Original Article

The prevalence of osteoporosis among Iranian postmenopausal women with type 2 diabetes: A systematic review and meta-analysis

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ABSTRACT

Osteoporosis is the most common metabolic bone disorder that is common in postmenopausal women with type 2 diabetes. Different studies have reported different prevalence of osteoporosis. This systematic review and meta-analysis was conducted to estimate the pooled prevalence of osteoporosis in Iranian postmenopausal women with type 2 diabetes. Search for eligible articles was performed using the keywords of osteoporosis, osteopenia, bone mineral density, OP, bone loss, Post menopaus*, diabetes, hyperglycemia, and Iran, and their possible combinations in the following databases: Scientific Information Database (SID), MagIran, PubMed, Scopus, and Web of Science. Heterogeneity between studies was examined with I^2. The data were analyzed using the meta-analysis method and random effects model with Stata version 11.0. The analysis of 4 papers with a sample size of 562 showed that the prevalence of osteoporosis in the lumbar spine and femoral neck of the Iranian post-menopausal women with type II diabetes was 25.26% (95% CI: 7.22—30.30) and 17.45% (95% CI: 0.25—34.65), respectively. Also, the prevalence of osteopenia in the lumbar spine and femoral neck of these patients was 45.23% (95% CI: 40.66—49.79) and 44.53% (95% CI: 36.60—52.47), respectively. There was no relationship between the prevalence of osteoporosis and osteopenia with sample size, year of publication, age and body mass index. Osteoporosis and osteopenia are prevalent in women, so healthy lifestyle education for these postmenopausal women are necessary to reduce the prevalence of these problems.

1. Introduction

Diabetes mellitus is a chronic metabolic disease that afflicts more than 383 million people around the world (8.3%), and it is estimated to reach 592 million by the year 2035, with a prevalence of 10% [1]. The prevalence of diabetes in Iran was 7.7% (equivalent to 2 million), and this rate would double by 2025 [2]. Poor diabetes management can have adverse consequences such as heart disease, stroke, blindness, renal failure, foot amputation and even death, which are potentially preventable by optimal metabolic control [3].

Patients with diabetes, along with macro- and microvascular complications, may experience various musculoskeletal disorders such as osteoporosis, osteopenia, diabetic foot syndrome, and Charcot's arthropathy [4,5]. Diabetic osteopathy is an underlying condition characterized by micro architectural changes that it can reduce bone quality and increase the risk of bone fractures. Osteoporosis is the most common metabolic disorder in the bone characterized by decreasing the density (mass/volume) normally mineralized bone [6]. T-score and Z-score indices are used to quantify bone density. T-score is a marker of the standard deviation of one person's bone density versus excessive bone density in healthy and young people, and Z-score also shows the standard deviation of one person's bone density relative to those with similar age, sex and race [7]. Accordingly, osteoporosis is defined as T score < −2.5 and osteopenia is classified as −2.5 < T score < -1 [8].

Menopause, age, family history of the fracture, race, immobility, smoking, corticosteroid use, and calcium and vitamin D deficiency are major risk factors for osteoporosis [9,10]. Each year postmenopausal women lose about 3—5% of their bone mass and they are more likely to be at risk for osteoporosis [11]. Women spend one-third of their life in conditions of bone loss and increased risk

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of osteoporosis fracture, so menopausal osteoporosis is very important [12].

The risk of osteoporosis in patients with type 2 diabetes (unlike diabetic type I patients) is unclear. In the presence of diabetes, bone can be affected by obesity, insulin, hypercalciuria, renal dysfunction, microangiopathy and inflammation [13]. Osteoporosis is a preventable and curable disease that is usually asymptomatic as long as the fracture in the body occurs [14]. In the United States, 10 and 34 million people have osteoporosis and osteopenia [15]. Osteoporosis causes 2 million fractures per year, which can reduce the quality of life and lead to disability and even death [16]. Various and limited studies were conducted on postmenopausal women with diabetes in Iran have reported different prevalence.

2. Methodology

2.1. Search strategy

This systematic and meta-analytic review was conducted and reported the prevalence of osteoporosis among Iranian postmenopausal women with type 2 diabetes according to the PRISMA statements [17]. We searched national and international databases Scientific Information Database (SID), MagIran, PubMed, Scopus, and Web of Science from inception until January 2019. Keywords and medical subject heading (MeSH) terms used in the search strategies were: osteoporosis, osteopenia, bone mineral density, OP, bone loss, Post menopaus*, diabetes, hyperglycemia, and Iran. To access further articles, searches were made as back-up (reviewing the list of referrals for eligible articles) and forwards (reviews of papers that were cited in eligible studies).

2.2. Study selection and data extraction

At this stage, two independent scholars gathered all the papers that referred to the prevalence of osteoporosis in postmenopausal women with type 2 diabetes. The inclusion criteria were observational studies, published in Persian or English, and access to full text of articles. Irrelevant studies were also excluded. In order to minimize study selection bias, data extraction, and evaluation of the quality of articles was done by two researchers, independently. Any disagreements were resolved in consultation. The required data such as first author, articles' publication year, the study location, sample size, mean age, body mass index (BMI), prevalence of osteoporosis and osteopenia in lumbar spine and femoral neck were entered into a pre-designed form. The quality of the articles was evaluated based on the STROBE checklist [18].

2.3. Statistical analysis

The prevalence was calculated as the ratio of patients with osteoporosis and osteopenia to the total number of patients. The standard error of the prevalence of osteoporosis and osteopenia for each study was calculated using the binomial distribution formula. Heterogeneity between selected studies was assessed with I^2 and Chi-square Q indexes. The I^2 index above 50% indicated heterogeneity between studies, so in this study, a random effects model was used to estimate the overall prevalence of osteoporosis and osteopenia [19]. The point prevalence of osteoporosis and osteopenia was estimated using forest plot with 95% confidence interval. Publication bias was evaluated using Egger's test. Also, meta-regression was used to identify potential heterogeneity among
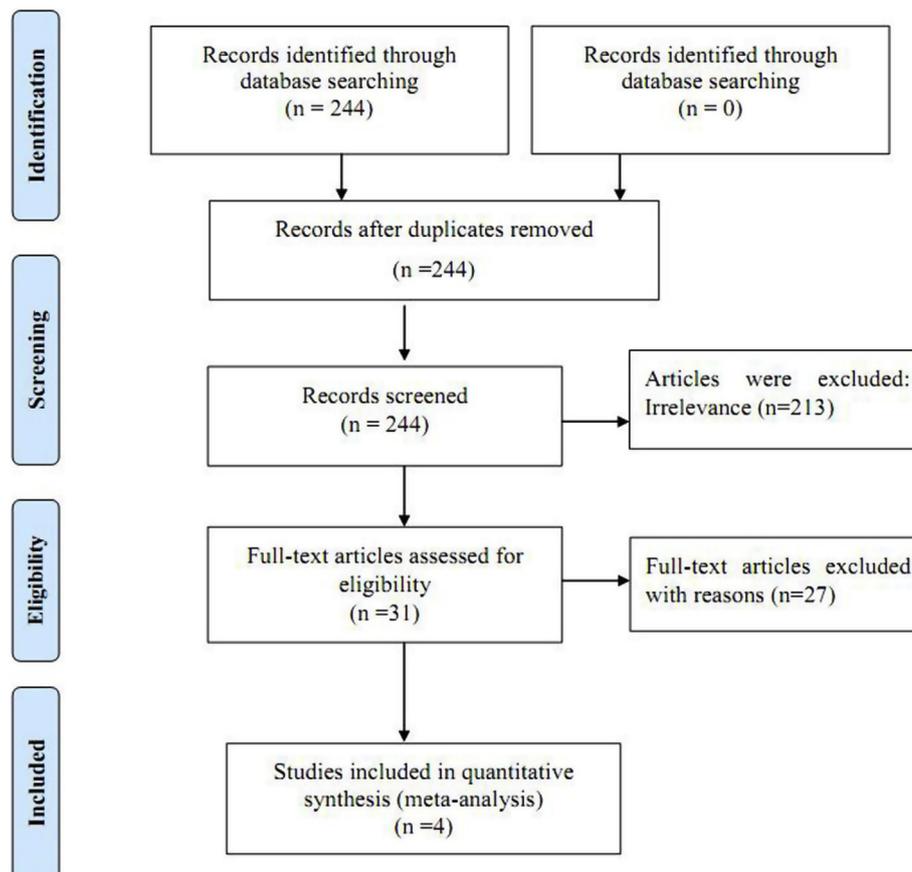

Fig. 1. The process of screening and studies selection.

Table 1
The characteristics of selected studies.

First author	Year	Sample size	Place	Age	lumbar		Hip	
					Osteoporosis	Osteopenia	Osteoporosis	Osteopenia
Aghajanpoor [20]	2016	200	Isfahan	66.9	39	44	4.9	47.5
Mobini [14]	2012	80	Sari	68.6	27.5	–	17.5	–
Moghimi [21]	2008	242	Sanandaj	53.6	7.9	46.3	30.2	48.3
Sharifi [22]	2006	40	Zanjan	58.6	27.5	45	–	30

selected studies. The analysis was performed with the Stata version 11.0.

3. Results

In the initial search, 244 articles were found. Two hundred and thirteen irrelevant articles were excluded from the analysis at the screening stage. Subsequently, 31 articles were examined for eligibility. In 26 articles, osteoporosis was studied in post-menopausal women without diabetes, and one study also examined the prevalence of osteoporosis in diabetic patients. Therefore, these 27 irrelevant studies were also excluded. Finally, 4 papers were analyzed.

All studies had moderate quality. National bases are not sensitive to Boolean operators. Therefore, keywords were searched as single-word (osteoporosis/diabetes/menopause). The process of searching and screening articles is presented in Fig. 1.

Four articles examined the prevalence of osteoporosis in 562 postmenopausal women with type 2 diabetes (an average of 140 subjects in each study). The sample size varied from 40 to 242 in selected papers. More details are reported in Table 1.

The pooled prevalence of the lumbar spine osteoporosis and osteopenia was 25.26% (95% CI: 7.22–30.30) and 45.23% (95% CI: 40.66–49.79), respectively, in postmenopausal women with type 2 diabetes (Fig. 2).

Also, the pooled prevalence of femoral neck osteoporosis and osteopenia was 17.45% (95% CI: 0.25–34.65%) and 44.53% (95% CI: 36-60-52.47), respectively, in these subjects (Fig. 3).

To assess the relationship between the prevalence of osteoporosis and osteopenia with age, body mass index, publication year,
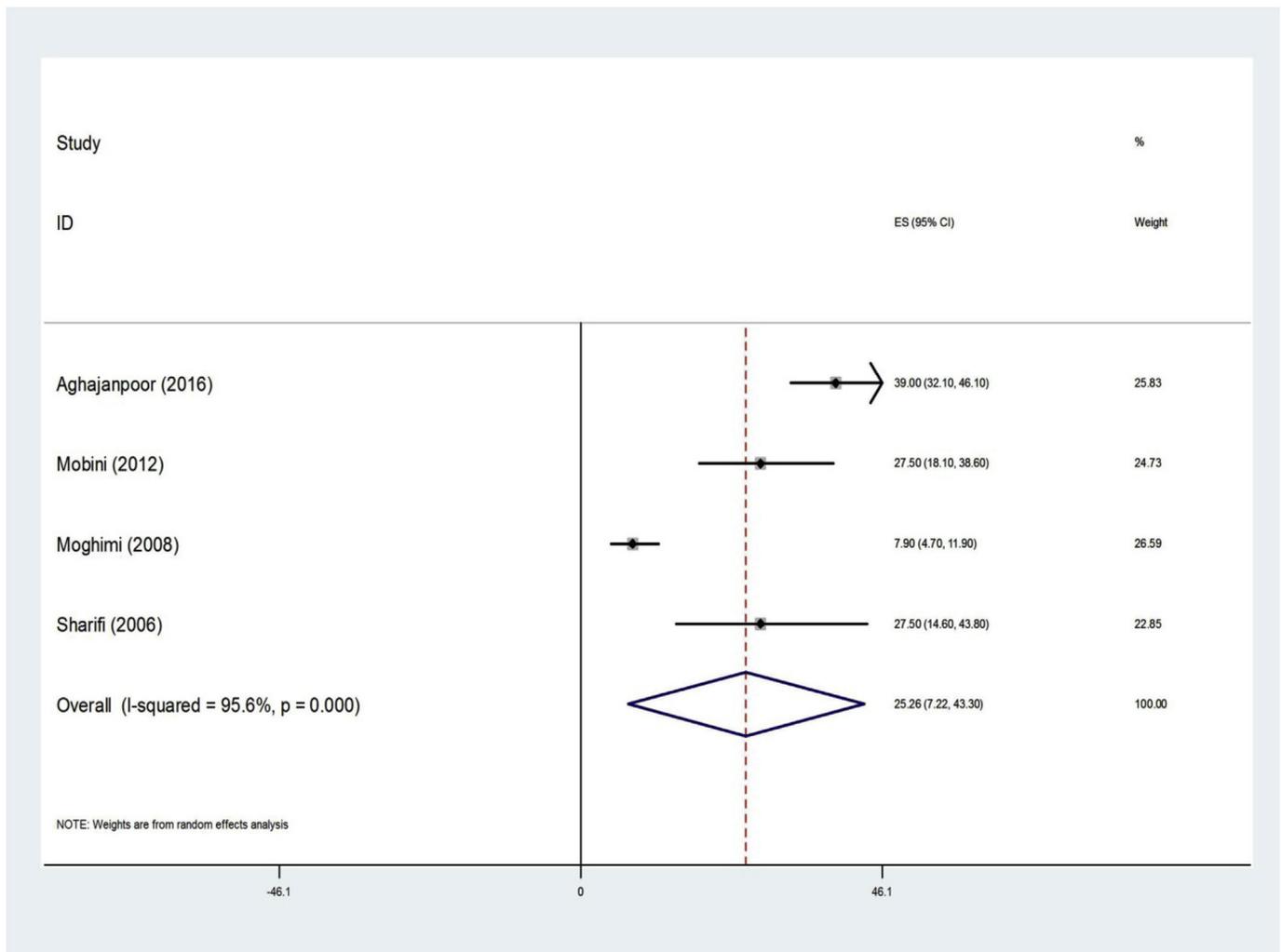
Fig. 2. The prevalence of lumbar spine osteoporosis and its 95% confidence interval in Iranian postmenopausal women based on random effects model.
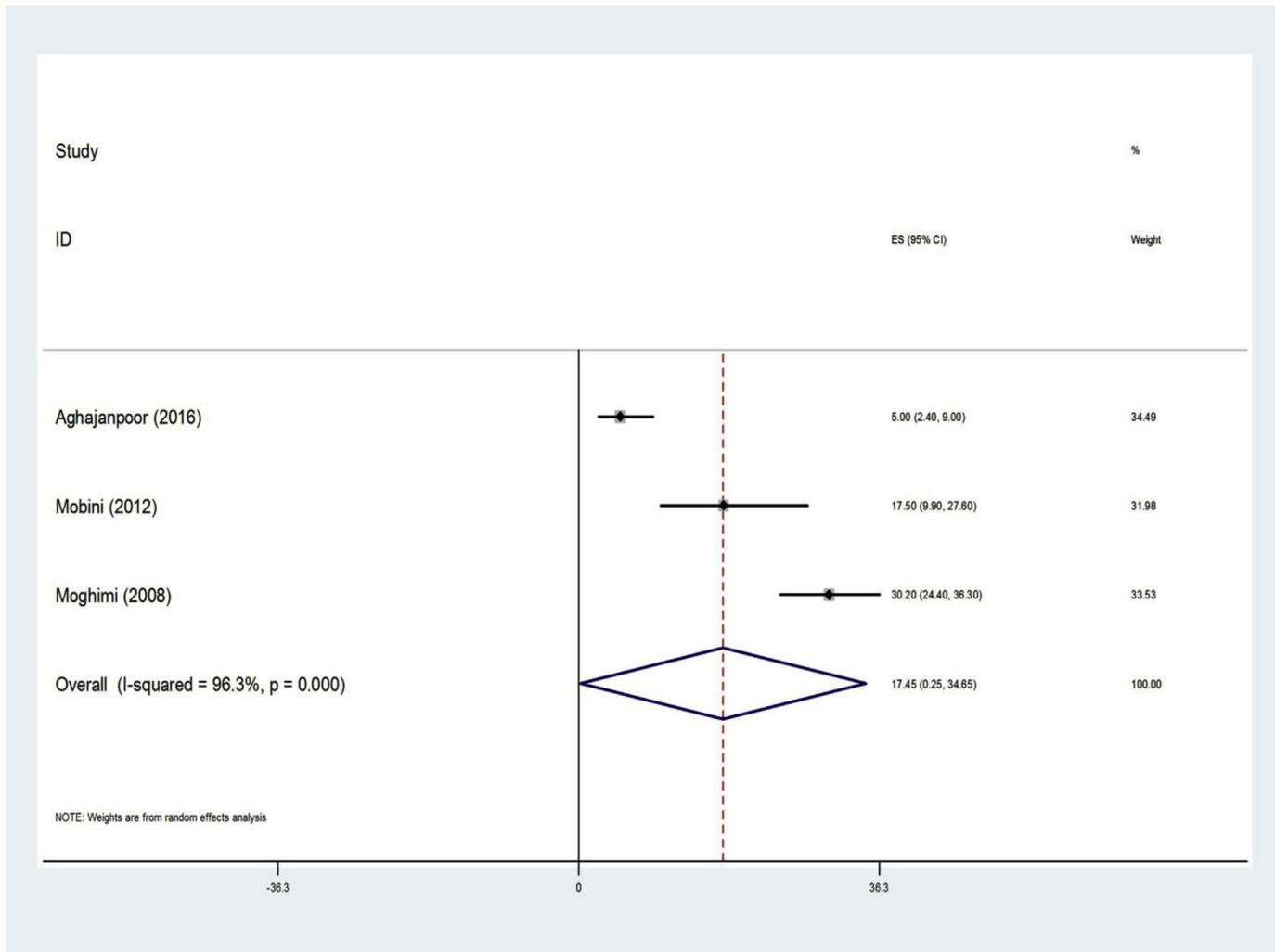
Fig. 3. The prevalence of femoral neck osteoporosis and its 95% confidence interval in Iranian postmenopausal women based on random effects model.

and sample size, a meta-regression analysis was used. The results showed that the prevalence of osteoporosis and osteopenia was not related to any of these variables ($p > 0.05$). Publication bias for the prevalence of osteoporosis ($p = 0.267$) and osteopenia ($p = 0.866$) in the lumbar spine, and osteopenia in the lumbar spine ($p = 0.444$) was not significant. Publication bias was significant only for the prevalence of osteopenia in the femoral area ($p = 0.032$) (Fig. 4).

4. Discussion

This systematic review and meta-analysis was conducted to evaluate the prevalence of osteoporosis and osteopenia among Iranian postmenopausal women with type 2 diabetes. The pooled prevalence of osteoporosis in the lumbar spine and femoral neck of these patients was 25.26% and 17.45%, respectively. Also, the prevalence of osteopenia in the lumbar spine and femoral neck was 45.23% and 44.53%, respectively. In a study by Prakash et al. (2017) on 96 Indian patients with type 2 diabetes, the prevalence of osteoporosis in the lumbar spine and femoral neck was 39.6% and 20.9%, respectively [6].The results of Pazhohi et al. (2001) showed that there is a relationship between diabetes and osteoporosis [23]. In the study of Moghimi et al. (2008), postmenopausal women with type 2 diabetes had a lower T-score than postmenopausal non-diabetic women and were more susceptible to fractures [21].The

high prevalence of osteoporosis in patients with diabetes can be attributed to renal dysfunction and obesity; although some researchers believe that the use of anti-diabetic drugs also has adverse effects on bone and the use of these drugs is associated with bone fracture [24—26].The results of a study on 35444 Norwegian people over 50 years old showed that during the 9 years follow up, 1643 new hip fractures occurred, and the relative risk of hip fractures in type 1 and type 2 diabetic patients compared with healthy ones was 6.9 and 1.8, respectively [27]. Type 2 diabetes has a complex effect on bone fragility. Patients with type 2 diabetes, especially those who are being treated with hypoglycemic agents or suffer from complications of diabetes such as neuropathy and retinopathy, are more at risk of bone fracture. Diabetic nephropathy also increases the risk of fractures due to accompanying secondary hyperparathyroidism and renal osteodystrophy [28,29].

Different studies have reported different results regarding bone mineral density (BMD) in diabetic patients. In some studies, BMD in diabetic patients was lower than non-diabetic patients [30—32]. In some other studies, it was similar [33,34] or higher than non-diabetic subjects [15,35—38].Type II diabetes has a direct effect on bone metabolism through hyperglycemia, oxidative stress, and the formation of advanced glycation end products, and leads to reduced bone turnover and bone formation [28]. According to Rakel, diabetic retinopathy may be associated with a decrease in BMD; these
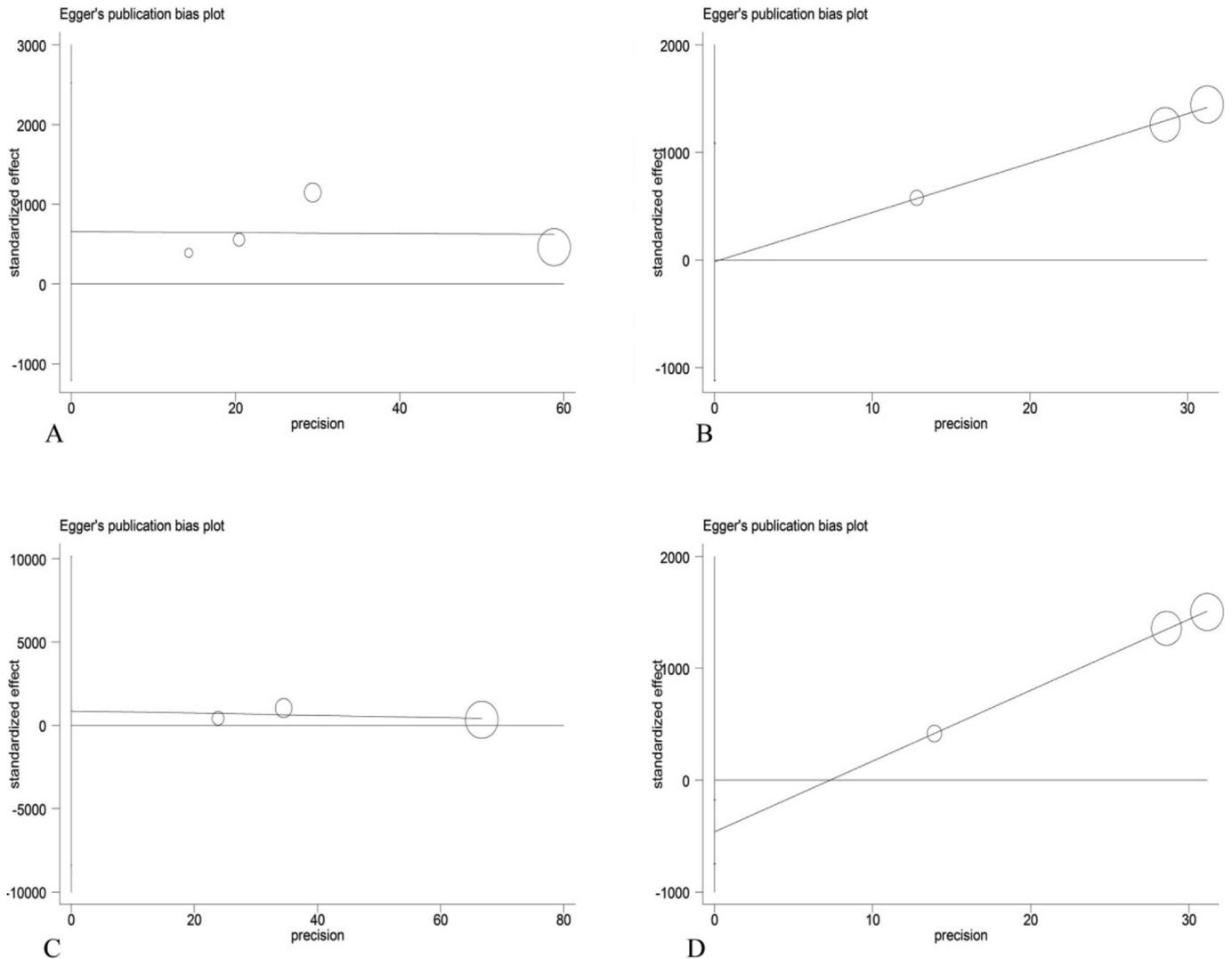
Fig. 4. Publication bias: osteoporosis (A) and osteopenia (B) in lumbar spine, osteoporosis (C) and osteopenia (D) in femoral neck.

patients are less likely to have physical activity due to visual impairment, as a result of which their muscle strength is reduced [39].

According to meta-regression results, the prevalence of osteoporosis and osteopenia was not significantly changed with the passage of time. It seems that health interventions provided for these patients did not effect on the overall prevalence of this problem. There was no association between age and body mass index with the prevalence of osteoporosis and osteopenia. Perhaps the reason for this finding is that patients were homogeneous in terms of age and body mass. One of the limitations of this study was the lack of information reported in some selected studies that would have prevented us from further investigations. Also, because there is no specific database for gray literature in Iran, such studies have not been entered into meta-analysis. One of the strengths of this study is the novelty of this research.

5. Conclusion

Osteoporosis and osteopenia in Iranian postmenopausal women with type 2 diabetes are prevalent. The simultaneous presence of osteoporosis and diabetes in these patients will multiply the risk of complications of these diseases. Therefore, in order to reduce the prevalence of these problems, healthy lifestyle education for these patients is necessary.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.07.036.

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