Clinical and Experimental Health Sciences

Interventions Preventing Osteoporosis in Primary Care: A Systematic Review

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Received: 05.11.2021 **Accepted:** 25.05.2022

ABSTRACT

Objective: The aim of this study was to conduct a systematic review to find interventions in primary health care that would increase osteoporosis prevention behaviors.

Methods: Systematic searches of CINAHL, Eric, Medline complete, PsycInfo, Ovid, Web of Science, Cochrane Library (N=1270). A total of 17 published articles met our inclusion criteria. English-language articles published between January 2000-May 2019, in primary care settings, participants with healthy or risk of osteoporosis, investigated osteoporosis preventing behaviors. The data extracted included population characteristics, diagnosis, mean age and setting, intervention and control groups, and outcomes of significance to the review question and specific objectives. In this review, a meta-analysis could not be performed due to the heterogeneity of the data.

Results: The majority of studies have been found to use multiple strategies to prevent osteoporosis. Eight studies focused only on the female gender and seven studies focused only on older adults. Compared to the control groups, it was found that the participants' osteoporosis knowledge increased significantly ($p<0.01$) with four interventions including prevention and self-management courses, counseling session, group discussion, various exercises, educational booklets, and motivational messages. Studies that assessed outcomes found that osteoporosis knowledge, calcium and vitamin D intake, bone mineral density, exercise, factors underlying behavior, quality of life, risk management, respectively.

Conclusion: Using educational interventions can improve osteoporosis knowledge, calcium-vitamin D intake, and bone mineral density among healthy or at-risk populations about osteoporosis in primary care. Behavior change provide also health promotion. Handling an individual's health beliefs, attitudes, and self-efficacy can facilitate behavior change.

Keywords: Intervention, osteoporosis, prevention, systematic review, primary care

1. INTRODUCTION

Osteoporosis (OP) is a systemic bone disease marked by decreased bone mass, degradation of bone tissue, disturbance of bone microarchitecture, and increased bone fragility (1). Osteoporosis is characterized only by a T score of less than 2.5 standard deviations below the mean Bone Mineral Density (BMD) of the young adult reference population (2).

It is estimated that OP affects millions of people around worldwide and fractures related to OP more than 8.9 million osteoporotic fractures occur yearly (3). OP and related health concerns are also important in Turkey. Although Turkey has a relatively lower incidence of osteoporosis compared to some European countries, the prevalence of osteoporosis increases with aging (4). According to Tüzün et al., the number of hip fractures will more than double in the next 25 years without modifying the age and gender risk variables (4). Furthermore, the prevalence of OP was shown to be higher in women than in men in various situations (4–6).

OP and the resultant fragility fractures have an impact in terms of mortality and morbidity on individuals, health care systems, and communities (7). According to National Osteoporosis Foundation, OP is responsible for billions of bone fractures and billions of economic burdens each year (8). In addition, the economic burden of OP-related fracture is significant, costing approximately $17.9 per annum in the USA (9). OP is a preventable and treatable disease, but we need to improve the awareness about the disease in general and the risk factors that lead to the problem (10–12).

Researches indicate that there are many modifiable and non-modifiable risk factors for OP and osteoporotic fractures. Major modifiable risk factors include poor nutrition, vitamin D deficiency, eating disorders, excessive alcohol consumption (>2 units daily), smoking, estrogen deficiency, insufficient exercise, fall risk, low body mass index (BMI<20 Kg/m^2), cigarette smoking, frequent falls. Major non-modifiable risk factors include history

DOI: 10.33808/clinexphealthsci.1019617

of falls, older age, women, white ethnicity, prior fracture, hormonal factors (13,14). The main goal of OP treatment is to prevent fractures. Pharmacological interventions for OP include calcium and vitamin D supplementation, hormone replacement therapy and bisphosphonates (9). In addition, robust screening programs are required (7).

OP and osteoporotic fractures can result permanent physical disability, decreased self-sufficiency, hospitalization, and an increased risk of death (15). Therefore, finding OP preventive behaviors require the need to decrease the risk of this disease. OP intervention is important to promoting bone health and improving OP preventive health behaviors (10). Consuming a healthy amount of calcium and engaging in weight-bearing exercise are two typical recommendations for lowering one's risk of developing OP (16). Education of people risk of OP and on various non-pharmacologic approaches to prevention and treatment that include nutrition, exercise, fall prevention and awareness of bone health, and would be vital for women of menopausal age and older (11).

Several interventions to minimize the risk of OP and hip fractures associated with OP have been described. The educational and counseling interventions aimed to promote OP knowledge and awareness, as well as with OP illness prevention. Calcium consumption, awareness, and self-efficacy are all improved through OP education initiatives.

OP education programs improve calcium intake, knowledge and self-efficacy (10,16,17). A multifaceted community-based intervention improved management of OP in high risk patients. This intervention includes bone mineral density testing, patient education and patient-tailored recommendations for OP treatment (18). Fall prevention exercise programs can reduce fall incidence and can decrease osteoporotic fracture (19). Providing hip protectors increases acceptance and adherence with hip protector use and giving education increases hip protector use in people living in the community (20). Using hip protectors lead to a reduction in hip fracture (21).

The aim of this study was to conduct a systematic review in order to find interventions in primary health care that would increase OP prevention behaviors.

2. METHODS

2.1. Search Strategy

A preliminary search was conducted in the following databases: CINAHL, Eric, Medline complete, PsycINFO, Ovid, Web of Science, Cochrane Library. The search was limited to original 18 years and older age, English articles that appeared in publications from January 2000 to May 2019. Search terms were as follows: [Osteoporosis OR "osteoporosis preventing behaviors" OR "bone mineral density" OR "dual energy x-ray absorptiometry"] AND [intervention OR program OR "health education"] AND ["primary care" OR "general practice" OR "family medicine" OR "primary care clinic" OR "community settings"].

All citations were imported into an Endnote version X9 and duplicates removed. Titles and abstracts were screened by search terms. Two researchers evaluated the results independently of each other, considering the inclusion and exclusion criteria.

2.2. Study Selection and Data Extraction

This review includes individuals aged 18 years and older who are healthy or at risk of OP.

The educational programs were defined as interventions, planned to improve knowledge, self-efficacy, health beliefs, self-monitoring, awareness of adults with OP screening, compliance of taking calcium and D vitamin, adherence with use of hip protectors, risk management, exercise, nutrition, prevention of the disease. Primary outcome reported OP preventing behaviors.

Studies were included if they (a) performed with adults and older adults at risk of OP (b) were recruited from primary care settings (a general practice, family practice, or primary care clinic, community settings) (c) were either randomized controlled trials (RCTs), quasi-experimental, or pretest-posttest studies, (d) investigated OP preventing behaviors (e) in English language (f) conducted with January 2000-May 2019. Studies were excluded if they existed a confirmed diagnosis of OP or osteopenia or taking medication related to OP. The result of the search and selection process are shown in Figure 1.

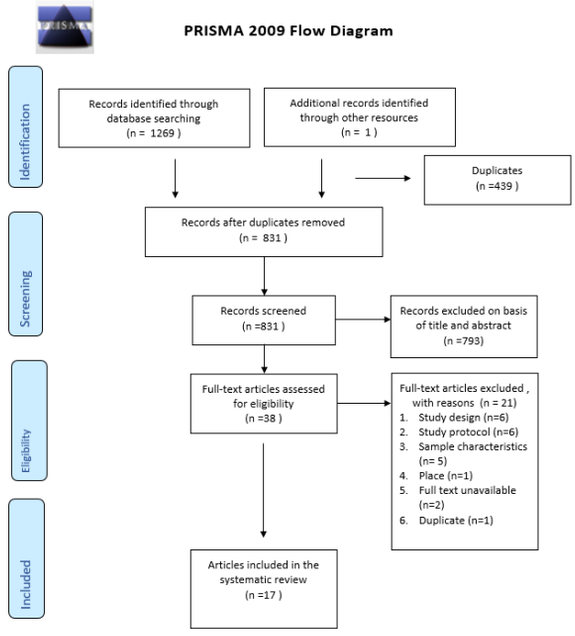

Figure 1. *Flow the diagram for study selection according to PRISMA*[22]

One researcher extracted data from each article by the Joanna Briggs Institute (JBI) SUMARI data extraction instrument. The data extracted included about population characteristic, diagnosis, mean age and setting, intervention and control groups, and outcomes about review question (see Table 1).

Table 1. *Characteristics of included studies*

References	Population	Groups	Follow-up	Outcome	Result
Randomized Controlled Trial					
Babatunde et al.	**Diagnosis:** at risk of OP **Mean age:** 70.2 **Male/Female:** 11/99 **Setting:** churches and community-senior centers	**Intervention group:** Osteoporosis education program n=59 6 weekly education program sessions. Short presentations/lectures, hands on activities and demonstrations involving the participants. Intervention guided by Revised Health Belief Model. **Control group:** Waiting list n=51	None	1.Calcium intake 2.Knowledge 3.Health belief 4.Self-efficacy	1.+p<0.001 2.+p<0.001 3.-p>0.05 4.+p<0.001
Birks et al.	**Diagnosis:** women with risk hip fracture **Mean age:** 78 **Male/Female:** 0/4168 **Setting:** primary care	**Intervention group**: Hip protectors sending mail three pairs of hip protectors along with instructions on how to use them and receiving a leaflet about other methods of reducing their fracture risk. n=1387 **Control group:** Sending mail leaflet n=2781	12 months 18 months 24 months	1.Hip fractures 2.Falling 3.Fear of falling	1: – p=0.40 2:+ p<0.001 (12 months) 2:+ p<0.01 (24 months) 3:+ p=0.003 (12 months) 3: – p=0.07 (18 months) 3:+p=0.04 (24 months)
Blaloc et al.	**Diagnosis:** women with menopause **Mean age:** 47.0±4.40 **Male/Female:** 0/547 **Setting:** twelve counties	**Intervention group I:** Tailored educational intervention includes two packet of written materials and one brief telephone counseling session**.** n=114 Intervention guided by Precaution Adoption Process Model. **Intervention group II:** Community-based intervention includes establishing an Osteoporosis Resource Center, conducting a workshop on osteoporosis prevention, and offering free bone density screening. n=159 **Control group (I):** n=105 **Individual level,** Nontailored education, received two packets of informational materials. No information specific to the individual participant. **Control group (II):** n=169 Community level, nontailored education.	3 months 6 months 12 months	1.Calcium intake 2.Exercise level Stage of change was assessed as a moderating variable. (unengaged, engaged action)	**Tailored intervention** 1: – p>0.05 **unengaged** 1: – p>0.05 **engaged** (baseline) 1: – p<0.10 (3 months) 1: + p<0.01 (6 months) 1: – p>0.05 (12 months) 1: – p>0.05 **action** (baseline) 1:+ p<0.05 (3 months) 1: + p<0.05 (6 months) 1: + p<0.05 (12 months) **Community intervention** 1: – p>0.05 **unengaged**(baseline) 1:+p<0.05 **(**3 months) 1: – p<0.10 (6 months) 1: – p>0.05 (12 months) 1: + p<0.01 **engaged** (baseline) 1: – p>0.05 (3-6-12 months) 1: – p>0.05 **action** (baseline-3-6 months) 1: – p<0.10 (12 months) **Tailored intervention** 2: – p>0.05 **unengaged** 2: – p>0.05 **engaged** 2: – p<0.10 **action** (baseline) 2: – p>0.05 (3-6-12 months) **Community intervention** 2: – p<0.10 **unengaged**(baseline) 2: – p>0.05 (3-6 months) 2: – p<0.10 (12 month) 2:+p<0.05 **engaged**(baseline) 2: – p>0.05 (3-6-12 months) 2: – p>0.05 **action** (baseline-3-6-12 months)

Table 1. *(Continued)*

Cameron et al.	**Diagnosis:** People at high risk of hip fracture **Age:**75 years or more **Sex:** Unclear **Setting:** Community and hospital trial	**Intervention group I:** The no cost group-who were fitted with free hip protectors (Community) n=58 **Intervention group II:** Community combined group-received free hip protectors and educational sessions about their use n=60 Intervention group III: The no cost group-who were fitted with free hip protectors (hospital) n=106 **Intervention group IV:** Hospital combined group-received free hip protectors and educational sessions about their use. n=99 **Control group I:** Provided a brochure about hip protectors (Community) n=53 **Control group II:** Provided a brochure about hip protectors (Hospital) n=103	3 months 6 months	1.Adherence with use of hip protectors(mean percentage) 2.Number of Falls: (mean per participant) 3.Number of fractures: hospital 4. Number of fractures :community 5.Number of hospitalizations: hospital 6. Number of hospitalizations: community	1: + p<0.001 (3-6 months) (comparison within hospital) 1: + p=0.000 (3-6 months) (comparison within community) 1:+p<0.001 (3-6 months) (comparison between hospital and community) 2:+p=0.010 (6 months) (comparison within hospital) 2:-p=0.356 (comparison within community) 2:-p=0.26 (comparison between hospital and community) 3: 1 (hospital control) 3: 5 (hospital no cost) 3:1 (hospital combined) 4: 0 (community control) 4: 2 (community no cost) 4: 0 (community combined) 5: 0 (hospital control) 5: 3 (hospital no cost) 5: 2(hospital combined) 6: 0 (community control) 6: 1 (community no cost) 6: 0 (community combined)
Ciaschini et al.	**Diagnosis:** Patients at risk for osteoporosis and fractures **Mean age:** 71.9±7.2 **Male/Female:** 12/188 **Setting:** Community dwelling	**Intervention group:** A multifaceted community-based care program. This group received personalized counseling about osteoporosis, provided written OS management plan and received educational materials on calcium and vitamin D, risk factors for OS and their BMD results. n=101 **Control group:** Usual care n=100	12 months	1.OS risk management 2.OS management 3.Quality of life	1:-p>0.05 2:-p=0.48 3: I: – p=0.58 C= – p=0.26
Cleghorn et al.	**Diagnosis:** women who are within five years of the menopause **Mean age:** Group 1: 52.2 Group 2: 51.8 **Male/Female:** 0/115 **Setting:** Community	**Intervention group I:** Received a supplement of 3L of calcium-fortified milk weekly in the first year In the second year, reverted to their usual diets. n=115 **Intervention group II:** Followed their usual diets in the first year. In the second year, received the milk supplement.	2 years	1.BMD at spine 2.BMD at forearm 3.Fasting urine levels	1:+p=0.006 2.-p>0.05 3. +p=0.03
Duckham et al.	**Diagnosis:** older adult **Mean age:** 72±5 **Male/ Female:**128/191 **Setting:** primary care	**Intervention group I:** Otago exercise program (OEP) consist of three 30-min home exercise session and at least two 30-min session of walking each week. Each participant received an instruction booklet, followed up two home visits and eight telephone calls. n=88 **Intervention group II:** Falls exercise management (FAME) consist of one 60-min exercise class, two 30-min home exercise sessions and two 30-min sessions of walking each week. n=105. **Control group:** Usual care n=126	6 months	1.BMD at femoral neck 2.BMD at other skeletal sites	1:-p=0.44 (OEP) 1:-p=0.53 (FAME) 2:-p>0.05

Table 1. *(Continued)*

Francis et al.	**Diagnosis:** people with risk factors **Mean age:** 63 **Sex:** 92% female **Setting:** Community	**Intervention group:** The Osteoporosis Prevention and Self-Management Course (OPSMC) consist of four weekly sessions which run for 2h and are led by two facilitators. n=103 Control group : Wait list n=95	6 weeks	1.Knowledge 2.Self-efficacy: exercise 3.Self-efficacy:Ca 4.Self-monitoring 5.Health-directed behavior	1:+p<0.001 2:-p=0.583 3:-p=0.711 4:-p=0.057 5:+p=0.020
Kalkim and Daghan	**Diagnosis:** risk of osteoporosis **Age range:**30-45 years **Male/Female:** 0/73 **Setting:** Family health center	**Intervention group:** An osteoporosis prevention program consists of a 4-week education program and a 24-week counseling program. Intervention guided by Health Belief Model. n=37 **Control group:** Usual care n=36	3 months 6 months	1.Knowledge 2.Health belief 3.Self efficacy 4.Calcium intake 5.Exercise	1: +p<0.001 2: +p<0.001 3: +p<0.001 4: +p<0.001 5: +p<0.001
Kloseck et al.	**Diagnosis:** older adults and risk of osteoporosis **Mean age:** 80.5±6.9 **Sex:** 88.6% female **Setting:** retirement community	**Intervention group:** Peer-led osteoporosis education and mentorship program. n=53 **Control group:** Usual care n=52	6 months	1.Behavior-BMD 2.Behavior-Vitamin D 3.Knowledge	1: +p<0.001 2: +p=0.02 3: – p=0.21
Kukuljan et al.	**Diagnosis:** healthy older man **Age range:**50-79 **Male/Female:** 180/0 **Setting:** community dwelling	**Intervention group I:** Exercise + milk group n=45 **Intervention group II:** Exercise group n=46 **Intervention group III:** Milk group n=45 **Control group :** Usual care n=44 **Exercise program:** warm-up and cool down, cycling and stretching, resistance training exercise, weight-bearing exercise **Milk group**: Calcium-vitamin D fortified milk	12 months 18 months	1.BMD 2.Take calcium and Vitamin D 3.Serum PTH	1:+p<0.01 (Lumbar spine) 2: +p<0.001 (greater in fortified group compared with nonfortified group) 3:-p>0.05 (12 months) (exercise-fortified milk group) 3: +p<0.05 (18 months) (a significant decrease exercise group compared to non-exercise group)
Levy et al.	**Diagnosis:** 65 years and older women **Mean age:**74.0 **Male/Female:**0/204 **Setting:** family physician	**Intervention group I:** Chart reminder n=102 **Intervention group II:** Patient education + chart reminder n=62 **Control group :** Usual care n=31	14 months	1.the rate of BMD	1:+p<0.029
Piaseu et al.	**Diagnosis:** students **Mean age:** 18,5 **Male/Female:**0/100 **Setting:** Nursing school	**Intervention group I:** Osteoporosis educational program (3 hours) This program consists of instructional materials and slide presentation n=50 **Control group :** wait list n=50	2 weeks	1.Knowledge 2.Attitude 3.Self-efficacy	1: + p<0.01 2: + p<0.01 3: + p<0.01
Hien et al.	**Diagnosis:** postmenopausal women **Age range:** 55-65 years **Male/Female:** 0/108 **Setting:** rural communes	**Intervention group:** Nutrition education (provided with visual education materials such as posters, leaflets, booklet and video tape) n= 57 **Control group :** Usual diet (provided education at the end of data collection period) n= 51	18 months	1.Calcium intake 2.Bone mass 3.Serum PTH	1: + p<0.01 2: + p<0.01 3: + p<0.01
Woo et al.	**Diagnosis:** elderly people **Age range:** 65-74 **Male/Female:**90/90 **Setting:** Community	**Intervention group I**: Tai Chi group n=60 **Intervention group II:** Resistance exercise group n=60 **Control group:** No exercise n=60	12 months	1.BMD 2.Muscle strength 3.Balance and flexibility 4.Falls	1: +p<0.05 (women-hip) 1:-p>0.05 (men-hip) 1:+p<0.05 (comparison between intervention and control group) 2:-p>0.05 3:-p>0.05 4:-p>0.05

Table 1. *(Continued)*

Yuksel et al.	**Diagnosis**: ≥ 65 or 50-64 years with one major risk factor **Mean age:** 62 **Male/Female:** 2/3 female **Setting:** community pharmacy	**Intervention group :** Multifaceted intervention (screening and patient education) printed materials, education and quantitative ultrasound n=129 **Control group:** Usual care n=133	16 weeks	1.BMD 2.Medication 3.Calcium intake 4.Vitamin D 5.Knowledge 6.Quality of life	1:+p=0.011 2:-p=0.30 3:+p=0.011 4:-p=0.66 5:-p>0.05 6:-p>0.05
Quasi Experimental Study					
Law and Shapiro	**Diagnosis:** frail elderly **Mean age:** 63.9±12.1 **Male/Female:** 0/116 **Setting:** community pharmacy	**Intervention group:** Screening and awareness program. Educational brochure, providing Ca supplements (Citracal), follow-up phone call. n=116 **Control group:** none	A week	1.Awareness 2.Self-rated risk	1:+p<0.001 2:-p>0.348

OP: Osteoporosis
BMD: Bone mineral density

2.3. Data Syntesis

Due to the variability of the individual's socio-demographics, intervention duration, and outcome assessments, meta-analysis was not possible. Using the JBI's established critical appraisal instruments, two researchers independently assessed papers for methodological quality for Randomized Controlled Trials (RCTs) and Quasi-Experimental studies (22) (Table 2 and Table 3). Scores on the critical appraisal instruments were determined maximum 13 points for RCTs and 9 points for quasi-experimental studies.

3. RESULTS

In all, 1270 articles were retrieved and appraised from our systematic review. A total of 17 published articles met our inclusion criteria (Figure 1) (23). Sixteen interventions were RCTs and one was quasi-experimental design (Table 1).

3.1. Methodological Quality

Assessment of methodological quality was carried out by two independent reviewers for the 16 RCTs and one Quasi-Experimental studies. Only two studies adopted allocation concealment (20,24). Six studies were high, with scores ranging from nine (18,21,25) to ten (20,24,26) in RCTs, one study score was eight (11) in quasi-experimental study. The methods of randomization were reported in ten studies. These studies were used block randomization (24,26), computer-randomization system (21,25,27), concealed number envelopes with the randomization sequence from a random numbers table (20,21), drawing lots (28), a random number generator (12,29). The three trials (10,17,18) did not report how they achieved randomization. The three trails (19,30,31) randomization process were unclear (Table 2 and Table 3).

Table 2. *Critical appraisal results for randomized controlled trials*

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Score
Babatunde et al.	Y	U	Y	U	U	U	Y	N	Y	U	Y	Y	Y	7/13
Birks et al.	Y	U	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	9/13
Blalock et al.	Y	U	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	8/13
Cameron et al.	Y	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y	Y	10/13
Ciascihinni et al.	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	9/13
Cleghorn et al.	U	U	N	U	U	U	Y	Y	N	Y	Y	Y	Y	6/13
Ducham et al.	U	N	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	8/13
Francis et al.	Y	U	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	8/13
Hien et al.	U	N	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	7/13
Kalkim&Daghan	Y	N	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	8/13
Kloseck et al.	Y	U	Y	N	U	U	Y	Y	N	Y	Y	Y	Y	8/13
Kukuljan et al.	Y	U	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	9/13
Levy et al.	Y	U	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	8/13
Piaseu et al.	Y	U	N	N	N	N	Y	NA	N	Y	Y	Y	Y	6/13
Woo et al.	Y	Y	N	Y	Y	U	Y	Y	N	Y	Y	Y	Y	10/13
Yuksel et al.	Y	N	Y	U	U	Y	Y	Y	Y	Y	Y	Y	Y	10/13

Y=Yes, N=No, U=Unclear, NA=Not applicable

JBI critical appraisal checklist for randomized controlled trials: Q1: Was true randomization used for assignment of participants to treatment groups? Q2:Was allocation to treatment groups concealed? Q3: Were treatment groups similar at baseline? Q4: Were participants blind to treatment assignment? Q5: Were those delivering treatment blind to treatment assignment? Q6:Were outcome assessors blind to treatment assignment? Q7: Were treatment groups treated identically other than the intervention of interest? Q8: Was follow-up complete, and if not, were strategies to address incomplete follow up utilized? Q9: Were participants analyzed in the groups to which they were randomized? Q10:Were outcome measured in the same way for treatment groups? Q11: Were outcomes measured in a reliable way? Q12: Was appropriate statistical analysis used? Q13: Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

Table 3. *Critical appraisal results for quasi-experimental study*

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Score
Law& Shapiro	Y	Y	Y	N	Y	Y	Y	Y	Y	8/9

Y=Yes, N=No, U=Unclear, NA=Not applicable

JBI critical appraisal checklist for quasi-experimental studies (non-randomized experimental studies): Q1: Is it clear in the study what is the "cause" and what is the "effect" (i.e., there is no confusion about which variable comes first?) Q2: Were the participants included in any comparisons similar? Q3: Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest? Q4: Was there a control group? Q5: Were there multiple measurements of the outcome both pre and post the intervention/exposure? Q6: Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed? Q7: Were the outcomes of participants included in any comparisons measured in the same way? Q8: Were the outcomes of participants included in any comparisons measured in the same way? Q9: Was appropriate statistical analysis used?

3.2. Intervention Participants

The mean age of the participants ranged from 18.5 (12) to 87 years (32). Of the 17 intervention studies, seven included both gender adult (10,18,19,24,26,27,32) eight included female-only samples participants (11,12,17,21,28–31) one included unclear and one included male-only samples adult participants (25). The sample sized ranged from 73 (28) to 4168 (21). Of the included studies, seven studies involved people with risk of OP or/and with risk of fracture related to OP (10,18,20,21,27,28,32), three studies involved people with menopausal women (17,30,31), seven studies involved people with older adult (11,19,24–26,29,32) one study involved people with students (12), one study involved people with healthy older man (25).

3.3. Intervention Settings

The included studies were conducted in Australia (20,25,27,30), Canada (18,26,32), China (24), Thailand (12), Turkey (28), UK (19,21), USA (10,11,17,29), Vietnam (31). Of the included studies, two included community-dwelling (18,25) one included nursing school (12), two included community pharmacies (11,26), eight included community (10,17,20,24,27,30–32), four included primary care (19,21,28,29).

3.4. Application of Theories or Models

Of the included studies, model was used in four studies and theory was not used in any study. These were two studies using Health Belief Model (10,28), one study using Precaution Adoption Process Model (17), one study using peer-support model (32).

3.5. Characteristics of Interventions

In all studies were implemented educational approaches improve preventing behaviors for OP. These approaches included short slide presentations/lectures, hands-on activities (e.g. pamphlet, brochure), demonstrations involving the participants (e.g. exercise), group discussion, provided printed materials and management plan (10,12,18,25,28,30).

3.6. Evidence of Intervention Effect on Outcome

3.6.1. Change Knowledge

Six studies examined OP knowledge after education interventions (10,12,26–28,32). There was a statistically significant difference in OP knowledge between in intervention group and the control group in four studies (10,12,27,28). These educational programs included slide presentation (10,12,28), group discussion, demonstration about exercise (12), hands on activities (10,28), CD about exercise, magnet board, educational booklet and motivational message (28). Length of the intervention ranged from 6 weeks or less (13, 26, 29) to 24 weeks (28). Other two studies did not find any difference in OP knowledge in groups ($p>0.05$) (25, 32). One of these studies included peer-led community education and mentorship program in six months follow up period (32).

3.6.2. Ca and Vitamin D Intake

After the interventions, seven studies focused at calcium and/or vitamin D intake (10,17,25,28,31,32). Six study found a statistically significant difference in calcium consumption between the intervention group and the control group in six studies (10,25,26,28,31). Calcium intake in the intervention group improved significantly ($p<0.001$) in two studies (10,28). In this trials, the intervention group received instruction regarding the benefits of calcium intake (10,28), the effect on bone, the calcium content of foods given (28), and the barriers to lowering risk factors related to calcium and vitamin D intake (10). The intervention group demonstrated statistically significant progress in calcium intake ($p<0.01$) after the 18-month nutrition education intervention compared to the control group (31). Visual education materials were distributed to the participants (e.g. posters, leaflet, booklet and video tape) (31). In addition, the same study reported that serum Parathyroid hormone (PTH) levels decreased by 12% in intervention group ($p<0.01$) (31). Kukuljan et al. (2011) reported a significant improvement calcium and vitamin D intake in the fortified group compared with non-fortified group at 12-18 months follow-up ($p<0.001$) (25). Yuksel et al. (2010) study reported that compare with control group, calcium intake in intervention group significantly improved ($p=0.011$), however there was no statistical significantly change vitamin D intake ($p=0.66$) (26).

3.6.3. Bone Mineral Density (BMD) or Bone Mass

After education interventions, eight studies examined bone mineral density or bone mass (18,19,24–26,29–32). Seven studies found a statistically significant difference between the intervention group and control group (e.g. printed materials,

education and ultrasounography or routine care) in BMD behavior, BMD test, bone mass, and BMD rate (24–26,29–32). The speed of sound (SOS (m/s) was measured using QUS instrument, and it was shown to be lowered by 0.5 percent in controls after 18 months (p<0.01) (31). Also, Cleghorn et al (2001) study measured bone mineral density by an XR-36 Quickson dual-energy x-ray densitometer at the lumbar spine and forearm at the first appointment and one and two years later. Using supplementing diet with calcium-fortified milk early in postmenopausal period delays bone loss at the spine (p=0.0006) (30). Another study measured femoral neck or other skeletal sites BMD results however no such effects were found for BMD (p>0.05) (19). Kloseck et al. (2017) reported a significant difference with regard to change in OP behavior (defined as obtaining BMD assessment, returning to their family physician and obtaining BMD results) compared with intervention group and control group (p<0.001) (32). The study to include weight bearing activities or resistance training by Kukuljan et al. (2011) was reported a significant net gains in femoral neck BMD compared the groups following the intervention period. In addition, increased BMD was reported in all intervention groups (exercise + milk or exercise or milk group) (p<0.01) (25). In Levy et al. study with only women older adults were of four groups that chart reminder (CR) alone, chart reminder plus mailed patient education (CR+ PtEd) and one to usual care. After the interventions, the rate of BMD testing were 45.2% in CR+ PtEd, 31.4% in CR and 9.7% in the usual care. The effect of CR+ PtEd group increased the rates of BMD (p<0.029) (29). The study to include Tai Chi or resistance exercise by Woo et al. (2007) was reported a significant change percentage change of BMD at the hip and spine comparison between the exercise and control groups (p<0.05) (24). Yuksel et al. (2010) reported that increase BMD testing in the multifaceted intervention group for 16 weeks (p=0.011) (26).

3.6.4. Exercise

Exercise was measured in three studies (17,24,28). Only one study reported a significant progress in exercise group compared to usual care group. This study provided CD about exercise for participants aged 30-45 (28). Other studies found no statistically significant effect on exercise (17), muscle strength, balance and flexibility (p>0.05) (24). Interventions in both studies consisted of behavioral exercise card (17), tai chi and resistance exercise (24).

3.6.5. Factors Underlying Behavior

In the study of Piaseu et al consisting of student participants health belief, attitudes and confidence in exercise and calcium intake had significant increase in the intervention group compared control group (p<0.01) (12). Babatunde et al. (2011) reported that a significant difference with regard to OP self-efficacy between the two groups for calcium intake (p<0.001) (10). In addition to the same study found no statistically significant effect on health belief with regard to OP prevention (p>0.05) (10). Kalkim and Dağhan (2017) reported that combined health belief and self-efficacy about OP was a significant increase (p<0.001) (28). One study reported that the OP screening and awareness program (e.g. educational brochure, providing Ca supplements, follow up phone calls) attendance improved OP awareness (p<0.001) however no such effects were found self-rated risk about OP (p>0.348) (11). Calcium self-efficacy were measured by Francis et al. (2009), using intervention about nutrition focus on calcium and vitamin D at 6 weeks, this study found no statistically significant effect on calcium self-efficacy (27). During follow-up, the same study found significant improvements in health-directed behavior, positive and active life engagement, skill and technique acquisition, and social integration and support (27).

3.6.6. Quality of Life

Only two studies assessed quality of life (18,26). One study intervention consists of personalized counseling, a management plan and educational materials on calcium, vitamin D intake, and OP risk factors. The immediate intervention protocol group (p=0.58) and delayed intervention protocol group/control group (p=0.26) had similar quality of life (18). Another study found no statistically significant (p>0.05) effect on quality of life (26).

3.6.7. Risk Management

Ciaschini et al. (2010) study conducted in community dwelling and 94% of the participants in this study were women. Participants in the intervention group increased pharmacological treatment, calcium and vitamin D intake. However, this study found no statistically significant difference in OP management (p=0.48) and risk management (p>0.05) (18). Cameron et al. (2011) study performed with 75 years or more individuals that having high risk of hip fracture in community and hospital settings. The study included into three groups. Control group received a brochure on hip protectors, intervention group-1 was given free hip protectors, intervention group-2 received free hip protectors and education about their use. The study reported that using of hip protectors was higher in the community setting at the time of the 3-month follow-up visit (p<0.001) (20). One study found no statistically significant difference on falls between either intervention or controls after 12 months (p>0.05) (24). Birks et al. (2004) study conducted in primary care and all of the participants in this study were women. Participants in the intervention group received three pairs of hip protectors along with instructions on how to use them and also a leaflet about fracture risk decrease methods. During follow-up period hip fracture status was similar between intervention and control groups (p=0.40) (21).

4. DISCUSSION

Osteoporosis and its related fractures are gradually becoming a global epidemic because of increase aging population. The

present review provides a first attempt to systematically review to preventive interventions for OP in primary care. While several risk factors cannot be modified, nutrition, calcium and vitamin D intake, exercises play a key role in bone health promotion and prevention of OP (33). Therefore, bone health education programs are an essential measure to prevent OP. Most of the interventions included our review were multifaceted, targeted participants at healthy people or at-risk/high risk patients and provided by physicians, nurses or community pharmacist.

Osteoporosis prevention programs that have been published varied greatly, but only four studies used model in this review. The usage of a model is known as useful in guiding interventions, understanding behavior change (10) and factors related to this behavior (10,28). Similarly, theories guide the techniques used to understand the conditions that affect behavior change and to achieve the expected goals of the interventions which will provide this change (34). It may be beneficial to increase the model or theory based interventions that improved attitude and self-efficacy in changing behaviors such as screening and nutrition.

The mean age of the participants, sample sizes, interventions variety and duration of follow up changed. Most studies focused only female participants (11,17,21,28–31) and older adults (11,19,24–26,29,32). The prevelance of osteoporosis is known to be higher in women than in men (4,5). However, this does not mean that OP is an insignificant disease in men. Rinonapoli et al. review (2021) explains why researchers and physicians should care about OP in men. It has indicates that secondary osteoporosis is more common in men, as OP is perceived as a female disease (35), and men thus benefit less from preventive approaches (36). In addition, being women and having older age are among the important risk factors in OP and its related fractures (13,14). It seems that this trend also continues in most of the studies included in this systematic review. Studies on younger participants have determined having insufficient knowledge and awareness about osteoporosis risk factors (12,28). In future studies, it should be considered that an increase in interventional studies focusing on the male gender and younger population will be beneficial in the prevention of osteoporosis.

The current review showed positive effects OP knowledge for the intervention group in four studies (10,12,27,28), although there were no significant differences between intervention and control groups in two studies (26,32). On the other hand, Kloseck et al. (2017) study reported statistically significant change behavior BMD and vitamin D intake (32). If a peer educator or mentoring programs is planned, criteria such as peer educators or mentors' education level, age, willingness to volunteer should be taken into consideration. Sava et al. (2020) study found that female community leaders had knowledge of OP and its risk factors, increase levels of health motivation and decrease levels of perceived barriers toward behavioral change (37). Knowing OP and its associated risk factors plays an important role in revealing behavioral change. In addition, factors underlying behavior affect OP knowledge. Bordes et al. (2020) study reported that participants had inadequate knowledge about OP, its risk factors and prevention. In addition des Bordes et al. (2020) study found that many misconceptions and concerns about medication side effects or fear of dependence (35). Nurses and physicians can play a leading role OP prevention and awareness.

Pinar et al (2017) had conducted a cross-sectional study (n=1792) to determine the prevalence of OP and associated risk factors in Turkish women aged 18-49 years. Pinar's study reported that most participants were at low risk of developing OP, %6.9 were at medium to high risk of developing the disease. From BMD levels measure by DXA 33.3% were osteopenia, %4.0 were osteoporotic (38). Current review found that seven studies reported that there was a statistically significant difference in the BMD behavior, BMD test, bone mass and the rate of BMD between the intervention group and the control group (e.g. printed materials, education and ultrasound or usual care) (24–26,29–32). Similarly, in the literature showed that interventions consisting in education and follow-up significantly improved BMD testing (39,40). These results indicated that necessary public health strategies might be beneficial not only for the risk group but also healthy individuals in protecting and improving bone health.

Weaver et al (2016) review reported the evidence of a positive effect of physical activity on bone mass and density as strong (41). Shoja et al (2020) review confirmed the significant positive effects of dynamic resistance exercise on BMD in post-menopausal women (42). In this systematic review found that exercise was measured only three studies (17,24,28). One study reported a significant improvement in exercise in the intervention group compared to control group (28). These studies used exercise CD for participants (28), behavioral exercise card (17), tai chi and resistance exercise (24).

5. CONCLUSION

Our systematic review contributes to the current knowledge of educational and multifaceted interventions for OP preventing behaviors. Using educational interventions can improve osteoporosis knowledge, calcium-vitamin D intake and bone mineral density among healthy or at risk populations about osteoporosis in primary care. Behavior change provide also health promotion. Handling individual's health beliefs, attitudes, and self-efficacy can facilitate behavior change. The results inform primary care physicians, nurses and community pharmacist assist in deciding on early interventions to prevent OP and its related fractures. Future studies may be focus on younger, male gender and healthy adults to improve bone health. Furthermore, it may be beneficial to increase the model or theory based interventions that improved attitude and self-efficacy in changing behaviors such as screening and nutrition. Exercise, quality of life and risk management are included in a few several interventions in this review. Therefore, researchers should take into consideration also with these issues.

This systematic review has some limitations. Meta-analysis could not be performed due to heterogeneity of the participants' socio-demographics factors, duration of intervention and outcome measurements. Despite this limitations, we believe this review provides brief and informative interventions that can be adapted in practical life.

Ethical approval

Not applicable.

Funding

The authors received no financial support of this article.

Conflict of interest

None

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How to cite this article: Baz S, Toraman AU. Interventions Preventing Osteoporosis in Primary Care: A Systematic Review. Clin Exp Health Sci 2022; 12: 772-782. DOI: 10.33808/clinexphealthsci.1019617