

Bone health education programs for older people: an integrative review

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Abstract Osteoporosis is a systemic disease characterized by a reduction in bone mineral density. The dissemination of knowledge about the disease can be a viable alternative for promoting preventive behavior and self-care. This study sought to identify the main characteristics of bone health programs for older persons. We conducted an integrative review, searching for studies published between 2011 and 2022 in the CAPES periodicals database, Web of Science, PubMed, and Google Scholar using English descriptors. A total of 10,093 studies were retrieved, seven of which were selected after applying the inclusion criteria. The findings show that bone health education programs aim to empower older people by increasing knowledge about the disease and raising awareness about calcium and vitamin D intake, osteoporosis medications, and the importance of changing habits and exercise. Programs generally consist of group or individual meetings, with sessions lasting 50 to 60 minutes. Class sizes may be limited or unrestricted. Follow-up during the educational process was also found to be important. Tailoring topics to the reality and interests of participants appears to be another positive way of promoting the adoption of self-care practices.

Key words Health promotion, Health education, Bone health, Osteoporosis

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Introduction

The population of older people is growing faster than all other age groups¹. Population ageing is a worldwide phenomenon driven by the development of science and technology in recent centuries². Aging is associated with changes that affect the musculoskeletal system and one of the effects of this process is osteoporosis^{3,4}.

Osteoporosis is a systemic disease characterized by a reduction in mineral density and deterioration of bone microarchitecture⁵. It affects both men and women, particularly postmenopausal women, leading to bone fragility and increased susceptibility to fractures⁶. The following risk factors for the development of the disease in Brazilians have been cited: lack of postmenopausal hormone therapy, low sun exposure, drinking, inadequate calcium intake, sedentarism, family history of osteoporosis, smoking, low weight and short stature, advanced age, low education level, late menarche, early menopause, and low body mass index⁴.

Diagnosis is based on the T-score, given by a bone density scan, where one standard deviation is equal to a 10-12% difference in bone mass⁶. Osteoporosis is highly prevalent, making it a global public health problem, has a devastating impact on physical and mental health, and exacts a significant economic burden⁶. In Brazil, one in five women have been diagnosed with the disease⁴. It is estimated that public spending on treatment and fractures resulting from the disease over the last 10 years amounted to more than R\$ 81 million⁷.

A cost-benefit analysis of osteoporosis treatment and prevention policies showed that treatment costs were more than 15 times greater than the costs that would have been incurred if preventive measures had been adopted⁸. The dissemination of information through educational initiatives is therefore a viable alternative for promoting preventive behavior and self-care^{9,10}.

This process involves the construction of knowledge using practices that contribute to increased autonomy in health care in accordance with patient needs¹⁰. Knowledge construction differs from health promotion, which suggests individual, collective, and political/government actions to solve public health problems and improve quality of life¹¹.

A previous study showed that knowledge of bone mineral density was a strong predictor of increased calcium intake and general awareness of osteoporosis¹². In addition, most studies un-

derpinning health education for older people draw attention to the importance of tailoring knowledge generation methods to the specific needs and reality of this group^{10,13-15}. In the same vein, another study highlighted the urgent need for more wide-ranging personalized programs that go beyond classroom education¹⁶. In light of the above, the aim of this study was to identify the main characteristics of bone health education programs for older people.

Methods

We conducted an integrative review, which is a method used to bring together, synthesize, and critically assess theoretical and critical evidence on a given area of research^{17,18}. The review involved the following stages: I - identification of the topic; II - definition of the research question; III - formulation of the study inclusion and exclusion criteria; IV - definition of search strategies and data extraction; V - critical assessment of the included studies; VI - interpretation of results and knowledge synthesis¹⁹.

We conducted searches of the periodicals database of the Agency for the Improvement of Higher Education Personnel (CAPES periodicals), Web of Science, PubMed, and Google Scholar between January and April 2022 using the following guiding question: What are the main characteristics of bone health education programs for older people? We used English descriptors taken from the Health Sciences Descriptors (DeCS), adopting specific (elderly, health education, osteoporosis) and broader (older people, bone mineral density) terms. First, we performed a simple search of Google Scholar with the combination elderly OR "older people" AND "health education" AND osteoporosis OR "bone mineral density", followed by an advanced search of the other databases using the following combinations: Any field (elderly OR older people) AND Title (health education) AND Any field (osteoporosis OR bone mineral density). These searches yielded 10,093 publications (Google Scholar = 9,830, CAPES database = 253, Web of Science = 3, and PubMed = 7).

The following inclusion criteria were used: articles published between 2011 and 2022 in Portuguese and English where the central theme was bone health education programs for older people. We excluded reflection papers, experience reports, systematic and integrative reviews, dissertations, theses, non-scientific editorials, and

duplicate articles. After applying the above criteria and screening the abstracts of the selected articles, a total of 30 articles were selected.

Data collection was systematized using a tool designed to extract relevant data and ensure the accuracy of information checking¹⁹. The information was extracted into the following categories: A - identification, B - institution, C - type of publication, D - methodology, E - assessment of methodological rigor. The latter was measured according to level of evidence based on the study design and classified into 6 levels: Level 1: Meta-analysis of multiple controlled and randomized studies; Level 2: Individual experimental study; Level 3: Quasi-experimental study; Level 4: Correlation descriptive or qualitative (non-experimental) study; Level 5: Case or experience report; and Level 6: Opinion of experts²⁰.

To assess the relevance and methodological adequacy of the selected studies, we used an instrument adapted from the previously validated Critical Appraisal Skills Programme (CASP) checklist, which addresses the following criteria: clarity in identifying objectives; adequacy and presentation of methodology; adequacy of sample selection; detailing of data collection and researcher-participant relationship; compliance with ethical aspects; rigor of data analysis; presentation and discussion of results; and study importance²¹. For the purposes of the present study, we selected articles that met 70% of the criteria, indicating good methodological quality and low risk of bias, resulting in a final sample of seven articles.

Results and discussion

The flowchart of the article selection process is shown in Figure 1. The searches of PubMed, Google Scholar, Web of Science, and CAPES periodicals yielded 10,093 results. Of the 30 selected articles, only seven met the inclusion criteria (23 were excluded because they did not address the theme, did not meet the inclusion criteria, failed to meet the methodological rigor criteria, were duplicates, or the full-text version was not available) (Figure 1). All the seven articles were published in English and the studies were undertaken in China, South Korea, Iran, the United States, and Canada. The following information was extracted from the articles: author(s), journal, level of evidence, study design, objectives, sample characteristics, main results, main topics, program duration and frequency, and pro-

gram educational strategies. The study designs were: randomized clinical trial (n=4), multicenter study (n=1), descriptive qualitative study (n=1), and prospective cohort study (n=1). The studies were classified into the following levels of evidence: Level I (n=2), Level III (n=4), and Level IV (n=1). The articles were published in the following journals: *Experimental and Therapeutic Medicine*, *Journal of Bone Metabolism*, *Journal of Client-Centered Nursing Care*, *Journal of Nutrition Education and Behavior*, *Nursing Research*, *Journal of Human Nutrition and Dietetics*, and *BMC Public Health*. The synthesis of the studies is presented in Charts 1 and 2. For presentation and discussion purposes, the information is structured into the following topics: Bone health education for older people: objectives and main results; and Main features of the bone health education strategies for older people. Other references are cited in the discussion due to their relevance to the topic in question.

Bone health education for older people: objectives and main results

Bone health education programs provided a range of benefits for older people with OP, including: improvements in bone mineral density (BMD), OP knowledge, self-efficacy, health beliefs, and quality of life^{22,23}; adherence to medication and physical exercise, and dietary patterns (increased calcium and vitamin D intake)^{22,24-28}; reductions in falling, fractures, and exposure to modifiable risk factors; and increased empowerment²⁴.

According to Laslett *et al.*²⁹, bone health education interventions are effective at promoting changes in individual behavior among older people because many risk factors are modifiable, including inadequate intake calcium and vitamin D, lack of physical activity, low BMI, and excessive drinking and smoking²⁹. Piaseu *et al.*³⁰ reported that such changes in behavior were predicted by knowledge when mediated by attitudes and self-efficacy, suggesting that bone health education programs should aim to enhance both self-efficacy and knowledge³⁰.

In contrast, other studies have shown that increased knowledge of OP does not always result in changes in self-efficacy or improvements in health belief scores among older people^{31,32}. Francis *et al.*³³ suggested that the lack of change in behavior may be a result of increased knowledge about OP, leading to a reduction in self-efficacy as participants realize that the type

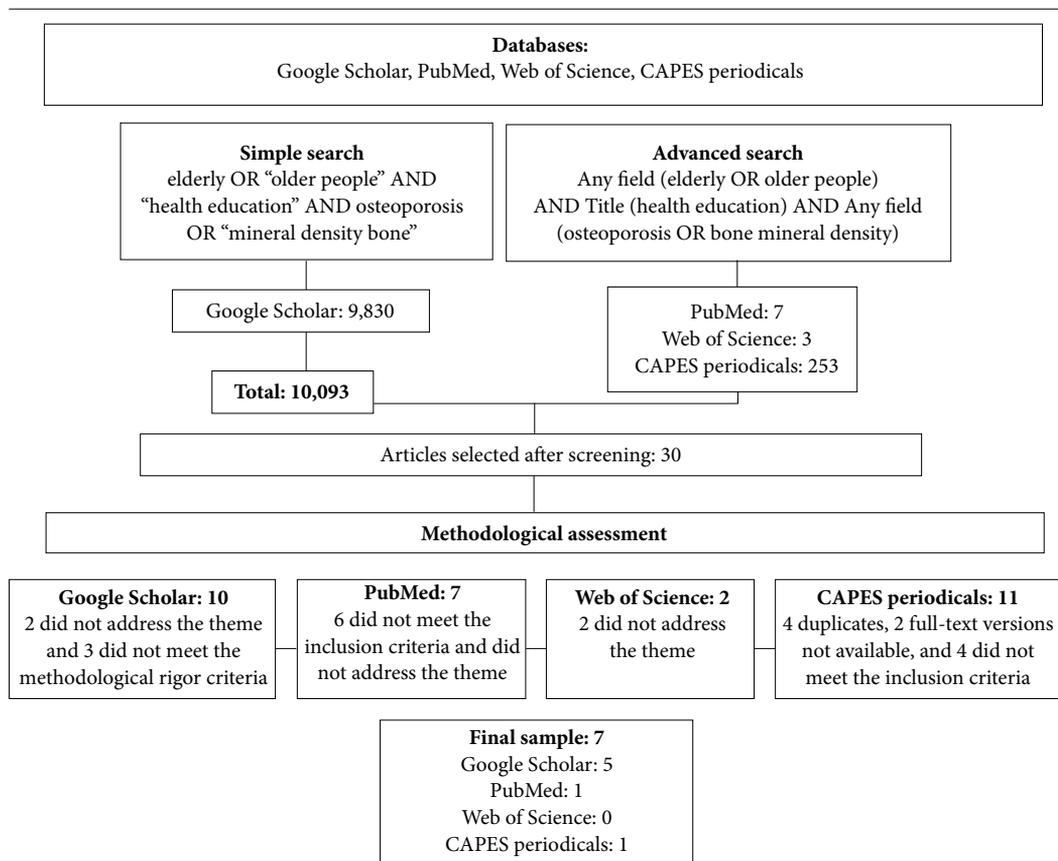


Figure 1. Flowchart of the article selection process.

Source: Co-author Silva EC.

of exercise they were doing in the past was not contributing to bone strengthening³³. The findings of other studies regarding the effects of educational programs on self-efficacy change were inconsistent^{34,35}, indicating that further research is required. Possible explanations for the difference between findings include the use of various types of study designs, the adoption of different methodological strategies by the educational programs, poor cultural adaptation of the education methodologies, small sample sizes, the lack of individualized interventions, and the recruitment setting.

Management for OP prevention is an important element of bone education strategies that aim to increase knowledge²². This type of intervention combines the collection of participant information, the formulation of an individual therapeutic schedule for each participant, and monitoring of their conditions²². The main out-

comes of the prevention interventions analyzed in this review were: increase in physical exercise, use of calcium and vitamin D supplements, adherence to drug therapy, improved quality of life, pain relief, increased knowledge about OP, and changes in health belief and self-efficacy^{22,25,26}. Follow-up and monitoring the condition of participants throughout the education process is key to increasing knowledge and self-efficacy²².

One of the studies evaluating the effects of an empowerment program based on the Health Belief Model (HBM) reported that behavioral changes had a positive impact on self-efficacy²⁵. Frameworks like the HBM and self-efficacy theory provide a theoretical underpinning for programs. The HBM is structured around the constructs perceived susceptibility, seriousness, benefits, and barriers, as well as the motivations behind decision-making (internal and external factors)³⁶. The OP self-efficacy theory evaluates

Chart 1. Synthesis of the bone education programs for older people.

Author(s)/ year/ Journal/ Level of evidence	Study design	Objectives	Sample characteristics	Main results
Wang <i>et al.</i> ²² / 2016/ ETM/I	Randomized trial.	To evaluate the effect of an OP club and discuss a novel model of health education and management for osteoporosis prevention.	n=436 (297 W/139 M) *Age: W 68.85±9.01/M 66.55±10.98 years.	- Higher levels of OP knowledge and health belief (P=0.01); - Better living behavior (P=0.01); - Medication compliance, relieved pain, and improved quality of life (P=0.01).
Jo <i>et al.</i> ²³ / 2018/ JBM/III	Multicenter study.	To determine the impact of an OP educational intervention including information about fracture risk and modifiable risk factors among older people with OP.	n=179 (164 W/15 M) *Age: 70.5±9.3 years.	- Decrease in mean risk of fracture (from 28.0% to 25.7%); - Increased knowledge about OP (P=0.001).
Rezaei <i>et al.</i> ²⁵ / 2019/ CCNCC/I	Randomized controlled trial.	To evaluate the effect of an empowerment program based on HBM on self-efficacy in the prevention of OP.	n=38 (W/M) *Age: ≥60 years.	- Greater adherence to regular exercise (P=0.01), calcium intake (P=0.03); and health motivation (P=0.02).
Babatunde <i>et al.</i> ²⁴ / 2011/ JNEB/III	Randomized controlled trial.	To assess the effectiveness of an OP education program to improve calcium intake, knowledge, and self-efficacy in community-dwelling older black adults.	n=110 (W/M) *Age: ≥65 years.	- Improvement in knowledge, self-efficacy, and calcium intake, and reduced susceptibility to OP (P=0.001).
Qi <i>et al.</i> ²⁶ / 2011/ NR/III	Randomized controlled trial.	To evaluate the effectiveness of an educational intervention based on the self-efficacy theory aimed at increasing the knowledge of osteoporosis and adoption of preventive behaviors.	n=83 (W/M) *Age: 64.08±9.48 years.	- Improvements in knowledge about OP (P=0.01); - Self-efficacy for exercise and medication adherence (P=0,01); - More time spent on moderate exercise (P=0.05).
Yu <i>et al.</i> ²⁷ / 2020/ JHND/IV	Qualitative descriptive study.	To examine perceptions of achieving calcium and vitamin D recommended dietary allowance (RDA).	n=45 (43 M/2 W) *Age: ≥58 years.	Prior knowledge of bone health education was not a factor influencing changes in calcium intake or the use of supplements.
Park <i>et al.</i> ²⁸ / 2017/ BMCPh/III	Prospective intervention study.	To evaluate changes in osteoporosis knowledge, osteoporosis self-efficacy, fall self-efficacy, physical exercise, and dietary pattern of calcium and vitamin D intake after OP education.	n=199 (156 W/43 M) *Age: W 76.6/M 74.9 years.	- Improved OP knowledge, self-efficacy, fall self-efficacy, and calcium and vitamin D intake (P=0.0001).

ETM = Experimental and Therapeutic Medicine; JBM = Journal of Bone Metabolism; CCNCC = Journal of Client Centered Nursing Care; JNEB = Journal of Nutrition Education and Behavior; NR = Nursing Research; BMCPh = Bio Med Central Public Health; W = women; M = men; *Age = mean age; OP = osteoporosis; HBM = Health Belief Model; RDA = Recommended Dietary Allowance.

Source: Authors.

knowledge, self-efficacy for exercise, adherence to medication, and participants' expectations regarding results²⁶.

Education and training programs underpinned by these constructs can promote greater

health motivation, particularly with regard to physical exercise and calcium intake, and lead to a decrease in susceptibility to OP^{24,25}. In addition, the use of these frameworks can benefit subpopulations such as immigrants or other

Chart 2. Educational features of the bone health programs for older people.

Topics	Frequency and duration	Program educational strategies
<ul style="list-style-type: none"> - Knowledge and understanding of risk factors for OP. - Preventive measures and diet guidance. - Exercise coaching. - Drug therapy. 	4 years: lectures once a month and communication parties once a year.	<ul style="list-style-type: none"> - Psychological intervention. - Use of information brochures. - Doubt clearing with specialists. - OP club²².
<ul style="list-style-type: none"> - OP and associated risk factors. - Nutrition education: calcium and vitamin D intake. - Lifestyle modifications. 	10 months: follow-up survey at second visit 3 months after initial survey.	<ul style="list-style-type: none"> - Participants attended individual education programs. - Participants received educational materials on OP. - PowerPoint presentation or video²³.
<ul style="list-style-type: none"> - OP: symptoms, evolution, diagnosis and treatment. - Physical, psychosocial, and economic effects. - OP prevention strategies. - Lifestyle modifications. 	8 training sessions: 4 weeks of group education. Participants received phone calls from researchers once a week for 4 consecutive weeks.	<ul style="list-style-type: none"> - Lectures, group discussions, presentation of experience by older person who had suffered a fracture. - Question and answer sessions. - Poster, pamphlets, and booklet. - Engagement of family members. - PowerPoint presentation²⁵.
<ul style="list-style-type: none"> - Seriousness of OP. - Susceptibility to OP. - Benefits of increasing calcium intake. - Barriers to reducing risk factors and improving vitamin D intake. - Facts, misconceptions, and considerations about dietary intake, medication and bone mineral density. 	6 weekly education program sessions with a maximum of 15 participants per session.	<ul style="list-style-type: none"> - Education program adapted from the RHBM, HBM, and self-efficacy theory for the prevention of OP. - Practices and demonstrations involving the participants. - Participants received a handout after each session²⁴.
<ul style="list-style-type: none"> - Bone health and OP: a guide for Asian women aged 50 years and over. - Improvement of cerebrovascular health and keeping the brain healthy. 	Data collected in the beginning and 2 weeks after the intervention.	<ul style="list-style-type: none"> - PowerPoint presentations in Mandarin. - Class booklet and leaflet about the exercise. - BMD-based individual targets and strategies, risk factors, eating preferences, and physical activity²⁶.
<ul style="list-style-type: none"> - Foundation of bones. - Fracture diagnosis/risk assessment. - Nutrition, exercise, and falls. - Preventive medication. - Self-management. - OP treatment. - Managing OP for a full and active life. 	Participants already taking part in an education program received a semi-structured interview 1 month after the intervention.	<ul style="list-style-type: none"> - Recommendations from a specialized site were followed together with individual or group sessions. - Participants received a self-management booklet. - Telephone interviews conducted to understand participants' perceptions²⁷.
<ul style="list-style-type: none"> - Comprehension of OP. - OP self-efficacy. - Falling self-efficacy risk factors. - Nutritional education stressing the importance of calcium and vitamin D intake. 	10-month intervention	<ul style="list-style-type: none"> - Individualized education program using a brochure developed by the Korean Society for Bone and Mineral Research. - Exercise program consisting of stretching. - Participants were educated through a formal program of therapeutic exercise initially by a physical trainer and then strongly encouraged to keep up with the program, independently, afterwards²⁸.

OP= Osteoporosis; RHBM = Revised Health Belief Model; HBM = Health Belief Model; BMD = bone mineral density.

Source: Authors.

foreign-born participants who only speak their native language. Tailoring content to the specific needs and interests of individuals, including the language they speak, is important to promote the adoption of preventive eating habits and physical exercise²⁶.

Physical exercise was included in the intervention methodology in five of the studies analyzed in this review^{22,23,26-28}, demonstrating that future bone health education programs should prioritize this aspect. In this regard, it is important to detail the type of exercise (prevention or treatment), intensity, and frequency, highlight the precautions that should be taken, and include training specialists in the team. Although the evidence points to increased physical exercise, it is not clear how this element affects participants' lives from a clinical point of view, especially in interventions where exercises are recommended on official sites^{25,26}.

Main features of the bone health education strategies for older people

Our findings show a certain level of standardization of content in most bone education programs. All except one of the strategies were capable of promoting significant behavioral changes²⁷. Group interventions^{24,25,27} focused on professional-participant interaction to promote empowerment, while individualized programs sought to motivate participants after the intervention or provide training with content tailored to individual needs and understanding^{22,23,26-28}.

Program duration and frequency did not appear to be a factor influencing improvements in knowledge and changes in habits. The programs analyzed in this review consisted of short-, medium-, and long-term interventions²²⁻²⁸. The length of education sessions ranged from 50 to 60 minutes²⁵. It is interesting to note that only one intervention²⁴ limited the number of participants per session (15 people for 30-45 minute sessions). Session duration, the importance given to content, and small class size showed a strong association with level of participant understanding³⁷ and facilitated participant-researcher interaction²⁴.

Another interesting feature was the inclusion of counseling on OP prevention skills in one program²². Offering family counseling in longer term education programs in conjunction with the use of audiovisual resources to present systematized themes and inviting older volunteers who have successfully coped with the disease can help improve results²⁵. Educational strategies should in-

clude themes that address OP comprehension, prevention, and awareness, current health conditions, diagnosis and treatment, changes in habits, and the consequences of OP²²⁻²⁸.

In this regard, limiting strategies to awareness raising to improve knowledge does not appear to be an interesting alternative. An initiative using group and individualized interventions where older people followed official guidance from a website and received a self-management booklet was not able to change participants' misconceptions about the disease and achieve calcium and vitamin D recommended dietary allowance²⁷. This approach shows that simply passing on knowledge without tailoring initiatives to the specific needs and context of participants and providing motivation is not sufficient to change habits, even subjectively²⁸.

This finding is consistent with approaches reported by other authors^{14,38}. Trying to promote preventive attitudes in older people without changing misconceptions acquired throughout life can hamper the adoption of new behaviors³⁸. Another study²⁷ showed that trying to promote preventive attitudes in older people without changing misconceptions acquired throughout life can hamper the adoption of new behaviors, explaining sub-optimal calcium and vitamin D levels. It is worth emphasizing that follow-up during bone health education programs should be performed in conjunction with the monitoring of the clinical condition of participants, especially those who have the disease²².

Limitations

Study limitations include the small sample size and the fact that further research is necessary to investigate the effect of educational programs on self-efficacy change. Although these limitations should be taken into account when considering the recommendations presented here, it is important to highlight that the studies analyzed in this review used an experimental or quasi-experimental study design, which provide a higher level of evidence on the topic of interest.

Conclusion

The studies included in this integrative literature review show that bone health education programs aimed to empower older people by increasing knowledge about the disease and raising awareness about calcium and vitamin D intake,

osteoporosis medications, and the importance of changing habits and exercise. Programs generally consisted of group or individual meetings with sessions lasting between 50 and 60 minutes. Class size were both limited or unrestricted. Follow-up during the education process was also found to be

important. Based on these findings, it is possible to assess the effectiveness of actions and design the most adequate approach to bone health education. Tailoring topics to the reality and interests of participants appears to be another positive way of promoting the adoption of self-care practices.

Collaborations

EM Ribeiro contributed to study conception and drafting the final version of the article. EAR Sera, TA Borges, and MF Dias contributed to the database searches and organization of the articles. EC Silva created the article selection process flow-chart. A Travassos, NB Osório, and LS Silva Neto supervised the research, revised the manuscript, and approved the final version to be published.

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