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Original Article

Review of ongoing trials in exercise and physical activity for postmenopausal osteoporosis

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Abstract

Osteoporosis is a major public health problem worldwide. While exercise and physical activity have been shown to improve the bone strength and quality of life of osteoporosis patients, there is still no clarity about the quantum, frequency, and pattern of exercises. This review of ongoing trials on exercise and physical activity among postmenopausal osteoporosis was conducted using the World Health Organization International Clinical Trial Registry Platform (WHO-ICTRP). "Postmenopausal osteoporosis" and "Exercise" were the keywords used for the review. The objective of this review was to identify the ongoing trials in exercise and physical activity for postmenopausal osteoporosis. The results revealed that there were 102 trials registered wherein 17 of them met the inclusion criteria. Four trials registered at the Australian New Zealand Clinical Trial Registry were from Australia. Three trials were from India registered at the Clinical Trial Registry of India. China and Germany each had two trials registered. One trail each has been registered in Istanbul, Serbia, Israel, Brazil, and Japan respectively. In the context of the comprehensive management of osteoporosis, there have been quite a few studies that have been registered across the globe for evidence on the impact of exercises. More studies need to focus on the type, duration, and frequency of exercises and physical activity for postmenopausal osteoporosis.

Keywords: clinical trials, evidence, exercise, physical activity, postmenopausal osteoporosis, trial registry, WHO-ICTRP

Introduction

Human bone undergoes two continuous processes - formation and decalcification of bone (Yao et al., 2020). The condition of deficient bone density is termed as osteoporosis. Deficient bone density is caused by either excessive resorption due to disease conditions such as hyperparathyroidism with osteitis fibrosa cystica or with too little bone formation (Rockville, 2004).

The available data published from nine industrialized countries include North America, Europe, Japan, and Australia show that osteoporosis affects up to 49 million people, and the prevalence ranges from nine to 38 percent among women and one to eight percent of men (Wade et al., 2014).

The study published from the Asian countries reveals the spiking trend. The prevalence of osteoporosis has increased in China over the last 12 years, affecting more than one-third of people aged 50 years and older. The incidence of osteoporosis increased with age and was higher amongst women than men (Chen et al., 2016). Osteoporosis risk in women is associated

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with age, age of the menopause, and post-menopausal duration (Tian et al., 2017). It is more common among postmenopausal women, accounting for around 25 to 30 percent of its occurrence in the United States and similarly in Europe (Keen & Reddivari, 2020). According to WHO standards, a high proportion of elderly Australian women have osteoporosis (Henry et al., 2000). In India, osteoporosis among women is a major public health challenge, as the survey reveals, by 2015, about 230 million people over the age of 50 were confirmed to have been suffering from it (Khadilkar & Mandlik, 2015). Women in South India of the Asian sub-continent often suffers from low bone mineral density (Bala et al., 2016).

Management of postmenopausal osteoporosis encompasses non-pharmacological treatment, e.g., weight bearing, fall-prevention strategies, and therapeutic management (Michaelsson & Aspenberg, 2016). Consistent practice of lifestyle intervention reduces bone deterioration, which comprises adequate calcium and vitamin D supplements, regular exercises, smoking cessation, fall prevention advice, and the regulation of heavy alcohol usage (Rosen & Drezner, 2021). It is definitive that exercises are effective in treating osteoporosis, improving bone strength, and avoiding serious complications such as hip and spine fracture (Andreoli et al., 2012).

A recently published systematic review presented the trend of exercise in maintaining and improving bone mineral density (Benedetti et al., 2018). Earlier, a study conducted to evaluate the efficacy of postmenopausal osteoporosis exercises found that bone mass improvement was modest but significant (Aloia et al., 1978). In addition, a systematic review found that exercises are beneficial in improving and reversing osteoporosis. However, the quantum and types of exercises need to be further studied for postmenopausal osteoporosis (Hamilton et al., 2010). Along with the exercises, yoga is also found to be effective in the rehabilitation of osteoporotic patients (Tuzun et al., 2010).

There is always poor compliance to osteoporosis medications. The fear of drug-related side effects is the most quoted cause for the non-compliance (Papaioannou et al., 2007). Comprehensive management of osteoporosis is focusing on lifestyle modification including exercises with or without medications. Exercise is now gaining acceptance and is still in the initial phase of research (Babu et al., 2013).

Past research publications illustrate the need for further research in this field. Currently, several studies have been registered in the various clinical trial registries around the world. However, the quantum of the studies is unknown. Therefore, this review will enable us to comprehend the number of studies registered, and it would enlighten and proliferate the interest in exercise and physical activity for the management of postmenopausal osteoporosis. It helps to highlight the research trends in this area and facilitates more collaborative research. Thus, the objective of this review was to identify the ongoing trials in exercise and physical activity for postmenopausal osteoporosis.

Materials and Methods

The World Health Organization-International Clinical Trial Registry Platform (WHO-ICTRP) which is a database to access the complete view of research with all completed and ongoing trials in the world was searched. This trial registry can be accessible to those who are into policy formulation and to the public. It maintains transparency and acts as a quality control agency for trials worldwide. However, the collated information in the database is unavailable. This database cumulates the data from Australian New Zealand Clinical Trials Registry, Chinese Clinical Trial Registry, ClinicalTrials.gov, EU Clinical Trials Register (EU-CTR), Iranian registry of clinical trials (IRCT), ISRCTN, The Netherlands National Trial Register, Brazilian Clinical Trials Registry (ReBec), Clinical Trials Registry – India, Clinical Research Information Service - Republic of Korea, Cuban Public Registry of Clinical Trials, German Clinical Trials Register, Iranian Registry of Clinical Trials, Japan Primary Registries Network, Pan African Clinical Trial Registry, Sri Lanka Clinical Trials Registry, Thai Clinical Trials Registry (TCTR) and Peruvian Clinical Trials Registry (REPEC).

The database was searched using the keywords "postmenopausal osteoporosis" AND exercise OR "physical activity" OR yoga. The ongoing

trials on exercise training (any type of exercise) on postmenopausal osteoporotic patients were included. Completed and published trials were excluded. The trials were searched from their inception to Dec 2020.

Inclusion criteria of the studies for this review

Population. The trials, which included postmenopausal women with osteoporosis above 40 years were included.

Intervention. The study participants had undergone some kind of exercise, physical activity, and yoga. This could be combined with any other treatment modalities.

Recruitment status. Pre-initiation (those studies registered but not recruited) and actively recruiting

The data abstracted from the studies included the database in which the trial is registered, scientific title, year of registration, country, design, inclusion criteria, sample size, type of intervention, duration, and the status of the study.

Results

The initial search revealed 102 studies. Based on the recruitment status, inclusion criteria, type of intervention, only 17 studies were included in the review. There were three studies registered at CTRI of India, four trials from Australia registered at ACTRN, two each from Germany and China, one each from Istanbul, Serbia, Pakistan, and Israel were registered at clinicaltrials.gov. One from Brazil registered at NCN and one from Japan registered at JPRN-UMIN. Among the 85 studies which were excluded, 44 completed their trials, 21 trials included other than postmenopausal women like adolescents, children, men, and premenopausal women, ten trials included other diseases like breast cancer survivors, sarcopenia, etc., two trials were withdrawn or terminated, six trials included other interventions like drugs, fish liver oil, etc. and three studies had no updates on recruitment status. The details of excluded studies are summarized in Figure 1.

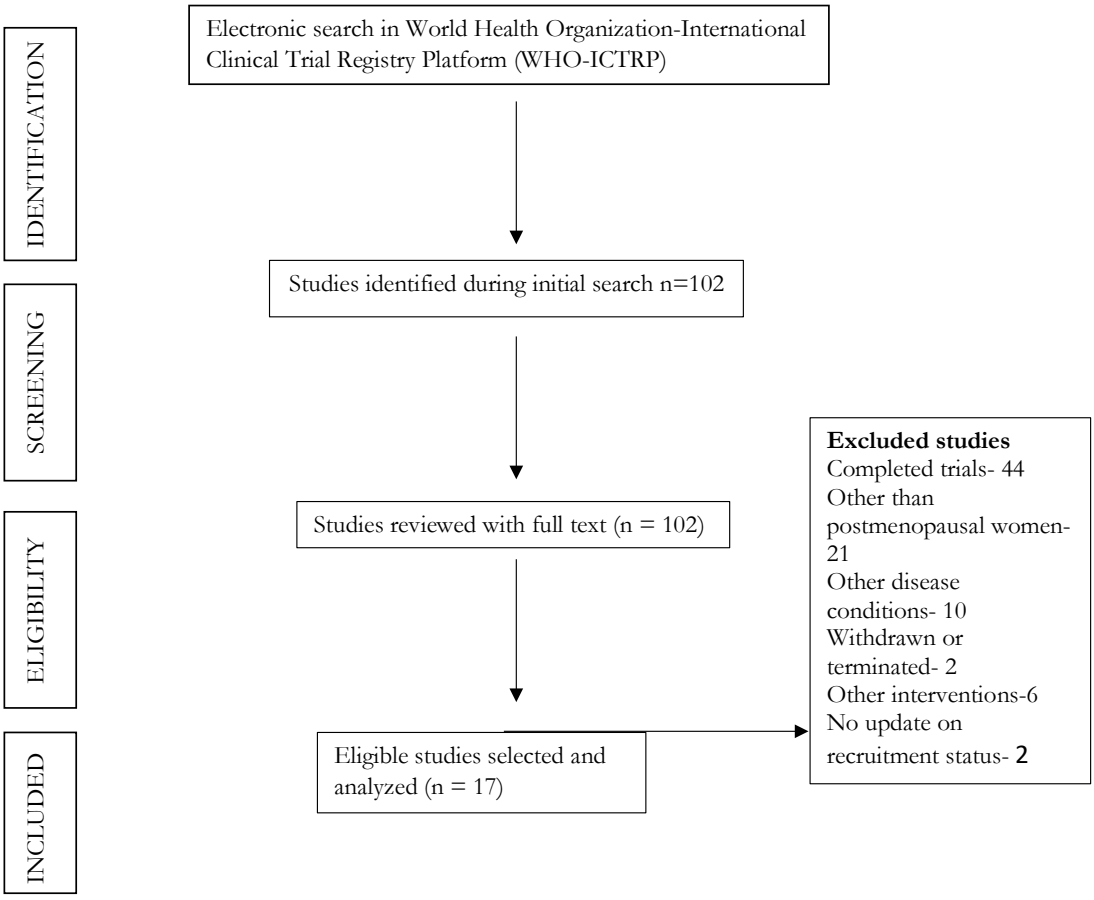

Figure 1. Details of the studies included in the review

The analysis of the studies exhibited that majority of the studies were randomized control trials (n=12), and five studies were of non-randomized trials. The sample size varied from 27 to 428. The interventions included were yoga, high-intensity resistance exercises, aerobic exercise, weight-bearing exercises, progressive resistance training exercises, and "Wu Xing Jian Gu" exercises. Among 16 studies selected, 11 were active and recruiting participants for the studies, the remaining studies were in the preinitiation period or not recruiting. A detailed description is given in Table 1.

The majority (13) of the trials with different interventions have a bone mineral density as the primary or secondary outcome measurement. Two studies have included yoga as the intervention with the different outcome measures such as bone health, quality of life, and compliance. Another study has the outcome of static balance score and dynamic balance score. High-intensity resistance exercises intervention is specified to evaluate its effect on BMD in two trials. Aerobic exercise was an intervention in two trials, one of which had enzyme activity of the matrix as an outcome measure, and bone mineral density in another trial. Weight-bearing exercises and progressive resistance training are the key interventions with changes in the physical disability, isometric leg strength, bone mineral density, postural balance change as the outcome measures. Two trials included pain as the outcome measure.

Discussion

This review provides the current details of the registered studies on the effect of exercise, physical activity, and yoga on postmenopausal osteoporosis, which are underway. There were a minimal number of trials registered across the globe. Maximum trials (4) were registered at ACTRN from Australia, next to it three trials from India at CTRI. China and Germany each registered two trials. One trail each has been registered in Istanbul, Serbia, Israel, Brazil, and Japan. An estimated 75 million people in Europe, the United States, and Japan are affected. In Europe alone, it is estimated that 22 million women between the age group of 50 and 84 years suffer from osteoporosis (International Osteoporosis Foundation, 2020). Consequently, in comparison to the severity of the osteoporosis problem, the number of trials registered is much smaller.

There are many limitations amongst the trials identified. Firstly, not all the studies were randomized trials. Also, the interventions included in the trials are heterogeneous, such as yoga, high-intensity resistance exercises, progressive resistance training, and whole-body vibration with high-intensity resistance training and Wu Xing Jain gu exercises. Some trials along with exercises found to be paired with other lifestyle changes. The duration of follow-up varied from three months to 16 years. Every type of exercise and physical activity has an impact and effect on the body. Thus, the complexity in combining the exercises makes it very difficult to generalize.

A study conducted in Turkey compared the effects of yoga with classical osteoporotic exercise and found that yoga was effective in improving pain, social functions, and balancing (Tüzün et al., 2010). As per our review, only two trials were registered to evaluate yoga's effectiveness. In comparing standard osteoporotic exercises with yoga, more trials must be necessary. There was a trial registered to evaluate the impact of whole-body vibration in conjunction with exercises. Reported types of exercises in the trials vary from trial to trial. Thus, to establish strong evidence on exercise variety, more detailed work is needed.

The common primary outcome measure in all the studies was bone mineral density. In only one study, it was changed to the enzyme activity of matrix metalloproteinase with functional status improvement.

Further, strength hip fracture and vertebral fracture are the most common complications of osteoporosis (Varacallo & Pizzutillo, 2018). Lifestyle modifications make it more likely to prevent complications and improve the quality of life. In many studies, exercises are found to be effective in improving bone strength and preventing complications in women with postmenopausal osteoporosis. Even then, the pattern and frequency of exercises are still unclear. A current guideline recommends exercises for the prevention and management of osteoporosis. Further, many

Table 1

Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
1	ClinicalTrials.gov/US-NLM	Effects of High-Intensity Multi-Modal Exercise Training on bone density and functional performance in Postmenopausal women	2020	Pakistan	Randomized controlled trial	• Postmenopausal women aged 45-70 years. • Body mass index (BMI) <30kg/m2 • Community ambulant without walking aid • Good general health • Willing for exercise therapy	108	In this group, Supervised High-intensity Progressive Resistance Training, High intensity weight bearing/ Impact exercises, and High challenging Balance Training will be given 2 times/week for 40-50 minutes sessions progressively over eight months.	8 months	Femoral neck BMD Lumbar spine BMD 1 RM for leg extensors. 1 RM for leg extensors 30-second sit to stand test. Time up and go test.	Recruiting
2	CTRI/India	Bone exercise for life: An intervention model on bone health and quality of life among menopausal women	2019	India	Non-randomized, Active Controlled Trial	Women aged 50 - 65 years, Menopausal at least since five years diagnosed as osteoporosis at femur or lumbar spine using DXA Normal ECG findings Cognitive, able to do their day-to-day activities.	140	Experiment: Yoga with dietary modifications include a calcium-rich diet, calcium, and vitamin D supplementation along with brisk walking for 30 min. Control: Non-yoga participants will be given a basic bone health care program.	2.6 yrs	Primary outcome measures: Impact on bone health Secondary outcomes: Quality of life Changes Compliance with dietary modifications Compliance with physical activity and yoga	Not yet recruiting
3	ClinicalTrials.gov/US-NLM	Effects of an optimized 18-months physical exercise on (Early)-Postmenopausal risk factors in women with Osteopenia and Osteoporosis (Actlife)	2019	Germany	Interventional (Clinical Trial)	48 -58 years postmenopausal women with osteopenia and osteoporosis at the lumbar spine or femoral neck Bone mineral density (BMD) <-1.0 standard deviation (SD) T-Score, WHO)	27	High-Intensity Resistance (HIT-RT) and Endurance exercise (HIIT) Ambulatory, consistently supervised group exercise training (Three training sessions of 40-45 min/week each).	18 months	Primary: BMD lumbar spine secondary: BMD total hip, fat-free mass, maximum leg strength, menopausal complaints, mid-thigh muscle density, para-vertebral muscle density.	Not yet recruiting

Table 1 Cont...

Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
4	CTRI/India	Effectiveness of lifestyle modification intervention program on quality of life, bone health status, physical function capacity and medication adherence among postmenopausal women with osteoporosis: A mixed-method study.	2019	India	Randomized, parallel-group trial method	Postmenopausal women whose bone density score is between 1 and 2.5 Â±SD	120	Lifestyle modification intervention program: Exercises will be taught to a patient once, on their visit to the outpatient department and asked them to practice at least thrice in a week by looking into the video. Brochure on osteoporosis	6 months	Primary outcome: Quality of life Secondary outcome: Bone health status, physical functional ability and medication adherence.	Not yet recruiting
5	ClinicalTrials.gov/US-NLM	The effect of Yoga Asana 'Vrksasana (Tree Pose)' on balance in the patients with osteoporosis	2019	Istanbul	Randomized. Intervention model	35–85-year females - Patients with a T score of bone mineral densitometry lower than -2.5.	50	To learn the exercises, the patients will be referred to a yoga-training program certified by yoga alliance. Both groups will be taught exercise series. The yoga group will be taught "tree pose".	6 months	Static balance score Berg balance test score Dynamic balance score Single leg stance test score Tandem stance test score Tandem walk test score. Timed sit and walk test score.	Recruiting
6	Clinical trials.gov/ US-NLM	Influence of specifically designed exercise program on serum matrix metalloproteinase and functional status in women with Postmenopausal Osteoporosis.	2018	Serbia	Interventional (Clinical Trial).	Females 50-70 years Osteoporosis, diagnosed by central osteo- densitometry.	100	Aerobic exercise will be conducted as a dose walk, 3-5 km/h, lasting 50 minutes per day, at least five days per week, for 12 weeks. Resistance training and balance exercises will be conducted as a group program and will involve exercises to strengthen the muscles of the upper and lower extremities and balance exercises.	12 weeks	Primary outcome changes in enzyme activity of matrix metalloproteinase-2, matrix metalloproteinase- 9, and tissue inhibitor of matrix metalloproteinase 1 (TIMP-1) in serum functional assessment of the musculoskeletal system using Timed-Up and Go Test" (TUG test) functional assessment of the musculoskeletal system using "Chair Rising Test ". Functional assessment of the musculoskeletal system using "One-Leg Stance Test" Secondary outcome: Detection of genotypes for the polymorphisms	Recruiting

Table 1 Cont...

Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
7	Clinicaltrials.gov/ US-NLM	Comparison of the effect of a weight-bearing protocol and a non-weight bearing protocol on osteoporotic women with chronic low back pain	2018	Israel	Non-randomized Interventional (Clinical Trial)	50 years and more women with osteoporosis (T score lower than -2.5) women who had suffered from non-specific low back pain for the last three months or more.	40	Weight-bearing group: Performing exercises in a weight-bearing posture Control group: Non-weight-bearing group performing exercises in a non-weight-bearing posture.	3 months	Primary: Change of physical disability Secondary: Change in lumbar range of motion - flexion and extension, change in pain intensity, change in health-related quality of life.	Recruiting
8	ACTRN/ Australia	The effectiveness of group-based exercise physiology services at alleviating multiple morbidities associated with ageing.	2018	Australia	Non-randomized trial	Both male and female individuals aged 50 years or older who are independently mobile (including with a walking aid). Individuals with a history of, or at risk of sarcopenia, osteoporosis, or poor balance.	45	Treatments comprise two one-hour group-based sessions for ten weeks. The first session each week is 100% exercise (progressive resistance training), the second session is 50% education and 50% exercise.	10 weeks	Primary outcomes: Isometric leg strength is measured by the strain gauge, Grip strength is measured by a grip strength dynamometer, Lower body strength, endurance, and muscular power. Secondary outcomes: Body composition, Quality of life, Functional ability and risk of fall.	Recruiting
9	ACTRN/ Australia	Wearable devices for assessing exercise targeting bone health in post-menopausal women with low bone mineral density	2018	Australia	Non-randomized trial	45 years and above and experienced menopause- Low BMD (<-1.0 T-score at the hip or lumbar spine). Confirmed by DXA scan	50	Exercise intervention will involve a progressive increase in the volume and intensity of high-impact exercise, in the form of hopping and skipping.	16 weeks	Primary outcome: Bone mineral density, bone microarchitecture, lean skeletal muscle mass, Bone turnover markers, c-terminal telopeptide (B-CTX), and procollagen type 1 propeptide (P1NP).	Recruiting

Table 1 Cont...
Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
10	Clinical trials.gov/ US-NLM	Effects of Vitamin D supplementation in muscle strength and postural balance training in vulnerable elderly women	2019	Brazil	Interventional Randomized prospective clinical trial, double-blind, placebo-controlled intervention	- Age > 60 years. - Osteoporosis or osteopenia (bone mineral density lower than -1.5 standard deviations of the T-score);	40	The experimental group, which will supplement vitamin D3 50,000 IU/ week, is in two capsules (25,000 IU/week each) and perform with a progressive resistance-training program. The placebo group will inject two capsules of equal size, volume, and colouration, composed of lactose, without the vitamin D3 supplement.	12 weeks	Primary outcome: Postural balance - semi-static – change Secondary outcome: Postural balance - dynamic – change, Muscular strength - Hand grip – change. Muscular strength - Isokinetic dynamometry – change. Muscular strength – one maximal repetition (RM)- change. Body composition and bone mineral density – change.	Recruiting
11	ACTRN/ Australia	Effect of high-intensity resistance and impact training on fracture risk in postmenopausal women with low bone mass who may or may not be on antiresorptive bone medication: The MEDEX-OP trial	2017	Australia	Randomized controlled trial	45 years postmenopausal women (>=5 years) - Low bone mass (BMD > 1 SD below the age-matched mean) - Community ambulant without walking aid - Good general health - Taking antiresorptive agents	160	High-intensity progressive resistance and impact loading exercise program	8 months	Primary outcome: Change in areal bone mineral density (BMD) of the total hip (DXA) and lumbar spine. Secondary: BMC at the total hip, BMC Areal Bone Mineral Density (aBMD) at the femoral neck, BMC at the lumbar spine, BMD at the forearm.	Recruiting
12	CTRI/ India	Effectiveness of structured exercise-based rehabilitation program on quality of life and hand function in type 2 diabetes mellitus with postmenopausal osteoporosis.	2017	India	Randomized, parallel-group, placebo-Controlled trial	40-65 years Type 2 diabetes mellitus with postmenopausal osteoporosis.	366	Structured exercises involving aerobic, weight bearing, and hand exercises will be given for three months five times a week. Control group: Routine medical care is given by the Physician.	3 months	Primary outcome: Bone mineral density Level of physical activity Shoulder range of motion. Grip strength Pinch strength Michigan Hand outcome Questionnaire (MHQ) upper extremity function. Quality of life Secondary outcome: Michigan hand outcome Questionnaire (MHQ) upper extremity function	Recruiting

Table 1 Cont...

Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
13	ChiCTR-INR/ China	The study of the clinical effect of appropriate technology 'Wu xing Jian Gu Exercise' on osteoporosis.	2016	China	Interventional study	To meet the WHO diagnostic criteria for osteoporosis, aged 60 to 75 years. - Did not find the tumour or accept the relevant treatment within five years. - Did not use drugs that affect bone metabolism.	194	"Wu Xing Jian Gu Exercise" (It is the Chinese form of exercise which includes five elements)	2 yrs	Bone biochemistry BMD	Not yet recruiting No updates
14	ChiCTR/ China	Effect of different exercise modes on bone mineral density in postmenopausal women with severe osteoporosis.	2016	China	Interventional study	Females within 10 years after menopause aged 50-70 years old; total bone mass decreased by more than 37% or T value of small -2.5.	100	Double leg jump training, stride jump of the way. Each jumping form repeated jumps 8-15 times in a row, enough rest between the groups, five groups. Use of perceived exertion level table (RPE) monitor exercise intensity and be controlled at RPE 13-15 points.	1 yr	Primary: Bone mineral density PINP S-CTX Athletic ability	Recruiting
15	JPRN-UMIN/ Japan	Effect of exercise on low back pain from osteoporosis and sarcopenia.	2015	Japan	Randomized control trial	Men and women 50-90 years old osteoporosis patients. In DXA, bone density YAM is less than 80% in either the lumbar spine or femur. - Patients that meet the definition of sarcopenia, who have muscle mass reduction.	72	Intervention: Drug therapy (bisphosphonate, vitamin D3) with exercise. Control: Drug therapy (bisphosphonate, vitamin D3) without exercise	Not clear	Primary: The transition of low back pain by numerical rating scale Secondary: - Bone density, muscle mass, muscle strength, changes in the body's ability. - Changes in intramuscular fat degeneration. - Changes in bone metabolism markers. - Trends of low back pain (JOABPEQ).	Preinitiation/Pending

Table 1 Cont...
Summary of Ongoing Trials Registered in Various Databases

Sl No	Database	Scientific title	Year of Registn	Country	Design	Inclusion criteria	Sample size	Intervention	Duration	Outcome	Status
16	ACTRN/ Australia	A semi-blind, block-randomized clinical trial investigating the effects of low-intensity whole-body vibration (WBV) with or without exercise on risk factors for hip fracture in postmenopausal women.	2015	Australia	Randomized controlled trial.	Women 60 years - at least five-year post-menopause - with low bone mineral density (hip BMD t score less than or equal to -1.0) - with or without anti-absorptive osteoporosis drug with no plans to change therapy for the next 21 months.	428	Intervention arm 1: Participants will stand on the 30 Hz WBV device installed in their home for 10 minutes five days per week for nine months. Compliance is recorded by the device. Arm 2 HiRIT + WBV: Participants will stand on the WBV device installed in their home for ten minutes five days per week for nine months and attend Griffith University for a 30-minute high-intensity resistance and impact training (HiRIT) session, supervised by a trained exercise physiologist or exercise scientist, twice per week for nine months.	21 months	Bone mineral density (BMD) of the left femoral neck	Recruiting
17	ClinicalTrials.gov	Effects of exercise on fracture risk, bone mineral density and falls in postmenopausal women. A 16-year follow-up of the Erlangen fitness and prevention study.	2010	Germany	Non-randomized Intervention model.	48 years and older	50	Physical exercise Two sessions/week, 50 weeks/year over 12 years of high-intensity exercise training.	16 yrs	overall-fractures Bone mineral density at lumbar spine and proximal femur. Secondary: Ten-year coronary heart disease. Metabolic syndrome Z-score.	Active, not recruiting

more study findings are required to ensure the ideal amount of exercise to improve skeletally or to prevent complications such as a fracture (Bittar et al., 2021).

Although exercises are shown to be effective in reversing bone loss, it depends on the individual characteristics of patients with osteoporosis. The quantum of loads of exercise on the skeleton should be chosen with caution. The age-related bone fragility may be avoided with the proper load. There is a need for good evidence to recommend exercise for the therapist (Russo, 2009). However, as per our review, there were only a minimum of 17 trials identified from different countries

Future recommendations for research

In the context of the comprehensive management of osteoporosis, there have been quite a few studies that have been registered across the globe for evidence on the impact of exercises. Such registered trials are also encouraging and triggering in escalating the research in the area covering the quantum, duration, pattern, and exercise frequency. It had extended the avenues for extensive research to benefit therapists and patients. This review report of ongoing trials envisages a forum for multi-centric collaborative research as well as for conjugating the various exercise systems.

Strengths and limitations

This review gives an overall idea about the quantity of the ongoing randomized control trials in the area of exercise, yoga, and physical activity on osteoporosis. Vigorous search methods were included to search the registry. Also, it provides the base for furthermore systematic reviews in this area.

The trials included were registered in the trial registry from the very recent year of 2008. Many trials were registered prospectively, and some have registered retrospectively which may provide varied information after the completion of the study. The review might have missed some of the studies, which were conducted before the mandate for registration. Some authors may not update the status of the study in the trial registry, which would have an impact on accurate data.

Conclusion

The present review of ongoing clinical trials provided information to support existing evidence on several current forward-looking initiatives. The number of trials in this area is only satisfactory. Many non-randomized trials have, however, also been registered. Further, many studies have been combined with other treatment modalities, so it may be difficult to establish the relationship of exercise with osteoporosis. More studies need to focus on the type, duration, and frequency of exercises for postmenopausal osteoporotic patients.

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