

Research – *Yoga for Strong & Healthy Bones*

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Yoga is a unique exercise characterised by:

- Isometric muscular contractions – locks, mudra, active stretching & postures
- Stretching exercises
- Relaxation & meditation
- Breathing exercise
- Contemplation
- Body awareness / attention– expanding somatosensory & proprioception experience

YOGA IS A PRACTICE – it is something to do...

Bone strength or resistance to fracture is more complex than bone density

Prevention should focus on more than bone density

Yoga provides the extra:

Posture

Strength of extensors

Balance

Falls prevention

Feelings of wellbeing

Osteoporosis is actually part of a bigger problem called ageing associated with:

FRAILTY SYNDROME – not just focus on bone mass ie medication as the only solution

It involves:

Loss of bone

Loss of muscle

Loss of balance & co-ordination

Degenerative disc disease

Posture deterioration

Loss of structural health

Loss of flexibility & ROM

? aerobic fitness

? Mind state

This increases Falls risk & Fracture risk – aches & pains & reduced functional independence

Posture is important – kyphosis increases fracture risk

- Falls is a major cause of fracture – so improved balance & confidence is important to reduce fracture risk

Yoga Benefits

- Yoga may improve bone quality
- Yoga may aid posture
- Yoga includes moves which stress the bones in various ways including rotation, which may aid the spine
- Yoga may improve muscle strength
- Yoga may improve balance
- Yoga may aid in falls prevention
- Yoga may aid well being & mood
- Yoga may aid osteoarthritis, often a co-morbidity with osteoporosis

Yoga Research related to Bone Health

TRAINING COURSE BY DR LOREN FISHMAN

Growing evidence that yoga may be viable for bone health and help prevent osteoporosis & the complications associated with osteoporosis ie fracture

BONES

• Yi-Hsueh Lu, PhD, Bernard Rosner, PhD, Gregory Chang, MD, PhD, and Loren M. Fishman, MD, B Phil (oxon.) Twelve-Minute Daily Yoga Regimen Reverses Osteoporotic Bone Loss Top Geriatr Rehabil. 2016 Apr; 32(2): 81–87.

This was a 10 year study of 741 internet recruited volunteers comparing pre yoga BMD vs Post yoga BMD.

Only 227 completed compliance of study (daily or 2nd daily) – bone density improved in spine (most), and femur. Hip had wide variation. Bone quality improved in those tested. No yoga serious injuries were reported with 90000 hrs of practice. The 12 yoga poses (12 mins of practice) studied here appear to be a safe and effective means to reverse bone loss in the spine and the femur and have weaker indications of positive effects on the total hip measurement of the DXA scan. There is qualitative evidence suggesting improved bone quality as a result of the practice of yoga. What is suggested by this study's results is that yoga can reverse bone loss that has reached the stages of osteopenia and osteoporosis.

• Eva Norlyk Smith, PhD, RYT-500,1 Anita Boser, LMP, CHP, RYT2,3Yoga, Vertebral Fractures, and Osteoporosis: Research and Recommendations International Journal of Yoga Therapy – No. 23 (1) | 2013

Review of literature was made to identify risk vs advantages of certain movements for people with osteoporosis. Flexion and spinal forward bend was identified as risky and should be avoided in yoga. Forward bend from hips is OK. Mild spinal twisting & extension were seen to be positive. Weight bearing and extension strengthening were seen as positive. Yoga should be adapted to individual needs. Spinal movement is considered healthy for the spine. Spinal bone adapts to Wolf's law of forces imposed. Yoga may aid bone quality & health.

• Luca Cristofolini, PhD Nicola Brandolini, MSc Valentina Danesi, MEng Mateusz M. Juszczak, PhD Paolo Erani, BEng Marco Viceconti, PhD Strain distribution in the lumbar vertebrae under different loading configurations Spine October 2013 Volume 13, Issue 10, Pages 1281–1292

Vertebral body of lumbar spine was found best to sustain compressive force tilt increased loading.

Flexion greatly increased anterior forces, possibly being too great & overloading. Rotation stressed the anterior spine moderately – this may be a viable force for strengthening.

Compression was least force ie strength training.

Loren Fishman surmised that rotation may be a safe force for strengthening the anterior spine, which occurs in yoga, while compression found in strength training was only low. It was high lighted the rotation needed to be with neutral or extension, not flexion, in order to be safe.

• Castrogiovanni P , Trovato FM , Szychlinska MA , Nsir H , Imbesi R , Musumeci G The importance of physical activity in osteoporosis. From the molecular pathways to the

clinical evidence. *Histol Histopathol.* 2016 Nov;31(11):1183-94.

Exercise, including vibration, is a stress which acts on bone cells to improve bone metabolism, bone quality and so aid people with osteoporosis. It aids bone homeostasis, and the whole skeletal system.

Yoga can provide a good alternative for healthy bones & falls prevention management.

BALANCE

- Tuzan, Aktas, Akarirmak, Sipahi, Tuzun Yoga might be an alternative training for the quality of life and balance in post menopausal osteoporosis *Int J Yoga.* 2014 Jul-Dec; 7(2): 133–137..

An observational study of yoga vs exercise over 12 weeks found yoga as good if not better in improving balance, reducing pain, and improving quality of life.

- Sabrina Youkhana [?] [?]; Catherine M. Dean; Moa Wolff; Catherine Sherrington; Anne Tiedemann Yoga-based exercise improves balance and mobility in people aged 60 and over: a systematic review and meta-analysis *Age Ageing* (2016) 45 (1): 21-29.

One third of community dwelling older adults fall annually. 6 Trials of 307 clients were found to improve balance (small) & mobility (mod).

- Anne Tiedemann; Sandra O'Rourke; Romina Sesto; Catherine Sherrington A 12-Week Iyengar Yoga Program Improved Balance and Mobility in Older Community Dwelling People: A Pilot Randomized Controlled Trial *J Gerontol A Biol Sci Med Sci* (2013) 68 (9): 1068-1075.

Twice weekly yoga over 12 weeks can aid older people with improved balance & mobility without major adverse events (some muscle pain). (Iyengar)

- Lyn Miller. Improving your flexibility & balance. ACSM Oct 2016

ACSM guidelines for balance recommend at least twice weekly practice with weight shifts, single leg balance, single leg balance with movement, such as yoga & Tai Chi.

- Meng Ni, BS,a Kiersten Mooney, BS,b Luca Richards, BA,b Anoop Balachandran, MS,a Mingwei Sun, BA,a Kysha Harriell, PhD,a Melanie Potiaumpai, BS, MS,a Joseph F. Signorile, PhDa,c Comparative Impacts of Tai Chi, Balance Training, and a Specially-Designed Yoga Program on Balance in Older Fallers *Archives of Physical Medicine and Rehabilitation* 2014

Yoga was found to be as effective as Tai Chi or traditional balance training to improve balance.

- Gérome C. Gauchard; Pierre Gangloff; Claude Jeandel; Philippe P. Perrin. Influence of Regular Proprioceptive and Bioenergetic Physical Activities on Balance Control in elderly women *J Gerontol A Biol Sci Med Sci* (2003) 58 (9): M846-M850.

Balance was found to be better in older women who specifically practiced proprioception type exercise like yoga (90 mins once per week), then aerobic exercise like jogging, cycling or swimming, or even walking.

- Erick Tadeu Prado, Vagner Raso, Renata Coelho Scharlach, and Cristiane Akemi Kasse Hatha yoga on body balance *Int J Yoga.* 2014 Jul-Dec; 7(2): 133–137.

5 months, 3 times per week, hatha yoga improved the postural balance mechanism in adults (vestibular, visual, somatosensory, muscular (postural tone), (CNS)

FALLS

• Hung Manh NGUYEN. Research on the Effectiveness of Yoga on Preventing Fall for the Elderly . International Journal of Science Culture and Sport September 2016 : 4(3) ISSN : 2148-1148

3 times per week yoga over 12 weeks for older adults (60-70) improved on Falls Efficacy Scale (possible indicator of reduced falls risk in ADL) (hatha) had a reduced fear of falling.

ARTHRITIS

• Elora C. Brenneman , Alexander B. Kuntz , Emily G. Wiebenga , Monica R. Maly A Yoga Strengthening Program Designed to Minimize the Knee Adduction Moment for Women with Knee Osteoarthritis: A Proof-Of-Principle Cohort Study
PLOS September 14, 2015 <http://dx.doi.org/10.1371/journal.pone.0136854>

A pilot style study found that yoga postures practiced 3 times per week (such as Chair & Lunges) could aid in strengthening the knee without increased joint forces for knee OA.

• Juyoung Park PhD , Ruth McCaffrey DNP, ARNP, BC, FNP, FAAN, David Newman PhD, Patricia Liehr PhD, RN, Joseph G. Ouslander MDA
Pilot Randomized Controlled Trial of the Effects of Chair Yoga on Pain and Physical Function Among Community-Dwelling Older Adults With Lower Extremity Osteoarthritis J American Geriatrics Society 23 Dec 2016 DOI: 10.1111/jgs.14717

Twice per week for 8 weeks of Chair yoga aided older people with OA with pain reduction & gait speed, but did not aid balance.

• Gholam A Ghasemi, Ainaz Golkar, and Sayyd M Marandi Effects of Hata Yoga on Knee Osteoarthritis Int J Prev Med. 2013 Apr; 4(Suppl 1): S133–S138.

3 times per week yoga over 8 weeks helped older women with knee pain, reduce pain, improve ADL & well being (Hatha).

• Corjena Cheung, Jean F Wyman, Barbara Resnick, and Kay Savik Yoga for managing knee osteoarthritis in older women: a pilot randomized controlled trial BMC Complement Altern Med. 2014; 14: 160.

Hatha Yoga an hour per week for 8 weeks helped older women better manage knee OA, with no adverse events observed & 95% compliance.

STRENGTH & PHYSICAL DEMAND

• Neha P. Gothe; Edward McAuley Yoga Is as Good as Stretching–Strengthening Exercises in Improving Functional Fitness Outcomes: Results From a Randomized Controlled Trial J Gerontol A Biol Sci Med Sci (2016) 71 (3): 406-411.

Yoga 3 times per week for 8 weeks was compared to normal stretching & strengthening and found to be just as effective for functional capacity. Yoga also had less equipment required to normal strength exercise.

• Longpré HS , Brenneman EC , Johnson AL , Maly MR .
Identifying yoga-based knee strengthening exercises using the knee adduction movement. Clin Biomech (Bristol, Avon). 2015 Oct;30(8):820-6.

Studying 6 standing yoga postures – chair, wide squat, lunges worked quads most. Hamstring was highest in hamstring stretch. Squat & lunge had most co-contraction. Wide knee squat & lunge had least knee adduction stress. Single standing balance had most knee adduction stress. So lunge & squat could be OK for knee strength with OA.

• Salem GJ , Yu SS, Wang MY, Samarawickrame S, Hashish R, Azen SP, Greendale GA.

Physical demand profiles of hatha yoga postures performed by older adults Evid Based Complement Alternat Med. 2013;2013:165763.

Following 32 weeks of yoga practice, older adults were assessed for biomechanical demands of 20 standing yoga postures compared to walking. Rectus abdominus was active generally in all postures.

• Man-Ying Wang¹ Sean S-Y Yu¹, Rami Hashish¹, Sachithra D Samarawickrame¹, Leslie Kazadi, Gail A Greendale and George Salem

The biomechanical demands of standing yoga poses in seniors: The Yoga empowers seniors study (YESS), BMC Complementary and Alternative Medicine, The official journal of the International Society for Complementary Medicine Research (ISCMR) 2013;13:8 DOI: 10.1186/1472-6882-13-8

Measure of static component of posture not the vinyasa or in & out

Warrior 1 (crescent) (front) Lifted, Warrior 2 (front), Chair, One legged balance – good for stability

Sideways E

Crescent (rear)

Lack of ankle DF on yoga

Tree /single balance most hip abduction & ankle inverters/PF

Warrior 2 – most hip adduction

Tree / Warrior 2 – most stress on knee ie care with pain

• Sean S.-Y. Yu, Man-Ying Wang, Sachithra Samarawickrame, Rami Hashish, Leslie Kazadi, Gail A. Greendale, and George J. Salem The Physical Demands of the Tree (Vrikshasana) and One-Leg Balance (Utthita Hasta Padangusthasana) Poses Performed by Seniors: A Biomechanical Examination Evid Based Complement Alternat Med. 2012; 2012: 971896.

Postures & loading based on seniors studies:

Wide Squat, W1, Chair – low knee joint lat stress – good for quads, con-contraction

Single leg most loading for knee stress – later if OA present

Wall aids balance not reducing stress on joints

Progression – big jump in forces from foot on floor to foot off floor regardless in Tree

Holding or no holding: still strong activation of hip abductors, so aid for strength & balance.

Single leg forward balance – big leap from support to no support

Activates PF on ankle if no support

Single balances good for ankle inverters ie balance

Little activation of quads hams with balances

Knee joint stress increased with single leg postures vs double leg postures

• Suhas Niranjana Yelluru, Ranjith Ravindra Shanbhag, SN Omkar Understanding Vrikshasana using body mounted sensors: A statistical approach Year : International J of Yoga 2016 | Volume : 9 | Issue : 1 | Page : 4-11

There is a complex motor co-ordination between hip Abd/add & ankle ankles to limit body sway when balancing in the Tree posture.

• SYLVIA J. WILCOX, RON HAGER, BARBARA LOCKHART, and MATTHEW K. SEELEY Ground Reaction Forces Generated by Twenty-eight Hatha Yoga Postures Int J Exerc Sci. 2012; 5(2): 114–126.

This study also suggests research indicating high & low impact exercise can improve bone health depending upon exercise compliance.

Ground reaction force was studied in 28 hatha yoga postures to see if sufficient to cause bone stimulation response. Ground reactions were seen to be low impact below 2 BW.

Upper limb forces being greater. However this did not take account of muscle isometric contractions. Gravity alone may not be high enough stimulus.

Putting together different exercise is unknown, but may be valuable, as it is more likely for exercise compliance ie variety. High intensity is usually short so may aid compliance.

POSTURE

- Deborah M. Kado, MD, MS, Dana Miller-Martinez, PhD, Li-Yung Lui, MA, MS, Peggy Cawthon, PhD, Wendy B. Katzman, PT, DPTSc, Teresa A. Hillier, MD, MS, Howard A. Fink, MD, MPH, and Kristine E. Ensrud, Hyperkyphosis, Kyphosis Progression, and Risk of Non-Spine Fractures in Older Community Dwelling Women: The Study of Osteoporotic Fractures (SOF) J Bone Miner Res. Author manuscript; available in PMC 2014 Oct 1.

Over 15 years with 994 women it found an increase in Kyphosis was identified as an independent risk factor for non spine fracture. Risk was 50% over 53 degrees hyperkyphosis. Increased risk of ill health. So posture does matter for older people.

- Rathore M, Sinha MB, Trivedi S, Siddiqui AU An Anatomical Insight into the Biomechanics of Cobra Posture International J. of Healthcare & Biomedical Research, Volume : 2, Issue:1, October 2013, Pages 61-66

Anatomical description of Cobra posture as extensor practice to reverse flexion posture issues.

- Wendy B. Katzman; Mei-Hua Huang; Nancy E. Lane; Kristine E. Ensrud; Deborah M. Kado Kyphosis and Decline in Physical Function Over 15 Years in Older Community-Dwelling Women: The Study of Osteoporotic Fractures J Gerontol A Biol Sci Med Sci (2013) 68 (8): 976-983.

Increase in kyphosis predicted worsening lower limb function in older women ie slower gait, reduced sit to stand.

- Mei-Hua Huang, Elizabeth Barrett-Connor, Gail A Greendale, and Deborah M Kado Hyperkyphotic Posture and Risk of Future Osteoporotic Fractures: The Rancho Bernardo Study J Bone Miner Res. 2006 Mar; 21(3): 419–423.

Hyperkyphosis can be independent risk factor for future fractures regardless of fracture history or BMD.

- Wendy B. Katzman, PT, DPTSc, Assistant Clinical Professor, Linda Wanek, PT, PhD, Professor, John A. Shepherd, PhD, Assistant Professor in Residence, and Deborah E. Sellmeyer, MD, Associate Professor Age-Related Hyperkyphosis: Its Causes, Consequences, and Management J Orthop Sports Phys Ther. 2010 Jun; 40(6): 352–360.

Age related postural hyperkyphosis is exaggerated anterior curvature of the thoracic spine. It impairs mobility, increases risk of falls & fractures. It may occur due to being sedentary, poor mobility, disc degeneration or muscle weakness. Hyperkyphosis is angle greater than 40 degrees (95 percentile value of normal young adults.) Often affects women greater than men. Exercise if compliant ie 3 times per week, mobilisation including self mobilisation, taping & bracing are helpful.

- Gail A. Greendale, MD, Anna McDivit, BS, Annie Carpenter, MS, Leanne Seeger, MD, and Mei-Hua Huang, DrPH Yoga for Women With Hyperkyphosis: Results of a Pilot Study Am J Public Health. 2002 October; 92(10): 1611–1614.

Yoga twice per week for 12 weeks for women was safe & improved function, strength & flexibility and posture awareness. No improvement in hyperkyphosis was observed.

- Gail A. Greendale, MD,* Mei-Hua Huang, DrPH,* Arun S. Karlamangla, PhD, MD,* Leanne Seeger, MD,† and Sybil Crawford, PhD‡ Yoga decreases kyphosis in senior women and men with adult onset hyperkyphosis: results of a randomized controlled trial *J Am Geriatr Soc.* 2009 Sep; 57(9): 1569–1579.

Yoga 3 times per week over 24 weeks helped older adults with hyperkyphosis (over 40 degrees) aid in small improvement 4.4%. (hatha yoga)
Targeting people with more malleable spine may get better results. How much change is possible?

- Deborah M Kado The rehabilitation of hyperkyphotic posture in the elderly *European journal of physical and rehabilitation medicine* · December 2009

Summary of kyphosis – increased risk of fracture, falls, health disorders & mortality – rehab is possible but not universal. Small improvements.

- Improving postural tone with sensory training – GravityFit Model

MODIFICATIONS OF ASANA

- Gail A. Greendale,1,* Leslie Kazadi, RYT,2 Sheila Mazdyasni, BS,1 Emmanuel Ramirez, BA,1 Man-Ying Wang,2 Sean S-Y Yu,2 and George Salem2
Yoga Empowers Seniors Study (YESS): Design and Asana Series *J Yoga Phys Ther.* 2012 Feb 27; 2(1): 107.

Discussion on how yoga can be modified to suit seniors & those with medical issues.

ROM

- Melayna Sager and Sylvain Grenier Comparison of Yoga Versus Static Stretching for Increasing Hip and Shoulder Range of Motion . *International Journal of Physical Medicine & Rehabilitation* June 20 2014

Yoga twice per week for 4 weeks was found to be more effective than static stretching in improving ROM of shoulder & hip.

- Jules Mitchell Stretching improves flexibility – Nov 2014 Blog

Stretching 3 mins per day (in n15, 30, 45 sec intervals OK) 3 times per week ie 9 mins per week does improve flexibility. Stretching doesn't require to be passive or relaxed. Contraction also works ie can strengthen & stretch at same time. Many yoga postures are active stretches.

Stretching may actually be rewiring the brain, as much as the connective tissue.

Increasing our nervous systems tolerance to stretch. Finding a new position in our bodies.

Muscle vs connective tissue fascia – fascia contains nerves & contractile fibres.

Connective is made of fibres, cells, proteins (water attracting) & water - movement aids in flushing fluid & nutrients.

“A major takeaway from this new flexibility paradigm is that when we increase our range of motion through stretching, it isn't because we pulled on our tissues and made them longer. It's because we visited the edge of our stretch (also called stretch “tolerance”) enough times that our brain started to feel comfortable there and it began to allow us to move deeper into that range.” Jenni Rawlings Yoga Dork

MIND, PAIN, QUALITY OF LIFE, & MOOD

- Neha P. Gothe; Arthur F. Kramer; Edward McAuley The Effects of an 8-Week Hatha Yoga Intervention on Executive Function in Older Adults *J Gerontol A Biol Sci Med Sci* (2014) 69 (9): 1109-1116.

Yoga 3 times per week for 8 weeks improved mental function on older adults better the stretching/strengthening group. Practice included meditation (hatha).

- Catherine Woodyard Exploring the therapeutic effects of yoga and its ability to increase quality of life *Int J Yoga*. 2011 Jul-Dec; 4(2): 49–54.

A review yoga therapeutic for various conditions, aided recovery, reduced stress, aided sleep, and improved well being.

- Knobben Sjoerd A meta-analysis of the effectiveness of yoga on mental health: taking on a dual perspective reflecting the medical & positive perspective of mental health 2013 Master Thesis University of Twente, Netherlands, Dept of Behavioural science & psychology

- Geoffrey W. Melville, Dennis Chang, Ben Colagiuri, Paul W. Marshall, and Birinder S. Cheema Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response *Evid Based Complement Alternat Med*. 2012; 2012: 501986.

Even 15 minute of chair yoga (BB< FB< SB< E RR 6 DB BR) or meditation (work place) can induce the relaxation response in adults. Yoga & meditation reduced perceived stress. Yoga increased HR, while meditation reduced HR, Both reduced RR & HRVariability.

- do Rosário JL , Orcesi LS, Kobayashi FN, Aun AN, Diolindo Assumpção IT, Blasioli GJ, Hanada ÉS. The immediate effects of modified Yoga positions on musculoskeletal pain relief. *J Bodyw Mov Ther*. 2013 Oct;17(4):469-74.

1 session of 2 20 min yoga positions was enough to relieve global muscle pain

BLOOD PRESSURE

- Miles SC , Chun-Chung C, Hsin-Fu L, Hunter SD, Dhindsa M, Nualnim N, Tanaka H. Arterial blood pressure and cardiovascular responses to yoga practice. *Altern Ther Health Med*. 2013 Jan-Feb;19(1):38-45.

1 session of 23 hatha yoga asana increased BP, HR, CO, especially in standing, as associated with isometric exercise, and was similar in trained & non trained yoga practitioners.

Should 1:2 breathing accompany practice to aid in balancing response?

Studies suggest effect of chronic yoga is to reduce blood pressure...

Maybe be more dynamic for people with BP.

- Adhana R , Gupta R, Dvivedii J, Ahmad S. The influence of the 2:1 yogic breathing technique on essential hypertension. *Indian J Physiol Pharmacol*. 2013 Jan-Mar;57(1): 38-44.

2 sessions of 5 mins per day for 12 weeks of 1:2 yoga breathing reduced essential hypertension by 12 mm Hg (8%) Sys & 7 mm Hg (7%) Dia

People with Osteoporosis are older adults and may have co-morbidities...

BACK PAIN

- American College of Physicians guidelines for back pain *Annals of Internal Medicine* 2017

Exercise (122) & motor controlled exercise good for LBP & radicular pain. Yoga (14) may be better than exercise, Tai Chi (2), Mindfulness (3), Relaxation (32) helpful for back pain.

Review of literature found yoga not only reduced depression, but actually promoted well being, aiding in the positive functioning of the person.

EYE CARE

- Jessica V. Jasien, Jost B. Jonas, C. Gustavo de Moraes, Robert Ritch Intraocular Pressure Rise in Subjects with and without Glaucoma during Four Common Yoga Positions *PLoS One*. 2015 Dec 23;10(12):

Head down inversion – down dog, forward bend, (these 2 had most pressure raise) plough, legs up is associated with intra ocular rise – whether is dangerous for glaucoma it is not know yet. Pressure returns to normal in sitting in 2 mins. Older clients at risk – less forward bend & down dog...

OVERVIEW OF YOGA

- Erik J Groessl*, Deepak Chopra and Paul J Mills
An Overview of Yoga Research for Health and Well-Being *J Yoga Phys Ther* 2015, 5:4

Yoga is positive for many health conditions, including spiritual development. Why some keep practicing. Yoga has risks but it is about modifying the practice for the person & health condition, and clearing with doctor. One view of yoga is the relief of suffering, which research supports.

YOGA RISK FACTORS

- Cramer H1, Krucoff C, Dobos G. Adverse events associated with yoga: a systematic review of published case reports and case series. *PLoS One*. 2013 Oct 16;8(10):e75515
Review of literature found 76 cases of yoga adverse events. Rarely seen in studies. Worse styles were Bikram, hatha, & pranayama. Aggravating factors included: headstand, lotus, and forceful breathing. Ashtanga may lead to M/S strains
Adapt practice for medical conditions, people with glaucoma should avoid inversions, people with osteoporosis avoid forceful yoga, especially flexions. Do not practice under the influence of drugs.
Yoga in Australia found only 2.4 % injury rate & minor issues.

STRENGTH TRAINING FOR BONES AS AN ALTERNATIVE

- Watson SL, Weeks BK, Weis LJ, Horan SA, Beck BR Heavy resistance training is safe and improves bone, function, and stature in postmenopausal women with low to very low bone mass: novel early findings from the LIFTMOR trial. *Osteoporos Int*. 2015 Dec;26(12):2889-94.

Brief high intensity strength training with post menopausal women with osteoporosis (low bone mass) was found to be safe, and improved bone density in NOF, spine, function and improved height. No fractures or injuries were recorded. So it was found to be safe. Included Dead Lift.

Twice per week for 30 mins for 8 months.

GUIDELINES FOR OSTEOPOROSIS

• Beck BR , Daly RM , Singh MA , Taaffe DR Exercise and Sports Science Australia (ESSA) position statement on exercise prescription for the prevention and management of osteoporosis. J Sci Med Sport. 2016 Oct 31. pii: S1440-2440(16)30217-1.

Evidence from animal and human trials indicates that bone responds positively to impact activities and high intensity progressive resistance training. Furthermore, the optimisation of muscle strength, balance and mobility minimises the risk of falls (and thereby fracture), which is particularly relevant for individuals with limited functional capacity and/or a very high risk of osteoporotic fracture. It is important that all exercise programs be accompanied by sufficient calcium and vitamin D, and address issues of comorbidity and safety. For example, loaded spine flexion is not recommended, and impact activities may require modification in the presence of osteoarthritis or frailty.

12 POSTURES OF STUDY

- | | | |
|-------------------------------|---------------------------|-----------------------|
| 1. Tree | 2. Triangle | 3. Hero 2 |
| 4. Long Side Stretch | 5. Reverse Triangle | 6. Locust |
| 7. Bridge | 8. Single Leg Lift | 9. Side leg extension |
| 10. Spinal twist straight leg | 11. Spinal twist bent leg | 12. Peace (or Corpse) |

