

Case Report

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Role of Complementary and Alternative Therapies to Reduce Morbidity in Oestrogen Deficiency Associated Osteoporosis: A Review



Kaveri Kuttappa^{1*}, Amulya Cherukumudi² and Roopa Mahinder

¹Ayurveda Specialist, Wellbeing Multispecialty Clinic, India

²General Physician, Wellbeing Multispecialty Clinic, India

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***Corresponding author:** Kaveri Kuttappa, Ayurveda Specialist, Wellbeing Multispecialty Clinic Bangalore, India

Abstract

Objective: To review and analyze the clinical studies performed on the role of complementary and alternative medicine, individually or combined, in reducing morbidity in estrogen deficiency associated osteoporosis. The morbidity is assessed in terms of the frequency of fractures, improvement in bone marrow density (BMD) and change in bone turnover parameters.

Background: with increasing age, there is a decreased absorption and storage of vitamin D and calcium, which are essential for maintaining bone health. This condition is further worsened estrogen deficiency, as well as in postmenopausal women. When faced with such a scenario, the body resorbs calcium from the bones to overcome the loss, and causes subsequent weakening of the bones and thus, increased susceptibility to frequent fractures and decreases in bone density.

Search methods: The study is based on review of clinical studies sourced from PubMed, Medline, Cochrane Database, and Journals specific to studies related to yoga, Ayurveda and naturopathy, with correlation to Ayurveda & Modern text.

Result: 16 out of the 17 research articles that have been reviewed showed that yoga, Ayurveda and naturopathy have a positive effect on BMD, bone growth and preserving the bone architecture.

Keywords: Estrogen deficiency; Postmenopausal; Osteoporosis; Bone marrow density; Complementary medicine; Alternate medicine; Ayurveda; Yoga

Introduction

Osteoporosis, a chronic and progressive disease is one of the most common metabolic bone diseases in the geriatric age group. It is essentially a systemic skeletal disease, characterized by low bone mass, and micro architectural breakdown of bone tissue, causing decrease in bone density and increase in bone fragility. The disease often does not become clinically apparent, until a fracture occurs, usually hip fracture. The fracture is usually a result of a trivial injury, like fall during bath. Fractures caused by major trauma like road traffic accidents etc. are not considered in this group. This review is aimed at studying the effectiveness of complementary and alternative therapies (yoga, Ayurveda and naturopathy only) to reduce the incidence of fractures as well as to improve bone density in those with osteoporosis.

Review of Clinical Studies

Postmenopausal osteoporosis is a major cause of debility in elderly women, due to estrogen deficiency associated with the biological process of menopause. This reduction in bone marrow density and increase in bone turnover markers, makes postmenopausal women susceptible to fractures with trivial falls, increased morbidity and restriction of routine activities. Keeping all this in mind, and considering the parameters of the review, 17 clinical studies were identified. Of these, 5 were randomized control trials spanning across yoga and Ayurveda and naturopathy. Jasmine et al conducted a study on *Shatavari moola churna* and *Kukkutanda twak bhasma* in postmenopausal osteoporosis, concluding that *Shatavari* showed encouraging

results in improving bone metabolism and enhancing bone formation. Eleven randomized control trials, have been conducted on the use of herbal formulation; Reosto introduced by Himalaya drug company pvt ltd, performed a RCT double blinded phase III clinical trial on two sets of postmenopausal woman: 100 Reddy J, et al. [1] and 105 Dongaokar et al. [2] postmenopausal women with osteoporosis respectively. The results for both drug trials, showed a statistically significant increase in BMD, serum calcium, and serum phosphorus, with decrease in serum alkaline phosphatase, which overall helps maintain the bone architecture. Using ovariectomized mice, Sung et al. showed, that the use of *Saurures chinensis* could prevent loss of bone and maintain integrity of the bone. Using a similar study, Mitra et al. showed that OST-6(Osteocare) at the dose of 500mg/kg BW for 90 days significantly increased BMD, serum calcium and decreased urinary calcium excretion with Pyridium links. These parameters are required to assess the bone strength, the trabecular meshwork and its integrity. Another RCT study, by Aswar UM et al, separated the phytoestrogen-rich fraction (IND-HE) from aerial parts of *Cissus quadrangularis L.* and evaluated its effect on osteoporosis caused by ovariectomy in rats; IND-HE showed increased bone thickness, reduced alkaline phosphatase and prevented bone loss. A similar RCT study, by Shirwaikar et al. showed, that the ethanol extract of *Cissus quadrangularis L* on ovariectomized mice, showed a positive change in the biomechanical, biochemical, and histological parameters, concluding the anti-osteoporotic effect of the plant. Further strengthening the theory of *Cissus quadrangularis L* being anti-osteoporotic, an RCT by Potu BK et al. used petroleum ether derived extract of *Cissus quadrangularis* in ovariectomized rats to show that CQ significantly increased the thickness of both cortical and trabecular bone. In another study Shirke SS et al. used methanolic extract of *P vulgaris L* seeds on ovariectomized mice, and they observed increases in BMD, reduced bone turnover markers, increased ash density, increased bone mechanical strength, and significantly increased bone Ca. The same author of the study, involving *P vulgaris L* seeds, Shirke SS et al. also evaluated the anti-osteoporotic benefits of phytoestrogen-

rich plant *Cuminum cyminum*, commonly known as cumin, which showed greater Bhasma (coral calyx) was tested on ovariectomized mice as part of the study by Reddy PN et al. where it improved the bone density and Ca: P ratio in comparison to those mice, that were fed a calcium rich diet. After analysis of the above studies, it shows that there is scope for application of Ayurveda and naturopathy in the treatment of osteoporosis in postmenopausal women. bone and ash densities with improved microarchitecture of bone; this was comparable to osteoprotective effect of estradiol. In the study using methanol extract of *Berberis aristata* daily for 42 days, Yogesh HS et al. observed that the BMD, biochemical and histological parameters improved, pointing attention to its anti-osteoporotic benefit. There are several natural sources of calcium available, and several are being used in daily Ayurveda practice. One such source, Praval as a complement to Ayurveda and Naturopathy, yoga is always found to further the improvement of the condition in any disease. With this in view, we have tried to establish the role yoga can play, in improving the parameters in oestrogen deficiency induced osteoporosis. As observed in the randomized control trial Bezerra L et al. yoga done for 6 months, failed to improve BMD, but it did improve the bone formation markers. This, however, is contradicted by the remaining 4 studies performed to evaluate the benefit of yoga on oestrogen deficiency induced osteoporosis. In a study by Motorwala et al. performing yoga regularly for 6 months, significantly improved the BMD in postmenopausal women. On putting postmenopausal women through a 12week programme of weight bearing yoga, Phoosowan et al. observed that there was a slowing of the bone resorption, which would be beneficial in postmenopausal osteoporosis. In a study by Sangiorgio SN et al. postmenopausal women practicing and teaching Bikram yoga, were followed up for 5 years, and there was a significant improvement in the BMD. Apart from improving bone marrow density, study conducted by Tazun S et al. found, yoga to improve the pain, physical functions, and social functions, improving the overall balance in postmenopausal osteoporosis (Table 1).

Table 1: Summary of Articles considered for Review.

Study name	Study design	Method	Result	Reference
Jasmine et al	Randomized control trial	4 groups of postmenopausal women chosen, group A was given Kukkutanda twak bhasma (egg shell calcium) given Shatavari moola churna(<i>Asparagus racemos</i>) and group C was given placebo	The effect of Shatavari on Asthi Kshayatmaka lakshana was better over Kukkutanda twak bhasma and placebo. Shatavari provided encouraging results on bone metabolism by preventing bone loss and enhancing bone formation	Gujarathi JR, Gujarathi RA (2012) Minimizing risk of postmenopausal osteoporosis through shatavari-A clinical study World Journal of Pharmaceutical research 2(1): 260-265.

Mitra et al	Randomized control trial	OST-6 (OsteoCare), a herbomineral formulation [Each gram of OST-6 contains Terminalia arjuna (bark 250 mg), Withania somnifera (root 250 mg), Commiphora mukul (gum resin 280 mg), Praval bhasma (220 mg)], was evaluated for its inhibitory effect on the progress of bone loss induced by ovariectomy in rats. Ovariectomized (Ovx) rats were administered with OST-6 at 250 and 500 mg/kg body weight, orally daily for 90 days	OST-6, at a dose of 500 mg/kg, significantly improved bone mineral contents, serum alkaline phosphatase levels, reduced the elevated urinary calcium and pyridinium cross-links excretion, number of TRAP positive cells and reversal of the Histologically, bone sections revealed narrowed and disappearance of trabeculae and widened medullary spaces	Mitra SK, Rangesh PR, Venkataranganna MV, Udupa UV, Gopumadhavan S and Seshadri SJ
Sung et al	Randomized control trial	Six- to seven-month-old female Sprague–Dawley rats were randomly assigned into either a sham-operated group or one of three ovariectomy (OVX) subgroups: OVX treated with vehicle, OVX with alendronate, and OVX with Saururus chinensis extract (SC). Rats began receiving treatment 4 weeks before the OVX treatment and continued receiving treatment for an additional 10 weeks after OVX (for a combined total of 14 weeks)	SC treatment could prevent OVX-induced loss of bone mass and deterioration in trabecular microarchitecture by suppressing bone turnover, thereby maintaining bone structural integrity	Sung MJ, Davaatseren M, Hur HJ, Kim HJ, Ryu SY, Choi YH, Cha MR and Kwon DY (2012) Antiosteoporotic Activity of Saururus chinensis Extract in Ovariectomized Rats. <i>Phytother Res</i> 26: 1182-1188.
Reddy J et al. [9]	A prospective, randomized, placebo-controlled, double blind, phase III clinical trial	100 postmenopausal patients were categorized into the Reosto and the placebo group, and both the groups were advised to consume the respective medications in a dose of 2 tablets twice daily, for 3 months. All the patients were monitored at monthly intervals for 3 months, and a detailed evaluation with Bone Mineral Density, hematological and bone-specific biochemical investigations were repeated at the end of 3 months	This study observed a highly significant increase in Bone Mineral Density, T- and Z- scores of the total body bones in the Reosto group as compared to the placebo group, at the end of the study. There was a highly significant increase in serum calcium, serum phosphorus, and a significant decrease in serum alkaline phosphatase levels in the Reosto group as compared to the placebo group, at the end of the study	[9]
Aswar UM et al.	Randomized control trial	IND-HE was separated from the ethanol extract of <i>C. quadrangularis</i> . Ovariectomized female Wistar rats were divided into four groups (n = 6). Group I: Control (distilled water), Group II: IND-HE (75 mg/kg p.o.), Group III: IND-HE (100 mg/kg p.o.) were treated once daily for 8 weeks and Group IV: standard estradiol group, received estrogen (1 mg/kg, s.c. bi-weekly).	IND-HE (75 and 100 mg/ kg) and estrogen treatment showed statistically significant increase in bone thickness, bone density and bone hardness. Alkaline phosphatase was significantly reduced by IND-HE (100 mg/kg p.o.) and estrogen treatment. Histopathology and DEXA results indicated that IND-HE (75 and 100 mg/kg) prevented bone loss.	Aswar UM, Mohan V, Bodhankar SL. Antiosteoporotic activity of phytoestrogen-rich fraction separated from ethanol extract of aerial parts of <i>Cissus quadrangularis</i> in ovariectomized rats. <i>Indian Journal of Pharmacology</i> 44(3): 345-350.
Shirke SS et al	Randomized control trial	Adult Sprague-Dawley rats were either bilaterally ovariectomized (OVX) or sham operated. OVX and sham control groups were administered vehicle, whereas the other two OVX groups were given 0.15 mg/kg estradiol and 1 g/kg methanolic extract of <i>P vulgaris</i> L seeds (MPV) orally for 10 weeks (10 rats per group)	Compared with the OVX control, MPV (1 g/kg PO) significantly decreased serum alkaline phosphatase and reduced serum tartrate resistant acid phosphatase and urinary Ca levels. It caused an increase in bone density, ash density, and bone mechanical strength and significantly increased bone Ca.	Shirke SS, Jadhav SR, Jagtap AG (2009) Osteoprotective effect of <i>Phaseolus vulgaris</i> L in ovariectomy-induced osteopenia in rats. <i>Menopause</i> 16(3): 589-596.

Shirwaikar et al	Randomized control trial	Healthy female albino rats were divided into five groups of six animals each. First group was sham operated and served as control. All the remaining groups were ovariectomized. Group 2 was fed with equivalent volume of saline and served as ovariectomized control. Groups 3-5 were orally treated with Raloxifen (5.4 mg/kg) and ethanol extract of <i>Cissus quadrangularis</i> (500 and 750 mg/kg), respectively	The findings assessed on the basis of biomechanical, biochemical and histopathological parameters showed that the ethanol extract of the plant had a definite antiosteoporotic effect.	Shirwaikar A, Khan S, Malini S (2003) Antiosteoporotic effect of ethanol extract of <i>Cissus quadrangularis</i> Linn. on ovariectomized rat. <i>J Ethnopharmacol</i> 89(2-3): 245-250.
Potu BK et al	Randomized control trial	Ovariectomized rats were randomly divided into four groups of eight animals each. The groups are 1. Sham operated (SHAM), 2. Ovariectomized (OVX), 3. Ovariectomized and treated with 25 mg/kg b.w of raloxifene (OVX+RAL), 4. Ovariectomized and treated with 500 mg/kg b.w of petroleum ether extract of CQ (OVX+CQ). The treatment continued for 30 days. At the end of the treatment, rats in all groups were sacrificed by cervical dislocation. Before sacrifice, blood was collected for the estimation of serum ALP, TRAP, Calcium and hydroxyproline; whereas the left femur was used for histomorphometrical analysis.	As compared to SHAM group, OVX group animals showed a significant rise in serum ALP, TRAP and hydroxyproline levels at the end of 1 month following ovariectomy while no significant change was seen in the serum calcium levels. ALP and TRAP levels of OVX + RAL and OVX + CQ groups showed a further increase following administration of raloxifene and <i>Cissus quadrangularis</i> . The serum hydroxyproline content was found to be increased in the OVX + CQ compared to SHAM group. CQ significantly increased the thickness of both cortical (p <0.001) and trabecular bone (p <0.001). These data suggest a strong anti-osteoporotic activity of CQ.	Potu BK, Nampurath GK, Rao MS, Bhat KM (2011) Effect of <i>Cissus quadrangularis</i> Linn on the development of osteopenia induced by ovariectomy in rats. <i>Clin Ter</i> 162(4): 307-312.
Shirke SS et al	Randomized control trial	Adult Sprague-Dawley rats were bilaterally ovariectomized (OVX) and randomly assigned to 3 groups (10 rats/group). Additional 10 animals were sham operated. OVX and sham control groups were orally administered with vehicle while the other two OVX groups were administered 0.15 mg/kg estradiol and 1 g/kg of methanolic extract of <i>Cuminum cyminum</i> (cumin) fruits (MCC) in two divided doses for 10 weeks.	Results were analyzed using ANOVA and Tukeys multiple comparison test. MCC (1 g/kg, p.o.) significantly reduced urinary calcium excretion and significantly increased calcium content and mechanical strength of bones in comparison to OVX control. It showed greater bone and ash densities and improved microarchitecture of bones in SEM analysis. The osteoprotective effect was comparable with estradiol.	Shirke SS, Jadhav SR, Jagtap AG (2008) Methanolic extract of <i>Cuminum cyminum</i> inhibits ovariectomy-induced bone loss in rats. <i>Exp Biol Med</i> (Maywood). 233(11): 1403-1410.
Yogesh H.S et al	Randomized control trial	Sprague-Dawley rats were divided into sham and OVX groups. The OVX rats were further divided into four groups, which received standard estrogen (0.0563 mg/kg) and 100, 300, and 500 mg/kg aqueous-methanol extract of <i>Berberis aristata</i> , daily for 42 days.	The experimental animals treated with <i>Berberis aristata</i> aqueous-methanol extract showed dose dependent activity. The significant increase in uterine weight, femur BMD, ash content and lumbar hardness were observed. In addition, increased levels of calcium and phosphorus in serum and significant decreased in urine were observed as compared to control OVX group. The histopathological results also confirm the protective effect of extract.	Yogesh HS, Chandrashekhar VM, Katti HR, Ganapaty S, Raghavendra HL, et al. (2010) Anti-osteoporotic activity of aqueous-methanol extract of <i>Berberis aristata</i> in ovariectomized rats. <i>J Ethnopharmacol</i> . 24;134(2): 334-8.

Reddy PN et al	Randomized control trial	Twenty-four female rats were ovariectomized, 12 sham operated, divided into three groups of 12 each, fed on low calcium diet (0.04% Ca) and treated either with vehicle or Praval bhasma (65 mg/kg body weight, twice a day) for 16 weeks	Compared to sham rats, CD-OVX animals showed an increase in urinary excretion of calcium (Ca) and phosphorus (P), decreased femoral weight and density which were significantly reversed in Praval bhasma treated animals. Measurement of cortical bone morphometric indices by CT-scanning technique showed increased medullary width and cross-sectional area, decreased periosteal area (PA), combined cortical thickness (CCT) and cortical area (CA)/periosteal area in CD-OVX animals compared to sham and PB-treated group. Scanning electron microscopy (SEM) study revealed porous and erosive appearance of the distal femur at the epiphysis and reduced Ca:P ratio in CD-OVX animals compared to sham and PB-treated group	Reddy PN, Lakshmana M, Udupa UV (2003) Effect of Praval bhasma (Coral calx), a natural source of rich calcium on bone mineralization in rats. Pharmacol Res. 48(6): 593-539.
Dongaokar D et al	A Prospective, Randomized, Placebo-Controlled, Double Blind, Phase III Clinical Trial	105 healthy women were randomized in Reosto and placebo groups, and both the groups were advised to consume the respective medications in dose of two tablets twice daily, orally, for 6 months. All the enrolled women were monitored at monthly intervals for 6 months, for any reported or observed adverse effects	Out of the 105 enrolled women, 11 women had normal Bone mineral density, and 16 women were lost to follow-up and the data of 78 women (39 from each group) was considered for statistical analysis. This study observed a significant increase in the T-score and Bone mineral density of lumbar spine, femur neck, and hip, in the Reosto group (which indicate the desirable remineralization of osteoporotic bones). There was also a significant increase in serum calcium and serum phosphorus, and a significant decrease in serum alkaline phosphatase levels	10
Bezerra L et al	Randomized control trial	A total of 48 postmenopausal women (mean age of 63.9 ± 5.6 years) participated in the present study. The sample was randomly assigned to one of two groups: Yoga Group (YG, n = 24) and Control Group (CG, n = 24)	The results of the present study indicate that six months of Yoga practice failed to induce significant improvements in post-menopausal women BMD. Conversely, the intervention did increase concentrations of the biochemical marker of bone formation as measured by serum osteocalcin, while it remained unchanged in the control group.	Bezerra L, Bottaro M, Reis, VM, Abdhala L, Lima R, et al. (2010) Effects of Yoga on Bone Metabolism in Postmenopausal Women. JEPonline 13(4): 58-65
Motorwala et al	Experimental study	30 females in the age group of 45–62 years suffering from postmenopausal osteoporosis with a dual-energy X-ray absorptiometry (DEXA) score of ≤ -2.5 underwent a 6 months fully supervised yoga session. All the participants completed the study. Pre-training and post-training BMD was calculated	Improvement in T-score of DEXA scans of -2.55 ± 0.25 at post-training as compared to a pre-training score of -2.69 ± 0.17.	Motorwala ZS, Kolke S, Panchal PY, Bedekar NS, Sancheti PK, et al. (2016) Effects of Yogasanas on osteoporosis in postmenopausal women. International Journal of Yoga 9(1): 44-48.

Phoosuwan et al	Cross sectional study	The experimental group attended the 12-week weight-bearing yoga training 3 days a week, 50 minutes a day while the control group lived their normal lives. After 12th week, the data collections were repeated in both groups. The experimental group (19 subjects, the mean age 54.320 yrs) and the control group (14 subjects, the mean age 54.430 yrs) were recruited	The weight-bearing yoga training had a positive effect on bone by slowing down bone resorption which was a very essential indicator for human health because it reduced the osteoporosis risks in the postmenopausal women	Phoosuwan M (1), Kritpet T, Yuktanandana P (2009) The effects of weight bearing yoga training on the bone resorption markers of the postmenopausal women J Med Assoc Thai 92 Suppl 5: S102-S108.
Sangiorgio SN et al	Observational study	The bone mineral content was measured using DEXA analysis of the proximal femur and lumbar spine of nine female Bikram Yoga instructors between the ages of 30 and 59, who not only participated in a minimum of 3 classes (4.5 hours) a week, but also actively taught Bikram Yoga classes. These same participants, who remained active as instructors and practitioners, were rescanned five years later	Post-menopausal subjects revealed a mean decrease in bone mineral density (BMD) of -6.0%, -8.1%, and -5.6% in the femoral neck, total hip, and total lumbar spine, respectively	Sangiorgio S, Mukherjee, A, Lau N, Mukherjee A, Mukhopadhyay P et al. (2014) Optimization of Physical Activity as a Countermeasure of Bone Loss: A 5-Year Study of Bikram Yoga Practice in Females. Health 6: 1124-1132.
Tuzun S et al	Observational study	Twenty-six postmenopausal osteoporotic women over 55 years of age were included in the study. A neuromuscular test battery and the QUALEFFO as a life quality index were used for the assessment of balance and life quality, respectively	The results showed that yoga education has a positive effect on pain, physical functions, and social functions. In conclusion; yoga appears to be an alternative physical activity for the rehabilitation of osteoporotic subjects.	Tuzun S, Aktas I, Akarirmak U, Sapahi S, Tuzun F Yoga might be an alternative training for the quality of life and balance in postmenopausal osteoporosis European journal of physical and rehabilitation medicine 46(1): 69-72.

Discussion

WHO defines osteoporosis on the basis of bone density; Low bone mass is an important feature Total and regional as well as mineral and osteoid bone mass are reduced There is micro architectural deterioration of bone tissue, leading to increased bone fragility. Fragility means compromised bone strength, which reflects integration of two main features, bone density and bone quality. Increased bone fragility leads to increase in fracture risk. WHO defines low bone mass on the basis of T score i.e. standard deviation (SD) of bone mineral density (BMD), with reference to mean of young adult population T Score: 0.00 to -1.00 Normal -1.00 to -2.5 Osteopenia < -2.5 Osteoporosis. In case of established osteoporosis, there is an added component of fragility fractures as well. A fragility fracture is one, which occurs due to fall from no greater than standing height of an individual or with normal use. The present epidemiological data and research studies on osteoporosis are based on these definitions. Bone has 2 components: 1) Fibrous tissue which gives resilience and toughness and 2) Mineral which gives hardness and rigidity. Collagen fibres are responsible for the tensile strength like tendons, while mineral salts have compressional strength. Minerals i.e. calcium, phosphorus, zinc, magnesium, fluoride, etc. are in the form of needle shaped crystals of hydroxyapatite and are arranged around collagen fibres. 35% of dry bone is osteoid i.e. organic ground substance (matrix made up of glycoprotein and collagen fibres Type 1). Osteoporosis is one of the most common cause of debility in the elderly age group,

as with progressing age, there is an impaired bone formation and increased bone resorption. There are broadly two types of osteoporosis- senile and postmenopausal. Apart from the age factor, there exists several risk factors that increase the chance of developing osteoporosis: family history, gender (women are 6 to 8 times more likely than men), being postmenopausal, advanced age, race (Caucasians are the most likely), low calcium intake, smoking, alcohol consumption, a sedentary lifestyle [3] and soft drink consumption [4,5]. Hormone replacement therapy was previously touted as a treatment for osteoporosis, and may, in fact, be quite useful for decreasing bone loss. However, this benefit decreases, if hormone therapy is discontinued. In addition, many women refuse hormone therapy, due to other known or perceived adverse effects [6,7]. Although pharmaceutical agents can be effective, there is an increased interest in non-pharmacological prevention and treatment of osteoporosis [8]. Although HRT and synthetic hormones are shown to recompense for the depletion of the hormone, and to impede the bone loss, the treatment is controversial and has been associated with a number of complications and adverse effects [9,10]. Traditional therapies for postmenopausal osteoporosis have emphasized agents that inhibit bone resorption, such as oestrogen and calcitonin]. Although the most effective method to reduce the rate of postmenopausal bone loss is oestrogen replacement therapy, it may be accompanied by side effects. It is recommended only for woman, who are at high risk of osteoporosis and have no contraindications for oestrogen.

The intent of this review was not only to review articles related to yoga, Ayurveda and naturopathy to manage osteoporosis, but it also to reduce dependence or supplement the pre-existing medications being used for oestrogen deficiency associated osteoporosis, which is primarily postmenopausal in nature. Plants containing phytoestrogen and triterpenoids have been used since time immemorial, in traditional system of medicine for the treatment of osteoporosis. *Cissus quadrangularis* L. (Vitaceae), a climbing shrub, characterized by a thick quadrangular fleshy stem, is an edible plant found in hotter parts of India, Sri Lanka, Malaya, Java and West Africa. Commonly known as the “bone setter,” [11] the plant is referred to as “Asthisamdhani” in Sanskrit and “Hadjod” in Hindi because of its ability to join bones [12]. The root is reported as most useful for the fractures of bones, with the same effects as plaster externally. The phytochemical analysis of the plant showed the presence of vitamin C, β -carotene, two symmetric tetracyclic triterpenoids, β -sitosterol, α -amyrin, α -amyrone and three stilbene derivatives and quadrangularins A, B, C. In addition to vitamin C, it also contains a high amount of carotene A, anabolic steroidal substance and calcium. The phytoestrogen steroid isolated has been shown, to influence early regeneration and quick mineralization of bone.

Four Indian plants, traditionally used in Ayurvedic medicine: *Asparagus racemosus* Wild, *Embllica officinalis* Gaertn, *Hemidesmus indicus* R. Br., and *Rubia cordifolia* L. were selected on the basis of their ethnobotanical use and of scientific evidence, that suggests a potential efficacy in the treatment of bone-loss diseases. *Hemidesmus indicus* showed the greatest antiosteoclastic activity, without toxic effect on osteogenic precursors. Therefore, *Hemidesmus indicus* exhibits the properties of an antiresorptive drug, and represents the ideal candidate for further clinical investigations. Fortyfive patients with Osteopenia/Osteoporosis were taken to evaluate the efficacy and safety of Laksha guggulu and Mukta shukti pishti in the management of Osteopenia/Osteoporosis [13]. The effect of Laksha Guggulu and Mukta Shukti Pishti on pain, activities of daily living, Jobs around the house, mobility, leisure, social activities, general health perception, mental functions (QUALIFFO-41) were encouraging i.e. statistically highly significant ($p < 0.001$) in the management of Osteopenia/Osteoporosis (Asthi Kshaya).

The study showed, that the raw material Mukta was calcium carbonate. The method followed in the study is not only quite safe, but also a natural source of nanonized pearl powder for adults. There are several other natural sources of calcium: *Shankha Bhasma* (conch shell- nanoparticle), *Sambuka* (snail shells), *Mrgasrgna* (Antelers), *Sukti* (oyster shell), *Samudraphena* (cuttlefish bone), *Kurmaprastha asthi* (Tortoise shell), *Kukkuta anda twak* (egg shell) and *Aja Asthi* (goats bone); all animal products mentioned having medicinal properties, but not primarily as a Calcium supplement. These undergo a complex process called MARANA & SHODANA to make it a nanoparticle

and are, therefore, easily assimilated. These minerals, along with metals, precious stones & mercury is mentioned in Ayurveda chemistry books called Rasashastra [14]. This shows us that there are several natural alternatives, to the usual calcium supplements, that can be used safely in patients with osteoporosis. Additionally, there are certain plants from the following families, which have shown the greatest benefits on bone: Alliceae, Asteraceae, Theaceae, Fabaceae, Oleaceae, Rosaceae, Ranunculaceae, Vitaceae, Zingiberaceae [15]. This review's primary objective was, to analyse the various research articles published on the effect of yoga, Ayurveda and naturopathy, on postmenopausal osteoporosis [16]. The idea is to depict the benefit of these alternate therapies have, on increasing bone density and improving bone turnover markers, thereby potentially reducing the burden on medications and hormones replacement therapies, which have several side effects of their own. Tackling osteoporosis through the above mentioned complementary and alternative therapies, could be further improved by lifestyle modification, as osteoporosis is further worsened by obesity and lack of exercise. One of the safest preventative measures and treatments for osteoporosis and osteopenia is yoga. It's something that anyone, at any age, can do anywhere; the benefits are many and risks are few if done correctly. A pilot study performed by Dr. Loren Fishman, Medical Director of Manhattan Physical Medicine and Rehabilitation in New York City, showed that when individuals practiced yoga for merely 10 minutes per day over a two-year period, their bone density increased [17]. In the 19th century, a German anatomist and surgeon, Julius Wolff, theorized that bone will adapt to the load which is placed on it, i.e., it becomes stronger to resist the load [18]. The inverse is also true; as the load decreases, bone becomes weaker. This phenomenon is perhaps best demonstrated by what happens to astronauts in space, who without the force of gravity working on their bones, are at a greater risk for developing osteoporosis. In holding yoga poses, tensile (stretching) force and isometric, compressive (weight-bearing) force stimulate the osteocytes (cells found in mature bone) to produce proteins and lay down new bone. Yoga produces both the stress of dynamic loading when moving into a pose and static loading by holding a pose. In addition, yoga stimulates the production of synovial fluid, which not only lubricates and nourishes the joints, but also activates chondrocytes (the cells found in healthy cartilage) to lay down new cartilage. Asanas that pull our muscles to act on the bone mobility, yoga surpasses the bone-strengthening benefits of gravity. These benefits are said to occur, when an Asana is held for anywhere between 12 and 72 seconds. Yoga, in practice, is found to be more effective when combined with some form of exercise. Exercise has an important impact on bone health. Several studies have increased awareness on how exercise can most constructively be used, to prevent the development of osteoporosis [19]. More specifically, researchers have discovered that weight-bearing exercises have the potential to bone mineral density [20]. Weight-bearing exercises such as running and jogging, for example, have

demonstrated more substantial increases in bone density, than other types of physical activity. Some of these potential benefits to maintaining BMD have been quantified, reporting decreases in the rate of bone mineral density deterioration [21]. Exercise at any age can improve bone health; Weight-bearing exercises, including weight training, hiking, climbing stairs, and walking, force the bones to work against gravity and are effective at increasing bone mass [22]. For most individuals, practicing weight-bearing exercise 3 times per week for 12 to 20 minutes, is sufficient to increase bone density. Since each joint will respond to the strain load individually, it's best to rotate exercise on sites and focus on each one for a limited time period. Continuing to exercise throughout life helps to reduce bone loss and the risk of falls [23]. Just as with yoga and Ayurveda medications, naturopathy also plays a big role in managing osteoporosis. Since Naturopathy is nothing but a method of therapy, that diagnoses and recommend through the make use of water, air, diet, light, heat and all other kind of daily procedure and modalities [24]. There are several ways to increase the calcium in one's diet; milk products are probably the top at the list. There are several foods that are rich in phytoestrogen: yams, chickpeas, soy etc. to name a few. There is also research in support of the positive effects of soy isoflavones, on reducing the risk of developing osteoporosis [25]. Diets high in soy may decrease bone reabsorption in postmenopausal women [26]. These are just a few examples of how a balanced natural diet, can improve the bone health in those with osteoporosis. None of the above mentioned methods, however, have been tried in combination. Most of the studies that have been analysed in this review have been in comparison, with one of the traditionally used drugs for osteoporosis (alendronate, raloxifene, oestrogen etc.) [27-29]. Each of these therapies has several merits, which could be added in combination, making it a better fit for someone with osteopenia or osteoporosis. Also, in combination, they have the ability to completely alleviate the need for hormone replacement therapy, in those with postmenopausal osteoporosis. These complementary and alternate therapies have an extra advantage of being beneficial in several other lifestyle disorders such as obesity, diabetes, hypertension etc., which may be associated with postmenopausal osteoporosis. The scope is endless, and this is definitely an avenue worth pursuing for the future, safe, balanced management of osteoporosis.

Conclusion

It is observed that Yoga, Ayurveda and Naturopathy are beneficial in improving BMD and preventing bone loss due to oestrogen deficiency. Naturopathy diet as such needs to be standardized and researched upon further. However, there is no study available where these have been used in combination. In combination, the benefits of each method are cumulative and can potentially rid the patient of medications. This requires further research and analysis, specifically for postmenopausal osteoporosis.

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