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Amoebiasis is a potentially severe and life-threatening infection caused by an enteric protozoan. During pregnancy, the amebic disease appears to be more frequently associated with low immunity

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Knowledge and behavior of Saudi women regarding osteoporosis prevention based on the health belief model

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ABSTRACT

Osteoporosis remains a global health problem. An osteoporosis-related fracture associated with significant morbidity, mortality, and health care costs. Bone health is becoming a serious concern in the kingdom as the prevalence of osteoporosis is expected to

increase in Saudi Arabia where hereditary background, nutrition, and geographical location have been identified as predisposing factors for osteoporosis, so the health belief model is a useful and effective model that can be also utilized to design intervention programs to improve osteoporosis preventive behaviors. *Aim:* to evaluate the knowledge and preventive behavior of Saudi women regarding osteoporosis in Tabuk city. *Design:* the descriptive design was used to achieve the aim of this study. *Setting:* This study conducted at five colleges of Tabuk University, the female section (science, applied medical sciences, home economics, business administration, sharia and systems). Sample: Simple random sample 25% about (5 colleges) of the total 20 Tabuk University colleges then all working women in the selected college (71) were taken according to inclusion criteria. Two tools of data collection were used; 1) self-administrated questionnaire sheet: It includes socio-demographic data, health history and knowledge assessment 2) modified likert scale: to assess the health belief model constructs, using a 5-point Likert scale. *Results:* The findings revealed that 69 % of the women had unsatisfactory knowledge regarding osteoporosis and the mean scores of cues to preventive action and perceived susceptibility was 25.5 ± 3.37 and 11.91 ± 2.04 respectively, also a significant positive correlation between total scores of knowledge, perceived barriers, cues to preventive action & perceived severity constructs. *Conclusion & recommendation*: Most of the Saudi women in Tabuk city have unsatisfactory knowledge regarding osteoporosis prevention; the study confirms the efficiency of the health belief model in improving preventive behaviors of osteoporosis. Therefore, health education programs based on the health belief model are important for Saudi women in Tabuk city to improve their knowledge & behavior toward the prevention of osteoporosis.

Keywords: Knowledge, Behavior, Osteoporosis, health belief model

1. BACKGROUND

Osteoporosis is a health threat concern and common bone disease around the world that characterized by low bone mass and degenerative changes to skeletal bone tissue microstructures. Nearly 61 million people across the world suffer from osteoporosis by 2020 (Zhang et al., 2014 & Puttapitakpong et al., 2014). Osteoporosis can occur in people of any age, but it's more common in women. In previous studies, the levels of osteoporosis and osteopenia in Turkey were 27%–33.3% (Tüzün et al., 2012). Morocco was 31%, Egypt was 28.4%, Bahrain was 27.1 and also The United Arab Emirates was 2.5% (El-Hajj et al., 2011). Modifiable risk Factors related to the progress of osteoporosis include unbalanced diet, low calcium intake, low vitamin D, sedentary lifestyle and smoking. Previous studies have shown there is a high prevalence rate of vitamin D deficiency in Saudi, women that act as predisposing factor for developing osteoporosis (Oommen et al., 2014).

Osteoporosis causes a lot of complications. The most common complication is fractures. Other possible complications include loss of height, stooping posture, loss of independence, isolation, persistent back, neck pain, chronic pain syndrome, and increased mortality (Swaim et al., 2008). Bone mineral density test (BMD) is used as an indirect indicator for diagnosis of osteoporosis and fracture risk. It is frequently used as an estimation measure for bone strength. Reducing the risk of osteoporosis and related fractures requires prevention and management strategies through early diagnosis are evaluated as a more effective, easier and more cost-effective approach than treating and treatment of people especially women with osteoporosis by correction ways of the quality of life (Karimi et al., 2017 & Tezcan et al., 2012). Proper knowledge can influence the adoption of preventive and screening behaviors by educating young people to adopt simple but effective preventive behaviors that include adequate calcium intake, regular physical exercise & receiving proper sunlight for vitamin D production in the skin (Mousavias et al., 2016 & Hossein, 2014). Osteoporosis is a silent disease that needs awareness to be raised among women to teach young women the risks of osteoporosis and ways to help preventing it (Puttapitakpong et al., 2014).

The models aim to identify and understand the modifiable factors for osteoporosis prevention and management; however, it is clear they require different approaches to target behavior change and to determine how these factors work (Barnhoon et al., 2008). The models also offer suggestions that can be effective on elements of behavior in a variety of conditions. One of the most effective models of health education is Health Belief Model (HBM) that plays a role in preventing diseases and unhealthy behaviors and it is based on individuals' motivation for action (Reynolds et al., 2016). Health Belief Model (HBM), which was the theoretical framework for this study, is one of the theoretical models that explain factors influencing healthy behavior and evaluating osteoporosis health beliefs and behaviors (Moodi et al., 2011). It has been constructed from six domains. These domains are perceived severity, perceived susceptibility, perceived benefit, perceived barriers, cues to action and perceived self-efficacy (Babatunde et al., 2012).

HBM postulates that individuals' participation in certain actions for prevention, early detection, and management of a particular health condition is conditioned by their perception and believe that they are susceptible to such condition even if they are

asymptomatic (perceived susceptibility); understand that the disease is a grave public health problem which can lead to serious complications (perceived severity); believe in the benefits of the recommended preventive actions (perceived benefits); and also understand that these benefits outweigh the expected barriers associated with such actions (perceived barriers). Thereafter, they believe that they possess the motive for living a healthy lifestyle and the required ability to perform these preventive behaviors (self-efficacy). Moreover, the model supposed that cues to action can act as behavior stimuli which may be divided to internal (e.g., past history for the disease) or external (e.g., mass media, health team) which additional increased the possibility of engaging in such preventive health behaviors (Ghanbary et al., 2015; Chanay & Anderson, 2016).

Significance of the study

Osteoporosis remains a major threat to women health associated with significant morbidity, mortality, and health care costs. The suggestion of establishing a fracture lia is on service in Saudi Arabia (AL Wahhabi, 2015). A study conducted in Riyadh city has shown that the prevalence of osteoporosis was 25 % of Saudi females, which stated that Saudi women are having vitamin D deficiency and osteoporosis more than other countries, that probably due to inappropriate sun exposure and diet (ALHaydhal, 2016).

The international osteoporosis foundation stated that the annual rate of fractures caused by osteoporosis and related costs will increase by about 50%, by the year 2025 (Sabin & Sarter, 2015). In Saudi Arabia the overall country prevalence of osteoporosis was 23% –24% (El-Hajj et al., 2011). Epidemiological studies showed that 34% of healthy Saudi women 50-79 years of age are suffering from osteoporosis. The prevalence of osteoporosis is expected to increase as the life expectancy in the kingdom is increased. Modifiable Risk Factors play a major role in the increasing prevalence of this disease as low calcium intake, physical inactivity, poor nutrition habits and a higher prevalence of vitamin D deficiency was being among the main causes and also bone health is becoming a serious concern in the kingdom (Sadat et al., 2012 & AL Wahhabi, 2015).

Aim of the study

To evaluate knowledge and behavior of Saudi women regarding osteoporosis prevention based on the health belief model. It will be done through:

1. Assess women 'knowledge regarding osteoporosis and health history
2. Assess preventive behavior regarding osteoporosis based on the health belief model.
3. Assess the relationship between women' knowledge and health belief model constructs.

Research questions

The main aim of the study is to address the following research questions

1. What is the level of knowledge of Saudi women toward osteoporosis?
2. What are the preventive behaviors of Saudi women regarding osteoporosis based on HBM?

2. SUBJECTS AND METHODS

Research Design

Descriptive design was used to fulfill the aim of this study.

Setting

The study was conducted at five colleges of Tabuk University, female section (Science, Applied Medical Sciences, Home economics, Business Administration, Sharia and Systems)

Subjects

Subject Type and Criteria

Simple random sample 25% about (5 colleges) of the total 20 Tabuk University colleges was selected randomly then all working women in the selected colleges were taken according to:

Inclusion Criteria

Females aged 30-50 years old, free from rheumatoid disease, osteoporosis, and mental illness, and accepted to participate in the research.

Subject Size

The study sample included all working women in the selected college (71) were taken according to inclusion criteria.

Tools of Data Collection

Two tools were used for collecting data

First tool

Self-administrated questionnaire sheet: it was developed by the researchers in Arabic language after reviewing related literature. It involved three main parts:

Socio-demographic data as (age, residence, social status, number of children, level of education

Health history of osteoporosis as (Family history, cessation of menstruation and history of bone densitometry)

Assessment the knowledge of women regarding to osteoporosis prevention as (definition, sign and symptoms, complications, investigations, treatment and preventive measures)

The scoring system for questionnaire sheet was calculated for each item as follows: correct answer was scored (two points), the incomplete answer was scored (one point), while unknown or incorrect answer was scored (zero). The total score for all questions related to knowledge was satisfactory if the percent score was ≥ 60% and poor if less than 60%.

Second tool

Modified likert scale: It consisted of 23 questions related to the health belief model constructs which are further divided into perceived susceptibility (3 questions), perceived severity (5 questions), perceived barriers (4 questions), perceived benefits (5 questions), and cues to action (6 questions).

Scoring system for questionnaire sheet was calculated for each item as follows: Each item in the scale is scored in 5-point likert scale ranging from (strongly agree = 5, agree = 4, no idea = 3, disagree = 2 strongly disagree = 1). The minimum total score is 23 and the maximum is 115 higher total scores indicate higher preventive behavior. The women score were classified as follows:' poor preventive behavior was less than 50% represent >58 marks, average preventive behavior of women equal 58 marks, good preventive behavior of women was more than 50% present<58 marks.

Methods

The study was executed according to the following steps

Approvals

Written official approval to conduct this research was obtained from the responsible authorities of Tabuk University. Also, written & oral informed consent was obtained from all from women before conducting the interview and after giving an explanation of the purpose of the study. The woman was reassured that all gathered information is confidential and used only for the purpose of the study. Each woman had the right to withdraw at any time from the study without giving any reasons and informed that the study will be not having any physical, social, or psychological risks.

Tools Reliability & Validity

The tools were reviewed for appropriateness, completeness, and legibility by an expert panel consisting of five community health nursing experts. The panel ascertains the face and content validity of the tools. The reliability was done by using Cronbach's Alpha coefficient test which revealed that each of the three tools consisted of relatively homogenous items as showed by the moderate to the high reliability of each tool. The knowledge internal consistency was 0.81; the total 23-items HBM was 0.91, with breakdowns by category: 0.62 (perceived susceptibility), 0.73(perceived severity of the disease), 0.76 (perceived benefits of osteoporosis prevention), 0.96 (perceived barriers of osteoporosis prevention), and cues to preventive action was 0.89.

Pilot Study

A pilot study was carried out on 10% of the sample of women that was excluded from the main sample with the main purpose to test the relevance and applicability of the tools.

Procedures

The previous settings were visited by the researchers two days/week according to the free time of the women. The researchers interviewed each woman after ensuring her health status, explained the aim of the study, and asked for participation. After taking consent, women were asked to fill the questionnaire. Average time for the completion of the questionnaire and the Likert scale was. (25-30 minutes). These phases were carried out from the beginning of March 2018 to the end of November 2018, covering over a period of 9 months.

Statistical Analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS version 20.0) Descriptive statistics were used to describe characteristics of the study subjects (e. g. frequency, percentages, mean, and standard deviation). Test of significance (Pearson correlation coefficient test & one sample t test) was used. Correlation coefficient was calculated between the total knowledge score and total HBM four main constructs regarding osteoporosis prevention. A statistically significant difference was measured at p-value ≤ .05.

3. RESULTS

Table 1 Distribution of the studied women according to their demographic characteristics (n = 71)

Items	No	%
Age:		
30-40	57	80.3
41-50	13	18.3
51-60	1	1.4
Mean ± SD 36.6 ± 5.31 years		
Place of residence:		
Rural	8	11.3
Urban	63	88.7
Social status:		
Single	6	8.5
Married	54	76.1
widow	4	5.6
Divorced	7	9.9
Number of children :		
No	6	8.5
1-3	40	56.3
4- 6	20	28.2
7 and more	5	7.0
Level of education:		
Higher education	48	67.6
Above intermediate education	20	28.2
Intermediate education	3	4.2

Table (1) shows the demographic characteristics of the studied women. It was clear that the majority of studied women's age ranged from 30- 40 years, with a mean of age 36.6 ± 5.31 years. As regard, their social status, 76.1% of them were married. Furthermore, 56.3% of them had three children, also nearly two thirds (67.6 %) of them were with a high educational level. In addition, the most (88.7%) of them were living in urban areas.

Table (2) clarifies the health history of the studied women. It was clear that 88.7% of the studied women didn't have family history of osteoporosis. A point of concern about the degree of kinship is that 9.9 % out of 11.3% of the women who had family history of osteoporosis had sisters affected with osteoporosis. In addition, all (100.0%) of studied women didn't have a history of cessation of the menstrual period but more than three- quarters of them (84.5%) had a number of pregnancies, Moreover, 97.2 % of them did not have a history of bone densitometry.

Table 2 Distribution of the studied women according to their health history (n = 71)

Items	No	%
Family history of osteoporosis.		
Yes	8	11.3
No	63	88.7
The degree of kinship.		
No	63	88.7
Mother	7	9.9
Sister	0	0.0
Daughter	0	0.0
Grandma	1	1.4
Aunt	0	0.0
Cessation of menstrual period.		
Yes	0	0.0
No	71	100.0
number of pregnancies		
Yes	60	84.5
No	11	15.5
History of bone densitometry		
Yes	2	2.8
No	69	97.2

Table 3 Percent distribution of the study subjects according to their knowledge regarding osteoporosis prevention (n=71).

Items	Unknown		Incomplete answer		Correct and complete answer	
	No	%	No	%	No	%
Definition of osteoporosis	3	4.2	67	94.4	1	1.4
Risk factors of osteoporosis	9	12.7	38	53.5	24	33.8
Signs &symptoms of osteoporosis	66	93.0	3	4.2	2	2.8
Complication of osteoporosis	18	25.4	41	57.7	12	16.9
Investigations of osteoporosis	6	8.5	48	67.6	17	23.9
Treatment of osteoporosis	7	9.9	48	67.6	16	22.5
Preventive measures of osteoporosis	11	15.5	39	54.9	21	29.6

Table (3) illustrates that the percent distribution of the study subjects according to their knowledge regarding osteoporosis prevention. It was found that 94.4 % reported incomplete answers about the definition of osteoporosis while only 1.4% of studied women reported correct and complete answers for the same items. Concerning symptoms of osteoporosis, 93.0% of studied women were unknown. In addition, more than half (53.5% and 57.7%) of studied women reported incomplete answers in relation to risk factors of osteoporosis and complication of osteoporosis respectively. Moreover, 67.6% of them reported an incomplete answer for investigations and treatment of osteoporosis.

Figure 1 clarifies the distribution of the study subjects according to their sources of knowledge about osteoporosis. It shows that 28.1% of studied women get information about osteoporosis from mass media. Moreover, 26.7 of them get information from surrounding people like family and relatives and from the health care teams like doctors or nurses respectively. While only 18.3% get information from reading books.

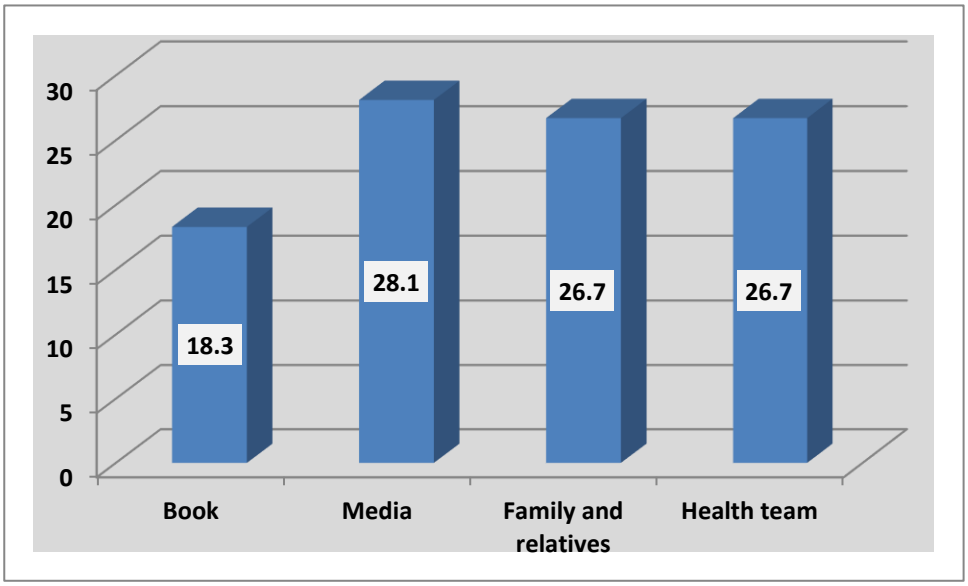

Figure 1 Distribution of the study subjects according to their sources of knowledge about osteoporosis prevention (n=71).

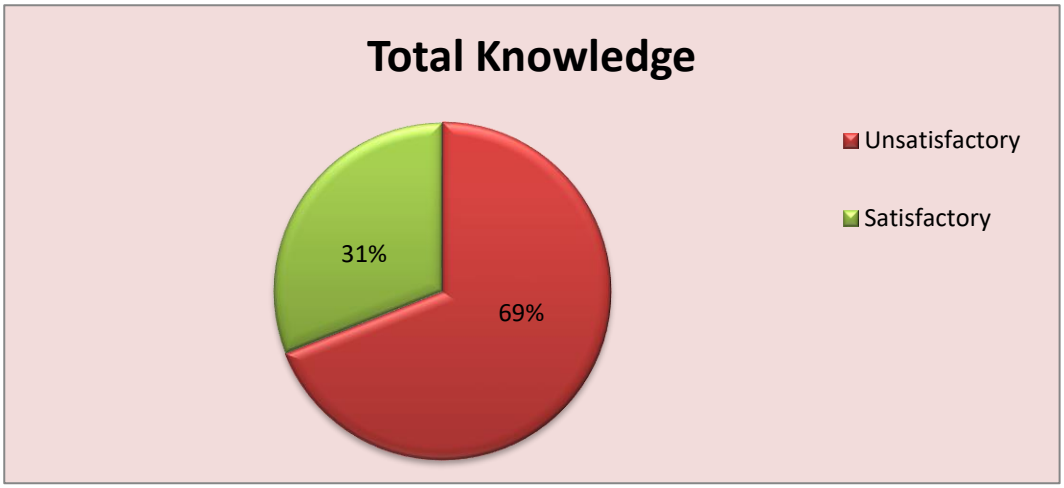

Figure 2 Distribution of the study subjects according to their total knowledge score regarding osteoporosis prevention (n = 71)

Figure 2 clarifies the distribution of the study women according to their total knowledge score. It shows that 69 % of the women had unsatisfactory knowledge regarding osteoporosis. While 31% of them had satisfactory knowledge level.

Table 4 Mean differences of the studied sample regarding HBM main four constructs regarding osteoporosis prevention (n=71).

HBM main four constructs (maximum score)	Mean ±SD	One sample t- test	P-value
Perceived susceptibility (15.00)	11.91 ± 2.04	49.201	.000
Perceived severity (25.00)	19.1 ± 3.08	52.168	.000
Perceived barriers (20.00)	14.49 ± 2.21	55.108	.000
Perceived benefits (25.00)	19.74 ± 2.84	58.543	.000
Cues to preventive action (30.00)	25.5 ± 3.37	63.981	.000
Total score (115.00)	90.85±7.72	99.09	.000

Table 4 shows the distribution of the study subjects according to HBM's main four constructs. It was found that the mean scores of cues to preventive action and perceived susceptibility were 25.5 ± 3.37 and 11.91 ± 2.04 respectively, while the mean score for perceived severity was 19.1 ± 3.08 with highly statistically significant difference (P ≤ 0.001).

Table 5 Correlation coefficient between the total knowledge and total HBM four main constructs regarding osteoporosis prevention (n=71).

Health believe model four constructs	Total Knowledge	
Perceived susceptibility	Pearson Correlation	0.07
	P-value	0.56
Perceived severity	Pearson Correlation	0.34
	P-value	.001**
Perceived barriers	Pearson Correlation	0.22
	P-value	0.05*
Perceived benefits	Pearson Correlation	-0.02-
	P-value	0.86
Cues to preventive action	Pearson Correlation	0.21
	P-value	0.05*

** Correlation is highly statistically significant at P ≤ .001

* Correlation is statistically significant at P ≤ 0.05

Table 5 indicates a highly statistically significant positive correlation (P ≤ 0.001) between total scores of knowledge & perceived severity construct. Moreover, a significant positive correlation (P ≤ 0. 05) was detected between perceived barriers, cues to preventive action & total studied women's scores of knowledge, while no significant correlation between total studied women's scores of knowledge & perceived susceptibility or perceived benefits constructs.

4. DISCUSSION

This study showed that a key prevention method for osteoporosis is that of community-based prevention strategies using a behavior change model, like HBM. Studies that have investigated preventive measures concerning osteoporosis have shown that awareness can be a fundamental aspect of guiding its prevention and indicated that up to one-eighth of Saudi nationals are in the dark regarding the disorder, making its prevention quite hard (Aladwani et al., 2019). Osteoporosis includes some controllable risk factors include a deficiency of physical activity, positive family history of osteoporosis, low body mass index (BMI), sedentary lifestyle, smoking, alcohol consumption, and an unbalanced diet that can aid in prevention (Idrees et al., 2018). In relation to the health history of the participants, it was clear that 88.7% of the studied women didn't have family history of osteoporosis & the majority of them did not have a history of bone densitometry. This was consistent with (Jeihooni et al., 2016). They investigate the effect of a walking education program based on the HBM on osteoporosis among women from health centers of Fars Province, Iran. Found that a history of osteoporosis in the family was (8.3%) of the experimental group and (13.3%) of the control group. Also, the history of bone densitometry was only (8.3%) of the experimental group and (11.7%) of the control group.

On the other hand, this finding was not in agreement with (Yekefallah et al., 2019). Found that 73.3% of a sample of women of reproductive age in Qazvin-Iran had a positive family history of osteoporosis. Also, the study by Bilal et al., 2017 who assess knowledge, beliefs and practices concerning osteoporosis among female medical school in Pakistan". Found that family history of osteoporosis was considered as a risk factor by (36.0%) of subjects. This conflict between both of two studies and our results is due to social, cultural and educational differences between study subjects. Concerning the knowledge regarding osteoporosis, this study revealed that, more than two -thirds of the women had unsatisfactory total knowledge regarding osteoporosis. Only 310% of them had satisfactory knowledge. These results were in the same line as (Al Seraty & Ali, 2014). They determine the impacts of intervention based HBM for prevention of osteoporosis among female students in Applied Medical Science, Shaqraa University, Saudi Arabia. Furthermore, Alshareef et al., (2018) evaluate the knowledge and awareness about risk factors of osteoporosis amongst young college women at a university in Riyadh, KSA Found that their knowledge about osteoporosis was 79.4% of the 1012 subjects questioned that reflect an insufficient amount of knowledge about the disease. In addition, Alamri et al., (2015) conducted a study in different regions in the Kingdom of Saudi Arabia in which 78% of the participant never heard of osteoporosis.

These findings also agree with at least six other researches. *First,* Hossein, 2014 had assessed "knowledge, practices and prevention among female adolescents in El-minia, Egypt". Reveals a lack of awareness about osteoporosis among female adolescent, hence the findings highlight the need for educational interventions to promote female adolescents' knowledge about osteoporosis.

Taking steps to prevent osteoporosis early in life is vital. *Second*, Ghaffari et al., (2012) who had conducted a study entitled "Effect of HBM based intervention on promoting nutritional behaviors about osteoporosis prevention amongst students in Isfahan, Iran". It was shown that the awareness of individuals about osteoporosis was low (35.80). *Third*, previously mentioned Bilal et al., (2017) their study indicated that knowledge about osteoporosis amongst the participants was limited and only 8.0% of them attained a high score on the knowledge. *Fourth*, previously mentioned (Mousavias et al., 2016) Found that the knowledge of students in the experimental group is poor before intervention application. *Fifth,* (Senthilraja et al., 2019) found in their cross-sectional study at teaching hospital in southern India. This study revealed deficiencies in awareness of osteoporosis in Indian postmenopausal women. Overall about 60% had poor awareness about osteoporosis and recommended a need to prioritize designing appropriate awareness campaigns in subjects at risk. *Sixth*, (Hosking et al., 2015) study knowledge change regarding osteoporosis prevention. Both of previous studies were consistent with our results.

On the contrary, the study by (Idrees et al., 2018) conducted a study at Rawalpindi, Pakistan; found that the majority of respondents showed awareness of osteoporosis knowledge among female adolescents regarding osteoporosis and its related consequences. Furthermore, a study from Malaysia (Khan et al., 2014) Showing those women were well knowledgeable about osteoporosis. Overall, the probable reasons for lower awareness on osteoporosis in particular could be low health extension workers' education, weak health institution linkages. Concerning sources of knowledge about osteoporosis, it is obvious from the current study that the mass media is the primary source of knowledge for the study subjects about osteoporosis. This was in agreement with (Yekefallah et al., 2019 & Idrees et al., 2018). The former, found that the majority of women used the internet, radio, and television to obtain information about osteoporosis. *The latter*, found that the best source of information was stated to be television (44.8%) and the internet. In addition, previously mentioned (Puttapitakpong et al., 2014) found that total knowledge about osteoporosis that young women teach from television and the internet. Furthermore, previously mentioned (Alshareef et al., 2018) found that social media is the most used source of information among participants (55.4%). Also, television is the best source to spread awareness among literate and illiterate people equally, which corresponds to a study from Egypt by (El-Tawab, 2016). On the contrary, these findings weren't in the same line as (Jeihooni et al., 2016). In this study, external cues for the subject's included family, friends, physicians, and health workers. These cues have an influential role as a source of information and support for walking behaviors and for providing resources and guidance people need to assess bone density leading to doing or not doing a behavior.

Cues of actions are social factors in the HBM and refer to perceived social pressures leading to doing or not doing a behavior. It was clear from the current study that, the mean scores of cues to action and perceived susceptibility were 25.5 ± 3.37 and 11.91 ± 2.04 respectively. This means that the understanding of the risk factors that can cause osteoporosis is good in our study and reflects that although women have the desire to follow preventive measures through cues to action as they perceived susceptibility of these measures but their preventive practices were poor as found in our study that 97.2 % of women did not have a history of bone densitometry. This was in agreement with the study of (Al- Muraikhi et al., 2017) that assesses the knowledge of osteoporosis risk factors and preventive practices among women of reproductive age in the state of Qatar, found that although women's overall knowledge score of osteoporosis was 61.4%. Furthermore, they perceived susceptibility of osteoporosis but only one - third of them participated in regular physical exercises. In addition, (Malak & Toama, 2015) who evaluate the effect of osteoporosis an educational program towards osteoporosis based on HBM on knowledge and health beliefs among Jordanian female teachers. Found that before the educational program the study population demonstrated a quite high level of health motivation. This indicated that there are cues towards increasing participation in preventive health care.

On the other hand, this result contradicts with the other two studies by (Hurst & Wham, 2007) and (Al- Muraikhi et al., 2017). *The former,* found that the perceived susceptibility in a survey conducted in New Zealand was low. *The latter,* in his study to assess health beliefs about osteoporosis among women attending primary health care centers in Qatar. Found that perceived susceptibility to osteoporosis with a mean score of 4.3 ± 0.9. In addition, a study among the female medical school of the Faculties of Medicine, at Colombo and Kelaniya by (Silva, 2015) found that perceived susceptibility for osteoporosis was low. The possible explanation for this low level of perceived susceptibility and difference could be the absence of any symptoms of osteoporosis, where most individuals do not perceive themselves at risk of a disease until they begin to experience the clinical picture of the disease because osteoporosis prevalence is much higher after menopause, it was not surprising that most of the women did not perceive they were at risk. The study findings reveal that the mean score of perceived benefits & perceived severity was 19.74 ± 2.84 and 19.1 ± 3.08 respectively. This was consistent with the study of (Sobeih & Abd Elwahed, 2018). They assess knowledge and perception of women at risk for osteoporosis in educational intervention and found that perceived benefits of exercise were 0% of the sample and 10% as regards seriousness of disease development and benefits of Ca+ intake before application of the program. Also the previously mentioned (Silva et al., 2015). Found that perceived seriousness of osteoporosis, less than half of the sample felt that if they had osteoporosis, their whole life would be changed.

On the contrary, (Ghaffari et al., 2012) *the former,* that determine the impact of education using the HBM on preventing osteoporosis among female students in Tehran. Found that perceived benefits of calcium intake and physical activity were high before and after the intervention. *The latter,* (Sava et al., 2020) Participants in his study of osteoporosis knowledge and health beliefs among female community leaders in peru, reporting higher perceived benefits of calcium also more likely to have higher osteoporosis knowledge scores ($p < 0.05$). Furthermore, previously mentioned (Malak & Toama, 2015) found perceived benefits of calcium intake and physical activities were high both before and after the program among the control and the intervention groups. The difference could be explained regarding the different places of the studies and type of sample. Additionally, the mean scores of the perceived barriers in our study were 14.49± 2.21. Perceived barriers refer to negative aspects of participating in a health-promoting behavior. Thus, in the context of osteoporosis prevention, the perceived barriers will be the time and money spent on a bone density scan (Kim et al., 2017). This was in the same line with (Sanaeinasab et al., 2014) who found that the majority of the teenagers were in the group low perceived calcium intake barriers. In addition, studies by (Ghaffari et al., 2012 & Torshizi et al., 2009) go in the same line with the present study. *The former,* study the effect of HBM - based intervention on promoting preventive behaviors about osteoporosis among students of female middle schools in Isfahan, Iran. *The latter* assesses the effect of education-based on the HBM on preventive factors of osteoporosis among postmenopausal women. Both of the two studies found low perceived barriers. Additionally, previously mentioned (Sava et al., 2020) found high levels of health motivation and lower levels of perceived barriers toward behavioral change among the study group.

Our study findings indicate a highly statistically significant positive correlation ($P \leq 0.001$) between total scores of knowledge & perceived severity construct. Also, a significant positive correlation ($P \leq 0.05$) was detected between perceived barriers, cues to preventive action & total studied women's scores of knowledge. It was observed that with increasing score of the knowledge about osteoporosis, the score of the perceived severity, cues to preventive action & perceived barriers significantly increased, in the same line with this result, (Hosseini et al., 2017). They assess nutritional preventive behavior of osteoporosis in female students: applying HBM. Their study findings showed that the knowledge had a positive and significant relationship with the perceived severity, perceived barriers, cues to preventive action & nutritional behavior. As a consequence, it can be stated that it is helpful to design educational interventions to take advantage based on the mentioned constructs of HBM on implementing osteoporosis preventive behaviors.

The present study illustrated a highly statistically significant positive correlation ($P \leq 0.001$) between total scores of knowledge & perceived severity construct. Also, a positive significant correlation ($P \leq 0.05$) was detected between perceived barriers, cues to preventive action & total studied women's scores of knowledge. This was consistent with (Zareban et al., 2016) found that there was a significant correlation between guidance for action, perceived susceptibility, perceived severity, knowledge and behavior.

5. CONCLUSION

Based on the results of the present study, it can be concluded that, most of the Saudi women in Tabuk city had unsatisfactory knowledge regarding the prevention of osteoporosis and a highly statistically significant positive correlation ($P \leq 0.001$) between total scores of knowledge & perceived severity construct. Also, a positive significant correlation ($P \leq 0.05$) was detected between perceived barriers, cues to preventive action & total studied women's scores of knowledge. This confirms the efficiency of HBM in improving preventive behaviors regarding osteoporosis.

Recommendations

Based on findings of this study, the following recommendations can be proposed:

- Health education programs based on the HBM are important for Saudi women in Tabuk city to improve their knowledge & behavior toward the prevention of osteoporosis.
- Community based education should be continuous to close the gap between knowledge and preventive strategies in adopting health-related behaviors of osteoporosis.
- Replication of the present study on a larger samples, and different settings.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

Ethical committee approval number & details

Ethical approval was received from the Local Research Ethics Committee of Tabuk University under ethical committee approval number (UT-85-17-2019) as found that the research satisfied the requirements of ethical approval criteria according to the rules and regulations of the National Committee of Bioethics.

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Data and materials availability

All data associated with this study are present in the paper.

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