loss in women living with osteoporosis, few studies have systematically explored concerns related to osteoporosis prevention. Previous studies, conducted in diverse populations, have applied the HPM to classify factors associated with health behaviors that mitigate risks of osteoporosis, particularly physical exercise and dietary intake .The key domains of the HPM include perceived susceptibility to and severity of a particular disease, perceived benefits and barriers of specific preventive behaviors, and environmental or internal cues to action (McLeod & Johnson 2020).

The concept of self-efficacy, defined as “the conviction that one can successfully execute the behavior required to produce the outcomes, has been incorporated into the model as a critical component of women’s ability to maintain long-term change (Ravanjakoben, 2018). Several validated scales exist for measuring HPM domains in the context of osteoporosis including the osteoporosis knowledge test (OKT), osteoporosis self-Efficacy scale (OSES), and osteoporosis health belief scale (OHBS). These scales have been utilized in descriptive and intervention studies involving a wide range of populations (women and men) in various countries (National Osteoporosis Foundation, 2018).

Few studies to date have applied the HPM framework to study the role of knowledge, self-efficacy, and health beliefs in osteoporosis-related preventive behaviors among women .To address this gap, we sought to examine the associations between osteoporosis-related preventive health behavior (i.e., physical exercise and dietary intake) and knowledge, self - efficacy and health beliefs among a large cohort of women with osteoporosis (Gul Pinar1 and Tevfik Pinar2, 2020).

In the light of the previous mentioned details the major aim of this study was to determine the impact of health promotion model and self-efficacy based education intervention on women's knowledge, beliefs and clinical outcomes regarding osteoporosis prevention. The aim of our study is significantly supported through research hypothesis, thus directing our attention to stress the importance and utilization of the health promotion model to maintain a healthy life style to prevent osteoporosis (Hussein, 2018).

So the researcher hypothesized that women who engaged in the health promotion model (study group) would demonstrate higher level of knowledge, stronger health believe, increased self-efficacy, and better clinical outcome (BMD, vitamin D & ionized Ca) about risk factors and preventive measures of osteoporosis than those who don't engage (control group).Such a study is essential to add to both national and international efforts, which seek to fight against osteoporosis through increasing knowledge and awareness among women (Shawashi1&Darawad1, 2020).

In relation to age; the findings of the present study illustrated that, about one third of both study and control groups were aged (30 - 40 years old) with their mean ages were (34.92 ± 2.43) for study& (36.54 ± 3.39) for control groups. This study finding was in line with that of Bahbadi, et al. (2020) who noted that the most frequent interviewed age groups for early detection of BC women at Faskous district were (30-39years) with mean age (38,7) years old.

Also, this study finding is supported with Abushaikha et al. (2016), El-Sayed & Abdel, (2013), Sanaeinasab et al. (2014), Sharifikia, et al. (2019), Ford, et al. (2011), Keskin, et al. (2014) who stated that essentially, primary prevention program of osteoporosis should be initiated at early age. Also, in the same line with El-Hay and Mohamed, (2015) who studied the effect of educational program on building accurate information and behavior among women about BC knowledge and BSE, and found that slightly less than half of the participants were in the age group of 35–45 years; and the majorities were married.

This study finding explained by the researchers' opinion may be due to this subjects under study were not detected and diagnosed early but, it was discovered accidently. However, the comparable studies have focused mainly on the postmenopausal adult population whose bone losses had already started and not that of young and middle age individuals.

Regarding to marital status; the current study showed that, the majorities of subjects in both groups were married. Supporting this study finding is Helmy& Ibrahim, (2020*)* who reported that the majority of BC women were married. This study finding explained by the researchers' experience could be due to our cultural habits and beliefs especially among rural or low socioeconomic people with less education to encourage early marriage.

According to occupation; the current study showed that, the majority of subjects in both groups were not work. This study result was congruent with Agency, (2017) who showed that the majority of the studied women were not working; this could be explained as the highest percentages of women, were housewife. The

present study is in accordance with Yi, et al. (2017), in his study about informational needs of Koreans women with BC, who reported that about two thirds of the studied samples were house wife. This study finding explained by the researchers' experience may be due to the fact that the house wife people tend to be less physically active and tend to have more sedentary life.

Regarding the place of residence; the present study showed that the majority of subjects in both groups were lived in rural area. This study finding is congruent with that of Mohamed, et al. (2020), who documented that the highest percentage of the included sample were from rural areas. This study finding explained by the researchers' experience may be due to women who lived in rural areas lack health and educational services; also cultures, norms, beliefs and place of livings of women has an effect on behaviors and patterns of life style, the nature of life and beliefs of women to accept the illness and modify their life style according to prescribed therapeutic regimen.

Regarding to menstruation, exposure to sun rays, smoking, age at puberty, education, breast feeding and pregnancy number; the current study illustrated that the majority of subjects in both groups, have regular menses, were exposed to sunrays, nonsmokers and have a menarche between ages 13-15 years old. But about half of the subjects were highly educated, breast feeding and have 1-3 pregnancy numbers. The finding were similar to a study Winzenberg, et al. (2018) that included women between 25–44 years of age, with almost half of them having a university degree .The present study is contradicted with Hussein, (2018) who found that about one third of both study and control groups were illiterate.

From the researcher's point of view, this could express the Egyptian women life style. So the present study showed that there was no statistical significant relation between women in both study and control groups regarding their demographic characteristics pre intervention (P>0.05), suggesting that the two groups were similar.

The present study showed that the majority of both groups had no (hormonal therapy, history of fracture, physical activity, medication or supplements used, previous diagnosis, diagnostic tests &osteoporosis treatment). While about half of both groups had a history of osteoporosis and previous injury. So the present study showed that there was no statistical significant relation between women in both study and control groups regarding their health status pre intervention (P>0.05), suggesting that the two groups were similar .This may be due to osteoporosis is not curable, and irreversible chronic disease once established. Thus, prevention is better than treatment. The results of the current study are consistent with Ahmed &Shrief, (2018) who stated that one-quarter of the study participants have a family history of BC, half of their relatives have BC and one-third of their mothers have BC. While this study findings were disagreement with El-lassy & Abd Elaziz (2019) who studied the impact of education program with regard to BSE on female employees in Damanhour University, and they found that the majority of the studied sample had no history of BC, and most had no previous breast problems or lump.

Regarding to the knowledge of the present study participants confirmed the generally high levels of knowledge regarding osteoporosis, as the mean scores of knowledge in the study group largely increased from (8.48 ± 1.95) to (14.55 ± 2.38), while the mean score of knowledge in control group slightly increased from (8.12 ±2.03) to (10.32 ±2.65).So the present study showed that there was no statistical significant relation between women in both study and control groups regarding their total knowledge level pre intervention (***p***=0.136).But there were a strongly highly statistical significant relation between the two groups post intervention (***p***=0.000). This result was congruent with the expectation to find better knowledge and awareness level regarding osteoporosis. A similar increase of knowledge was reported by the study that reported a high level of knowledge among Saudi females, which was explained by the presence of an osteoporosis awareness and prevention campaign through the Center of Excellence for Osteoporosis in King Abdul-Aziz University women (Shawashi1& Darawad1, 2020)

This result was supported by John& Kibusi, (2020), who revealed that continuous education helps in the early prevention and management of preeclampsia for improving maternal and neonatal survival. This study result was supported by several studies (Abushaikha ,et al. (2016), Chan, et al. (2015), El-Sayed & Abdel, (2013) & Turner, et al. (2014) that have already been conducted on osteoporosis preventive interventions using this model, in most of which knowledge improved after the intervention .In addition, this study finding was in agreement with Mohamed, et al. (2020) who reported that education based on HPM was proved to be effective in the prevention of disease during pregnancy in the intervention group and the intervention improves the compliance to treatment and showed higher recovery among the studied pregnant women compared to the control group.

Moreover, this result is supported by Masso-Calderón, et al. (2016) who studied the effect of educational intervention on breast self- examination, breast cancer prevention-related knowledge, and healthy lifestyles in scholars from a low-income area in Bogota, Colombia, and found that knowledge of the breast self-examination technique significantly increases across all measurements with P value less than 0.0001.

This study finding explained by the researchers' opinion may be attributed to the effect of using educational program among study group that attain knowledge and proper self-care practices and life style modifications. From the researchers' point of view, these results could relate to the effect of education on the human being, as education improves the level of knowledge, especially if it is continued .This indicates the importance of educating females regarding such an important topic. So, the findings of this study indicated that the HPM was successful in increasing knowledge of osteoporosis ($p < .05$) this may be due to increasing self-efficacy of women so that they have a strong commitment to conducting behaviors to prevent osteoporosis. This is confirmed the importance & success of the HPM in improving the knowledge of women regarding prevention of osteoporosis.

The current study revealed that there was visible improvement in women beliefs of study group than in control group. With the mean scores of beliefs in the study group largely increased from (30.64 ± 4.23) to (70.01 ± 10.30), while the mean

score in control group slightly increased from (29.42 ±5.84) to (31.95 ± 6.54).So the present study showed that there was a highly statistical significant relation for women in the study group regarding their belief (p=0.000), while there was no statistical significant relation for women in control groups pre intervention (p=0.298). So the study findings showed that there was no statistical significant relation between women in both groups before intervention (p=0.744). But there was a highly statistical significant relation between women in the two groups post intervention (p=0.000).This study findings was congruent with the expectation to find better beliefs regarding osteoporosis.

The results of our study were consistent with the previous studies Ghaffari, et al. (2012) & Ziccardi, et al. (2020) who found perceived barriers including calcium intake and exercise behaviors were reduced by education. Moreover, this result is supported by Drieling, et al. (2017) who reported that exercise barrier beliefs of the women in the intervention group were lower than those in the control group after education. Interestingly, Abushaikha, et al. (2016), Chan, et al. (2015), El-Sayed& Abdel, (2013)&Turner ,et al. (2014).In this study, a significant increase was seen in the women' belief of perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise, and perceived benefits of calcium intake to prevent osteoporosis among the intervention group, besides it was seen that perceived barriers of calcium and perceived barriers of physical activity were low after the intervention ($p < .05$).

Several studies showed that the health behaviors of women about osteoporosis significantly increased after intervention Al-Otaibi, (2015), Edmonds, et al. (2012), Elsabagh, et al. (2015), Evenson & Sanders, (2016) & Ford, et al. (2011) Furthermore, Kazemi, et al. (2011) found that implementing the educational intervention based on health belief model was effective in preventive behaviors of pregnant women and modifying the pregnant women's beliefs. This study findings was contradicted with Zhang, et al. (2018) found that education could not change the physical activity and nutrition barriers, though the subjects were young, also, in a different study performed by Puttapitakpong, et al. (2019), the women did not seem to have appropriate osteoporosis preventive behaviors.

The current study revealed that self-efficacy scores increased in women of study group than in control group ,with the mean scores in the study group largely increased from (7.79 ± 1.47) to (14.40 ± 2.77),while the mean score in control group slightly increased from (8.25 ± 2.89) to (9.54 ± 1.97). So the present study showed that there was a highly statistical significant relation for women in the study group regarding their self-efficacy (p=0.000), while there was no statistical significant relation for women in control groups pre intervention (p=0.793).So the study findings showed that there was no statistical significant relation between women in both groups before intervention (p=0.065) but there was a statistical significant relation between women in the two groups post intervention (p=0.031).

This study finding is congruent with Kaveh, et al. (2018) who 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. In the same line with Ali, et al. (2019) who reported that the mean scores of self-efficacy in his study showed that both groups had low

ability to control diet and walk, before intervention .While, after the intervention, the mean score of self-efficacy increased significantly in the experimental group.

This study finding inconsistent with those of Jessup, et al. (2017) and Aree and Petlamul, (2018) who found that participants reported less self-efficacy concerning exercise and calcium intake. From the researchers' point of view this may be due to women who have high self-efficacy and believe that they can achieve what they want, are highly effective and healthy. Thus, efficacy can play an important role to assist women in adopting or maintaining healthy behaviors.

Regarding women in the study group the current study showed that there was a highly statistical significant positive correlation between women's level of knowledge, beliefs and self-efficacy score post intervention. That means women with high level of knowledge were having good beliefs and enhancing self-efficacy, which indicated that increasing women's knowledge is the first step towards promoting positive health behaviors in order to enhance self-efficacy. Women who had good knowledge associated with proper self-care and life style change or modification, reduces the physical, psychological, emotional, and social problems.

In the same line, AbdElgaffar and Atia, (2018) & Zarshenas, et al. (2017) revealed a statistically significant relation between total knowledge and belief, with P value less than 0.048. Despite this, some studies Drieling, et al. (2017); Ziccardi, et al. (2020) reported that high OKT score was not associated with osteoporosis health beliefs and preventive behaviors among women.

The current study revealed that there were significant correlations between calcium and vit.D levels and women' knowledge and beliefs in the study group while, there were no significant correlation between BMD, self -efficacy score and women's knowledge and believes in the same group. This study result may be explained that the study women who were applied the educational program according to HPM and follow instructions found in the booklet, this lead to improvement of their knowledge and believes about osteoprosis life style which in turn improve calcium and vit D level in the body and lead to better clinical outcome. In the same line with Evenson & Sanders, (2016) who found that implementing the educational intervention based on health belief model was effective in preventive behaviors of pregnant women and modifying their beliefs. While, this study results contradicted with, Khoshnood, et al. (2019) and El-Sayed and Abdel (2013), who stated that there is no significant change between groups for unhealthy behaviors (especially low calcium intake) after osteoporosis education.

This study finding could be related to the effective relation between the level of knowledge and belief, as well as, when knowledge increases, belief improves. This indicated that modifiable lifestyle at an early age will have a greater impact on the prevention of osteoporosis, which include health education and promotion programs such as increasing calcium intake and physical activity should be emphasized for bone health maintenance.

So The HPM indicates that education was effective in changing the behaviors of women to reduce the risk for osteoporosis. This result was expected, so that the

hypotheses of the research have been proven .Finally, the study findings supported the research hypothesis which confirmed that health promotion model and self-efficacy based education intervention had statistical significant positive effect on women's knowledge and beliefs regarding osteoporosis. Because it was proofed that the women in study group who received health promotion model and self-efficacy based education intervention reported high level of knowledge, belief , increase in their self-efficacy score and better clinical outcomes, versus women in control group who don't receive it.

So, the health promotion model could be used as a theoretical framework to collect descriptive information on the level of self-efficacy that Egyptian women possess relative to their risk for developing osteoporosis. Furthermore, implementing the educational intervention based on health promotion model was effective in preventive behaviors of women and modifying their beliefs.

Conclusion

Based on the findings of the current study, it can be concluded that the health promotion model based educational intervention had a statistical significant positive effect on increasing women's knowledge, beliefs, self-efficacy, clinical outcomes and risk reduction behaviors to prevent osteoporosis. More importantly, there was a highly statistical significant positive correlation between women's level of knowledge, beliefs and their self-efficacy score post intervention.

Recommendations

Recommendations can be classified as those pertaining to the patients and public at large and those pertaining to further researches:-

1) Health providers should focus more extensively on the health promotion and more high-quality research with comprehensive design.
2) Therefore, future studies must be based on targeting healthcare professionals, especially nurses in healthcare centers and nursing schools, to engage them in education efforts regarding osteoporosis.
3) Efforts should be made to raise the level of osteoporosis awareness among women.
4) Educational programs and mass media should provide more information based on scientific knowledge about osteoporosis to female individuals.
5) Health promotion program could be used as a model for promoting a healthy lifestyle to prevent osteoporosis.

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