Original Article

A cross-sectional study on knowledge, attitude and practice of osteoporosis prevention in patients with breast cancer undergoing endocrine therapy: A cross-sectional study

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ABSTRACT

Objectives: This study aims to understand the current status of knowledge, health beliefs, and behavior related to osteoporosis prevention in patients with breast cancer during endocrine therapy and to analyze its influencing factors.
Methods: From December 2022 to June 2023, convenience sampling was used to investigate patients with breast cancer receiving endocrine therapy in a Class III Grade A hospital in Shanghai using the general information questionnaire, Osteoporosis-Related preventive Behavior Questionnaire, Osteoporosis Knowledge Questionnaire (OKT), and Osteoporosis Health Belief Scale (OHBS).
Results: Four hundred thirty-five questionnaires were distributed, and 403 valid questionnaires were collected, with an effective recovery rate of 92.6%. OKT failed in 282 cases (70.0%), and the standard score was (52.53 ± 12.01). The standard score of OHBS was (72.46 ± 5.79). The results of univariate analysis showed that age was negatively correlated with daily sunshine time. It was positively correlated with calcium/vitamin D supplementation and bone mineral density measurement. Multiple linear regression analysis showed that age and education level influenced OKT and OHBS scale scores ($P < 0.05$). Pearson correlation analysis showed a significant positive correlation between OKT and OHBS ($P < 0.05$).
Conclusions: Patients with breast cancer with endocrine therapy have poor knowledge of osteoporosis and low levels of health belief, and most of them have wrong prevention behaviors.

Introduction

Breast cancer is a common cancer that affects women's health. In the past 10 years, the incidence rate of breast cancer in China has increased by 37%, the mortality rate has increased by 38.9%,[1] and the number of new cases in China is estimated to be 357,200 in 2022.[2] The incidence and mortality of breast cancer in China have an upward trend, and the disease burden should not be underestimated. Breast cancer is a hormone-dependent tumor, and the growth of tumor cells is affected by hormone levels.[3] Endocrine therapy (ET) is the first-line treatment for patients with hormone receptor-positive breast cancer.[4] The mechanism of endocrine therapy is to block the source of estrogen or signal transduction pathways, reduce the estrogen level, and destroy the endocrine environment required for tumor cell growth to achieve an anti-tumor effect.[5] Endocrine drugs for breast cancer are broadly

classified as Selective Estrogen Receptor Modulators (SERMs), Selective estrogen receptor down-regulation (SERD), Aromatase inhibitors (AIs), ovarian function suppression (OFS) such as luteinizing hormone-releasing hormone antagonists (LH-Rha) and so on.[6] About three-quarters of patients with breast cancer are hormone receptor-positive[7] and receive 5–10 years of home endocrine therapy.

Endocrine therapy can significantly reduce the risk of breast cancer recurrence and metastasis but also cause a series of symptoms, including perimenopausal symptoms, musculoskeletal joint symptoms, cognitive impairment, sleep disorders, fatigue, etc.[8,9] Studies have shown that patients with breast cancer receiving endocrine therapy have decreased estrogen levels, increased osteoclast formation and bone resorption, which affects bone mineral density and bone health.[5] In such patients, abnormal bone metabolism is as high as 60%,[10] resulting in bone loss,

mainly bone and joint pain/stiffness, carpal tunnel syndrome, and other bone and joint symptoms. In severe cases, it can progress to Osteoporosis (OP) and even fracture.[11] Din et al.[12] and Crew et al.[13] found that the incidence of bone and joint stiffness/pain and other symptoms in patients with breast cancer undergoing AIs was 9.9%–47%, and the peak of symptoms appeared around half a year after treatment. Chen Qian et al.[14] and Sun et al.[15] followed up the bone mass loss of patients with early breast cancer during endocrine therapy and found that bone mineral density showed a continuous downward trend during AI treatment, especially in the first year. The lumbar spine was the most common site of OP. The independence of limb function and the quality of life of patients with breast cancer who have undergone surgery are severely compromised, which can be a huge economic burden.[16] Active early prevention is more conducive to improving the quality of life and prognosis of patients with breast cancer with endocrine therapy. Therefore, this study aims to understand the current status of knowledge, health beliefs, and related preventive behaviors of osteoporosis in patients with early breast cancer after endocrine therapy and to analyze its influencing factors. The aim of this study was to provide a basis for bone health management during endocrine therapy in patients with early breast cancer.

Methods

Study design and participants

This is a cross-sectional study. A convenience sample of women with breast cancer were selected which treated in the breast cancer endocrine therapy clinic of a Class III Grade A hospital in Shanghai from December 2022 to June 2023. Investigators searched for suitable patients by screening lists of daily clinic visits, obtaining patient names and other information. The authors then introduced the purpose of the study to the patients after the visit and invited them to participate in the study.

The inclusion criteria for patients in this study were (1) Age $\geq$ 18 years old; (2) patients with early breast cancer confirmed by pathology, In this study, patients with early breast cancer were defined as those with stage I-III breast cancer; (3) current endocrine therapy; (4) have complete understanding ability, can fill out the questionnaire independently or answer the questions. The exclusion criteria for patients in this study were cognitive impairment, mental disorders, inability to cooperate.

Sample size calculation

The sample size for regression analysis should be 10–20 times the number of independent variables.[17] In this study, the general data included 9 variables, and the osteoporosis prevention behavior questionnaire included 7 variables, for a total of 16 variables. The required sample size was calculated to be at least 160–320 cases. Considering the attrition rate of 20% of the sample size, this study finally determined the sample size of 384 cases.

Questionnaire

General information questionnaire

All of them were self-designed by researchers after a literature review. The patient's general information questionnaire included demographic data and disease-related data. At the same time, we set seven items after the general information questionnaire to measure the osteoporosis related preventive behaviors of patients, including the frequency of drinking coffee/carbonated drinks/tea per week, the frequency of eating calcium-rich foods such as milk, the frequency of weekly exercise, the duration of sunshine per day, whether bone mineral density was examined, and whether taking calcium or vitamin D.

Osteoporosis Knowledge Tests (OKT)

This study used the osteoporosis knowledge questionnaire to evaluate the patients' mastery of osteoporosis-related knowledge Estimates. OKT

was compiled by Kim et al.[18] and translated and revised into Chinese by Chen et al.[19] The OKT consists of three parts: osteoporosis risk factors, exercise knowledge, and calcium knowledge. The questionnaire consisted of 26 questions, and each question was given 1 point for a correct answer and 0 points for a wrong answer or not knowing. The total score ranged from 0 to 26 points. The score was converted to standard score, standard score = score/highest dimension score $\times$ 100, standard score $\geq$ 60 was defined as pass, and standard score $<$ 60 was defined as fail.[20] The Cronbach's α coefficient of each part of the questionnaire was 0.83–0.87,[19] The Cronbach's α coefficient for OKT with the study sample ($n = 403$) was 0.85.

Osteoporosis Health Belief Scale (OHBS)

OHBS was compiled by Kim et al.[18] and translated and revised by Chen et al.,[21] including seven dimensions of movement disorders: health motivation, vulnerability, severity, benefits of calcium intake, barriers to calcium intake, and exercise benefits. Each dimension consists of six items, using Likert1-5 scores, strongly disagree = 1. Disagree = 2 points, neutral = 3 points, agree = 4 points, strongly agree = 5 points. The dyskinesia and calcium intake disorders subscales were scored in reverse. The score was converted into the standard score, standard score = score/highest dimension score $\times$ 100, the higher the total score, the stronger the sense of health belief. The Cronbach's α coefficient of the total scale and each subscale was 0.68–0.85,[21] The Cronbach's α coefficient for OHBS with the study sample ($n = 403$) was 0.83.

Data collection

The study was approved by the ethics committee of Shanghai Cancer Centre, South Fudan University (Approval No. 2010225-12). The researcher explained the purpose of this study to the patients and then issued the questionnaire after the patients had signed the informed consent form. The researcher explained the filling method and precautions of the questionnaire, and the patients filled in the questionnaire faithfully, retrieved it on the spot, and checked it on the place to find out the gaps and fill in the gaps to ensure the quality of the questionnaire. All questionnaires were checked by double entry to ensure the accuracy of the entered data.

Statistical analysis

SPSS 25.0 software was used to establish a database and perform statistical analysis. The number of cases and percentage described enumeration data. The measurement data were expressed as mean $\pm$ standard deviation (Mean $\pm$ SD). Independent t test or one-way analysis of variance was used to compare the differences in OKT score, OHBS score, and osteoporosis prevention behavior among different patients. Multivariate linear regression analysis was used for multivariate analysis. Pearson correlation analysis was used for correlation analysis. $P < 0.05$ was considered statistically significant.

Results

The number of survey participants and response rate

Four hundred thirty-five questionnaires were distributed, and 403 valid questionnaires were collected, with an effective recovery rate of 92.6%. Table 1 summarizes the basic attributes of the participants.

General data

All participants were female. Table 1 summarizes the basic attributes of the participants.

Table 1

Comparison of OKT and OHBS scale scores among different subjects ($N = 403$, Mean $\pm$ SD, score).

Subject	n (%)	OKT	F/t	P	OHBS	F/t	P
Age, years			24.151	0.000		27.555	0.000
< 40	69 (17.1)	59.02 ± 11.40			76.63 ± 5.05		
40–60	233 (57.8)	53.08 ± 10.97			72.09 ± 5.37		
> 60	101 (25.1)	46.83 ± 12.25			70.47 ± 5.85		
Degree of education			−5.470	0.000		−5.057	0.000
High school and below	217 (53.8)	49.61 ± 11.83			71.15 ± 5.67		
Bachelor's degree or above	186 (46.2)	55.95 ± 11.34			73.99 ± 5.57		
Marital status			−0.664	0.507		−3.090	0.002
Married	391 (97.0)	52.42 ± 12.05			72.31 ± 5.77		
Single	9 (2.2)	55.12 ± 12.00			78.30 ± 4.39		
Divorced	3 (0.7)	58.97 ± 5.87			74.60 ± 3.38		
Payment method			−7.718	0.473		0.212	0.832
Medical insurance	336 (83.4)	52.34 ± 12.07			72.49 ± 5.60		
Self-paying	67 (16.6)	53.50 ± 11.76			72.33 ± 6.71		
Chronic diseases			1.572	0.117		1.652	0.099
No	302 (74.9)	53.08 ± 11.75			72.44 ± 5.77		
Yes	101 (25.1)	50.91 ± 12.68			71.64 ± 5.79		
Menopause status			2.157	0.143		2.061	0.152
Yes	212 (52.6)	51.70 ± 11.93			72.07 ± 5.34		
No	191 (47.4)	53.46 ± 12.07			72.90 ± 6.23		
Surgical procedures			0.232	0.793		2.948	0.054
Breast-conserving surgery	133 (33.0)	52.28 ± 12.48			73.46 ± 6.00		
Mastectomy	249 (61.8)	52.53 ± 11.69			71.98 ± 5.61		
No surgery	21 (5.2)	54.21 ± 13.20			71.92 ± 6.04		
Treatment of axillary lymph nodes			0.214	0.807		0.155	0.857
Sentinel lymph node biopsy	179 (44.4)	52.42 ± 12.12			72.60 ± 6.28		
Axillary lymph node dissection	203 (50.4)	52.46 ± 11.84			72.40 ± 5.32		
No surgery	21 (5.2)	54.21 ± 13.20			71.92 ± 6.04		
Endocrine therapy regimens			6.530	0.000		7.744	0.000
AI	175 (43.4)	49.36 ± 12.70			70.90 ± 5.91		
SERMs	93 (23.1)	53.34 ± 11.15			72.83 ± 5.64		
AI + OFS	107 (26.6)	55.85 ± 10.79			73.79 ± 5.19		
SERMs + OFS	24 (6.0)	56.73 ± 9.57			75.83 ± 5.07		
OFS	4 (1.0)	58.65 ± 12.70			76.78 ± 4.01		
Duration of endocrine therapy, years			2.454	0.063		3.468	0.016
< 1	122 (30.3)	53.40 ± 12.37			72.09 ± 6.00		
1–3	87 (21.6)	54.86 ± 11.49			73.33 ± 5.42		
3–5	94 (23.3)	51.06 ± 12.23			73.49 ± 5.66		
> 5	100 (24.8)	50.84 ± 11.55			71.19 ± 5.75		

SERMs, Selective Estrogen Receptor Modulators; AIs, Aromatase inhibitors; OFS, ovarian function suppression; OKT, Osteoporosis Knowledge Tests; OHBS, Osteoporosis Health Belief Scale.

Osteoporosis-related preventive behavior questionnaire

Among the 403 subjects in this study, a high-risk diet, short daily sunshine time, and no exercise habits accounted for the majority, and the implementation of non-drug preventive measures was not in place. In this study, among 151 (37.5%) patients who underwent bone mineral density measurement, 68.9% (104/151) had osteopenia or osteoporosis, and the patients had poor awareness of osteoporosis risk assessment. The osteoporosis-related preventive behaviors of the remaining patients are shown in Table 2.

OKT and OHBS scores of the subjects

Only 30.0% (121 cases) of the patients passed the OKT scale, and the patients had a low mastery of osteoporosis knowledge. The scores of other scales and dimensions are shown in Table 3.

Results- influencing factor analysis

The results of univariate analysis showed that there were statistically significant differences in OKT scores among patients with different ages, education levels and endocrine therapy regimens ($P < 0.05$). There were

statistically significant differences in OHBS scores among patients with different ages, education levels, marital status and endocrine therapy regimens ($P < 0.05$). There were statistically significant differences in daily sunshine time, calcium/vitamin D supplementation and bone mineral density measurement among patients of different ages ($P < 0.05$). See Tables 1 and 4 for details.

Influencing factors: multiple linear regression analysis

Multiple linear regression analysis was performed with OKT and OHBS scale scores as dependent variables and factors with $P < 0.1$ in univariate analysis as independent variables. The results showed that age and education level were the influencing factors of osteoporosis knowledge and health belief, which could explain 11.9% and 12.0% of the total variation. The results of the analysis are shown in Table 5.

Correlation analysis of scale scores

Pearson correlation analysis showed that the osteoporosis knowledge level of patients with breast cancer with endocrine therapy was significantly positively correlated with the health belief level ($r = 0.230$, $P \le 0.001$).

Table 2
Osteoporosis-related behavior questionnaire of the study subjects (N = 403).

Subject		n (%)
High frequency of coffee/ carbonated drinks/ strong tea consumption	< 3 times/week	127 (31.5)
	≥ 3 times/week	276 (68.5)
Foods high in calcium (milk/soy products)	< 3 times/week	245 (60.8)
	≥ 3 times/week	158 (39.2)
Exercise	No exercise habits	142 (35.2)
	< 3 times/week or < 30 min/d	90 (22.3)
	≥ 3 times/week and ≥ 30 min/d	171 (42.4)
Daily sunshine time	< 30 min	184 (45.7)
	≥ 30 min	219 (54.3)
Calcium supplementation	Yes	244 (60.5)
	No	159 (39.5)
Vitamin D supplementation	Yes	235 (58.3)
	No	168 (41.7)
Bone densitometry	Yes	151 (37.5)
	No	252 (62.5)

Table 3
OHBS scores of the study subjects (N = 403).

Dimensions	Original scoring range	Original mean score	Standard score (Mean ± SD)
OKT	0–26	13.33 ± 4.15	52.53 ± 12.01
Risk factor	0–11	5.82 ± 2.17	57.10 ± 19.97
Exercise knowledge	0–7	3.27 ± 1.63	44.73 ± 19.87
Calcium knowledge	0–8	4.25 ± 1.63	59.58 ± 24.19
OHBS	42–210	157.10 ± 18.00	72.46 ± 5.79
Liability	6–30	16.60 ± 6.36	55.88 ± 19.07
Seriousness	6–30	16.75 ± 7.10	55.88 ± 20.47
Benefits of exercise	6–30	24.29 ± 5.03	77.03 ± 15.43
Benefits of calcium intake	6–30	25.78 ± 4.30	81.17 ± 14.25
Dyskinesia	6–30	22.15 ± 6.07	72.60 ± 16.57
Calcium intake disorders	6–30	24.78 ± 4.52	79.66 ± 14.59
Motivation for health	6–30	26.75 ± 2.86	85.03 ± 12.05

OKT, Osteoporosis Knowledge Tests; OHBS, Osteoporosis Health Belief Scale.

Discussion

The results of this study showed that patients had a serious lack of osteoporosis self-management knowledge, especially exercise knowledge and understanding of risk factors. In this study, the average score of OKT was 52.53, and the pass rate was only 30.02%. Patients with older age and lower education levels had a worse understanding of osteoporosis, which was consistent with the results of Wang Qiaona et al.[22] With the increase of age, patients' ability to understand and remember knowledge becomes worse, and their cognitive function gradually declines.[23] Compared with the rich social work of young patients, elderly patients participate in fewer social activities and lack access to relevant knowledge. However, patients with higher education levels have more comprehensive access to knowledge and stronger information absorption and discrimination abilities.[24] Therefore, it is recommended that medical staff choose appropriate education methods and channels according to different portrait materials and provide patients with sustainable education based on the professional education curve. For elderly patients, medical resources should be provided to the community, and activities such as expert lectures and free medical visits should be carried out regularly to meet their knowledge needs. At the same time, medical staff can also use the network platform to push both interesting and scientific osteoporosis knowledge for patients with low educational levels, conveniently and efficiently expand the coverage of education, broaden the way patients obtain knowledge, and build a comprehensive bone health support system with hospital-community network interconnection.

The results of the study showed that the score of motor knowledge was the lowest among all dimensions of the OKT scale (46.72), followed by risk factors (52.92), which was consistent with the research results of Wang et al.[24] Patients needed more understanding of the best exercise method and exercise intensity. Lack of knowledge of risk factors leads to underestimation of the risk of osteoporosis. The lack of relevant expertise is related to the way patients obtain information.[25] Most of the patients received the relevant knowledge through non-professional ways. The professionalism and accuracy of the information were difficult to ensure, and the depth and breadth of understanding were lacking. Based on comprehensive education, medical staff should aim for the weak links, recommend appropriate exercise methods, guide patients to achieve the required exercise intensity and exercise duration and emphasize the importance of scientific exercise. And they should guide patients to correctly identify risk factors, explain the importance of regular monitoring of bone mass, help patients to determine their personal risk level, and continuously improve patients' knowledge of osteoporosis self-management.

The results of this study showed that patients had a low level of health beliefs and insufficient knowledge of the susceptibility and severity of osteoporosis. At the same time, patients who were older or had undergone axillary lymph node dissection had weaker health belief levels. It is like the results of Chen et al.[26] and Ren et al.[25] Patients who were younger or did not undergo surgery were more health-conscious and more confident in adhering to healthy behaviors. The positive influence of health belief on patients' psychology and adaptive ability can enhance patients' health-promoting behaviors and help them form a correct lifestyle.[27] Therefore, a higher level of health belief is helpful to improve the enthusiasm of patients with osteoporosis self-management behavior. Studies have shown that enhancing peer support and encouraging patients' emotional disclosure can help reduce the barriers to patients' perceived health behaviors and perceived benefits and promote the formation of health beliefs.[28,29] Therefore, health professionals should invite patients with strong beliefs to share their experiences, encourage patients to keep a diary of the physical and psychological benefits of health-promoting behaviors, and use more vivid and specific educational models to inform patients that maintaining bone health is a long-term process and that good self-management of osteoporosis is helpful in preventing and reducing symptoms of bone loss.

In this study, patients had low scores in the vulnerability and severity dimensions, thought that they had a low probability of osteoporosis and had insufficient knowledge of its severity. It is consistent with the results of Wang et al.[30] Osteoporosis is also known as a "silent disease". Due to the absence of clinical symptoms and signs in the early stage, patients pay much less attention to osteoporosis than other aspects of the disease. However, patients' perceived susceptibility and severity are essential factors for disease prevention.[31] At the same time, the results of this study

Table 4
Results of univariate analysis of osteoporosis-related preventive behaviours of the study subjects [n (%)].

Subject	Daily sunshine time		Calcium/vitamin D supplementation was given		Bone densitometry	
	< 30 min	≥ 30 min	Yes	No	Yes	No
Age, years						
< 40	22 (5.5)	47 (11.7)	34 (8.4)	35 (8.7)	28 (6.9)	41 (10.2)
40–60	110 (27.3)	123 (30.5)	153 (38.0)	80 (19.9)	74 (18.4)	159 (39.5)
> 60	52 (12.9)	49 (12.2)	51 (12.7)	50 (12.4)	49 (12.2)	52 (12.9)
F	3.476		5.089		4.458	
P	0.032		0.007		0.012	

Table 5

Multiple linear regression analysis of influencing factors of OKT, OHBS scores in patients ($N = 403$).

Dependent variable	Regression coefficient	SE	Standard regression coefficient	t	P
OKT					
Age	−0.325	0.075	−0.321	−4.348	< 0.001
Degree of education	3.514	1.261	0.146	2.787	0.006
Duration of endocrine therapy	0.076	0.510	0.007	0.148	0.882
Endocrine therapy regimens					
SERMs	−1.268	1.729	−0.045	−0.734	0.464
AI + OFS	−1.370	1.962	−0.050	−0.699	0.485
SERMs + OFS	−0.851	2.868	−0.017	−0.297	0.767
OFS	1.294	5.904	0.011	0.219	0.827
OHBS					
Age	−0.214	0.037	−0.437	−5.730	< 0.001
Degree of education	1.134	0.599	0.098	1.893	0.059
Chronic diseases	−0.714	0.655	−0.053	−1.089	0.277
Duration of endocrine therapy	0.417	0.247	0.084	1.689	0.092
Marital status					
Married	0.968	1.920	0.025	0.504	0.614
Single	1.730	3.114	0.026	0.555	0.579
Surgical procedures					
No surgery	−2.286	1.315	−0.088	−1.738	0.083
Axillary lymph node dissection	−1.352	0.584	−0.114	−2.316	0.021
OHBS					
Endocrine therapy regimens					
SERMs	−1.209	0.840	−0.088	−1.439	0.151
AI + OFS	−1.481	0.934	−0.113	−1.586	0.114
SERMs + OFS	0.177	1.369	0.007	0.129	0.897
OFS	1.668	2.811	0.029	0.593	0.553

Regression model with OKT score as the dependent variable: $R^2 = 0.138$, $\Delta R^2 = 0.123$, $F = 9.018$, $P < 0.001$.
Regression model with OHBS score as the dependent variable: $R^2 = 0.185$, $\Delta R^2 = 0.160$, $F = 7.384$, $P < 0.001$.
SERMs, Selective Estrogen Receptor Modulators; AIs, Aromatase inhibitors; OFS, ovarian function suppression; OKT, Osteoporosis Knowledge Tests; OHBS, Osteoporosis Health Belief Scale.

showed that patients with higher levels of osteoporosis knowledge had a stronger sense of health belief. Therefore, medical staff should introduce osteoporosis-related expertise to patients at the beginning of endocrine therapy, enhance their knowledge reserve of osteoporosis self-management, and improve patients' awareness of the risk of osteoporosis caused by endocrine therapy and its profound impact to improve patients' enthusiasm for osteoporosis self-management behavior and improve their initiative to maintain health outcomes.

The results of this study indicate that patients lack adequate osteoporosis prevention behaviors. Bone health-related behaviors play an essential role in the prevention of osteoporosis. Insufficient protein intake, excessive consumption of caffeinated beverages and inadequate sunlight exposure are risk factors for osteoporosis.[32] The results of this study showed that the majority of patients had problems in osteoporosis prevention behaviors: 60.8% of the patients consumed foods high in calcium at low frequency, 68.5% drank coffee frequently every week, 45.7% had less than 30 minutes of sunshine every day, 35.2% reported no exercise habits, and 22.3% reported low frequency/low-intensity exercise, which was similar to the study results of Shi et al.[33] Univariate analysis showed that age was the influencing factor of daily sunshine time, calcium/vitamin D supplementation and bone mineral density measurement. Therefore, medical staff should pay attention to explaining the importance of sunshine, calcium and vitamin D supplementation, and regular monitoring of bone mineral density, and inform patients that exercise and calcium supplementation are indispensable for promoting bone health. Meanwhile, patients taking aromatase inhibitors in this study had lower OKT and OHBS scores. However, some studies have shown that patients taking aromatase inhibitors have a higher risk of osteoporosis.[15] Aromatase inhibitors reduce circulating estrogen levels, which increase bone loss, decrease bone mineral density, and increase the risk of fractures.[34] This suggests that we should pay more attention to the health behavior of patients taking aromatase inhibitors while improving their knowledge and health beliefs about osteoporosis. It is suggested that medical staff should correct patients' wrong osteoporosis

prevention behaviors through comprehensive and standardized professional guidance, formulate short and long-term goals with patients, improve their awareness of adhering to healthy behaviors, and help them develop good living habits. With the increase of the duration of endocrine therapy, patients have a lack of awareness of long-term osteoporosis prevention at home, and the participation of medical staff is insufficient, which is not conducive to the bone health of patients. Subsequently, our hospital will build a standardized follow-up plan for patients with breast cancer with endocrine therapy based on the Internet platform. Medical staff will follow up patients regularly by telephone or Wechat to assess the problems existing in patients' self-management, help patients effectively correct bad living habits and improve their osteoporosis self-management ability.

Implications for nursing practice and research

This study shows that medical staff should strengthen the knowledge reserve of osteoporosis in patients with early breast cancer undergoing endocrine therapy, improve the enthusiasm of patients' osteoporosis self-management behavior, correct patients' wrong osteoporosis prevention behavior, supervise the implementation of patients' health behavior, improve the initiative to maintain health outcomes, and ultimately promote patients to establish and adhere to a healthy lifestyle.

Limitations

In the literature search, we found no authoritative questionnaires on osteoporosis health behaviors in patients with breast cancer receiving endocrine therapy. In order to reduce the burden of patients filling out the questionnaire, the research group added seven questions to the general information questionnaire to measure the patients' osteoporosis-related preventive behaviors. In this survey, the participants were all patients attending the breast cancer endocrine therapy clinic of a

specialized cancer hospital. Single-centre sampling may affect the generalization of the conclusions to a certain extent. In the future, it will be necessary to design recruitment methods that allow more patients presenting at other hospitals to be enrolled.

Conclusions

This study showed that early patients with breast cancer with endocrine therapy have poor knowledge of osteoporosis and low health belief levels, and most of them have wrong prevention behaviours. According to the results of the study, medical staff can provide patients with multi-channel, comprehensive and sustainable health education based on professional education curves according to different portrait data. To enhance patients' osteoporosis knowledge reserve, improve patients' osteoporosis self-management behaviour enthusiasm, correct patients' wrong osteoporosis prevention behaviour, supervise the implementation of patients' healthy behaviour, improve the initiative to maintain health outcomes, and ultimately promote patients to establish and adhere to a healthy lifestyle.

CRediT authorship contribution statement

Zhenqi Lu, Jiajia Qiu, Yun Li, Lichen Tang, Ping Li: Conceptualization, Methodology; **Yan Ma, Weiwu Lu**: Data collection, Data curation, Analysis, Writing. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

This study was reviewed and approved by the Ethics Review Board of Fudan University Shanghai Cancer Centre (Approval No. 2010225-12) and was conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All participants provided written informed consent.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Declaration of competing interest

The authors declare no conflict of interest. Professor Zhenqi Lu, the corresponding author, serves on the editorial board of the *Asia–Pacific Journal of Oncology Nursing*. The article underwent standard review procedures of the journal, with peer review conducted independently of Professor Lu and their research groups.

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