Osteoporos Int (2014) 25:1209–1224
DOI 10.1007/s00198-013-2573-5

REVIEW

Effectiveness and characteristics of multifaceted osteoporosis group education—a systematic review

A. L. Jensen · K. Lomborg · G. Wind · B. L. Langdahl

Received: 11 July 2013 / Accepted: 31 October 2013 / Published online: 23 November 2013

Abstract
Summary The characteristics and effectiveness of osteoporosis multifaceted group education were determined from a systematic review of international literature. Findings showed that these educational programmes may be beneficial in a variety of important factors for the prevention, treatment and management of osteoporosis.
Introduction This systematic review investigated quantitative studies on osteoporosis multifaceted group education. The purpose was to investigate the characteristics as well as the effectiveness of this form of osteoporosis patient education.
Methods Preferred Reporting Items for Systematic Reviews and Meta-Analyses guided this systematic review. Relevant databases were searched until January 2013.
Results Seven studies published between 1993 and 2011 including osteoporosis patients with or without fractures were found. The multifaceted educational programmes all consisted of three overall themes: (1) Knowledge of osteoporosis, (2) Medication and diet and (3) Exercise, but with different foci across the studies. Overall, 24 outcome measures representing six topics were applied: (1) Health-related quality of life, (2) Psychosocial function, (3) Pain, (4) Physical activity, (5) Knowledge and (6) Medication and diet.

The review showed that multifaceted osteoporosis group education can increase the patients' knowledge of osteoporosis as well as their health-related quality of life, physical activity and psychosocial functioning. It has the potential to increase adherence to both pharmacological and non-pharmacological treatments.
Conclusions Multifaceted group education may have a positive impact on the patients' ability to engage in preventing and managing osteoporosis. Further research directed towards the complexity of multifaceted group education is needed. In addition, research investigating the educational needs of specific groups of osteoporotic patients is required.

Keywords Intervention · Multifaceted group education · Osteoporose · Patient education · Review

A. L. Jensen (✉) · K. Lomborg
Faculty of Health Sciences, Department of Public Health, Section of Nursing, Aarhus University, Hoegh-Guldbergs Gade 6A, Building 1633, 8000 Aarhus C, Denmark
e-mail: alj@sygeplejevid.au.dk

K. Lomborg
e-mail: kl@sygeplejevid.au.dk
e-mail: kirlom@rm.dk

K. Lomborg
Section for Research in Patient Involvement, Aarhus University Hospital, Norrebrogade 44, Building 12A, 8000 Aarhus C, Denmark

G. Wind
Department of Culture and Society, Anthropology and Ethnography, Aarhus University, Mosegaard Alle 20, Højbjerg 8270, Denmark
e-mail: etngw@hum.au.dk

B. L. Langdahl
Department of Endocrinology and Internal Medicine, Aarhus University Hospital, Tage Hansen-Gade 2, 8000 Aarhus C, Denmark
e-mail: bente.langdahl@aarhus.rm.dk

Introduction

Patient education in the treatment of osteoporosis is a recognised intervention in disease prevention and management [1, 2]. The aims of osteoporosis patient education programmes are to motivate patients to participate in the prevention or the management of osteoporosis and to improve quality of life. This is essential as the effectiveness of pharmacological or non-pharmacological therapy depends on the behaviour of the patients and their ability to take an active role in managing their own health and disease [3–5]. Multifaceted group education is one of the many present day osteoporosis

patient education programmes and is the focus of this systematic review.

Osteoporosis is a multifactorial disease [6]. This implies that education for patients with osteoporosis must include knowledge of a variety of aspects. According to the WHO Technical Report Series on 'Prevention and Management of Osteoporosis', patients must be provided with a basis of information together with an activity plan and regular follow-up [7]. The basic information includes, e.g. knowledge of the disease and its consequences, the diagnosis and treatment, diet, exercise, lifestyle and other risk factors, and of falls and fracture prevention [7]. Therefore, to meet this requirement, patient education must be multifaceted. In this review, we define multifaceted education as education addressing more than two of the above topics. This is in contrast to another type of osteoporosis patient education programme that aims primarily at one aspect, e.g. therapeutic exercises or pain management [8, 9]. As multifaceted education covers all aspects (or more than two) of osteoporosis, it may have the potential to help the patients to manage and cope with many facets of osteoporosis and subsequently be a more effective intervention.

Another aspect of concern is the increasing elderly population in western societies, which will increase the incidence of osteoporosis. It is estimated that the impact of osteoporosis in terms of lost productivity and increased health care costs will escalate [10]. The complications, the decreased mobility, disability and reduced quality of life, can have on the patients and necessitates effective and inexpensive educational interventions [11]. Group education could be a solution to these problems and beneficial by being less expensive than individual patient education [12, 13]. Wilson et al. describe this in a study on asthma education where small group education (six to eight individuals) was significantly less costly and simpler to deliver than individual education [14]. Small group programmes also have the potential to provide social support through interaction between participants [12, 14]. Furthermore, studies on small group education illustrate that it is possible to include individual considerations as disease severity and personal living conditions to the same degree as in individual education [12].

Regretfully, the variety of methods and ways of organising osteoporosis education challenges our ability to evaluate the effects of different kinds of osteoporosis group education. Systematic reviews that identify, compare and evaluate different types of osteoporosis education are therefore important, and to our knowledge, no comprehensive reviews of osteoporosis multifaceted group education for patients with osteoporosis have been published. The purpose of our systematic review is therefore to critically assess studies on osteoporosis multifaceted group education with the aim of investigating the characteristics as well as the effectiveness of this form of patient education.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [15] guided the reporting of this systematic review. PRISMA is developed to ensure the transparent and complete reporting of systematic reviews and consists of a 27-item checklist. PRISMA does not in detail address the conduct of systematic review. This review is conducted in accordance with methods suggested by Cooper (16) and the Cochrane Collaboration (17). In order to establish specific features associated with a multifaceted group education programme and describe the effectiveness of the educational programmes, the review was directed by the following research questions:

1. What are the characteristics of multifaceted osteoporosis group education?
2. How was the effectiveness of multifaceted osteoporosis group education evaluated and what are the results?

Literature search

We included articles which investigated groups of patients diagnosed with osteoporosis, who attended multifaceted osteoporosis specific group education. The study designs could be randomised controlled trials or observation studies. Articles presenting qualitative studies or reviews were excluded. The literature search was carried out between October 2012 and January 2013, when the final update was completed. The following databases were searched for relevant studies: PubMed, Embase, The Cochrane Library, Cinahl and ERIC (Education Resources Information Center). The literature search was carried out by the first author and a research librarian. The following search terms were used 'osteoporosis' and ('education' or 'patient education' or 'group education' or 'self-help' or 'group-based' or 'teaching' or 'rehabilitation' or 'health education' or 'schools' or 'intervention'). The search was limited to adults aged 45 years and older, included indexed as well as not indexed journals and other published materials, for example, conference abstracts, dissertations and book chapters without language limitations [16].

In total, 1,507 articles were identified, 439 of which were duplicates. The remaining 1,068 articles were screened twice for eligibility by the first author using the in- and exclusion criteria. The screening of the 1,068 articles followed two steps: (1) A review of the titles and abstracts, which led to exclusion of 1,014 articles. The excluded articles described studies on medical intervention, treatment intervention and diagnostic interventions and articles representing other patient groups. (2) The remaining 54 articles were examined for in-

and exclusion criteria by full-text reading. Figure 1 illustrates the identification and selection of articles. We identified a total of eight articles [17–24], of which one article was identified by reference harvesting [17].

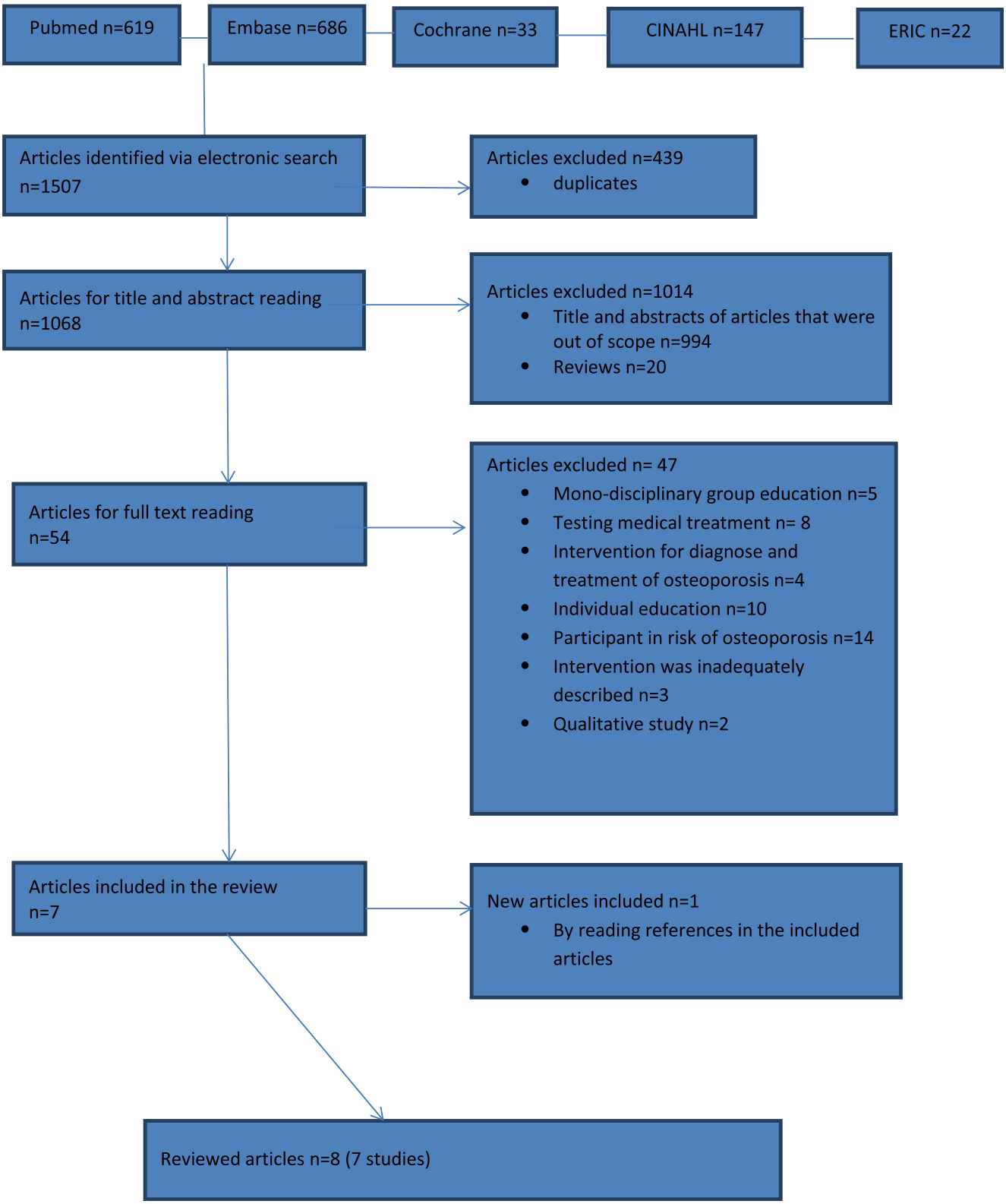

Fig. 1 The identification and selection of articles

The methodology of the included studies is presented by providing structured summaries of each study in Tables 1. Furthermore, the risk of bias in the included studies was assessed using the "risk of bias" tool provided by the Cochrane Collaboration [25]. The RCT studies, with the exception of the study by Laslett et al. [23], were found to have low risk of bias in five of seven possible domains. It is impossible to blind participants and personnel in this kind of RCT; we therefore included all studies, even though they were evaluated as high risk of bias in the "blinding of participants and personnel" domain.

Analysis

We extracted the data from the included studies into three tables. The characteristics of the included articles, data collection and result are described in Table 1. The education programmes and the comparison programmes are outlined in Table 2. Some of the educational programmes lacked description of number of participant in the groups [18–20, 24], and one intervention did not state intervention length [17]. We e-mailed the authors and asked for the missing data, but without success. Outcome measures were classified into six topics during analysis. Table 3 presents these six topics and the connected outcome measures and results. All data were reviewed by the first author and verified by one of the other authors. Data from the tables were analysed and interpreted in relation to the review questions. No meta-analysis was performed as the studies were not considered combinable because of the large number of different outcome measures and the inadequate number of studies [26].

Results

Eight articles met the inclusion criteria [17–24]. Two of the articles outlined different parts of the same study. The first focused on knowledge of osteoporosis and the second on knowledge and adherence. Both articles were included because they complement each other [21, 22]. In all, it leads to an inclusion of seven studies published between 1993 and 2011. Of the seven studies, two were observational studies and the remaining five were RCTs. The studies originated from Europe ($n=3$), North America ($n=3$) and Australia ($n=1$). Participants were recruited from outpatients' clinics ($n=5$), a retirement community ($n=1$) and an emergency department ($n=1$). Overall, 923 participants were included in the seven studies and 525 of them took part in multifaceted group education. Sample size ranged from 50 to 300 participants. Of the included studies, four were conducted only with women and the remaining three studies included both women and men. Collectively, 849 women and 74 men participated. The studies represented participants with a mean age from 63.5 to 81.1 years. The fracture status of the participants was described in five studies (485 participants with vertebral fracture and 35 participants without vertebral fracture) [18–20, 23, 24]. In four of these five studies, only participant with vertebral fracture were included (470 participants) [18, 19, 23, 24] . The two remaining studies included participant without and with vertebral fracture, but no description on the fracture status was given (430 participants) [17, 21, 22].

Description of the multifaceted educational programme

The content of the seven structured multifaceted educational programmes was similar, even though they were named differently. They all consisted of three overall themes: (1) Knowledge of osteoporosis, (2) Medication and diet and (3) Exercise. Furthermore, e.g. activity of daily living [19, 22, 24], pain [18, 20, 22, 23] and prevention of fall [20, 22–24] were also featured in some of the educational programmes. Theories on health behaviour change and learning approach were sparsely described in the articles. In five educational programmes, theories of empowerment [21, 22], self-management [20, 23], action planning, self-efficacy [23] and coping [17, 19] were used. The two remaining educational programmes [18, 24] did not outline any view of the behaviour change theory or learning approach. The use of theories on health behaviour change and learning approach were not transparent. In one study, it was linked to the choice of outcome measures [23]. In three studies [20–22], goal planning or personal planning as part of the educational programme was described, but no detailed description of the content and process of the goal planning activity was outlined. These programmes used theories of self-management and empowerment.

Only three studies [17, 21–23] described the group sizes, which varied from 4–20 individuals. The programmes lasted from 5–27 h, running 1–2 times per week for 4–12 weeks. The typical length of a programme was 4–5 weeks, totalling 5–12 h in all. The number of different educators ranged from 1–4. Additional descriptions of the multifaceted educational programmes are presented in Table 2.

Outcome of multifaceted osteoporosis group education programme

The overall goal of the studies in this review was similar in the sense that they aimed to test the effectiveness of multifaceted group education. However, there were clear differences in focus across the studies. Collectively 24 outcome measures were applied, hence 6 tests and 18 scales or questionnaires. As described, outcome measures

Table 1 The characteristics of the included articles, data collection and results

Authors/publication year/county/setting/ref	Study design/randomisation	Aim	Patients' characteristics: numbers including number of dropouts, sex, age and fracture type	Primary focus	Time of measure	Main conclusion
Gold et al./1993/USA/patients from an outpatient clinic/[17]	Observational study Non-randomised	To test if intervention patients would experience significant improvements in psychosocial functioning while comparison patients would remain stable or worsen in their psychosocial functioning	Women and men, $n=103$. Fracture status not described Control group matched to intervention group Intervention, $n=43$ (36 women and 7 men) Control, $n=60$ (55 women and 5 men) No dropout of patients Mean age - Intervention: 67.87 - Control: 65.14	Psychosocial functioning	Baseline 2 months	Significant differences in critical areas of psychosocial functioning
Kessenich et al./2000/Canada/outpatient clinic/[18]	Observational study Non-randomised	To test if an 8-week educational support group and a weekly phone call would improve physical and emotional function	Women, $n=50$. Patients with at least one vertebral fracture Intervention, $n=25$ Control, $n=25$ No dropout of patients Mean age - Intervention: 71±6.1 - Control: 69.6±7.0	Health-related quality of life (HRQL)	Baseline 2 months (end of education)	No significant difference between groups
Gold et al./2004/USA/continuing care retirement communities/[19]	RCT modified crossover trial Unit of randomisation was site. Researchers (not biostatistician) were blinded to allocation status until a site was enrolled. Personnel involved with subject contacts, data collection and intervention administration were blinded to the intervention status and hypotheses study Patients were unaware of the content intervention that they did not receive initially	To determine the effectiveness of a multidisciplinary intervention that could be used in clinical settings to reduce disability associated with vertebral fracture	Women, $n=185$. Patients had at least one vertebral fracture Intervention $n=94$, (5 sites), $n=72$ at 12-month follow-up (77 %) Control $n=91$(4 sites), $n=77$ at 12-month follow-up (85 %) Mean age - Intervention group 80.2±4.8 - Control group 82.0±6.2	Health-related measures Physical impairment Performance measures	Baseline 3, 6, 9 and 12 months	Significant decrease in psychological symptoms and significant increase intrunk-extension strength after intervention No significant effect on pain
Alp et al./2007/Turkey/outpatient clinic/[20]	RCT Single-blind randomisation was done using a computer-generated table of random numbers. An independent researcher gave the questionnaires and did the outcome measurements	To test the self-management model for postmenopausal and idiopathic osteoporotic subjects	Women, $n=50$. Patients without fracture, with wrist or vertebral fracture. Intervention, $n=25$, $n=21$ at 6-month follow-up (84 %) Control group, $n=25$; $n=24$ at 6-month follow-up (96 %) Mean age - All 66±12 - Intervention group 64±8	Pain Quality of life Balance Function	Baseline 5 weeks (end of education) 6 months	No significant change in pain after 6 months Significant change in intervention group in several areas of SF-36 No significant change in physical activity

Table 1 (continued)

Authors/publication year/county/setting/ref	Study design/randomisation	Aim	Patients' characteristics: numbers including number of dropouts, sex, age and fracture type	Primary focus	Time of measure	Main conclusion
			- Control group 67±11			
Nielsen et al./2010/Denmark/outpatient clinic/[21, 22]	RCT Randomised in blocks of eight to either the intervention group or the control group Allocation was single-blinded	To test the hypothesis that participation in an osteoporosis-specific multidisciplinary group-based patient education programme would increase both patients' knowledge about osteoporosis and their compliance to treatment	Women and men, $n=300$. Patients without fracture, with vertebral and hip fracture. Intervention, $n=147$; $n=136$ at 24-month follow-up (93 %) Control, $n=144$; $n=130$ at 24-month follow-up (90 %) Mean age - Intervention group: 63(45–81) - Control group: 64 (48–80)	Knowledge Adherence to treatment	Baseline 3, 12 and 24 months	Significantly increase in patients' knowledge of osteoporosis after 3, 12 and 24 months in the intervention group Significantly higher adherence with pharmacological therapy at 24 months in the intervention group
Laslett et al./2011/Australia/an emergency department/[23]	RCT Allocation was single-blinded and by group Patients were unaware of the intervention they were attending until they arrived at the first session	To determine if group education either one session or four sessions resulted in a change in knowledge, intake of dietary calcium or exercise self-efficacy, physical activity, use of calcium supplements and osteoporosis medications	Women and men, $n=146$. Patients had a recent osteoporotic fracture (wrist or hip). Four week session (four groups): $n=75$, $n=54$ at 3-month follow-up (72 %) One-session (4 groups): $n=71$, $n=52$ at 3-month follow-up (83 %) Mean age - 4-week session: 68.3 (66.19;70.33) - One session: 69.3 (66.9;71.61)	Osteoporosis knowledge Calcium intake Exercise and physical activity	Baseline 3 months	Significant increase in knowledge and calcium intake from food in both groups Significantly higher medical compliance in patients attending four-session education
Bergland et al./2011/Norway/outpatient clinic/[24]	RCT Patients were randomised into blocks of eight using a computer-generated list Researchers not involved in the study performed the randomisation Patients were assessed three times by a physiotherapist who did not know which of the two groups the patients belonged to	To evaluate the effect of a 3-month course of circuit exercises plus a 3-h lesson	Women, $n=89$. Patients with vertebral fractures. Intervention, $n=45$; $n=38$ at 12-month follow-up (84 %) Control group, $n=42$; $n=32$ at 12-month follow-up (24 %) Mean age - All 71.4 (range 60–83). - Intervention group: mean age 70.8 - Control group, mean age 72.0	Exercise Quality of life	Baseline 3 months 12 months	Significant improved mobility Significant change in intervention group in several areas of SF-36

Table 2 The educational programme and the comparison programme

Authors/publication year/ref	Educators	Size of classes	Length of educational programme/completion	Content of educational programme	Use of theories on health behaviour change and learning	Comparison programme
Gold et al./1993/[17]	Endocrinologists, geriatricians, physiotherapists, nutritionists=4 Plus other support personnel	≤4 persons of same gender	4-day outpatient programme (hour not described) 100 % participation rate	Group programme • Information on osteoporosis • Adherence to diet and medicine. • Exercise recommendation and classes • Coping skills Individual physiotherapy evaluation at the beginning of the programme	Stress and coping paradigm described by Lazarus Duke University preventive and therapeutic Program for Osteoporosis (DUPATPO)	Usual osteoporosis care
Kessenich et al./ 2000/[18]	Nurse and dietician=2 Expert speakers=8	Not described	8-week session for 1½-h and a weekly telephone call (12 h) 18 attended all sessions 7 attended 75–88 %	Group programme • Lecture on eight topics from expert speakers: ○ Overview of osteoporosis ○ Pharmacology ○ Nutritional management ○ Humour therapy ○ Pain control ○ Tai Chi ○ Herbal therapy ○ Physiotherapy A weekly phone call to remain of the upcoming session	None	Usual clinical care
Gold et al./2004/[19]	Physiotherapist, occupational therapist or social worker and a person who has osteoporosis=2	Not described	- Exercise class 3×weeks for 45 min - Coping class 2×weeks for 45 min (5 h) - Self maintenance period for 6 months	Group programme • Exercise on ○ Safe exercise ○ Optimal skeletal alignment ○ Body mechanics for activities of daily living ○ Recreational activities ○ Deformity caused by VFs ○ Avoiding forward bending and twisting to prevent high-risk loading of the vertebral bodies. • General and osteoporosis-specific education ○ coping skills ○ stress reduction/relaxation ○ social networking skills ○ Lifestyle modifications appropriate for osteoporosis management ○ self-maintenance	Use word as coping skills and accessing and accepting social support	Registered nurse=1 Control: - General health issues of older women 1×week for 45 min - Exercise class 3×weeks for 45 min. - Coping class 2×weeks for 45 min

Table 2 (continued)

Authors/publication year/ref	Educators	Size of classes	Length of educational programme/completion	Content of educational programme	Use of theories on health behaviour change and learning	Comparison programme
Alp et al./2007/[20]	Not described	Not described	5-week session: 5×weeks for 50 min (5 h)	Group programme Three essential tasks: medical, psychological and social management. • It is Never Too Late ○ Prevention • There Is More You Can Do ○ Medication • Taking Charge ○ Pain management ○ Emotional well-being ○ Change in social role • Living Safe and Sound ○ Risk of fall ○ Exercise video • Putting It All Together ○ Bodily change ○ Personal plan	Self-management and behavioural change inspired by Bandura. Choices for better Bone Health	Control group: no intervention.
Nielsen et al./2008, 2010/[21, 22]	Physicians, dieticians, physiotherapists, and nurses=4	8–12 persons	4-week session 4×weeks for 3 h (12 h) After 1 year 2-h brush-up course, in the same groups as in the initial sessions	Group programme • How does osteoporosis develop? • Medical work-up • Diet • Prevention of falls • Fractures and pain • Pharmacological treatment • Physical exercises • How to live with osteoporosis in the conduct of everyday life • Goal planning and supported the patients in making informed choices	Empowerment Dialogue-based	No intervention. Patients with previous vertebral or hip fractures were offered instruction in an exercise programme (4×weeks 1 h) They were asked to continue with osteoporosis therapy as prescribed and follow their usual daily activities. They were offered control visits at GP or clinic as appropriate
Laslett et al./2011/[23]	Nurse and trained lay leader=2	12–20 persons	4-week session: 4×weeks for 2.5 h (10 h)	Group programme • Osteoporosis pathology/bone anatomy • Bone density measurement • Self-management principles • Fall prevention • Risk factors for osteoporosis • Problem-solving • Exercise • Posture • Personal goal setting • Pain management	Self-management by Lorig, K. Self-efficacy Action planning Osteoporosis Prevention and Self-Management Course (OPSMC)	Structured programme:A shortened version of the OPSMC. No action planning One session: 1×weeks for 2.5 h

Table 2 (continued)

Authors/publication year/ref	Educators	Size of classes	Length of educational programme/completion	Content of educational programme	Use of theories on health behaviour change and learning	Comparison programme
				• Relaxation • Working with your doctor • Nutrition • Communications skills • Medications • Support from others		
Bergland et al./2011/ [24]	Physiotherapist=1	Not described	- 3-h session of information and supervision. - 1-h exercise session 2 times per week in 3 months (27 h)	Group programme • Exercise programme focusing on: ○ Prevention of falls and fractures ○ Improving balance and coordination ○ Improving posture • Information and supervision about: ○ Risk factors for falls, osteoporosis and fractures ○ Body awareness ○ Ergonomic advice and daily-life situation	None	None. Patients were asked to maintain their current lifestyle

were classified into six topics: (1) Health-related quality of life, (2) Psychosocial function, (3) Pain, (4) Physical activity, (5) Knowledge and (6) Medication and diet. The life-quality assessments measured by Short Form Health Survey (SF-36) [18, 20], The Quality of Life Questionnaire issued by the European Foundation for Osteoporosis ('QUALEFFO-41') [18, 24] and the 90-item Hopkins Symptom checklist were used in two studies [17, 19]. The remaining tests, scales and questionnaires were used only once. Physical activity and pain were the most common outcome measures used. They were applied in four of the studies. The study by Laslett et al. [23] used outcome measures in five of the topics compared to Gold et al. [17] where the outcome measure focused solely on psychosocial status. Multifaceted group education was tested against 'no intervention (=standard care)' in six of the studies [17–22, 24], and in one study, two kinds of multifaceted group education were tested [23]. Time of measure varied from baseline and up to 24 months. The characteristics and effectiveness of the six topics are closely examined below and outlined in Table 3.

Health-related quality of life

Health-related quality of life was the primary outcome measure in three studies [18, 20, 24]. Two of the three studies showed significant changes in both the intervention and the control group as well as between intervention group and control group in different topics of health-related quality of life (Table 3) [20, 24]. Only women with osteoporosis were included in these studies, with the mean age varying between 66 and 71.4 years. Two of the studies included women with fractures, and one study included women with or without fractures. The study by Kessenich et al. showed no significant change in or between the groups [18]. This study included women with fractures and had the shortest follow-up time, contrary to the study by Bergland et al., which had a 12-month follow-up time and showed significant improvement on several aspects of health-related quality of life (Table 3) [24].

Psychosocial function

Psychosocial function was the primary outcome measure in three studies [17, 19, 23]. Two of the studies demonstrated that psychosocial functioning of older women and men can be significantly improved with multifaceted education [17, 19]. This was not the case in the study by Laslett et al., which measured self-efficacy on calcium and on exercise. Here, no differences between the groups or over time were found [23]. Further, participant in these studies varied in sex, age and fracture status. Two of the studies include men and women with a mean age of 66 and 68.5 years [17, 23], which was in

Table 3 Outcome measures and results in relations to different topics

Topic	Outcome measures	Results related to topic
Health-related quality of life [18, 20, 24]	• Life-quality assessments measured by Short Form Health Survey (SF-36) [18, 20] • The 10-step Cantril Ladder [18] • The Quality of Life Questionnaire issued by the European Foundation for Osteoporosis ('QUALEFFO-41') [18, 24] • The General Health Questionnaire (GHQ-20) [24] • A simple questionnaire included four main items: a) understanding the purpose and benefits of medications, b) Joining regular physical activities, c) Making personal plans for better bone health, and d) New falls [20]	Kessenich et al. [18] • No significant change in or between groups shown in The 10-step Cantril Ladder, QUALEFFO-41, SF-36-Aggregate physical function and SF-36- Aggregate mental function at 8 weeks (end of intervention) Alp et al. [20] • A significant change in score in IT group at 5 weeks and 6 months in SF-physical functioning ($P<0.001$), SF- physical health problems ($P<0.001$), SF- emotional problems ($P<0.01$), SF-social functioning (5 weeks: $P<0.05$) (6 month: $P<0.001$), SF-mental health ($P<0.001$), SF-vitality ($P<0.001$) • A significant change in score in CT group in role SF-physical health problems at 5 weeks ($P<0.05$) and 6 month ($P<0.05$) • No significant change in score in both groups in SF-general health perceptions ($P>0.05$) • Improvements observed were determined to be superior in IT group at the end of the 6 months Bergland et al. [24] • At 3 months, IT group had a significantly better result in, GHQ-20 ($P<0.009$) and QUALEFFO-41: mental function ($P<0.006$).No different in score on QUALEFFO-41: total score, general health perception, leisure time/social function and physical function • At 12 months IT group had significant a better result QUALEFFO-41: total score ($P<0.019$), mental function ($P<0.04$), physical function ($P<0.044$) and pain ($P<0.005$) • No different in score on GHQ-20, QUALEFFO-41: general health perception and leisure time/social function
Psychosocial functioning [17, 19, 23]	• The Short Psychiatric Evaluation Scale29 [17] • The 10-item Rosenberg Self-Esteem scale30 [17] • The 90-item Hopkins Symptom Checklist (SCL-90_R) [17, 19] • Calcium and exercise self-efficacy using Osteoporosis Self-Efficacy Scale [23]	Gold 1993 et al. [17] • For IT group a significant change in stress symptoms ($P=0.013$) • In SCL-90-R for IT group a significant change on psychiatric symptoms (GSI) ($P=0.0002$) • In SCL-90-R on independent variable the IT group showed a significant change on somatisation ($P=0.006$), obsessive ($P=0.001$), and anxiety ($P=0.005$) at 2-month follow-up • No effects found on Self-esteem • No significant change found for the CT group in any of the use outcome measures Gold 2004 et al. [19] • Psychological symptoms decreased significantly in IT group for phase 1 ($P=0.011$) and CT group for phase 2 ($P=0.006$) (receiving intervention) Laslett et al. [23] • There were no differences between the groups or over time in calcium or exercise self-efficacy
Pain [18–20, 23]	• Pain - subscale of the Functional Status Index (FSI) [19] • Pain intensity measured by visual analogue scale [20] • Short Form Health Survey Pain (SF-36) [18, 20] • The Quality of Life Questionnaire issued by the European Foundation for Osteoporosis ('QUALEFFO-41') Pain [18, 24]	Kessenich et al. [18] • No significant difference in or between groups Alp et al. [20] • Pain VAS changed significantly after 5 ($P<0.001$) weeks and 6 ($P<0.001$) month in IT group and CT group after 5 weeks ($P<0.05$) and after 6 months ($P<0.001$) • SF- pain changed significantly in IT group at 5 weeks ($P<0.01$) and at 6 months ($P<0.001$). In CT group SF-pain changed significantly at 6 months ($P<0.05$) Gold 2004 et al. [19] • No significant change in pain with activity Bergland et al. [24] • At 3 months no difference in score on QUALEFFO-41: pain • At 12 months, intervention group had significant better result QUALEFFO-41: pain ($P<0.005$)

Table 3 (continued)

Topic	Outcome measures	Results related to topic
Physical activity [19, 20, 23, 24]	• Balance testing by Sensitized Romberg Test (SRT) [20] • Functional assessment by Timed Sit to Stand test (TSS) [20] • Physical Activity Scale (PAS) [20] • Trunk extension strength [19] • Peak torque - subscale of the FSI [19] • Walking at maximum speed (MWS) [24] • Timed Up and GO (TUG) [24] • Functional Reach (FR) [24] • Community Healthy Activities Model Program for Seniors questionnaire (CHAMPS) [23]	Gold 2004 [19] • Trunk extension strength increased significantly for both IT group phase 1 ($P=0.001$) and CT group phase 2 ($P=0.001$) Alp et al. [20] • SRT and TSS test showed significant change of score in IT group after 5 weeks ($P<0.001$) and after 6 months ($P<0.001$) • No change in physical activity scale are described in both groups Laslett et al. [23] • No difference in and between groups or over time in physical activity Bergland et al. [24] • For MWS a significant change in score for IT group at 3 ($P=0.001$) and 12 months ($P=0.019$) • For TUG significant change in score for IT group at 3 ($P=0.026$) and 12 months ($P=0.021$) • For FR significant change in score for IT group at 3 ($P=0.001$) but not at 12 months ($P=0.049$)
Knowledge [21–23]	• Patients' knowledge of osteoporosis (Patienters Viden Om Osteoporose) PAVIOS [21, 22] • Osteoporosis Knowledge Assessment Tool (OKAT) [23]	Nielsen et.al [21, 22] • Change from baseline in knowledge score at 3 ($P<0.001$), 12 ($P<0.001$) and 24 ($P<0.001$)months was significantly higher in the IT group than in the CT group Laslett et.al [23] • Osteoporosis knowledge increased significantly both one-session and a 4-week course ($P<0.001$). No significant change in or between groups
Medicine and diet [22, 23]	• Adherence to medication using a self-completed questionnaire comprising nine questions on adherence [22] • Medication and calcium intake using Food Frequency questionnaire [23]	Laslett et al. [23] • Osteoporosis calcium from food increased from baseline to 3 months in both groups ($P<0.01$). No significant change in calcium supplement (either one-session or the 4-week OPSMC) • Adherence to medicine increased significantly in the four week OPSMC group ($P=0.039$) compared to the one-session group Nielsen et al. [22] • Adherence with medicine at 24 months was significantly higher in the IT group compared to the CT group ($P=0.006$)

IT intervention, *CT* control

contrast to the study by Gold et al., where only women were included and the mean age was 81 years [19]. Further two of the studies included only participants with fractures [19, 23] and in the study by Gold et al., fracture status was not described [17].

Pain

Four studies included pain as an outcome measure [18–20, 24]. These studies included osteoporotic women with a mean age of 66 to 71.4, with at least one vertebral fracture. Two studies showed significant improvement [20, 24]. Of these studies, the study by Bergland at al. showed significantly better results using QUALEFFO-41 pain ($P<0.005$) after 12 months. In this study, the main activity of the educational programme was exercise, as 24 h of the 27 h of the programme were allocated to physical activity. The other study by Alp et al., 50 min of the 5-h programme were allocated to exercise. This study showed a significantly better outcome in the intervention group after 5 weeks, but this improvement levelled off after 3 months [20].

Physical activity

Physical activity outcome measures were examined by nine different scales or tests in four studies. None of the four studies used the same scales or tests. Three of the studies included only women [19, 20, 24], and one included men and women [23]. All the participants had experienced osteoporotic fracture, and the mean age varied from 63 to 82 years.

The different tests used outcomes of significance for improving physical activity. Two scales (Physical Activity Scale (PAS) and Community Healthy Activities Model Program for Seniors questionnaire (CHAMPS)) had a general perspective

on physical activity. These two physical activity scales showed no difference in and between the groups in either of the studies they were used in [20, 23]. A characteristic for both these studies was the short follow-up time of 3 and 6 months. Further additional outcome measures focused on specific physical abilities. For example, mobility measured by 'maximum walking speed' (MWS) and 'timed up and go' (TUG) in the study by Bergland et al. [24]. Here, MWS and TUG showed a statistically better result in the intervention group compared with the control group after 3 and 12 months. Most of the specific physical outcome measures showed a significant change, and the results are outlined in Table 3.

Knowledge

Only two studies investigated knowledge as the primary outcome measure [21–23], and the participants included both men and women. In the study by Laslett et al., two different types of educational programme were compared [23]. The educational programmes varied in length; one comprised a 2½-h session and the other involved four sessions totalling10 h. Also, the one-session group education did not contain action planning. In the study by Nielsen et al., participants with or without fractures were included, and the mean age was 63.5 [22]. This was different from the study by Laslett et al., where all participants had a recent osteoporotic fracture and the mean age was 73 [23]. The two studies also varied in follow-up, which was 3 months in the study by Laslett et al. compared to 24 months in the study by Nielsen et al. [23]. All three types of multifaceted group education showed a significant increase in the participants' knowledge. The 24-month follow-up period in the study by Nielsen et al. made it possible to demonstrate that knowledge on osteoporosis can stay significantly increased for a longer period [21, 22].

Medication and diet

The two studies [22, 23] that investigated knowledge also investigated adherence to medication and diet (calcium supplement and calcium from food). Participants attending the four-session educational programme by Laslett et al. and the educational programme by Nielsen et al. demonstrated significant better adherences to medication compared to one-session educational programme or standard care. This may indicate that the length and content of the intervention influences the participants' adherence to medication. Only Laslett et al. investigated intake of calcium from food and calcium supplement. It showed how participants attending the one-session and the four-session educational programme significantly increased calcium intake from diet. There were no significant changes in or between groups in relation to calcium supplement [23].

Discussion

This systematic review indicates that multifaceted group education can have a significant effect on a variety of important factors for the prevention, treatment and management of osteoporosis. The patients' knowledge of osteoporosis can be increased as well as their health-related quality of life, psychical activity and psychosocial functioning. Also, multifaceted group education has the potential to increase adherence to both pharmacological and non-pharmacological treatments. Only one study demonstrated no significant effect of group education on any of the included outcome measures [18]. This small-scale observational study by Kessenich et al. had 50 participants and a short follow-up time (2 months), which may have had an impact on the statistical power of the study. Even though the review shows a significant effect on different outcome measures, it also highlights the challenges in investigating the outcome of multifaceted osteoporosis education programmes.

Aim and outcome measures

A unique aspect of our review is that it elucidates a variety of different ways of investigating and thereby evaluating osteoporosis patient education programmes. Despite the resemblances in the content of the educational programme, 24 different outcome measures are used. Only three outcome measures were used more than once: The life-quality assessments measured by SF-36, The 'QUALEFFO-41' and the 90-item Hopkins Symptom checklist [18, 20, 24]. In relation to exercise, nine different tests or scales were used to measure. Together, this demonstrates the challenge of comparing multifaceted osteoporosis group education and other kinds of osteoporosis patient education. None of the studies in this review directly state the aim of the educational programmes. It is however likely that the outcome measures indirectly state the aim of the educational programmes. Studies on interventions should provide information of how it complied with the aim and the needs of the target group [27]. In the included studies, the impaired description of the connection between the aim of the educational programme, target group and content of the educational programme reduced our ability to determine how effective multifaceted osteoporosis educational programmes should be constructed.

Outcome measures with an overall perspective

Two studies investigated the effect of multifaceted education on patients' knowledge [22, 23]. The items included in PAVIOS [28] and OKAT [29] measured a broad range of knowledge about osteoporosis, including risk factors and the consequences of pharmacological and non-pharmacological treatments. In contrast to OKAT, PAVIOS also includes

knowledge of the diagnosis and on the National Patients Association, but none of the instruments included questions relating to the consequences of osteoporosis. A systematic review on "knowledge about osteoporosis" found 17 instruments to test patients' or populations' knowledge of osteoporosis [30]. OKAT was included in this review, which also described that knowledge of osteoporosis mainly addresses risk factors, treatment and preventive behaviour. In addition, only a few instruments assess knowledge of the diagnosis, treatment and the consequences of osteoporosis [30]. The development and use of many different instruments shows that knowledge about osteoporosis is considered of great importance for the prevention and management of osteoporosis. Some of these instruments are more useful in multifaceted interventions because they capture all topics of multifaceted group education. This could for example be PAVIOS, which captures most topics included in multifaceted group education and thereby provides a comprehensive evaluation of the programme in relation to knowledge [28].

Another important issue regarding knowledge was that even the one-session programme in the study by Laslett et al. showed that the patients' degree of knowledge increased [23]. This corresponds with other educational interventions including small-scale interventions that report the aptitude to change the patients' and populations' knowledge of osteoporosis [31–35].

Outcome measures directed at specific aims

Pain was an outcome measure in four studies [18–20, 24], but only the study by Bergland et al. showed a significant improvement over time [24]. This programme was different because it included 24 h of exercise compared to the other programmes, where exercise lasted a maximum of 3 h. A review on the effect of therapeutic exercise found seven studies that included pain as an outcome measure and concluded that there was conflicting evidence as to how much exercise lead to reduction in pain [9]. The content of the therapeutic exercise was not included in the analysis. However, in the three studies that reported a reduction in pain, the therapeutic exercise programmes were significantly longer (hours of exercise) and performed under supervision [36–38]. The four programmes, where exercise had no effect on pain, were shorter and in two cases carried out at home without supervision. This indicates that if pain reduction is part of the aim of a multifaceted group educational programme, which includes exercise as a mean, it should be of longer duration and performed under supervision [9].

Behaviour change

In the studies by Laslett et al. and Nielsen et al. knowledge was regarded as a contributor and prerequisite to osteoporosis preventive change [22, 23]. Their programmes included behavioural change strategies, e.g. self-management and action planning [23] or empowerment or goal planning [22]. In the study by Nielsen et al., no association between knowledge score and adherence to medicine was found [22]. The study by Lastell et al. showed that the adherence to osteoporosis medications over time was significantly better for the participants attending the four-session programme, even though there was no significant difference in knowledge between the two groups of participants [23]. This is similar to the study by Blalock, which shows that small-scale studies can facilitate an increase in knowledge, but not promote behaviour change [33]. A paper by Lorig on self-management demonstrated that educational interventions including a self-managing intervention were significantly more likely to promote behaviour change than interventions without health behaviour strategies [39]. This supports the perspective that to change a person's health behaviour, the interventions must provide more than knowledge. They must also include actions that focus on health belief and behavioural change [4, 39]. Another perspective is health literacy, which encompasses the individual's ability to understand and use health information [40]. A study by Satterfield et al. showed that women who understood the effect of a particular behaviour, e.g. the benefits of calcium supplements were more likely to act in accordance with that behaviour [32]. This suggests that gaining knowledge and making plans for behavioural change should be seen in the context of patients' ability to understand and use health information [40]. Further, using theories of health behaviour and learning may be important for the effectiveness of patient educational programme.

Guidelines

The content of the included multifaceted educational programmes contained education on knowledge of osteoporosis, medication/diet and exercise. Other topics, e.g. activity of daily living and pain, are more crudely described. The lack of description of the content of the educational programmes and the context in which they were conducted makes it impossible to conclude why some topics seems more important to include in this type of patient education than others. As described in the introduction, the WHO Technical Report Series on 'Prevention and Management of Osteoporosis' includes patient education as a specific focus area and outlines basic information for patients with osteoporosis [7]. Only one of the multifaceted educational programmes seems to address all the educational topics listed as basic information [23]. In addition, osteoporosis guidelines do not advise on the form and content of osteoporosis patient education. For example, patient education is not described in the European guidance for the diagnosis and management of osteoporosis [11, 41]. Other osteoporosis guidelines recommend osteoporosis

patient education [1, 42] and describe the education of patients to be a key to ensuring good management of osteoporosis [43], but they make no recommendation on the different types of educational programmes. Therefore, more investigations on how best to educate patients with osteoporosis are urgently needed and the wisdom acquired from these studies should be included in future guidelines on management of osteoporosis.

Strengths and limitations

This systematic review has a number of limitations. Three of the studies were small-scale studies with less power and an increased risk of type II error [17, 18, 20]. Despite this, two of these studies showed significant changes in the intervention group on several outcome measures. Along with the fact that some of the negative results may be due to the small numbers of participants, the effect of multidisciplinary group education might be underestimated. Other bias [25] included the fact that some studies did not outline the required information, making it impossible to draw conclusion on or consequences of, e.g. group size. This entailed that we are unable to conclude on the effectiveness and potential of small or larger size of group education.

Another aspect was the follow-up time. Only one study had a long follow-up time of 24 months. In four studies, the follow-up time was less than 6 months. The small number of participants and the short duration of many of the included studies should stimulate further research with longer follow-up times and more participants.

In this review, 92 % of participants were women and three of the seven studies included only women. Therefore, we cannot make any conclusion on the effect on multifaceted group education regarding men with osteoporosis. Although research on men is appearing, most clinical studies are conducted among women. Research on gender differences in patients with osteoporosis have shown that men being diagnosed with osteoporosis feel stigmatised because osteoporosis is characterised as a women's disease, and this can prevent some men from seeking treatment [44–46]. This highlights the importance of further research on how men experience being diagnosed with osteoporosis and what type of education would best be able to improve quality of life in male patients. A male specific questionnaire has been developed and may be useful in future studies [47]. Another characteristic of the participants was that most of them had vertebral fractures. Three studies included participants with and without fractures [19, 20, 22]. Hence, this review imparts sparse knowledge on osteoporotic women without fractures and the effect of multifaceted group education. This underlines the need for studies in this area to investigate the effect and experience of educational interventions for this group of patients.

On a more positive note, the geographical variation of the included studies (Europe, North America and Australia) contributed to strengthening our findings with a broader interpretation and possible transition to other clinical settings. However, we cannot omit the prospect that local conditions that are not outlined in the articles may have influenced the design and performance of the programmes. Further, the participants stemmed mainly from outpatient clinics and did not reflect the wide-ranging osteoporosis patient population.

Qualitative studies were excluded because they do not test the effect of an intervention [48]. During the literature review, we found three qualitative studies that reported on osteoporosis patient education. These qualitative studies draw attention to important aspects of group education, e.g. one study indicates the necessity of adjusting educational intervention to the participants' needs, which may not clearly be linked to disease severity [49]. Therefore, using qualitative studies in the development of osteoporosis patient education is important.

Conclusion

This systematic review demonstrates that multifaceted group education may have a positive impact on very different topics of importance for the patients' ability to engage in preventing and managing osteoporosis. It showed that knowledge and health-related quality of life can increase and possibly have a positive effect on calcium intake, adherence to medication, pain, psychosocial function and physical activity. Besides the reduction of pain, which seems to be associated with a programme where the participants exercised for significantly longer periods, it was not possible to conclude why some of the programmes led to improvement in specific topics. However, this stresses the importance of clarifying the aim and goal of multifaceted osteoporosis group education with the emphasis on the specific knowledge and skills and in relation to the target group.

Clearly, further research directed towards the complexity of multifaceted group education as well as the educational needs of additional specific groups of patients is needed. This research would have to be sufficiently powered to address the unanswered questions and could by using different research methods contribute with important knowledge of how best to develop osteoporosis patient education. Thereafter, the important step forward will be the implementation of education of patients with osteoporosis and individuals at risk of osteoporosis in the management of osteoporosis.

Acknowledgments The authors would like to thank research librarian Edith Clausen from Aarhus University Hospital for her assistance with the literature search. This article was funded by the Faculty of Health Sciences at Aarhus University and Aarhus University Hospital.

Conflicts of interest None.

References

1. Papaioannou A, Morin S, Cheung AM, Atkinson S, Brown JP, Feldman S, Hanley DA, Hodsman A, Jamal SA, Kaiser SM, Kvern B, Siminoski K, Leslie WD (2010) 2010 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: summary. CMAJ 182:1864–1873
2. Kastner M, Straus SE (2008) Clinical decision support tools for osteoporosis disease management: a systematic review of randomized controlled trials. J Gen Intern Med 23:2095–2105
3. Ryan P, Pumilia NJ, Henak B, Chang T (2009) Development and performance usability testing of a theory-based, computerized, tailored intervention. CIN: Comput Inform Nurs 27: 288–300
4. Coster S, Norman I (2009) Cochrane reviews of educational and self-management interventions to guide nursing practice: a review. Int J Nurs Stud 46:508–528
5. Sujic R, Gignac MA, Cockerill R, Beaton DE (2011) A review of patient-centred post-fracture interventions in the context of theories of health behaviour change. Osteoporos Int 22:2213–2224
6. Gronholz MJ (2008) Prevention, diagnosis, and management of osteoporosis-related fracture: a multifactoral osteopathic approach. J Am Osteopath Assoc 108:575–585
7. WHO Scientific group. Prevention and management of osteoporosis. 2003
8. Jensen AL, Harder I (2004) The osteoporotic pain experience. Osteoporos Int 15:204–208
9. Dusdal K, Grundmanis J, Luttin K, Ritchie P, Rompre C, Sidhu R, Harris SR (2011) Effects of therapeutic exercise for persons with osteoporotic vertebral fractures: a systematic review. Osteoporos Int 22:755–769
10. Reginster JY, Burlet N (2006) Osteoporosis: a still increasing prevalence. Bone 38:S4–S9
11. Kanis JA, McCloskey EV, Johansson H, Cooper C, Rizzoli R, Reginster JY (2013) European guidance for the diagnosis and management of osteoporosis in postmenopausal women. Osteoporos Int 24:23–57
12. Wilson SR (1997) Individual versus group education: is one better? Patient Educ Couns 32:S67–S75
13. Rickheim PL, Weaver TW, Flader JL, Kendall DM (2002) Assessment of group versus individual diabetes education: a randomized study. Diabetes Care 25:269–274
14. Wilson SR, Scamagas P, German DF, Hughes GW, Lulla S, Coss S, Chardon L, Thomas RG, Starr-Schneidkraut N, Stancavage FB (1993) A controlled trial of two forms of self-management education for adults with asthma. Am J Med 94:564–576
15. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 339:b2700
16. Schmucker C, Bluemle A, Briel M, Portalupi S, Lang B, Motschall E, Schwarzer G, Bassler D, Mueller KF, von EE, Meerpohl JJ (2013) A protocol for a systematic review on the impact of unpublished studies and studies published in the gray literature in meta-analyses. Syst Rev 2:24
17. Gold DT, Stegmaier KY, Bales CW, Lyles KW, Westlund RE, Drezner MD (1993) Psychosocial functioning and osteoporosis in late life: results of a multidisciplinary intervention. J Women's Health 2:149–155
18. Kessenich CR, Gordon HG, Patton CL, Griffith LE, Hamlin A, Rosen CJ (2000) Support group intervention for women with osteoporosis. Rehabil Nurs 25:88–92
19. Gold DT, Shipp KM, Pieper CF, Duncan PW, Martinez S, Lyles KW (2004) Group treatment improves trunk strength and psychological status in older women with vertebral fractures: results of a randomized, clinical trial. J Am Geriatr Soc 52:1471–1478
20. Alp A, Kanat E, Yurtkuran M (2007) Efficacy of a self-management program for osteoporotic subjects. Am J Phys Med Rehabil 86:633–640
21. Nielsen D, Ryg J, Nissen N, Nielsen W, Knold B, Brixen K (2008) Multidisciplinary patient education in groups increases knowledge on osteoporosis: a randomized controlled trial. Scand J Public Health 36: 346–352
22. Nielsen D, Ryg J, Nielsen W, Knold B, Nissen N, Brixen K (2010) Patient education in groups increases knowledge of osteoporosis and adherence to treatment: a two-year randomized controlled trial. Patient Educ Couns 81:155–160
23. Laslett LL, Lynch J, Sullivan TR, McNeil JD (2011) Osteoporosis education improves osteoporosis knowledge and dietary calcium: comparison of a 4 week and a one-session education course. Int J Rheum Dis 14:239–247
24. Bergland A, Thorsen H, Karesen R (2011) Effect of exercise on mobility, balance, and health-related quality of life in osteoporotic women with a history of vertebral fracture: a randomized, controlled trial. Osteoporos Int 22:1863–1871
25. Higgins JP, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, Savovic J, Schulz KF, Weeks L, Sterne JA (2011) The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ 343:d5928
26. Cooper HM (2010) Research synthesis and meta-analysis: a step-by-step approach, 4th edn. Sage, Thousand Oaks
27. Naidoo J, Wills J (2009) Foundations for health promotion, 3rd edn. Bailliere Tindall, Toronto
28. Ryg J, Nissen N, Nielsen D, Brixen KT (2005) Patients' and population's knowledge of osteoporosis. Ugeskr Laeger 167: 282–285
29. Winzenberg TM, Oldenburg B, Frendin S, Jones G (2003) The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: the Osteoporosis Knowledge Assessment Tool (OKAT). BMC Musculoskelet Disord 4:17
30. Werner P (2005) Knowledge about osteoporosis: assessment, correlates and outcomes. Osteoporos Int 16:115–127
31. Ribeiro V, Blakeley JA (2001) Evaluation of an osteoporosis workshop for women. Public Health Nurs 18:186–193
32. Satterfield T, Johnson SM, Slovic P, Neil N, Schein JR (2000) Perceived risks and reported behaviors associated with osteoporosis and its treatment. Women Health 31:21–40
33. Blalock SJ, Currey SS, DeVellis RF, DeVellis BM, Giorgino KB, Anderson JJ, Dooley MA, Gold DT (2000) Effects of educational materials concerning osteoporosis on women's knowledge, beliefs, and behavior. Am J Health Promot 14:161–169
34. Brecher LS, Pomerantz SC, Snyder BA, Janora DM, Klotzbach-Shimomura KM, Cavalieri TA (2002) Osteoporosis prevention project: a model multidisciplinary educational intervention. JAOA: J Am Osteopath Assoc 102:327
35. Sedlak CA, Doheny MO, Jones SL (2000) Osteoporosis education programs: changing knowledge and behaviors. Public Health Nurs 17:398–402
36. Smith A.A., Summers G.D., Baxendale A., Butterly R.J. A randomized controlled trial of the effects of weight-bearing exercise and resistance training on risk factors for fracture in women with osteoporosis. 1998; 128
37. Malmros B, Mortensen L, Jensen MB, Charles P (1998) Positive effects of physiotherapy on chronic pain and performance in osteoporosis. Osteoporos Int 8:215–221
38. Bennell KL, Matthews B, Greig A, Briggs A, Kelly A, Sherburn M, Larsen J, Wark J (2010) Effects of an exercise and manual therapy program on physical impairments, function and quality-of-life in people with osteoporotic vertebral fracture: a randomised, single-blind controlled pilot trial. BMC Musculoskelet Disord 11:36

39. Lorig K (2003) Self-management education: more than a nice extra. Med Care 41:699–701
40. Sorensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, Brand H (2012) Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health 12:80
41. Watts NB, Adler RA, Bilezikian JP, Drake MT, Eastell R, Orwoll ES, Finkelstein JS (2012) Osteoporosis in men: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab 97:1802–1822
42. Danish Bone Society (Dansk Knoglemedicinsk Selskab). Guidance for the diagnosis and management of osteoporosis (Vejledning til udredning og behandling af osteoporose). Danish Bone Society 2013; 1–27 http://wp.dkms.dk/?page_id=1089
43. NAMS (2010) Management of osteoporosis in postmenopausal women: 2010 position statement of The North American Menopause Society (NAMS). Menopause (10723714) 17:25–54
44. Solimeo SL, Weber TJ, Gold DT (2011) Older men's explanatory model for osteoporosis. Gerontologist 51:530–539
45. Feldstein AC, Nichols G, Orwoll E, Elmer PJ, Smith DH, Herson M, Aickin M (2005) The near absence of osteoporosis treatment in older men with fractures. Osteoporos Int 16:953–962
46. Nielsen DS, Brixen K, Huniche L (2011) Men's experiences of living with osteoporosis: focus group interviews. Am J Mens Health 5:166–167
47. Solimeo SL, Silverman SL, Calderon AD, Nguyen A, Gold DT (2012) Measuring health-related quality of life (HRQOL) in osteoporotic males using the Male OPAQ. Osteoporos Int 23:841–852
48. Denzin NK, Lincoln YS (2011) The Sage handbook of qualitative research, 4th edn. Sage, Thousand Oaks
49. Nielsen D, Huniche L, Brixen K, Sahota O, Masud T (2013) Handling knowledge on osteoporosis—a qualitative study. Scand J Caring Sci 27(3):516–24