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AN APPRAISAL ON PRESERVING POSTMENOPAUSAL QUALITY OF LIFE USING VARIOUS EXERCISES: A PARADIGM SHIFT

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ABSTRACT

BACKGROUND
Menopause is the cessation of ovarian function that mainly leads to osteoporosis. Osteoporosis (OP) initially manifests by presenting pain that leads to reduced mobility and increase risk of stress fracture.

OBJECTIVE
To compare the effects of widely suggested initial non pharmacological treatment including various exercises on acquiring post-menopausal quality of life (QoL).

DATA SOURCES
The articles were accessed through the Google Scholar, Research gate, PubMed and Science direct that includes Randomized Controlled Trials (RCT).

STUDY SELECTION
Data included from 2000-2016, females travailed from postmenopausal pains, fractures and limited functioning.

RESULTS
20 studies fulfilled the criteria required for this review and hence 1796 participants included, out of them 139 females received anaerobic exercise, 699 received aerobics and balance training while 451 did not perform any exercise. Anaerobic activity delivered extreme value in growing bone density (BMD), muscle bulk over and above lessening the threat of stress fractures, despite a fact that equilibrium exercises enhance kinesis.

LIMITATIONS
RCTs used different outcome measurement tools. Multiple accessible RCTs with results of individual item of scales are negligible as no single study catered all the parameters.

CONCLUSION
Effect of exercises on postmenopausal QoL is significant from selected studies. As exercises help in reduction of pains leading to functional mobility and improve confidence of females hence increase
morbidity.

KEYWORDS
Osteoporosis, Fractures, Pain, Post-menopause, Quality of Life (QoL), Activities of Daily Living (ADL), Exercises

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INTRODUCTION

The axiom 'paradigm shift' was first coined by Thomas Kuhn in his exceedingly influential book titled The Structure of Scientific Revolutions. The word paradigm elucidates perception, assumption, theory, model or frame of reference. At any point of time the experience of paradigm shift helps individuals in seeing things by entirely different and new perspective and comprehends that the previous thinking style was incorrect or incomplete[1]. At hand numerous paradigm shifts are there for postmenopausal pains, fractures and activity limitations because of osteoporosis but none more important than that is the use of exercise[1].

Osteoporosis (OP) is a condition which weakens bones and there is an amplified peril of fractures. Fractures severely affect the quality of life causing extreme long-lasting pain and affect structures like ligaments and tendons[2].

Osteoporosis is a worldwide issue for healthcare industry; meanwhile proximately 200 million individuals are affected with this ailment globally. In 2014 its' estimated prevalence in USA was 14 million people3. According to the recent estimates, amount of individuals devouring Osteoporosis is doing to increase drastically to over 200 million. While, the hip fracture cases are expected to escalate up to 240% by 2050, as compared to the ones in 1990. The major problem caused by osteoporosis is the anxiety of fractures: annually, around 8.9 million fractures are triggered by this disease[4] .

Pharmacological interventions as the practice of consuming anti restorative and anabolic agents including: estrogens, a selective estrogen receptor modulator (SERM), bisphosphonates, and calcitonin because they boost bone density (BMD) in addition drop off risks for osteoporotic fractures but on the other hand the cost and adverse effects carried by such drugs cannot be neglected that include headache, anorexia, vertigo, diarrhea, edema and skin rashes.

While, there is still a possibility of introducing physical exercises to the manifestation of the disease and it might pave way to a healthy lifestyle5. Bone tissue is extremely dynamic in its ability to remodel, responding to various stimuli including exercise and vibration[5]. Therefore, it can be understood how physical activity would support and improve the bone form [6,7]. But according to principle of individuality, except for identical twins, no two people have the same characteristics and they unlikely shows precisely the same response.

The greatest value of exercise as a preventive & treatment strategy is that it is somewhat in expensive, non-invasive. The most important consideration in designing exercise includes the mode, frequency, duration, intensity and progression of activity. As low impact activities are recommended initially with gradual inclusion of vigorous exercises as tolerated. Swimming, walking or exercise cycling were the earliest opportunity and the frequency was also in variation in every study. Thus regular exercise is a powerful method of counteracting the decline in peak aerobic power, muscle strength and flexibility that otherwise progressively limits the independence of the elderly person. Moderate physical activity is pleasant and safe form of treatment for most seniors, with affirmative upshot on voluminous facets of health. In general, older adults should be encouraged to make moderate exercises in their habitual activity without excessive preliminary testing and detailed exercise program. All the types of exercises were incorporated including whole body vibrations.

Resistance exercises are such physical activities that are intended to advance muscle asset, power, and endurance. On contrary, one study discussed effect of brisk walking with resistance conveyed; it

lays substantial loads on skeleton throughout a work out session, which escalate BMD8. One study conducted on elderly females also reported positive effect of exercises on body composition[9] . The workout prescribed amount in resistance exercise drill, explained by the

degree of repetitions and resistance, measured by workouts, amount of sets completed as well as stretch of the resistance drill programs. Along with these, the use of machines, elastic belts, dumbbells, and weighted vests are all a part of exercises.

Whole body vibration (WBV) another variety of workout progressively more established for the capability to inhibit muscular atrophy, bone fractures, and osteoporosis[10].

As compared to the traditional training practices, it requires a reduced amount of time and, consequently, it can be projected to gain advanced amenableness in formerly inactive patients [11,12]. In WBV training, the subject positions on a platform that spawns vibrations of definite frequency and amplitude. They are at that juncture transferred to the body where the sensory receptors are stimulated (most likely muscle spindles) and so amplify the drive to alpha motor neurons (motor units) via the monosynaptic stretch reflex, and therefore pledge muscle contractions. A further reduction in physical activity is brought about by a desk-bound lifestyle and if the same continues, it will develop into a cascade of bone forfeiture. The prominence of physical pursuits is very well known to all but what is missing, is the proper guidelines for the type of exercises and their duration.

Vibration is said to be the most common causative factor of low back pain and several musculoskeletal and neurovestibular complications. Recent study specified that extremely truncated mechanical signs applied in the direction of the bone can cause insufficient array of frequency. vibration can be applied as a non-pharmacological interpolation to avoid or to converse bone loss if the mechanical indications are noninvasively and commendably delivered on the human skeleton to reach the sites with the greatest risk of osteoporosis for example lumbar spine[13].

Aerobic training can swiftly cause an individual out of breath, similar to sprinting or bracing a heavy weight. Illustrations of aerobic exercises are cardio machines, spinning, running, walking, hiking, dancing, kickboxing, swimming, etc. Its focal perseverance is to provide strength to the heart and lungs, and all supplementary musculatures contained by the body. The major arising problem is that the aerobic training correspondences to all the fore mentioned activities. Load comportment and resistance aerobic workout are advocated for persons with OP, as they intensify muscle bulk and bone concreteness, also tumble the chance of fractures[14]. Aerobic activities can be reflected through Gymnastics and dancing, and despite the fact they magnify muscular activity they are concomitant with advanced BMD merely at tibia [15,16].

The main aim of these exercises is to enhance leg muscles helping patients to have a steady walk. Hence it promotes greater mobility and better balance. Rendering to Canada's Physical Activity Guide, altogether every grownup has to go through an intense aerobic workout for a minimum 30 minutes 5 days in a week. A superfluous time of workout for women can lead to 0.8% upsurge in hip BMD, and 7%–8% upsurge in peak BMD outcomes and hence 50% lessening to fracture risk[17]. Ever since there is certainly no prime exercise stratagem, a multimodal workout package integrating majority of the fore mentioned strategies can be implemented, flexible exercise sequencers can lead to truncated ordeal fracture efficiency[18].

METHODOLOGY

Data Sources and Search Strategy

The literature was reconnoitered by using Google Scholar and Research gate. The initial search was done by using keywords of exercise, osteoporosis, postmenopausal. The articles were regained from Google Scholar, research gate, Science direct and PubMed. Literature was examined from 2000 to 2016. PRISMA (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) guidelines were used.

Study Selection and Data Extraction

Literature that was searched was filtered by setting the time range. Data fitted from 2000 to 2016 were counted in. Eligibility criteria for the studies that were
to be incorporated in this review were Randomized Controlled Trials (RCT) for postmenopausal females affected from osteoporosis. It counted in those studies that cover physical activities as a part of
rehabilitation program. However, all types of exercises were the main focus among all studies. RCTs associating categories of exercise techniques, in that aerobics, with or without loading and anaerobic. The RCTs that compared exercises group with
control group were also considered. Detailed studies were addressed rather than summary of the articles. The quality of life was evaluated through functional goals, activities of daily living, postural control, pain free physical mobility, and social interaction. Therefore, our outcome measures of interest were quality of movement, functional independence, activities of daily living, social interaction, assessment time or follow up can be varied in studies, such as 2 months to 10 years follow up studies. DXA (dual-energy x-ray absorptiometry) and QUS (quantitative ultrasound) were used to assess bone mineral density before and after the intervention.

Quality Appraisal

Reviewers analyze the quality of data and risk of bias. They assessed the source of article, patient blindness, dropouts and intervention details.

Statistical Analysis

This systematic review was conducted to compare the outcomes postmenopausal QoL using various exercises by finding various articles online, reviewing those articles and reviews possess key words
exercise, osteoporosis, postmenopausal.

RESULTS

Study Selection

Initially 11,000 studies appeared in the internet search using keywords of exercise, osteoporosis, postmenopausal, Quality of Life, fall, fractures and pain by using the filter of time and 2435 articles from 2000 till 2016. This search was further narrow down by focusing on outcome measures, such as postmenopausal females, quality of movement, activities of daily living, and types of aerobic and aerobic exercises. The available data having any of these outcome measures was found 1800. This
review included only Randomized Control Trial (RCT), there were 808 citations. After thorough review the extraneous researches were disqualified to be a part of this review. Researches that established to be pertinent for this review but the unavailability of their full text were also excluded. 27 full texts were selected as a suitable material for this review. After deleting repetitive searches total 20 studies were qualified to be part of this review. Summary of study selection is shown in Figure 1.

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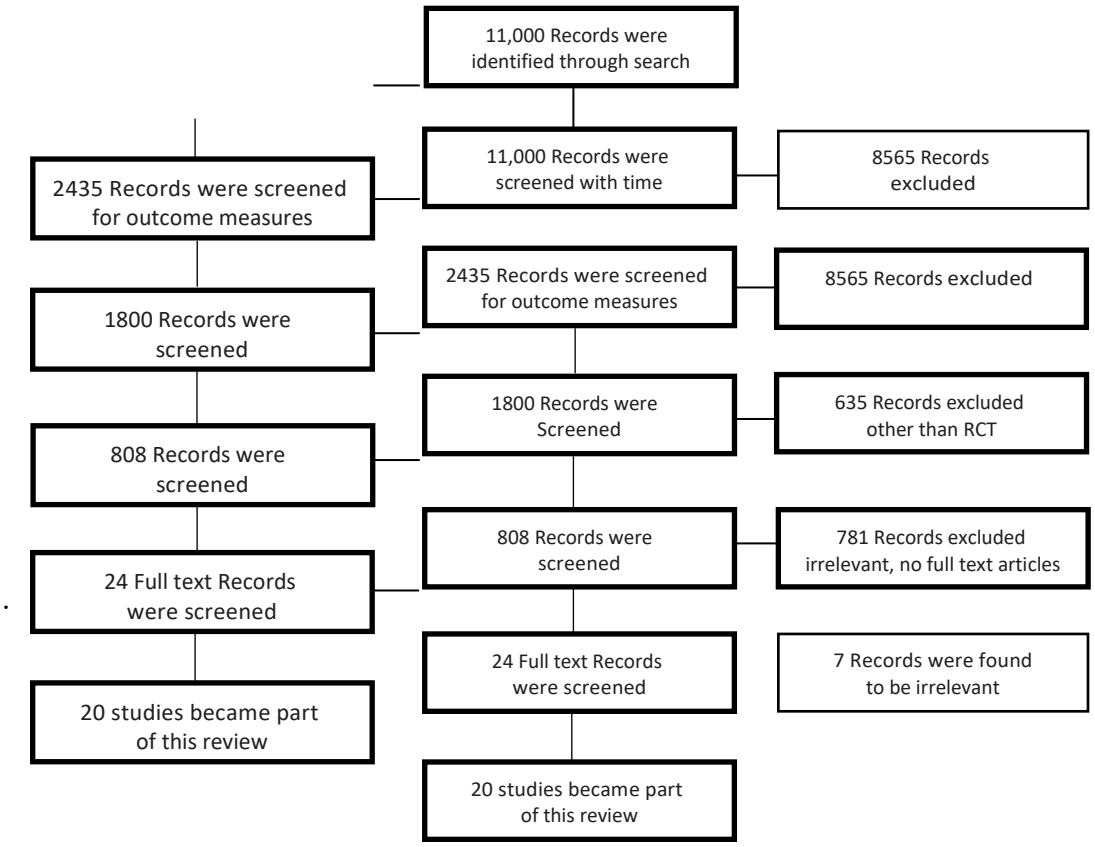
Figure 1: Study Selection



Study Characteristics

Study characteristics consist of participants' individuality, interventions and outcome measures are described in Table.

Participants' Characteristics

All the selected 20 studies were conducted on postmenopausal females. This reviewincluded1796 participants, 139 females out of them went through anaerobic exercise, 699 were among pure exercise group included aerobics and balance training.

The training which helped the most in enhancing the bone mineral density range along with decreases the fractures chances with improved mobility are
great intensity, strength training with resistance. On the other hand, high intensity exercises did not worsen the fractures.

When during exercises vitamin D and calcium doses were used as a single interventions, they had very limited effect.

Intervention

Different types of exercies including aerobics and anaerobics along with balance exercises.

Measuring Tools

DEXA, QoL: EQ-5D, dynamometer, treadmill, QCT, pain scale, sit and reach test, quantitative ultrasound (QUS), near tandem stand (NTS) and stair-excursion (SE) test for various parameters used
in this review.

Outcome Measures

Different outcome measures were used in the selected studies, including bone mineral density that was measured through DEXA, QUS, BMI, etc.

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A person's health can be improved drastically by consistent corporeal commotions. Also, it can augment musculoskeletal fitness in addition to reducing the risk of serious diseases[19]. As mentioned earlier, "Many healthy elderly people may be at or near the functional threshold for dependence, wherein they are in jeopardy of losing the capacity to carry out the activities of daily living. With further worsening of musculoskeletal fitness, an individual may lose the capacity to perform daily activities, such as getting out of a chair or climbing stairs." Hence it is a complete cycle. If the musculoskeletal fitness is reduced, it will lead to the inactivity[19]. Severe diseases can be decreased through improving the musculoskeletal function. It will further help in delaying any disability and hence dependence[20.] Another crucial point is that high muscular strength results in very little dependence [21,22]. It is also revealed through two different systematic reviews that the functional dependence, mobility, bone health, psychological improvement and complete quality of life can be improved by the improvement in musculoskeletal fitness. While on the other hand, it has hostile effects on the health. So, it is very essential to maintain the functional status. For this reason, physical exercise involving resistance drill and flexibility activities are performed bare minimum twice a week[23].

DISCUSSION

Regular vigorous exercise requires to strengthening of bone health. According to the analysis exercises help in maintaining mobility, BMD, physicality and the strength training[14]. Balanced and intense exercise has a very positive relationship, peak BMD[17]. When the intense strength training is performed twice a week, it helps in preserving bone muscle, according to one RCT.

Moreover, it helps in enhancing the muscle strength and balance in postmenopausal women[24].

For deduction in fractures the falls should be prevented, and balance must be improved through balance exercises. It is seen that when this program included balance and lower-body strength training, it reduced almost 40% hip fractures[25]. It was also suggested by a ten-year follow-up study that a low-intensity program can cause a decrease fractures[26]. Although most of the postmenopausal females have insecurity that osteoporosis may increase the risk of fractures[27].

Exercises also helped to decrease the negative feelings in osteoporotic females.

It is also found that patients who had experienced osteoporotic fractures in the past had a negligible risk of falling and its fear and the fractures linked with it[28].

According to one study, exercises can also produce an increase in wrist fractures[29].

It is surprising that it does not add to the risk of fractures in any other body parts as well as end up in delaying fractures in various different body parts[28]. Additionally, it was found that moderate

intensity activities reduces risk of fractures [30,31].

Four important types of exercises are highlighted by the Osteoporosis Canada: strength, postural, balance, and aerobic training.

The most effective training was strength training which is also known as resistance training[32]. Through strength training, it is expected that people will lose muscle mass between 50% and 55 % by age 70 and might also result in improving BMD[33,34].

The menace of fractures will be diminished by increasing BMD in the hip.

The back-strengthening exercises reduced the chances of fracture in postmenopausal women as compared to the control group[26]. Whereas, it was also found that the exercises lowered the risk of spinal fractures[35]. The best exercise for improving BMD for the neck of femur is Progressive resistive strength training36. While, in this category walking was also included. It was found through the data that walking helps in reducing bone resorption in old women[31].There is least risk in walking and therefore it is recommended. A crucial point to note is that walking cannot replace the strength training exercises. Postural training is very important as it helps in reducing the risk of stress fracture after decreasing the spinal load and its basic aim is to make the muscles strong with the back and hip. This training prevents fractures by improving the posture of spine so avoiding fractures due to minor twisting of vertebrae[37]. The combination of high velocity resistance training and challenging movement and balance shows a considerable gain in bone mass, density of femoral neck as well as lumber spine. Hence it is a great tactic to improve numerous musculoskeletal and functional performance trials in elderly people who are in peril[29].

The people who do not have any previous habit of exercise show considerable after effects of post-menopause and their osteoporotic condition does not show much improvement. According to the research, the high-stress and weight bearing exercises show considerable increase in peak bone mass[38]. It is however seen that after the menopause there will be a decrease in the bone mass density, even while exercising[39]. Another observation shows that muscle mass quickly decreases in osteoporotic adults.

Due to all these reasons, it is extremely important for all the adults to exercise regularly to be able to fight against all the diseases. One hindrance towards exercise is that the osteoporotic symptoms are missing. Very few signs are found including loss of the height and back pain. Therefore, it is very complicated. OP is also diagnosed after a fracture and that is a chronic stage when the recovery becomes impossible. A hip fracture depicts a very critical case where the mortality rate is 40% within a year while still being in the long-term care (LTC). Also, at least 10% fractured again and only 40% patients could return to their previous life after the fracture[40].

It is hence seen that the only possible intervention is exercise on a regular basis. It will help in getting rid of the progression of OP[41]. It is very interesting that through a single intervention of exercise, far negative results are produces, according to one RCT[42]. It is also suggested that along with exercise, patients should also devour calcium and vitamin D supplements aimed at improving bone healthiness. The function of calcium and vitamin D is maintaining and protecting bones and allowing body to absorb stored calcium[43].

The amount of vitamin D supplements to be consumed daily is 800 to 2000 IU, according to Osteoporosis Canada. It is for those adults who are over fifty years. These adults should also be at elevated risk of fracture and also have vitamin D deficiency. While, the younger adults require 400 IU vitamin D supplements every day16. Many side effects are seen if consumption exceeds over 2,000 IU in any age. These may possibly consist of dermal reactions, drowsiness, nausea, vomiting, and variations in blood sugar levels and blood pressure[44]. Cardiovascular system can potentially be impacted by scarcity or abundance of Vitamin D[45,46].

OP Canada has recommended the number of dietary supplements for adults over 50 years i.e. three portions of dairy goods that is comparable to 1,200 mg of elementary calcium, whilst adults less than 50 years can consume bear minimum two portions as the main reason being that the body does not produce calcium naturally. It is suggested that the high-risk individual should take 500 mg of calcium daily in case they are unable to meet the calcium requirement[16]. Similarly, there should be enough intake of vitamin D as well, since calcium being capable of founding kidney stones, tiredness, depression, and hypercalcemia[47]. Despite the fact that the Scientific Advisory Council of OP Canada recommends supplements

consumption on a daily basis intended for individuals who are at greater threat of fracture, various foundations claim that its consumption should not be in the absence of any other type of intervention48. Calcium concomitants also go in vain after consuming as a chief agent in opposition to OP and fractures; in addition to that it provided minimum evidences in amelioration to BMD. It contributes in the cardiovascular incidences for instance myocardial infarction, and stroke in exceptional circumstances, however these are being signified by inadequate verifications[49].

The risk of cardiovascular events may be increased by calcium supplements due to vascular insufficiencies such was suggested by an RCT done by NIHAARP in 2013. It was most likely stemmed from

vascular calcification took place by the synthetic ingestion50. Many researches like a meta-analysis done in 2015 about postmenopausal women, established no association.

It is seen that the calcium consumed all the way through natural resources has a converse association with cardiovascular ailments and further blood turmoil. Another meta-analysis in 2016 found 9% reduction in stroke threat for each 200 g of natural dairy consumption per diem[51,52]. As a consequence, better nutritional calcium ingestion is appreciated on calcium adjuncts. Calcium not only improves bone health, but also helps in muscle contraction and is continuously used while exercising[43]. A problem faced by the patients with OP after exercise is that to compensate for the loss of calcium, more calcium is released by the bones, hence the level of BMD if further lowered53.

The individuals performing exercise depict a drastic improvement in the quality of life along with the realms of physical function, aches and vivacity. It is thus obvious that exercise has various positive effects on the quality of life. The exercise therapy can only be efficient with the compliance of enduring individuals by way of exercise regime. The implication of physical activity can therefore be understood by the fact that before time exercise intrusion shows rapid improvement as compared to the later phases. Hence, for patients with physical problems, a short exercise intervention is enough and will also help in reducing medical costs. The improvement in pain was brought about by the long-duration exercise only. Hence, the individuals with tenderness tribulations will require more time for improvement. Comparative analysis provided the evidence that physical function, pain and vitality had significant improvement in the individuals performing a variety of exercises in amalgamation. Combined work outs enhanced strength, elasticity, coordination and equilibrium; by this means drop off the risk of falling, advance endurance and perk up cardiovascular robustness[54].

Auxiliary studies possibly will be required by utilizing questionnaire that is disease-specific (such as the Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO) to gauge the consequences of diverse sorts of workout on quality of life among elderly females. The recommendations on exercise protocol were not standardized in these studies as it accommodated only high-quality investigations. It is also seen that exercise is always helpful for improving the condition of the patients with osteoporosis. The exercise interventions not only help in improving the bone health but in addition progress physical function and vitality domains of quality of life. Psychological domains are also as important as the physical health and both domains should be improved in future. Physical activity is very helpful in reducing the peril aspects of unrelieved disease and disability[55].

Cumulative evidences suggest advancement in collective well-being eminence and a decline in threat of long-lasting ailment and debility due to boosted musculoskeletal fitness56. Enhancements in musculoskeletal function have colossal latency for adjourning the commencement of debility, dependence and protracted disease56. Aforementioned longitudinal studies revealed that individuals with eminent intensities of muscular strength

have rarer functional limitations[57]. According to the two recent systematic reviews, the improved musculoskeletal fitness helps with functional objectivity, kinesis, glucose homeostasis, bone health, psychological prosperity and gross quality of life. It also has deleterious effects on the peril of falls, ailment and untimely death. Intrusions that progress musculoskeletal aptness are predominantly imperative for cultivating

the health statuses of elderly individuals with a low musculoskeletal reserve. This study provides prominence of incriminating in accomplishments that boost the musculoskeletal system and is complemented by way of outcomes from current epidemiologic investigation[22]. This evidence based study is responsible for unswerving sustenance to the contemporary commendations that resistance working out and flexibility drills are implemented at minimum twice in a week for the up keeping functional eminence, promote ultimate physical commotion and augment overall quality of life[57].

CONCLUSION

Effect of exercises on postmenopausal Quality of Life is significant from elected studies, after assessing bone mineral density most preferably through DEXA.

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Author's Name	Study Design/ Sample Size	Treatment Frequency/ Duration of Study	Mean Age	Measuring Tool	Outcome Measures	Result
Zaki ME[4]. 2014	RCT 80	Exercise group (EG): 40 resistive training, 3 days/week. Whole body vibration (WBV) group: 20 minutes/3 days /week. Duration: 8 months	WBV group: 57.34+5.3 years, Resistance exercise: 56.95+4.1 years	DEXA	Anabolic to bone, increase BMD.	BMI and waist/hip ratio high. Significant associations between physical activity duration and BMD at all sites.
RoghaniT, et al[14]. 2012	RCT 36	Aerobic group: 12 treadmill 30min/day, 3 days/week for 6 weeks. Weighted vest group: 12 aerobic plus wore the vest (weight: 4-8& body weight). Control group: 12	45-65 years	BMI, Body fat Caliper, Serum BALP and NTX:(ELISA) Balance test: (NTS) near tandem stand and (SE) stairexcursion test.	Increase BMD, Enhances osteoblastic activity and reduces osteoclastic activity.	Weighted -vest group: ? Fat(p=0.01), lean mass significantly increased (p=0.005), NTS score? (104.66% after 6 weeks) and BALP? (p B 0.05) Aerobic group: BALP? (p B 0.05). After 6 weeks: exercise group: NTS score? (49.68%) Control group: NTS score? (28.96%)
Brill PA et al[57]. 2000	RCT 50	Resistive training group: 25 Aerobic exercise training group: 25 3 days/ week for 6 months	50-58 years	DEXA	Increase BMD	Mean values of BMD, (Ca) serum calcium and (PTH) parathynoid hormone significantly? in both groups.

						Similarly, changes in group (A)> group (B)
Verschueren SM, et al 11. 2003	RCT 70	Whole body vibration group: 25 Resistance training group: 22 Control group: 23 3 days/week for 24 weeks	58-74	Bone density: DXA, Isometric and dynamic strength: dynamomete	WBC training is an effective approach to change the well known risk factors of falls and fractures in older women	? in isometrci (+15%) and dynamic muscle strength (+16%) p<0.01. BMD of the significantly increased (+0.93%, p<0.05). Women enrolled in resistance training or age matched controls had no significant changes in BMD of hip (-0.60% and -0.62% respectively).
Thiem U, et al43. 2014	Cross sectional 196	7 years follow up	> 65 years	Qo'L: EQ-SD	Falls. Fracture Pain	lncrease numbers of fractures because of fear of fall and poor balance
Kemmler W. et al41. 2004	RCT 50 ([EG]), 33 control group (CG)	Exercise Eroup:50 Group training: 2 sessions/week home training: 2 sessions/week Control group: 33	48-60 years	Isometric strength: dynamomet er Endurance: treadmill (BMD): DXA, QCT, Pain: pain scale	Pain reduced Functional mobility increased	Significant change in bone mass from baseline Significant change in pain levels
Chien M Y, et al1. 2000	RCT EG: 22 CG: 22	Exercise Group: 22 Treadmill: intensity> 70% of (VO2max) maximal oxygen consumption (30 minutes)	48-65 years	Physical fitness: sit and reach test	For osteopenic postmenopausal women, aerobics with intense workout	Exercise Group: Significant 7 in Quadriceps strength, VO2max

		stepping exercise: after treadmill, a 20 cm-high bench is used for 10 minutes (3 times/week) Duration: 24 weeks Control group: 22			(moderate intensity) was effective.	and muscular endurance. BMD of the L2-L4: 2.0% (P>0.05) BMD of femoral neck 6.8% (P<0.05) Control group: ? in, BMD of the L2-L4: 2.3% (P<0.05) BMD of femoral neck 1.5% (P>0.05)
Burge R, et al[3]. 2007	RCT 112	30-minute fact walk 3 days/week 60 minute training 2 days/week for 1 year	45-65 years	BMD, DEXA	BMD increased After exercising	BMD training group: + 0.005g/cm2 (+0.018),+0.58% Control group: ? -0.003g/cm2(+0.019), -0.36%,)p=0.041). In postmenopausal women (low BMD) there is a positive effect of physical exercise on BMD of hip.
Moreira LD, et al[7]. 2013	RCT 108	Aquatic Exercise Group: 64 24 weeks sessions Control Group: 44	58.8 years	Flexibility: Wells' Sit and Reach Test (FLEX); static balance: the Unipedal Stance Test (UST); mobility, the Timed-Up-and-Go	Balance increased in the AEG, number of falls decreased	Vitamin-D significantly ? in, Control Group 21% Exercise Group 23% Decline in, number of falls (2.00 to 0.29, P< 0.0001), number of fallers 44% (P<0.0001)

				test (TUG); maximal isometric strength of back extensor (SBE), hip flexor (SHF), and knee extensor (SKE).		

Author's Name	Study Design/ Sample Size	Treatment Frequency/ Duration of Study	Mean Age	Measuring Tool	Outcome Measures	Result
Engelke M, et al[16]. 2006	RCT 50	Exercise group: 30 group training: 2 sessions/week home training: 2 sessions/week Control Group: 20	55.1+3.3 years	BMD: DEXA, quantitative ultrasound (QUS) Questionnaire for gauging the Pain intensity and frequence on different skeletal regions	BMD increased	DXA lumbar spine, Exercise Group: 0.8% Control Group: -3.3% P<0.001. QCT trabecular ROI, EG: 1.1% CG: -7.7% P<0.001. QCT cortical ROI, EG: 5.3% P<0.001 CG: -2.6% P<0.001 DXA total hip: EG: -0.2% CG -1.9%,P<0.001 DXA distal forearm, EG:

						-2.8% P<0.001 CG: -3.8% P<0.001 BUA, EG: -0.3% CG - 5.4% P<0.001 SOS, EG: 0.3% CG - 1.0% P<0.001 At year 3 (between-group differences compared with exercise group) DXA lumbar spine: 4.1%P<0.001. QCT trabecular ROI: 8.8% P<0.001
Asikalnen TM, et al[8]. 2006	RCT 134	Continuous Exercise group: 45 Fractionated Into 2 daily bout 45 For 15 weeks Control Group: 42	50-60 years	Questionnair, interviews, and training logs	Ambulatlon and muscle strength escalate	Significant improvement in muscle strength of lower extremity.
King M. et el[44] 2000	RCT 103	strengthening and endurance exercises: 51 flexibility and stretching exercises:52	65 years	SeIf assesed physical performance. observed functioning and well-being	greater improvements in flexibility	Fit & Firm subjects: Improvements in strength and endurance compared to Stretch & Flex subjects. Stretch & Flex subjects: greater improvements in bodily pain.

Olsen CF et al[14]. 2014	RCT 89	Interventlon group: 47 group-based circuit exercise program: 3-month educational session: 3-hr Control group: 42	65 years	Falls Efficacy scale - (FES-I)	Intervention had a positive and strong effect on fear of falling as measured with the FES-1	IT group had significant result at both follow-ups in comparison with the CT group. 3 months follow up (p?=0.004), effect size (0.4). 12 months follow-up (p?=0.001). effect size (0.7). The effect of the Intervention were established by multiple regression analysis\
Smulders E, et al[24]. 2010	RCT 96	Participated in the NFPP: 50 Control Group: 46	65-70 years	Activity-specific Balance Confidence Scale, quality of life (QOL), (Questionnaire of the European Foundation for Osteoporosis), and activity level (LASA) Physical Activity Questionnair. pedometer.	lmproving balance confidence and reducing number of falls, NFPP was effective.	Exercise group: Fall rate (39%) < control group Balance confidence ? 13.9% (P=.001). QOL and activity levels had no difference in both group.
Romero-Franco N, et al	RCT 118	BMD > -2.0 SD: 95 BMD = -2.0 SD :23	50-65 year	Resistive multi-sensor platform. fear of falling	BMD = 2 .0SD is significantly associated with	Women with BMO =-2 .0SD reported a sicnificantly increased

14 . 20 14				(FoF) and the history of falls in the last 12 months were investigated.	postural instability	FoF when compnred to women with BMD>-2.0SO (P:0.024, n2=0.045. 1-B=0.624)
Marques EA. et al[53]. 2011.	RCT 49	ET group: 27 Control group: 22 2 days a week for 8 months	60 years	BMD: DEXA, muscle strength, balance, handgrip strength, walking performance, fat mass and anthropometric data.	In older women, the impending risk factors for falls and fractures can be reduced from multicomp- onent exercises and moderate- impact weight bearing exercises.	ET group: ? in fat mass. ? in Handgrip strength, strength on knee flexion at 180O/s BMD at femoral neck (+2.8%).
Sinaki M, et at[26]. 2002	RCT 50	Exercise Group: 27 Control Group: 23	58-75 years	BMD: spine radiographs, back extensor strength	In estrogendeficient women, strong back muscles can reduce vertebral fractures.	At 10 year follow-up: difference between the two groups was statistically significant (p=0.001)
Iwamoto J, et al[27]. 2004	RCT 25	Dynamic balance training: 1 day/week. Daily static balance and resistance training: 3 months	61-85 years	static balance and resistance	In elderly women, exercise program may promote ambulatory competency	Significant? in knee extensor muscle strength, step length and maximum standing time on one leg. No significant change in hip flexor muscle strength and walking speed.
Glenoudis J, et al[29]. 2014	RCT 162	Osteoporosis education/awareness and behavioral change program: 81	60 years	BMD using(DXA), falls risk assessment. Muscle	Musculoskeletal and functional performance	Exercise group: BMD of lumbar spine 0.971>0.135

		Standard care self management control group: 81 3 days a week for 12 months		function, Sit-to-Stand, Four Square Step Test, Timed Up and Go test.	enhancement in adults (fall risk or low BMD)	BMD of femoral neck 0.730>0.031 Muscle function: Sit-to-Stand test 14.5>3.5 Four Square Step Test: 8.1>1.4 Timed up and Go Test: 10.2>1.2 Control Group: BMD of lumbar spine 0.968>0.145 BMD of femoral neck 0.713>0.082 Muscle function: Sit-to-Stand test 14.9>3.0 Four Square Step Test: 8.0>1.2 Timed up and Go Test: 9.8>3.2
El Mohsen AM, et al56. 2016	RCT 24	Experimental group: 12 Control group: 12 5 times/week for six weeks	50-60 years	isokinetic peak torque for both groups (before and after six weeks of program): Biodex System 3 isokinetic dynamometer Balance for both groups: Berg Balance Scale	The effect of the Weight bearing Exercises was assessed for Better Balance in osteopenia	In experimental group, mean values of all measured variables post-intervention significantly? in comparison with preintervention mean values. Satistically significant? in mean values (post intervention) of

						all measured variables excluding those of the hip extensors in the experimental group in comparison with the control group.

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