Prevalence of Osteoporosis Among Iranian Postmenopausal Women: A Systematic Review and Meta-analysis

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ABSTRACT

OBJECTIVES: Osteoporosis is the most common metabolic bone disease. It is considered the silent epidemic, with high prevalence after menopause, in the current time. Different studies conducted in Iran have reported different prevalence. The present systematic review and meta-analysis aims to estimate the overall prevalence of osteoporosis in Iranian postmenopausal women.

METHODS: The national scientific databases Scientific Information Database and Magiran and the international scientific databases PubMed, Web of Science, and Scopus were searched for related articles without any time limitation. The keywords osteopenia, osteoporosis, post menopause, OP, bone mineral density, and Iran along with their combinations were used in the search. The inconsistency in the data was examined using I² test. The data were analyzed using the meta-analysis method and the random-effects model in Stata software, version 14.

RESULTS: The analysis of 26 articles with a sample size of 6735 showed that the prevalence of osteoporosis and osteopenia in Iranian postmenopausal women is, respectively, 33.70% (95% CI [confidence interval]: 22.68-44.73) and 47.60% (95% CI: 32.88-62.32). The pooled prevalence of osteoporosis in the spine and in the femur bone was 31.99% and 15.93%, respectively. Also, the prevalence of osteopenia in the spine and in the femur bone was 22.48% and 39.88%, respectively.

CONCLUSION: Osteoporosis and osteopenia are highly prevalent in Iranian postmenopausal women to the extent that one-third of women suffer from osteoporosis and nearly half of them suffer from osteopenia. It seems essential to teach a healthy lifestyle to these women to reduce the prevalence of these issues.

KEYWORDS: Osteoporosis, menopause, Iran, systematic review

Introduction

Osteoporosis is the most common bone metabolic disease and the fourth major enemy of humans after cancer, cardiovascular disease, and stroke, which increases with age.1-3 Osteoporosis is characterized by low bone mass and destruction of bone tissue structure, leading to increased bone fragility and susceptibility to fractured bones.3 Osteoporosis is one of the major health problems in any country because of its association with fractures.4 T-score and Z-score indices are used to quantify bone density. The World Health Organization (WHO) defines osteoporosis as a bone mineral density that lies 2.5 SDs or more below the mean maximum bone mineral density.5 T-score indicates changes in the standard deviation of a person’s bone density relative to the maximum bone mineral density in healthy and young individuals, and Z-score also shows changes in standard deviation of a person’s bone density relative to people of similar age, sex, and race.6 Accordingly, osteoporosis is defined as a T-score <-2.5 and osteopenia as -2.5 < T-score <-1.³ Age, sex, race, genetics, low calcium intake, and activity have an effect on bone mass.³ Menopause is one of the most important causes of osteoporosis. Postmenopausal women lose 3% to 5% of their bone mass annually. These women lose part of their bone mass and are exposed to osteoporosis for up to 7 years after menopause.³ The reason for bone loss after menopause is the reduction in estrogen production by the ovaries.³ Menopausal osteoporosis is important because women spend one-third of their lives under conditions of reduced bone mass and increased risk of fractures, and the rate of bone loss in the first few years of menopause is high.10 Bone loss in postmenopausal women occurs in

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2 phases. The initial short phase lasts 3 to 5 years and trabecular bone loss occurs rapidly (menopause-related bone loss), and in the long-term phase, men and women gradually lose their cortical and trabecular bones for over 10 to 20 years (age-related bone loss).\textsuperscript{11,12} Fracture, disability, and chronic pain are the most common clinical consequences of osteoporosis.\textsuperscript{13} Pelvic, vertebral, and distal radius fractures are the most common osteoporotic fractures. These fractures not only cause morbidity but also increase the chances of mortality, with mortality following hip fracture in the first year being 20%.\textsuperscript{14} Also the disability-adjusted life year caused by osteoporosis in Iran was 36,026 years.\textsuperscript{15} Various studies that have investigated the prevalence of osteoporosis in postmenopausal women in Iran have reported different results, and there is no general estimation.\textsuperscript{16-18} This systematic review and meta-analysis study was conducted to estimate the overall prevalence of osteoporosis and osteopenia in Iranian postmenopausal women.

Study Quality Assessment
The methodological quality of the articles was evaluated based on 10 items selected from the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (title and abstract, goals and hypotheses, setting, inclusion and exclusion criteria, sample size, statistical methods, descriptive data, interpretation of findings, research limitations, and funding).\textsuperscript{20}

Statistical Analysis
Analyses were performed with Stata version 14 software. The prevalence of osteoporosis and osteopenia in postmenopausal women was calculated as the proportion of women with these problems to all postmenopausal women. Also, the standard error of the prevalence of osteoporosis and osteopenia for each study was calculated using binomial distribution formula. The heterogeneity between the studies was investigated by Cochran $Q$ test with a significant level less than .1 and $P$ statistic.\textsuperscript{21} $P$ value for $\chi^2$-based $Q$ test less than .05 and $I^2$ index above 50% showed heterogeneity between studies, so we used an effect of meta-analysis to estimate the Der Simonian and Laird pooled effect. Point estimation of the prevalence of osteoporosis and osteopenia was estimated by a forest plot with 95% confidence interval (95% CI). The Begg test was used to evaluate publication bias.\textsuperscript{22} Meta-analysis was also applied to identify the potential source of heterogeneity factors among selected studies. Sensitivity analysis was also used to investigate the effect of excluding each study on the cumulative prevalence of osteoporosis and osteopenia.

Results
Database searching led to the retrieval of 114 articles. At the screening and eligibility stages, 83 (due to nonrelevance) and 5 articles (due to not reporting prevalence) were excluded from the analysis. Finally, 26 articles were included in the analysis. The search and screening process of articles is presented in Figure 1. Because national databases were not sensitive to Boolean operators, the word search was performed in a single word, so more articles were found. Twenty-six articles examined the prevalence of osteoporosis in 6735 postmenopausal women. The sample size in the selected articles varied from 75 to 706 individuals. More details are reported in Table 1.

The pooled prevalence of osteoporosis in Iranian postmenopausal women was 33.70% (95% CI: 22.68–44.73) (Figure 2). The pooled prevalence of osteopenia was 47.60% (95% CI: 32.62–62.32).

The pooled prevalence of osteoporosis in the lumbar spine and femur was 31.99% (95% CI: 26.29–37.70) and 15.93% (95% CI: 9.89–21.96), respectively. Also, the prevalence of osteopenia in the lumbar spine and femur was 48.22% (95% CI: 44.52–51.92) and 39.88 (95% CI: 31.72–48.04), respectively. The results of the meta-regression showed that there was only a relationship between femur osteoporosis and sample size...
Eghbali et al

(\(P = .006\)). In other words, with the increase in sample size, the prevalence of femur osteoporosis has increased (Figure 3). There was no relationship between the prevalence of osteoporosis and osteopenia with year of publication and age of samples (Table 2). Also, publication bias was not significant for estimating the prevalence of osteoporosis and osteopenia. The results of sensitivity analysis showed that no study alone had an effect on the prevalence of osteoporosis and osteopenia.

**Discussion**

This systematic review and meta-analysis study was conducted to estimate the prevalence of osteoporosis among Iranian postmenopausal women. The prevalence of osteoporosis and osteopenia in Iranian postmenopausal women was 33.70% and 47.60%, respectively, and the prevalence of osteoporosis in the lumbar spine and femur neck was 31.99% and 15.93%, respectively. The results of a study on postmenopausal women referring to Kurdistan Densitometry Center showed that the overall prevalence of osteoporosis and osteopenia was 34.4% and 69.8%, respectively. Only 14.8% of the subjects had normal bone density. The results of a study in Kuwait also showed that the prevalence of spine and femur osteoporosis in postmenopausal women was 35.4% and 42.8%, respectively, which is approximately similar to the present study. Consistent with the results of the present study, the findings of the study by Cipriani et al showed that the prevalence of osteoporosis in the spine and femur of Italian postmenopausal women was 28.4% and 16.2%, respectively, and the overall prevalence of osteopenia was 56%.

The results of the study by Jang et al of 362 postmenopausal women over 45 years old in Chuncheon (South Korea) showed that the prevalence of osteoporosis in women 45 to 64 years old was 30.6%, in women 65 to 74 years old was...
### Table 1. Characteristics of the selected articles.

| FIRST AUTHOR               | YEAR | SAMPLE SIZE | PLACE     | LUMBAR OSTEOPOROSIS | LUMBAR OSTEOPENIA | FEMUR OSTEOPOROSIS | FEMUR OSTEOPENIA | TOTAL OSTEOPOROSIS | TOTAL OSTEOPENIA | MEAN AGE (YEAR) |
|----------------------------|------|-------------|-----------|---------------------|-------------------|--------------------|-------------------|--------------------|-----------------|----------------|
| Hosseinpour               | 2016 | 300         | Fasa      | 26.2                | —                 | 19.8               | —                 | 7.9                | —               | 74.9           |
| Eftekhari-Sadat           | 2016 | 99          | Tabriz    | 36.4                | 49.5              | 38.4               | 24.2              | —                  | —               | 57             |
| Aghajanpoor               | 2016 | 200         | Isfahan   | 39                  | 44                | 4.9                | 47.5              | —                  | —               | 66.9           |
| Aghajanpoor               | 2016 | 400         | Isfahan   | 40                  | 43.3              | 4.5                | 27.3              | —                  | —               | 65.2           |
| Shariati Bafghi           | 2014 | 151         | Tehran    | 30.5                | —                 | 15.9               | —                 | —                  | —               | 61.2           |
| Etemadrezaei              | 2014 | 250         | Mashhad   | 17                  | 44                | 8                  | 40                | —                  | —               | 52.9           |
| Mohammadbeig              | 2013 | 275         | Shiraz    | —                   | —                 | —                  | —                 | —                  | 70.2            | 58.2           |
| Nobakht Motlaghi          | 2013 | 430         | Fasa      | 16.8                | 55.8              | 31                 | 46.8              | 34.1               | —               | 56.4           |
| Hassanzadeh               | 2012 | 275         | Shiraz    | —                   | —                 | —                  | —                 | 70.2               | —               | 58.5           |
| Maryam                   | 2012 | 80          | Sari      | 27.5                | —                 | 17.5               | —                 | 48.8               | 30              | 66.6           |
| Maryam                   | 2012 | 80          | Sari      | 46.3                | —                 | 27.5               | —                 | —                  | —               | 68.8           |
| Mehrdad Aghaei Sedigh     | 2012 | 98          | Gorgan    | 46.9                | —                 | 17.3               | —                 | 13.3               | —               | 57.8           |
| Maddah                   | 2011 | 706         | Guilan    | —                   | —                 | —                  | —                 | 15.7               | —               | 62.5           |
| Motaghi                   | 2011 | 341         | Isfahan   | —                   | —                 | —                  | —                 | 20.8               | 39.6            | 59.7           |
| Ahmadzadeh                | 2010 | 210         | Tehran    | —                   | —                 | —                  | —                 | 20.3               | 41.7            | 57.3           |
| Khojastehpour             | 2009 | 114         | Shiraz    | —                   | —                 | —                  | —                 | 15.7               | —               | 62.5           |
| Eghbali                   | 2009 | 406         | Bushehr   | 32                  | 7.4               | 29.6               | 3.9               | —                  | —               | 59.1           |
| Bayat                     | 2008 | 200         | Tehran    | 25.5                | 51                | 7                  | 47.5              | 26                 | 52.5            | 57.2           |
| Shokrollahi               | 2008 | 75          | Shiraz    | —                   | —                 | —                  | —                 | 77.3               | —               | 49             |
| Mojibian                  | 2006 | 502         | Yazd      | 20.5                | 52                | 43                 | 43                | —                  | —               | 60.5           |
| Derakhshan                | 2006 | 305         | Sanandaj  | 17                  | 56.1              | 30.8               | 47.9              | 34.4               | 69.8            | 57.7           |
| Salimzadeh                | 2005 | 268         | Karaj     | —                   | —                 | —                  | —                 | 40.7               | —               | 59.4           |
| Salimzadeh                | 2005 | 268         | Karaj     | —                   | —                 | —                  | —                 | 33.2               | —               | 59.4           |
| Mosalanezhad              | 2004 | 250         | Shiraz    | —                   | —                 | —                  | —                 | 60.6               | —               | 60.6           |
| Sedaghat                  | 2003 | 180         | Tehran    | —                   | —                 | —                  | —                 | 28.8               | —               | 52.7           |
| Dabaghmanesh              | 2002 | 272         | —         | 31.1                | —                 | 13.6               | —                 | —                  | —               | —              |
52.5%, and in women older than 75 years was 68.7%, which is consistent with the prevalence reported in our study. Various studies have shown that the prevalence of osteoporosis in Arab countries is lower than in Iran. For example, the prevalence of osteoporosis in Saudi Arabia was also 30.5%, Lebanon 11%, Bahrain 27.1%, and Qatar 12.3%. The results of the study by Tian et al. showed that the prevalence of osteoporosis in postmenopausal women in Gansu province was 9.65% and 27.09%, respectively. The results of a US population over 50 showed that the prevalence of osteoporosis was 10.3%. Osteoporosis is associated with age, duration of menopause, weight, calcium-containing food intake, physical activity, and having a history of previous fractures. The reason for the difference in the prevalence of menopause in previous studies may be due to differences in demographic and clinical characteristics of the studied samples. The results of another study showed that the prevalence of osteoporosis was higher in women without physical activity than in other women. The development of good living habits, avoidance of alcohol and tobacco, physical activity, and consumption of calcium-containing and vitamin D–containing foods have been suggested for the management of osteoporosis.

The prevalence of osteoporosis and osteopenia did not change significantly over time (between 2003 and 2017), indicating that health programs for postmenopausal women have not had a significant effect on the overall prevalence of this problem. It seems that the reason for this finding can be attributed to economic and social problems of Iranian society that affect the lifestyle, nutrition, and even the follow-up of the comorbidities of these patients.

One limitation of this study was inadequate information on selected studies. Providing new and comprehensive information is the strength of this study. Hemmati et al. have previously systematically reviewed the prevalence of osteoporosis in

![Figure 2. Prevalence of overall osteoporosis and its 95% confidence interval in Iranian postmenopausal women based on random-effects model.](image)

![Figure 3. Meta-regression analysis of the relationship between the prevalence of femur osteoporosis with sample size.](image)
postmenopausal women, but clear mistakes in study selection and data extraction had diverted the true prevalence of osteoporosis in this group of women. As health care decisions are based on the findings of such research, using the wrong results can lead to incorrect decisions. One-third of postmenopausal women in Iran have osteoporosis and nearly half of them have osteopenia, so teaching healthy lifestyle to these women to reduce the prevalence of these problems seems necessary.

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Author Contributions
TE was involved in study design, RGG and KA were involved in data collection, KA and EM were involved in grammar editing and final revision, and SD and RGG were involved in statistical analysis.

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Table 2. Results of univariate meta-regression for the prevalence of lumbar spine and femur osteoporosis.

| DEPENDENT | NO. OF STUDIES | COEFFICIENT | SE | T VALUE | P VALUE |
|-----------|----------------|-------------|----|---------|---------|
| Lumbar spine Age | 13 | 0.51 | 0.47 | 1.08 | 0.303 |
| Year | 13 | 1.43 | 0.72 | 1.98 | 0.073 |
| Sample size | 13 | 0.08 | 0.08 | 0.99 | 0.345 |
| Femur Age | 13 | -0.02 | 0.51 | -0.05 | 0.963 |
| Year | 13 | -0.59 | 0.85 | -0.69 | 0.505 |
| Sample size | 13 | 0.27 | 0.08 | 3.41 | 0.006 |

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