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Role of Physical Activity in Preventing Osteoporosis in Postmenopausal Women: Systematic Review

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Abstract

***Objectives*:** To assess the effectiveness of different types of physical activities (e.g., weight-bearing exercises, resistance training, aerobic exercises) in preventing osteoporosis in postmenopausal women. ***Methods*:** A comprehensive computerized search of pertinent databases was conducted in order to find studies that satisfied the inclusion requirements. To find pertinent information, a thorough search of PubMed, SCOPUS, Science Direct, and Web of Science was conducted. ***Results*:** Our data included seven trials with 30,728 women. Each study included a different exercise program, such as walking impulse, general regular exercise, aerobic exercise, and multipurpose exercise. Frequent regular exercise for a longer duration (>1 h) had considerably stronger preventative benefits for postmenopausal osteoporosis. The multifunctional exercise regimen described here had a positive impact on specific musculoskeletal, BMD, body composition, and cardiometabolic endpoints. After a meal, 45 minutes of suprathreshold speed-enhanced accelerated walking on level ground can prevent or mitigate postmenopausal osteoporosis in stationary women. Hormone replacement therapy and aerobic exercise can raise vertebral bone mineral density. ***Conclusion*:** For postmenopausal women, physical activity is a crucial non-pharmacological intervention in preventing osteoporosis. Personalized exercise prescriptions are necessary, nevertheless, as evidenced by the variation in the efficacy of various exercise regimens. Subsequent studies have to persist in refining our comprehension of the ideal workout plans for averting osteoporosis and tackling the obstacles associated with consistency and durability.

Keywords: Physical activity, Exercise, Osteoporosis, Postmenopausal women, Systematic review.

INTRODUCTION

As a disorder with significant health consequences, osteoporosis is identified clinically by the fractures that result from increased bone fragility [1]. Using the WHO diagnostic criteria, it was projected in 2010 that 22 million women in the EU over 50 had osteoporosis [1]. Public health and physicians have difficulties due to the large social and individual costs associated with osteoporosis, especially since the majority of individuals with the condition do not receive treatment [2].

Over two million people in the UK alone are affected by osteoporosis, which is more than double the number of people suffering from dementia, one of the most common diseases among the elderly. This information comes from a survey on the current management of postmenopausal women with osteoporosis. An estimated 300,000 individuals experience fragility fractures annually, with over 70,000 of them involving the hip joint. These fractures can lead to disability, loss of independence, and in severe cases, even death [3].

By blocking the resolution mechanism, the usual treatment, which is essentially pharmaceutical, seeks to lower the incidence of fractures [4]. The combined use of successive antiresorptive/anabolic pharmacotherapeutic cycles with denosumab, teriparatide, selective estrogen receptor regulators, and aminobisphosphonates appears to have no correlation with the reduction of fracture risk, despite the fact that the advantages appear to outweigh the risks. However, because of the rise in bone mass and muscle strength that comes with exercise, this could contribute to preserving bone architecture [5]. Because it is thought to enhance muscle mass and decrease fat mass, muscle

strengthening exercise would be beneficial, particularly for osteoporotic menopausal women, who would benefit from a reduction in falls and fractures due to the stimulation of osteogenesis [6].

After menopause, estrogen levels drop, which speeds up bone resorption and raises women's risk of osteoporosis and consequent fractures. While there are pharmaceutical therapies available, they may not be appropriate for long-term use and frequently have potential negative effects. As a result, non-pharmacological therapies—physical activity in particular—are gaining popularity as a means of preventing osteoporosis. Exercise has been demonstrated to increase muscle strength, bone density, and balance, all of which can lower the risk of fractures and falls. It is yet unknown, though, what kind, level, and frequency of physical activity is best for postmenopausal women to avoid osteoporosis. This study aims to offer evidence-based suggestions for integrating physical activity into osteoporosis prevention programs by methodically analyzing the body of current information.

OBJECTIVES

1. To assess the effectiveness of different types of physical activities (e.g., weight-bearing exercises, resistance training, aerobic exercises) in preventing osteoporosis in postmenopausal women.
2. To identify potential barriers and facilitators for the implementation of physical activity programs aimed at osteoporosis prevention in postmenopausal women.
3. To provide evidence-based recommendations for healthcare providers and policymakers on incorporating physical activity into osteoporosis prevention strategies for postmenopausal women.

METHODS

We implemented this systematic review in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [7] criteria. An internet-based search was performed on PubMed, Web of Science, SCOPUS, and Science Direct to find English-language studies on the effectiveness of different types of physical activities in preventing osteoporosis in postmenopausal women. Relevant keywords were used in the search method in these scenarios. Two reviewers separately searched through the search outcomes, chose relevant papers, collected data, and utilized the appropriate assessment procedures to establish how strong the included study was. These reviewers independently extracted essential data and critically appraised the quality of included research using established evaluation tools, ensuring the inclusion of high-quality studies and reliable data for subsequent analysis and synthesis in this systematic review.

Eligibility Criteria:

Inclusion criteria:

1. Studies that investigate the effectiveness of different types of physical activities in preventing osteoporosis in postmenopausal women.
2. Research that is printed in publications with peer review.
3. Recent studies published within (2000-2024).
4. Studies available in the English language.
5. Research conducted on human subjects.

Exclusion criteria:

1. Studies that do not focus on the prevention of ostroporosis.
2. Studies not available in the English language.
3. Animal or in vitro studies.
4. Reviews, case reports, editorials, and opinion pieces.

Data Extraction

Rayyan (QCRI) was utilized to check the search results and ensure accuracy [8]. The inclusion and exclusion criteria were employed to establish the relevance of the search results titles and abstracts. The study team thoroughly reviewed papers that met the inclusion criteria. Consensus was employed to resolve disputes. Key study data were recorded using an established data extraction form, including titles, authors, publication year, study location, participant demographics, intervention, follow-up duration, BMI, and primary outcomes. To investigate the probability of bias, a neutral evaluation instrument was developed.

Strategy for Data Synthesis

Using information from relevant studies, descriptions of the research findings and features were produced in order to offer a qualitative assessment. Following the completion of data collection for the systematic review, the most effective way to ensure the utilization of the data from the included studies was determined.

Risk of Bias Assessment

The Joanna Briggs Institute (JBI) [9] critical assessment criteria designed for studies reporting prevalence data will be applied to evaluate the quality of the research included in this investigation. Nine questions make up this tool, and the answers are ranked as either positive (rated as 1) or negative (scored as 0), unclear, or irrelevant. Based on total ratings that fall below 4, between 5 and 7, and above 8, studies will be categorized as poor, moderate, or high quality, respectively. Researchers will independently assess the quality of the studies they undertake, and any disagreements in the evaluations will be settled by cooperative discussion to guarantee agreement and precision in the quality assessment procedure.

RESULTS

Systematic Search Outcomes

Following the removal of 468 duplicates, a systematic search yielded 911 study papers. After 443 studies' titles and abstracts were reviewed, 391 papers were rejected. Out of the 52 reports that needed to be obtained, 2 articles were not found. 50 articles passed the full-text screening procedure; 31 were dismissed because the study results were erroneous, 8 because the population type was incorrect, 2 were editor's letters, and 2 were abstracts. The eligibility requirements were satisfied by seven research publications that have been incorporated in this systematic review. Figure 1 depicts an overview of the approach used to choose the research.

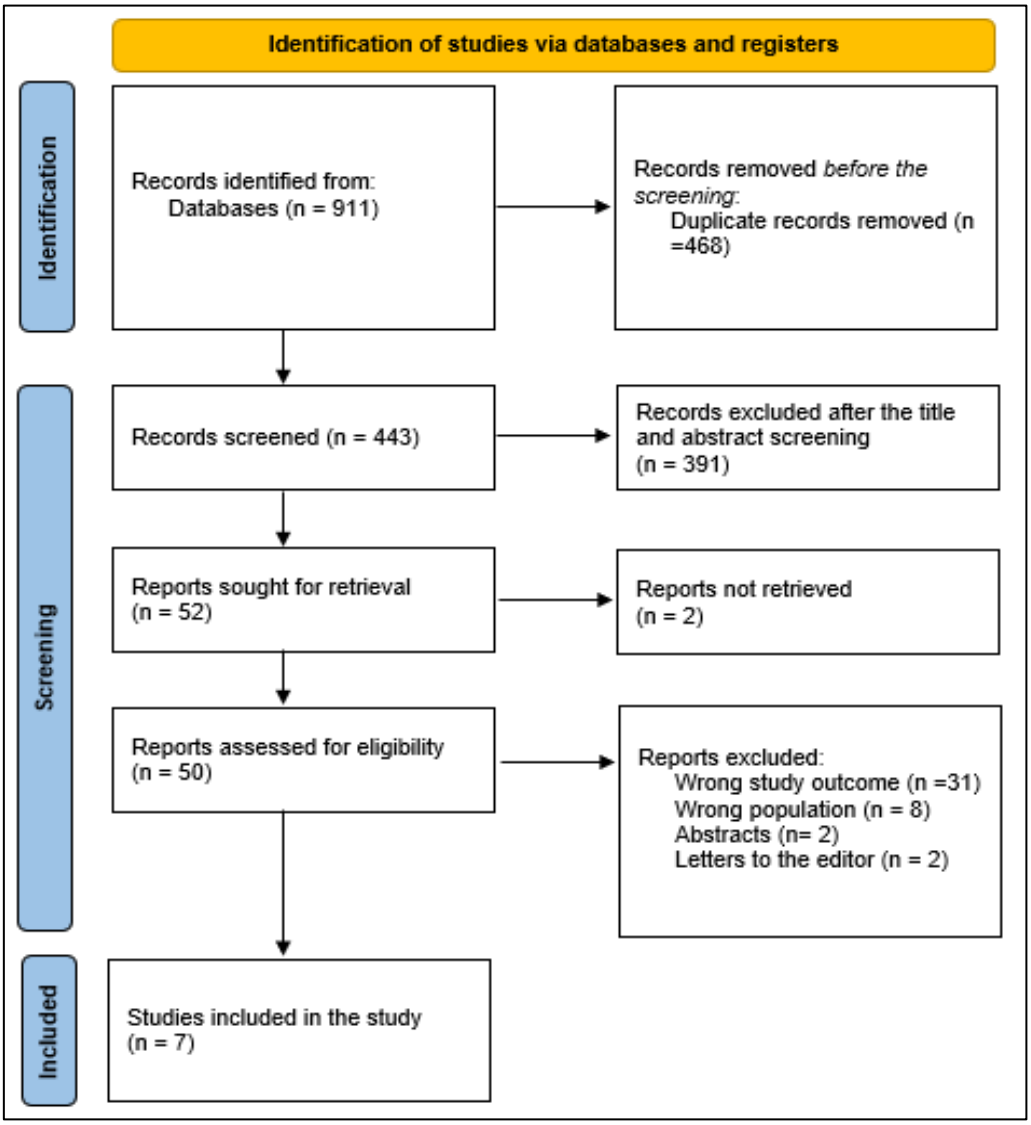

Figure 1: A PRISMA diagram is used to summarize the study decisions

Sociodemographic of the Comprised Participants and Studies

Table 1 displays the sociodemographic information from the research articles. Our data included seven trials with 30,728 women. Three studies were retrospective cohorts [13, 15, 16], two were case-controls [10, 14], one was a retrospective observational study [11], and one was a cross-sectional study [12]. Three studies were conducted in Germany [13, 15, 16], two in China [10, 14], one in Italy [11], and one in Taiwan [12]. The earliest study was conducted in 2005 [15] and the latest in 2023 [11].

Clinical outcomes

The clinical data are presented in Table (2). Each study included a different exercise program, such as walking impulse, general regular exercise, aerobic exercise, and multipurpose exercise [10, 16]. Frequent regular exercise for a longer duration (>1 h) had considerably stronger preventative benefits for postmenopausal osteoporosis [12, 16]. The multifunctional exercise regimen described here had a positive impact on specific musculoskeletal, BMD, body composition, and cardiometabolic endpoints [13, 15]. After a meal, 45 minutes of suprathreshold speed-enhanced accelerated walking on level ground can

prevent or mitigate postmenopausal osteoporosis in stationary women [10]. Hormone replacement therapy and aerobic exercise can raise vertebral bone mineral density [14].

Table 1: Sociodemographic parameters of the involved populations

Study	Study design	Country	Participants	Mean age
Zheng *et al.*, 2021 [10]	Case-control	China	40	57.4 ± 1.7
Cerulli *et al.*, 2023 [11]	Retrospective observational study	Italy	30	60.6 ± 8.4
Chang *et al.*, 2022 [12]	Cross-sectional	Taiwan	30,046	59 ± 5
Kemmler *et al.*, 2017 [13]	Retrospective cohort	Germany	242	55.1 ± 3.3
Zhu & Yan, 2016 [14]	Case-control	China	70	47.1 ± 1.5
Kemmler *et al.*, 2005 [15]	Retrospective cohort	Germany	78	55.2 ± 3.3
Kemmler *et al.*, 2012 [16]	Retrospective cohort	Germany	222	55.1 ± 3.3

Table 2: Clinical parameters and outcomes of the comprised research

Study ID	Intervention	Follow-up duration	BMI	Main outcomes	JBI
Zheng *et al.*, 2021 [10]	Exercise meal and 45-minute walking impulse	4	26.2 ± 1.0	After a meal, 45 minutes of suprathreshold speed-enhanced accelerated walking on level ground can prevent or mitigate postmenopausal osteoporosis in stationary women. Alternatively, 40 minutes of downhill exercise, but not 40 minutes of uphill exercise, can avoid circadian PTH over-secretion.	Moderate
Cerulli *et al.*, 2023 [11]	Domestic activities, and transport (moderate and vigorous intensity)	NM	24.4 ± 3.3	The participants' moderate-to-vigorous-intensity transportation, household, and leisure activities were examined to see if they were sufficient to ensure a delayed start of osteoporosis.	Moderate
Chang *et al.*, 2022 [12]	General regular exercise	45	23.7 ± 3.5	Exercise for a longer duration (>1 h) had considerably stronger preventative benefits for postmenopausal osteoporosis. Frequent exercise was also closely linked to a decrease in the incidence of osteoporosis in postmenopausal women.	Moderate
Kemmler *et al.*, 2017 [13]	Multipurpose exercise	16 y	25.2± 3.2	The multifunctional exercise regimen described here had a positive impact on both specific musculoskeletal and cardiometabolic endpoints, two variables that respond to exercise differently.	Moderate
Zhu & Yan, 2016 [14]	Aerobic exercise	NM	NM	In postmenopausal women, hormone replacement therapy and aerobic exercise can raise vertebral bone mineral density. This has a major positive therapeutic impact on the prevention and management of postmenopausal osteoporosis and is deserving of promotion.	High
Kemmler *et al.*, 2005 [15]	Multipurpose exercise	3 y	NM	how well a varied training program works to offset the unfavorable effects of aging and/or the menopausal transition on blood lipids, body composition, physical fitness, and BMD.	Moderate
Kemmler *et al.*, 2012 [16]	General regular exercise	12 y	NM	This work added to the body of evidence supporting the effectiveness of exercise programs in preventing fractures, with a focus on bone strength, even though we were only narrowly unable to find any discernible benefits on total fracture risk or rate ratio.	Moderate

*NM=Not-mentioned

DISCUSSION

Summary Findings

This systematic review's objective was to examine the available data regarding physical activity/exercises and their effectiveness in preventing osteoporosis in postmenopausal women. It was discovered that frequent, regular exercise lasting longer than an hour (>1 h) provided noticeably greater prophylactic effects against postmenopausal osteoporosis [12, 16]. The multimodal exercise program outlined here improved some endpoints related to the musculoskeletal system, bone mineral density, body composition, and metabolism [13, 15]. Postmenopausal osteoporosis in stationary women can be prevented or lessened by 45 minutes of suprathreshold speed-enhanced rapid walking on level ground following a meal [10]. Aerobic exercise and hormone replacement treatment have been shown to increase spinal bone mineral density [14].

Interpretation

Al Khaldi & Porter suggested that weight-bearing activities are beneficial for all durations, with or without the addition of calcium and vitamin D; non-weight-bearing exercises, on the other hand, may be beneficial for longer durations and when calcium and vitamin D are given. When paired with HRT, a combination of these workouts improved BMD [17].

Numerous measures are frequently required for osteoporosis treatment and prevention. A pharmaceutical strategy is frequently used to treat osteoporosis since medications such as estrogen, calcitonin, and bisphosphonates limit bone reabsorption to preserve BMD [18].

The goal of physiotherapeutic interventions for osteoporosis prevention and treatment throughout the past few decades has been to either maintain bone mass or lower the risk of falls. Various methods are employed, including body awareness training, hydrotherapy, group exercise, and training [19]. Many of these methods seek to enhance muscle power and bone strength by lessening disruptions in bone metabolism. As a result, pain is reduced and bone structure is enhanced [19].

Physiotherapists have shown that exercises are the most effective strategy, based on several case-control and observational studies. The exercises' method is based on their systematic effects on the body, which improve body coordination, balance, and muscle strength [19]. By maintaining or raising BMD, which in turn strengthens muscles and improves balance, exercise helps reduce the risk of falls. Additionally, it can improve quality of life by reducing fall risk factors, overcoming limitations, and carrying out everyday activities [20].

A meta-systematic review and meta-analysis were crafted by Martyn-St and Carroll [21] in order to ascertain the effectiveness of progressive high-intensity resistance exercise on postmenopausal women's BMD. Resistance training is clearly beneficial in maintaining BMD at the LS (lumbar spine), as demonstrated by the fact that some patients were already undergoing HRT. Last but not least, Howe *et al.*, [22] examined the literature to ascertain the efficacy of activities generally in preventing fractures and bone loss in postmenopausal women. Subjects in good health who had previously had fractures were taken into account for inclusion. It was discovered that the ideal fitness regimen to stave off osteoporosis is still up for debate.

In conclusion, there are still some disagreements on the efficacy of various exercise regimens in preventing osteoporosis, and there is no consensus on the best frequency or length of exercise. For these reasons, this dissertation will conduct a systematic review to find relevant research to shed light on these issues.

Even with the encouraging outcomes, a number of difficulties still exist. Because many postmenopausal women may struggle with motivation, time restraints, or physical limitations, adhering to fitness programs is a big hurdle. Additionally, as the advantages of physical activity on bone health are greatest with continuous, lifetime participation, the long-term sustainability of exercise treatments is crucial. Further high-quality randomized controlled studies are also required to determine the best kinds and amounts of physical activity for the prevention of osteoporosis.

Future Directions

Future studies should concentrate on determining the most practicable and beneficial fitness programs for various postmenopausal women populations. This involves investigating the potential benefits of new or combination exercise modalities for improving bone health, such as high-intensity interval training or combining balance and flexibility exercises. Additionally, longitudinal research is required to evaluate the long-term impacts of consistent physical exercise on bone mineral density and fracture risk.

Additionally, studies should look into ways to increase exercise program adherence, especially for women who have physical restrictions or coexisting medical issues. This could entail creating customized interventions that take into account each person's abilities and preferences in addition to using technology—like wearables and smartphone apps—to track and encourage physical activity.

Education about the advantages of physical activity for bone health should be given top priority in public health campaigns, especially for postmenopausal women. Partnerships between health care physicians, fitness experts, and neighborhood associations may improve the use and attractiveness of workout regimens. It is recommended that policymakers incorporate

suggestions for physical activity into frameworks aimed at preventing osteoporosis. This will guarantee that exercise is acknowledged as a fundamental component of managing bone health.

CONCLUSION

For postmenopausal women, physical activity is a crucial non-pharmacological intervention in preventing osteoporosis. Personalized exercise prescriptions are necessary, nevertheless, as evidenced by the variation in the efficacy of various exercise regimens. Subsequent studies have to persist in refining our comprehension of the ideal workout plans for averting osteoporosis and tackling the obstacles associated with consistency and durability.

REFERENCES

1. Hernlund, E., Svedbom, A., Ivergard, M., Compston, J., Cooper, C., Stenmark, J., McCloskey, E. V., Jonsson, B., & Kanis, J. A. (2013). Osteoporosis in the European Union: Medical management, epidemiology and economic burden. A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA). *Arch. Osteoporos*, *8*, 136.
2. Kanis, J. A., McCloskey, E. V., Johansson, H., Cooper, C., Rizzoli, R., & Reginster, J. Y. (2019). European guidance for the diagnosis and management of osteoporosis in postmenopausal women. *Osteoporos. Int.*, *30*, 3–44.
3. Garnero, P., Sornay-Rendu, E., Claustrat, B., & Delmas, P. D. (2000). Biochemical markers of bone turnover, endogenous hormones and the risk of fractures in postmenopausal women: the OFELY study. *Journal of bone and mineral research*, *15*(8), 1526-36.
4. Riek, A. E., & Towler, D. A. (2011). The pharmacological management of osteoporosis. *Mo. Med.*, *108*, 118–123.
5. Villafane, J. H., Valdes, K., Bertozzi, L., & Negrini, S. (2017). Minimal Clinically Important Difference of Grip and Pinch Strength in Women with Thumb Carpometacarpal Osteoarthritis When Compared to Healthy Subjects. *Rehabil. Nurs*, *42*, 139–145.
6. Pillastrini, P., Ferrari, S., Rattin, S., Cupello, A., Villafañe, J. H., & Vanti, C. (2015). Exercise and tropism of the multifidus muscle in low back pain: A short review. *J. Phys. Ther. Sci.*, *27*, 943–945.
7. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., & Chou, R. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International journal of surgery*, *88*, 105906.
8. Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. *Systematic reviews*, *5*, 1-0.
9. Munn, Z., Aromataris, E., Tufanaru, C., Stern, C., Porritt, K., Farrow, J., Lockwood, C., Stephenson, M., Moola, S., Lizarondo, L., & McArthur, A. (2019). The development of software to support multiple systematic review types: the Joanna Briggs Institute System for the Unified Management, Assessment and Review of Information (JBI SUMARI). *JBI evidence implementation*, *17*(1), 36-43.
10. Zheng, Q., Kernozek, T., Daoud-Gray, A., & Borer, K. T. (2021). Anabolic bone stimulus requires a pre-exercise meal and 45-minute walking impulse of suprathreshold speed-enhanced momentum to prevent or mitigate postmenopausal osteoporosis within circadian constraints. *Nutrients*, *13*(11), 3727.
11. Cerulli, C., Moretti, E., Parisi, A., Tranchita, E., Di Lauro, M., Minganti, C., Perrone, M. A., Murri, A., Greco, F., Marrone, G., & Noce, A. (2023). Correlation between physical activity, nutritional intake, and osteoporosis in postmenopausal women: a preliminary evaluation. *European Review for Medical & Pharmacological Sciences*, *27*(12).
12. Chang, C. F., Lee, J. I., Huang, S. P., Geng, J. H., & Chen, S. C. (2022). Regular exercise decreases the risk of osteoporosis in postmenopausal women. *Frontiers in Public Health*, *10*, 897363.
13. Kemmler, W., Kohl, M., & von Stengel, S. (2017). Long-term effects of exercise in postmenopausal women: 16-year results of the Erlangen Fitness and Osteoporosis Prevention Study (EFOPS). *Menopause*, *24*(1), 45-51.
14. Zhu, J., & Yan, Q. (2016). Hormone replacement combined with the prevention effect of aerobic exercise on osteoporosis of postmenopausal women. In *2016 6th International Conference on Machinery, Materials, Environment, Biotechnology and Computer* (pp. 487-490). Atlantis Press.
15. Kemmler, W., Von Stengel, S., Weineck, J., Lauber, D., Kalender, W., & Engelke, K. (2005). Exercise effects on menopausal risk factors of early postmenopausal women: 3-yr Erlangen fitness osteoporosis prevention study results. *Medicine & Science in Sports & Exercise*, *37*(2), 194-203.
16. Kemmler, W., Von Stengel, S., Bebenek, M., Engelke, K., Hentschke, C., & Kalender, W. A. (2012). Exercise and fractures in postmenopausal women: 12-year results of the Erlangen Fitness and Osteoporosis Prevention Study (EFOPS). *Osteoporosis International*, *23*, 1267-76.
17. Al Khaldi, M., & Porter, S. L. (2016). Exercise Intervention for Osteoporosis Prevention in Postmenopausal Women: A Systematic Review. *J Nov Physiother*, *7*(323), 2.
18. Eichner, S. F., Lloyd, K. B., & Timpe, E. M. (2003). Comparing therapies for postmenopausal osteoporosis prevention and treatment. *Annals of Pharmacotherapy*, *37*(5), 711-24.
19. Lange, U., Teichmann, J., & Uhlemann, C. (2005). Current knowledge about physiotherapeutic

strategies in osteoporosis prevention and treatment. *Rheumatology international*, *26*, 99-106.

20. Heydarnejad, S., & Dehkordi, A. H. (2010). The effect of an exercise program on the health-quality of life in older adults. *Dan Med Bull*, *57*(4), 113-7.
21. Martyn-St James, M., & Carroll, S. (2009). A meta-analysis of impact exercise on postmenopausal bone loss: the case for mixed loading exercise programmes. *British journal of sports medicine*, *43*(12), 898-908.
22. Howe, T. E., Shea, B., Dawson, L. J., Downie, F., Murray, A., Ross, C., Harbour, R. T., Caldwell, L. M., & Creed, G. (2011). Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane database of systematic reviews*, *7*.