Original Article

Burden of Osteopenia and Osteoporosis among Postmenopausal Women in India: A Systematic Review and Meta-Analysis

D. S. Anupama, Judith Angelitta Noronha, Kiran K. V. Acharya[1], Mukhyaprana M Prabhu[2], Jyothi Shetty[3], Ravi Shankar[4], Baby S. Nayak[5]

Departments of OBG Nursing and [5]Paediatric Nursing, Manipal College of Nursing, Manipal Academy of Higher Education, Departments of [1]Orthopedics, [2]Medicine and [3]OBG, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, [4]Department of Biostatistics, Vallabhai Patel Chest Institute, University of Delhi, New Delhi, India

Abstract

Aim: Postmenopausal osteoporosis is a major public health problem around the world. The objective of this systematic review is to determine the prevalence of osteoporosis in postmenopausal women in India. **Materials and Methods:** This review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. We identified relevant studies through a search of literature published from 2010 to January 2021 in the databases PubMed, Web of Science, ProQuest, CINHAL, and PEDro databases. We searched for cross-sectional studies involving India that were published in English. **Results:** There was a total of 1631 hits in the initial search and out of which 60 studies were selected for full-text review. Twelve studies were selected for qualitative analysis. Excluded studies were 48 with reasons: 20 studies had included other diseases such as knee arthritis, celiac diseases, diabetes mellitus, and kidney diseases. Eleven studies included premenopausal women, young adults, and men. Ten studies outcomes were different, and seven studies were excluded as they have done retrospective analysis and were commentaries. The pooled prevalence of osteoporosis at the lumbar spine region was 29%, the hip region was 6% and the femoral neck region was 29% whereas the pooled prevalence of osteopenia at the lumbar spine region was 37%, the hip was 6%, and femoral neck region was 37%. **Conclusion:** This systematic review found that postmenopausal women are at significant risk of developing low bone mineral density, and the prevalence of osteoporosis and osteopenia was high in the lumbar area.

Keywords: *India, postmenopausal osteoporosis, prevalence, systematic review*

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Introduction

Osteoporosis is characterized by microarchitectural bone tissue deterioration and bone mass loss. Porous bone, which is a hallmark of osteoporosis, increases bone breakage.[1] The most prevalent complication of osteoporosis is a fracture.[2] More than 8.9 million fractures are caused by osteoporosis per year worldwide, over 4.5 million cases occurring in America and Europe. It affects around 21% of women aged 50–84 years, affecting over 12 million women in nations such as Germany, France, Italy, Spain, and the United Kingdom.[3] In developing countries, the lifetime risk of a wrist, hip, or vertebral fracture is estimated to be between 30% and 40%, which is comparable to the risk of heart disease.[4] The disease is easily diagnosed using single or dual-energy absorptiometry to calculate bone mineral density (BMD).[5]

Two-thirds of the world's elderly live in countries of developing economies, which are seeing greater population growth than developed countries. Nearly 8 out of 10 of the world's elderly are anticipated to live in underdeveloped countries by 2050.[6] In

Address for correspondence: Dr. Judith Angelitta Noronha, Department of OBG Nursing, Manipal College of Nursing, Manipal Academy of Higher Education, Manipal - 576 104, Karnataka, India.
E-mail: judith.n@manipal.edu

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addition, Asia is expected to see a two-fold increase in the number of elderly people, with the population of individuals aged 60 and above expected to rise from 549 million in 2017 to about 1.3 billion by 2050. The risk of fractures that include hip, elbow, and vertebras requiring medical care is about 40% over the course of a lifetime, which is equivalent to the risk of heart disease.[7]

On the basis of nominal limits set by a World Health Organization expert panel, BMD is usually classified as normal, osteopenia, and osteoporosis. Usually, most of the women fall under the classification of osteopenia[8] and a major burden of fractures comes from women with osteopenia or normal BMD as the combined accounting for almost half of the population at risk.[9]

Postmenopausal women are more likely to develop osteoporosis, which not only causes morbidity but also has a substantial negative influence on their quality of life. The knowledge level of people in developing nations about osteoporosis is inadequate.[10] An estimated 9 million new osteoporosis fractures occurred in the year 2000, with 1.6 million hip fractures, 1.7 million forearm fractures, and 1.4 million clinical vertebral fractures.[2] In the current medical practice, there is an insufficient way of diagnosing and treating postmenopausal osteoporosis.[11] From the age of 50 years, women face a 40% lifetime risk of symptomatic spine, hip, and distal radius fractures, while men face a 13% lifetime risk.[12] In a study conducted in Gansu Province, the prevalence of osteoporosis was 9.65% and osteopenia was 27.09% among postmenopausal women.[13] According to one systematic review, the prevalence of osteoporosis has consistently increased from 14.94% in 2008 to 27.96% between 2012 and 2015.[14]

Being the world's second-most populous country India, with a vast disparity between its many socioeconomic classes and it stands second to China in terms of numbers of adults aged 60 and above, a position that seems unlikely to change in the decades ahead.[15] Indian women from the low socio-economic status consume a low calcium diet and are prone to get affected with the hip fracture earlier compared to western women.[16]

India is a diverse country, and women are not impervious to the complex issues she faces, the osteoporosis is among the major health problem in postmenopausal women. Knowing the "prevalence of osteoporosis and osteopenia in postmenopausal women" is vital for the thorough management of the disease. Thus, the goal of this systematic review is to determine the low BMD in postmenopausal women in India. As a corollary, we expect, it will contribute significantly to the management of osteoporosis.

Materials and Methods

Literature search and selection criteria

The preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[17] were used while conducting this study. To identify research articles that estimated the "prevalence of osteoporosis" till March 2021, an electronic search was undertaken in the "PubMed-Medline," "Web of Science," "ProQuest," "CINHAL," and PEDro databases. "Free text and medical subject header" terms were merged with osteoporosis-related" keywords in these searches. "Osteoporosis," "osteopenia," "OP," "BMD," "brittle-bone disease," "bone," "prevalence," "cross-sectional," "epidemiology survey or investigation," "India," and "Indian" were among the search terms. The publication language was limited to English. To identify potential research as thoroughly as feasible, the "reference lists of included articles and earlier reviews" were referred. The studies were limited to those that investigated postmenopausal women from India.

Inclusion criteria

The population included the "postmenopausal osteoporotic women" from India and the geographically defined and clinical setting was considered. The study's time frame was limited from 2001 to 2021. Information from prospective "cross-sectional studies" with specified osteoporosis diagnostic criteria was included.

Exclusion criteria

Studies that were conducted on postmenopausal women with other diseases such as endocrine diseases and metabolic disorders were excluded. Reviews, case reports, letter to the editor, and commentaries were excluded from the study.

Quality assessment of the studies

Standardized Joanna Briggs Institute quality assessment instrument was used for the quality assessment of the studies. Quality was assessed by two independent reviewers and discrepancies were resolved by a third reviewer (BSN).

Data extraction

Using a standardized data collecting sheet, two investigators (ADS and JN) extracted data independently. Disagreements were worked out with the help of team members. Year of publication and the study, author details, place, study design, age of participants, sample size, survey response rate, method of sample selection,

source of the sample, and equipment used for BMD measurement were all collected from each study. The "prevalence rate of osteoporosis and osteopenia" in various environments was the outcome of interest.

Statistical analysis

The overall prevalence of osteoporosis and osteopenia among postmenopausal women was assessed by a meta-analysis model. The data obtained from the studies were entered into the excel sheet and meta-analysis was carried out using STATA software version 13.1. STATA is a statistical software package developed by StataCorp (USA)

Results

This review was conducted based on "The PRISMA" guidelines [Figure 1]. It is an evidence-based minimal set of components for systematic review and meta-analysis reporting. The PRISMA flow chart depicts the study selection process. In the initial search, there was a total of 1631 hits. A total of 5 studies were identified in the additional records. There were 1365 studies left after the duplicates were removed. Upon title and abstract screening, 60 studies were found to be eligible for full-text screening, which was conducted using inclusion criteria. Finally, 12 [Table 1] studies were included for the qualitative and quantitative analysis. Full-text articles (n = 48) were excluded for the reasons studies with other diseases such as knee arthritis, celiac diseases, diabetes mellitus, kidney diseases (n = 20), studies included premenopausal women, young adults and men (n = 11), studies with outcomes other than prevalence (n = 10), and studies adopted retrospective analysis and commentaries (n = 7).

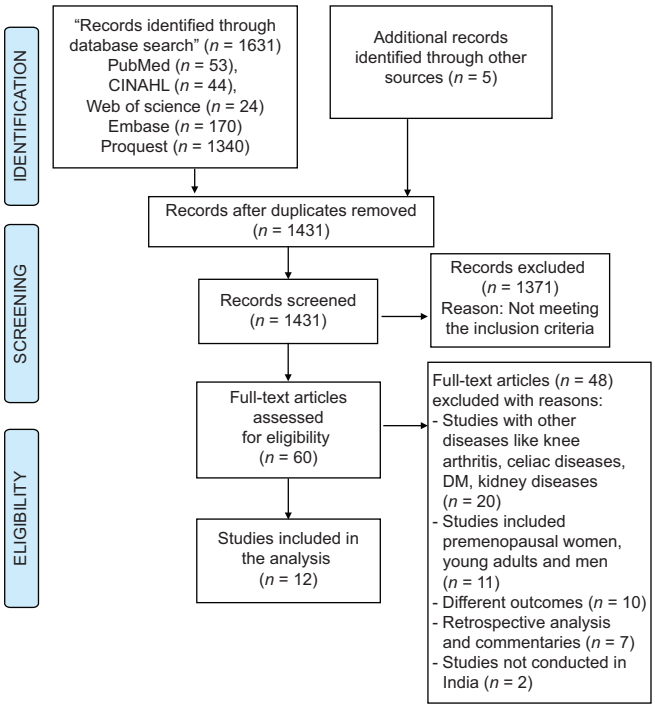

Figure 1: PRISMA diagram. PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Characteristics of the studies

The studies reviewed in this article were published between 2010 and 2021. There were three studies from Chandigarh[18-20] and Tamil Nadu,[21-23] two from Hyderabad and Delhi,[24-27] one each from West Bengal[28] and Pune.[29]

Method of assessment

Eleven studies[18-24,26-29] used "Dual-energy X-ray absorptiometry" (DEXA) for assessing BMD, whereas the calcaneus ultrasound method adopted in one study.[25] In all the studies, WHO diagnostic criteria were adopted.

Pooled prevalence rates of osteoporosis and osteopenia

"DEXA" is the gold standard for measuring bone health status. It is measured at different parts of the body, especially at the lumbar spine and femoral neck region. In the present review, the pooled prevalence of osteoporosis and osteopenia was assessed separately for the lumbar spine and femoral neck region. The pooled prevalence of osteoporosis at the lumbar spine region was 29% (confidence interval [CI] 0.15–0.43) [Figure 2], the hip was 6% (CI 0.04–0.08) [Figure 3], and the femoral neck region was 29% (CI 0.20–0.38) [Figure 4], whereas the pooled prevalence of osteopenia at lumbar spine region was 37% (CI 0.34–0.40) [Figure 5], the hip was 6% (CI 0.04–0.08) [Figure 6], and femoral neck region was 37% (CI 0.24–0.50) [Figure 7]. However, one study[25] reported osteoporosis and osteopenia together as low BMD and calcaneus ultrasound method was used for diagnosis, hence it was excluded from meta-analysis.

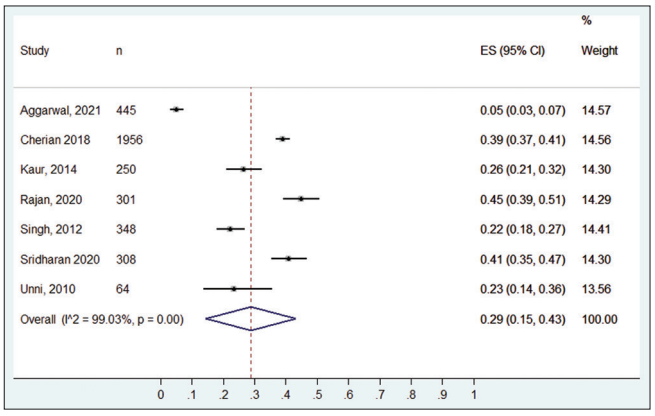

Figure 2: Forest plot depicting the pooled estimate of prevalence of osteoporosis at Lumbar spine region with CI 95% obtained by random effect model. CI: Confidence interval

Table 1: Details of the included studies

Author, year of study	Objectives	Study design	Sample size/sample	Diagnosis method	Results
Unni *et al*., 2010[29]	To study the prevalence of osteopenia and osteoporosis in women aged above 40 years	Pune	64	DEXA	23.2% of the study subjects had osteoporosis and 40% had osteopenia
Aggarwal *et al*., 2011[18]	To determine the prevalence of osteoporosis, and in turn increase the awareness, education, prevention, and treatment of osteoporosis	Chandigarh, India	200	Lunar DPX-PRO total body pencil beam densitometer	The prevalence of low BMD was found in more than half of this population (53%)
Marwaha *et al*., 2011[24]	To assess the bone health status in elderly Indians and compare pDXA with central DXA in evaluation of osteoporosis	Delhi	808	DEXA (Prodigy Oracle (GE Lunar Corp., Madison, WI)	Osteoporosis 42.5%, osteopenia is 44.9%
Singh *et al*., 2012[27]	To determine discordance in the diagnosis of osteoporosis among postmenopausal Indian women using hip and spine DEXA	Hyderabad, India.	348	DEXA (Hologic)	Osteoporosis: Total hip 4.26% Lumbar spine 22.07% Osteopenia: Total hip 17.82% 21.70 Lumbar spine 35.11%
Kaur, 2014[23]	To examine possible associations between ABO blood groups and the risk of osteoporosis among postmenopausal women of North India	Panjab, Haryana, and Chandigarh (North India)	250	DEXA	40.4% had osteopenia of the lumbar spine (L1–L4) and 34.8% had osteopenia of the proximal femur
Matsuzaki *et al*., 2017[22]	To investigate association between hip bone mineral density and fat and lean mass in a cross-sectional study from southern India	Hyderabad India	248	DEXA Hologic Discovery densitometer	Osteopenia 51.2% Osteoporosis 14.9%
Cherian *et al*., 2018[20]	The influence of various databases on classification of BMD in south-Indian postmenopausal women aged above 50 years	Tamil Nadu	1956	DEXA Hologic	Prevalence of osteoporosis at the lumbar spine and femoral neck was 39% and 22%
Chawla *et al*., 2018[21]	To add data from India on women above the age of 40 years with respect to low BMD and its associated high risk factors	Delhi	24	DEXA	The prevalence of osteopenia in the study was 36%, and that of osteoporosis was 4%; the overall prevalence of low BMD being 40%
Pan *et al*., 2020[25]	To assess the status of bone health and find its determinants among women aged 40 years and above in a rural population of West Bengal	West Bengal	260	Calcaneal quantitative ultrasound	13.1% were screened positive for osteoporosis and 77.7% had low BMD
Rajan *et al*., 2020[26]	To study the performance of 3 categories: FRAX® (without BMD), FRAX® (with BMD), and FRAX® (with BMD and TBS) in predicting fragility vertebral fractures in rural postmenopausal women	Tamil Nadu	301	DEXA	The prevalence of osteoporosis at spine was 45%, and femoral neck was 32.6%

Contd...

Table 1: Contd...

Author, year of study	Objectives	Study design	Sample size/sample	Diagnosis method	Results
Sridharan *et al*., 2020[28]	To assess the relationship between various anthropometric measures and BMD in 308 rural dwelling South Indian postmenopausal women	Tamil Nadu	325	DEXA	91 (29.5%) had osteoporosis at the NOF and 126 (40.9%) at the LS
Aggarwal, 2021[19]	To determine the reference range for bone mineral density for the healthy population of India	Chandigarh	445	DEXA	33% and 5% of women had osteopenia and osteoporosis

DEXA: Dual-Energy X-ray Absorptiometry, BMD: Bone mineral density, pDXA: Peripheral DXA, TBS: Trabecular bone score, NOF: Femur Neck, LS: Lumbar Spine

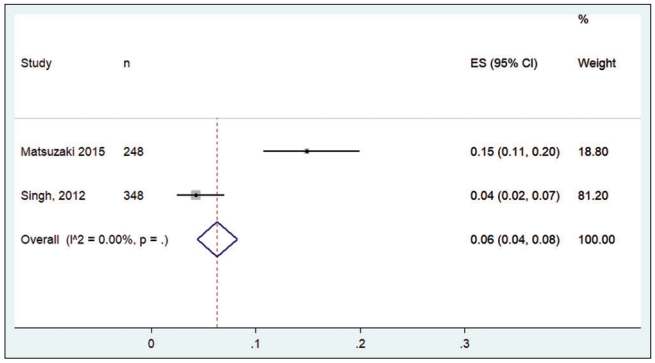

Figure 3: Forest plot depicting the pooled estimate of prevalence of osteoporosis at hip region with CI 95% obtained by random effect model. CI: Confidence interval

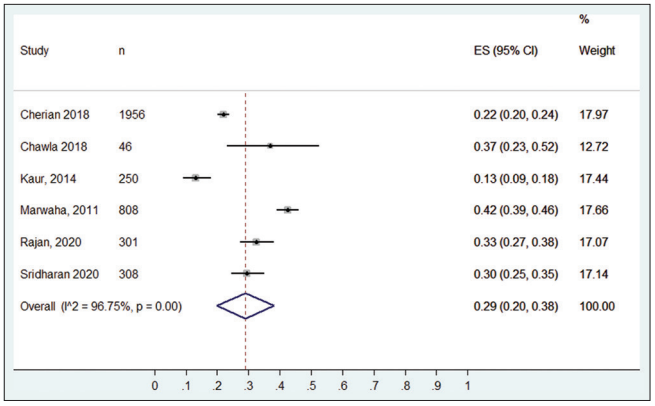

Figure 4: Forest plot depicting the pooled estimate of prevalence of osteoporosis at femoral neck region with CI 95% obtained by random effect model. CI: Confidence interval

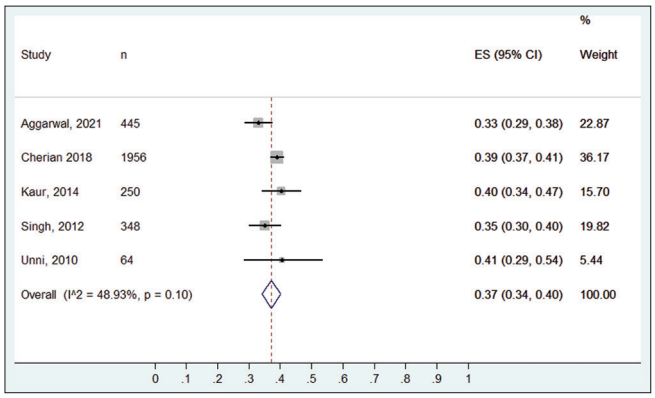

Figure 5: Forest plot depicting the pooled estimate of prevalence of osteopenia at Lumbar spine region with CI 95% obtained by random effect model. CI: Confidence interval

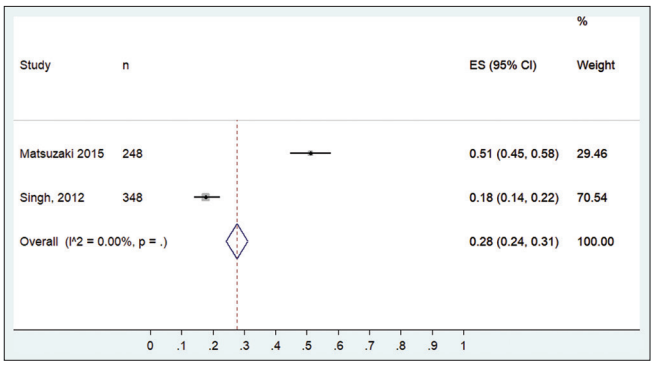

Figure 6: Forest plot depicting the pooled estimate of prevalence of osteopenia at hip region with CI 95% obtained by random effect model. CI: Confidence interval

Discussion

The proportion of people above the age of 65 years is increasing at an alarming rate. The number of people with osteoporosis may rise sharply in accordance with the population boom. Osteoporosis affects one-third of adults between the ages of 50 and 60 years and more than half of those over the age of 80 years. According to a systematic review conducted in China, osteoporosis was shown to be more prevalent in females (25.41%) than in men (15.33%), and it was also more common in the elderly.[14] In this systematic review, the prevalence of osteoporosis ranged from 4.16% to 53%, while osteopenia was found to be between 33% and 64.6%. A review conducted by Khadilkar and Mandlik in 2015 on the "epidemiology and treatment of osteoporosis" in women with an Indian perspective indicated that "prevalence of osteoporosis" in Indian women of various age groups ranged from 8% to 62%, as reported in many studies. The overall "prevalence of osteoporosis" was analyzed at different areas in our review, at the hip, it was 6% (CI 0.04–0.08), the lumbar spine region was 29% (CI 0.15–0.43), and the femoral neck region was

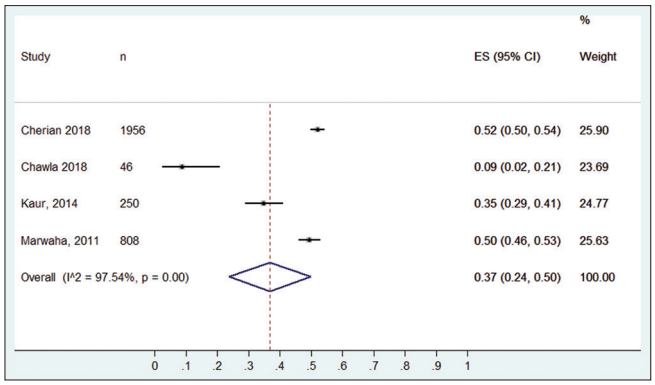

Figure 7: Forest plot depicting the pooled estimate of prevalence of osteopenia at femoral neck region with CI 95% obtained by random effect model. CI: Confidence interval

29% (CI 0.20–0.38). According to a systematic review conducted among Iranian women, the "prevalence of osteoporosis" was 32% in the lumbar spine, 25% in the femoral neck, and 21% in the hip,[30] which was almost comparable to the prevalence rates among Indian women. Except for the hip prevalence rates, which is differed and it was more prevalent among Iranian women. In this review, the prevalence of osteopenia at the lumbar spine region was 37% (CI 0.34–0.40), the hip region was 6% (CI 0.04–0.08), and the femoral neck region was 37% (CI 0.24–0.50) which is similar to the results of a systematic review published from Saudi Arabia that revealed that 36% of women were osteopenic and 32% were osteoporotic.[31] However, the Middle East and North Africa area has a diverse prevalence rate of OP, which is typically equivalent to that of "postmenopausal Caucasian women in North America" which varied from 10.3% to 30%, but greater than that recorded in Europe which is 20%, which was similar to our findings.[32] However, we could not find any systematic review on prevalence available to compare with South Asian or South-East Asian Countries.

Recommendations

According to our review, India has a high prevalence of postmenopausal osteoporosis, which is undeniably one of the country's significant public health issues. The contributing factors for the high prevalence of osteoporosis may be decreased calcium and Vitamin D intake, increased lifespan, gender disparity, and lack of awareness about the bone health.[33] Along with this low physical activity is also one of the causes of osteoporosis in India.[34] Furthermore, it is likely that a calcium shortage in the diet, especially early in life, leads to a lower peak bone mass and, as a result, osteoporosis occurs at an younger age.[35] Given the ubiquity of osteoporosis among postmenopausal women, the significant morbidity, mortality, and financial costs of osteoporotic fractures, as well as the availability of suitable medical treatments for prevention and management emphasize the need of identifying and treating "high-risk" individuals.[36] However, existing healthcare service is insufficient, and many people who are at high risk of osteoporosis are not detected or treated. It is indeed a time to consider and brainstorm possible osteoporosis management strategies adaptable to India.

At present, there are no policy directives or specific programs to combat the burden on osteoporosis in India. Except for the management of chronic noncommunicable disease, physical activity, and diet, which are mentioned in the National Health Policy 2017,[37] no emphasis has been directed to osteoporosis. Although it was incorporated into primary health care, lifestyle changes are focused in the Health and Wellness Centre under Ayushman Bharath is a general approach,[38] no vertical programs for osteoporosis were implemented. Inculcation of screening, diagnosis, pharmacological treatment, and nonphysician health professional care services multidimensional services, such as exercise, diet, medication compliance, counseling, education, demonstration, and so on through the vertical health program or programs related to Noncommunicable Diseases may be a rational hope for dealing with a major health risk of osteoporosis. Given the high "prevalence of osteoporosis among postmenopausal women," which can result in significant morbidity, it is vital to ensure that all Indian women have access to comprehensive disease care and prevention.

Strengths and limitations

Most of the studies included in the study had large sample sizes, which was a strength in this review. Data collection was done by two independent researchers and analyzed the publications separately to assure data accuracy. When reporting our findings, we adhere to the PRISMA statement. The method of determining BMD was heterogeneous, which was one of the study's shortcomings. It was hard to evaluate several studies that combined osteoporosis and osteopenia and indicated low BMD.

Conclusion

Osteoporosis has become more prevalent in the past 10 years, impacting more than one-third of the population aged 50 and above. Postmenopausal women are more likely than males to develop osteoporosis, and the risk increases with age. Clinicians must identify the risk of fracture among the postmenopausal women. A FRAX score can assist clinicians in identifying persons who are at high risk of fracture and may require special assistance. Furthermore, there is a need for more

population-based studies with the representative sample from across the country adopting bone densitometry to validate these findings. More prevalence studies are needed in India since there is a scarcity of research in the field of osteoporosis. In addition, there is an immediate need for policymakers to initiate necessary steps to prevent and control osteoporosis by incorporating it into the health policy and initiating a vertical health program for osteoporosis.

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Conflicts of interest

There are no conflicts of interest.

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