CYTOPLAN

Health Information Series

Part 5 Part 5 Part 5 Part 5 Part 5 Part 5 Part 5 Part 5

OSTEOPOROSIS

For Professional Use Only

This booklet is for information only and is not intended as a replacement for medical advice that is based on individual circumstances.

What is Osteoporosis?

Osteoporosis is defined as a decreased bone mass with deterioration of the structure of the bone, resulting in increased fragility of bones and resultant fractures.

What is Osteopenia?

Osteopenia is defined as a reduced bone mass due to inadequate synthesis. Bone mass density, however, is not sufficiently low to be classified as osteoporosis.

Peak bone mass is acquired usually by the end of the teenage years. Although the length and shape of bone does not normally change after ossification (bone formation) is complete, bone tissue is continually being remodelled and replaced when damaged throughout life.

Bone is a dynamic tissue that is continuously being broken down and restructured: **osteoblasts** are the bone forming cells which secrete collagen and other constituents of bone tissue and continue to lay down osteoid (bone matrix) for mineralization; Remodelling of bone is carried out by the **osteoclasts,** which are responsible for absorption and removal of bone. A fine balance of osteoblast and osteoclast activity maintains normal bone structure.

Certain factors can affect this delicate balance - illness, diet or medication, for example - however, for the healthy individual this balance is maintained, providing healthy strong bones. Peak bone mass is considered to be between the ages of 20-30 years. As we age, a gradual decline of bone mineral density occurs, with an increased rate of loss frequently experienced as we approach our fifties. Both men and women are at risk of reduced bone density: women experience an increased rate of loss after the menopause, due to hormonal changes.

Practitioners are increasingly reporting seeing more patients, both male and female, at a younger age with poor skeletal structure.

Lifestyle factors including:

- Lack of impact exercise: bone renewal and remodelling is affected by stress acting on bones. Exercise should include forms of impact, which is why walking is an ideal exercise for bones;
- Excess exercise places an increased need for bone building nutrients: without adequate nutritional support, bone loss will exceed renewal and remodelling;
- Smoking and increased exposure to free radicals;
- Poor diet, with lack of essential nutrients;
- Dietary excess of protein, saturated fats, alcohol and salt all reflect in the rate of absorption and calcium excretion;
- A number of prescription medications are known to have a negative effect on bone density: long term steroid therapy is a particular concern; and
- High serum homocysteine concentration is weakening to bone, as it interfers with collagen cross-linking, potentially increasing the risk of osteoporotic fracture. Findings of a trial reported that, 'the homocysteine concentration, which is easily modifiable by means of dietary intervention, is an important risk factor for hip fracture in older persons'. (McLean et al 2004)

The Osteoporotic male

Osteoporosis has long been long considered a condition for the aging female. It is now becoming clear that men are also at risk, and are estimated to lose bone mineral density at a rate of up to 1% per year with advancing age. One in eight men over the age of 50 will experience an osteoporosis-related fracture in their lifetime. In contrast to early studies, it is now considered that declining sex steroid levels, in particular declining bio-available oestradiol levels, appear to play an important role in mediating age-related bone loss in men. (Khosla et al 2008)

Studies have confirmed that osteoporotic fractures in men are an increasing problem, with 30% of hip fractures occurring in men. The increasing aging population is expected to lead to an increase in this number. (Gennari, Bilezikian 2007)

Research confirms that dietary intervention should always be considered. A study of men aged 39 to 42 years found that for adult men, a dietary pattern of adequate calcium intake, moderate protein and generous potassium contributes to a higher bone mineral density than a diet where calcium is adequate, but protein and potassium are low. Suggestions to incorporate fruit, vegetables and dairy products into the diet to maintain bone mineral density were made. (Whiting et al 2002)

Prevention or Preservation is the ideal approach to bone health. Prevention starts at birth and continues until we reach our late teens or early twenties. Adequate nutrition providing all the nutrients required for health and bone formation is essential. Good nutrition combined with regular exercise will ensure we build strong bones and optimum bone density. A review of bone health in the young concluded that, 'over 40% of adult peak bone mass is acquired during adolescence. This period is when lifestyle choices, including ensuring adequate dietary calcium, regular weight-bearing exercise and avoiding hormonal insufficiency, are especially important. Current calcium intakes for adolescent females are woefully inadequate'. (Weaver 2000) The importance of calcium in the developing bone of the young is clear but not to the exclusion of additional bone nutrients. A study of 330 children aged 8yrs found that those consuming a diet high in fruit and vegetables and demonstrating an elevated intake of potassium had increased bone mineral density at all sites. (Jones et al 2001)

Whilst the focus of this research was for females, both young males and females alike are building up their adult peak bone mass, and consideration should be given to all the nutrients implicated in developing strong, healthy bones for both sexes.

At twenty years plus, we move towards preserving our existing bone density, and ensuring that our diet has sufficient nutrients for regeneration to take place. If bone has developed to its optimum in early years, we are already ahead of the game. Reduced bone mass and density at twenty means we are constantly in a catch-up situation, and more effort is required to sustain existing bone structure and density.

Diet

A healthy diet, providing all the essential nutrients for bone development, is a good starting point: a poor diet increases osteoporosis risk. In particular, decreased intakes of vitamins D and K and minerals calcium, potassium and magnesium have been associated with increased osteoporosis risk, as has a low protein diet. The confusing element is that an excess of protein is believed to also contribute to osteoporosis via increased acid load in the body. It is therefore important to eat protein from a wide range of sources: animal products in general are believed to increase the acid balance. Vegetarian sources of protein can be included and an increase in alkaline foods such as fruit and vegetables can assist with maintaining the correct acid/alkaline balance in the body.

As with all aspects of diet, a healthy, balanced approach to food and nutrition is the key.

Eating one particular food group to the exemption of others is not the ideal. For example, bran (frequently chosen for its health-promoting image) can reduce your absorption of minerals, including those for your bones. Pulses, beans and nuts are healthy sources of protein and nutrients with many health benefits, but these together with bran can also be high in phytate, which inhibits the absorption of calcium and magnesium. Vegetarians and vegans are recommended to ensure that they use a variety of protein sources, to maintain a full range of amino acids to stop levels of phytate impacting on nutrient absorption.

Salt

For those wishing to conserve calcium, it is worth remembering that for every 1g dietary salt consumed, approximately 26mg of calcium is lost in the urine. This has been established in adults, but not in children. (Weaver 2000). A study of post-menopausal women found that those on a high salt diet had an increased urinary calcium loss, and that this loss decreased significantly when potassium was included in the diet. (Sellmeyer et al 2008)

Many basic foods contain salt. Processed and packaged foods frequently contain higher levels of salt.

Government figures consider our salt intake is falling, and we now consume 8.6g of salt per day. A quick look through your grocery cupboard and freezer may raise serious doubts that many are attaining this figure. Targets for 2010 are to reduce our intake to 6g which is approximately 1 teaspoonful of salt.

Soft Drinks

Drinks that you or your child consume may also be impacting on calcium and your bones. For a number of years, concern has been expressed into the consumption of phosphoric acid in fizzy drinks as a potential cause for the loss of calcium. Disappointingly, the Framingham Osteoporosis Study did not confirm this. The research did find, 'cola intake in women was associated with significantly lower bone mineral density at each hip site, but not the spine. Similar results were seen for diet cola and, although weaker, for decaffeinated cola'. (Tucker et al 2006)

Earlier research found among physically active girls that cola beverages in particular were highly associated with bone fractures, although the mechanism for this was not fully explored. Reference was made to

laboratory investigations reporting possible bone resorption from high levels of phosphorus intake, and a change in the calcium to phosphorus ratio in the diet due to the phosphoric acid content in cola drinks. (Wyshak 2000) Until conclusive research is available, we must make our own decision regarding phosphoric acid's various links to bone strength.
One interesting consideration regarding phosphoric acid and its inclusion in soft drinks is that phosphoric acid is acidic by nature and is used in the dental industry to assist with adhesion in dental treatments. Topical application of phosphoric acid etches the surface of the tooth enamel - something you may prefer to avoid!

Exercise

Regular exercise, particularly weight-bearing and resistance exercise, reduces the risk of osteoporosis. It has been shown to increase bone mineral density and slow bone loss. Walking is considered an ideal exercise for all ages, as the impact of walking assists with strengthening and maintaining bone structure. Running and jogging is not suited to all, due to impact damage to joints - particularly the knees.

Whilst we are aware that inactivity of the elderly impacts on their bone density and strength, we do not perhaps relate the importance of exercise to the bones of our children. A two year study of 99 girls aged between 7 and 9 years found that those carrying out higher levels of activity, increased bone mineral density and bone size. Exercise was general school activity based for 40 minutes per school day, totalling 200 minutes per week. (Linden et al 2006)

Nutrients for bone

Calcium

Calcium is an important mineral in bone formation: 99% of calcium in the body is found in bone. A wealth of research is available showing the importance of calcium in the developing bones throughout childhood and teenage years. This assists in achieving a peak bone mass essential for maintaining bone density as we age.

Calcium concerns

The research is less conclusive into the benefits as we age of calcium alone. Research indicates that calcium achieves increases in bone mineral density for those adults with a reduced intake of dietary calcium; additional calcium when the dietary intake is at required levels is unlikely to increase bone mass. Studies have shown that increasing calcium results in increased levels of urinary calcium. (Ilich et al 2000)

Recent research is raising concerns with calcium supplementation and the potential for cardio vascular problems. The research was a randomised, placebo controlled trial whose objective was to determine the effect of calcium supplementation on myocardial infarction, stroke and sudden death in healthy, post-menopausal women. It concluded that, 'Calcium supplementation in healthy, post-menopausal women is associated with upward trends in cardio-vascular event rates. This potentially detrimental effect should be balanced against the likely benefits of calcium on bone'. (Boland et al 2008) This research is subject to current controversy: further research is required.

On the basis of these research results, there would be some logic in providing patient guidance on increasing dietary sources of calcium and ensuring that calcium supplements are given in a form which the body is able to utilise. A comparative study of calcium found that a 1200mg dose of calcium carbonate did not differ significantly from placebo. (Hanzlik et al 2005)

Bioavailability: as discussed, the bioavailability of calcium can be reduced by phytate, found in pulses and some grains and seeds, by binding calcium and reducing its availability for absorption. Oxalate found in a number of fruits and vegetables also inhibits absorption of calcium.

Calcium is more effectively asborbed in an acid environment. Therefore, good levels of hydrochloric acid in the stomach are important.

Both calcium absorption and hydrochloric acid production decrease as we age. Those regularly consuming antacid preparations, and those prescribed acid-suppressing medication such as Proton Pump Inhibitors, should be aware of the implications on a reduced ability for calcium absorption. Research confirms, 'the use of proton pump inhibitors for 7 or more years is associated with a significantly increased risk of an osteoporosis-related fracture. There is an increased risk of hip fracture after 5 or more years' exposure'. (Targownik et al 2008)

The addition of the non-digestible prebiotic oligosaccharides inulin and oligofructose was found to significantly improve the absorption of calcium. (Griffin et al 2002) Prebiotics can be found in our following products: Probiotic Plus, Fos-a-dophilus and Cyto-Biotic Active (listed as fructo-oligosaccharides or inulin).

Vitamin D is also essential for promoting calcium absorption and the normal mineralisation of bone.

Not just calcium!

No one single substance, food, vitamin or mineral can produce strong healthy bones. A number of nutrients are essential to develop the complex matrix of bone. Bone health and osteoporosis should be seen as much more than a need for calcium.

A review published in the Journal of the American College of Nutrition entitled 'Nutrition in Bone Health Revisited: A Story Beyond Calcium' sums this fact up well. 'Osteoporosis is a complex, multi-factorial condition characterized by reduced bone mass and impaired micro-architectural structure, leading to an increased susceptibility to fractures. Although most of the bone strength (including bone mass and quality) is genetically determined, many other factors (nutritional, environmental and life-style) also influence bone.

Nutrition is an important modifiable factor in the development and maintenance of bone mass and the prevention and treatment of osteoporosis. Approximately 80–90% of bone mineral content is comprised of calcium and phosphorus. Other dietary components, such as protein, magnesium, zinc, copper, iron, fluoride and vitamins D, A, C, and K are required for normal bone metabolism, while other ingested compounds not usually categorized as nutrients (e.g. caffeine, alcohol and phytoestrogens) may also impact on bone health. Unravelling the interaction between different factors, (nutritional, environmental, lifestyle, and heredity) help us to understand the complexity of the development of osteoporosis and subsequent fractures'. (Ilich et al 2000)

Vitamin C is an essential component in collagen formation and bone growth. Smokers, or those exposed to passive smoke, may wish to consider additional vitamin C because smoking depletes antioxidant levels, including that of vitamin C. Food storage techniques and length of storage are a particular concern with vitamin C. Research has shown that vitamin C loss occurs in the storage of juice affected by both temperature and length of storage. (Klimczak et al 2006)

Vitamin D

For the uptake of calcium, we require vitamin D. Vitamin D status declines with age, with a decreased ability to synthesise vitamin D from sunlight. Reduced exposure to sunlight has become increasingly common because of elected avoidance of sun exposure. The use of sun screens also reduces the potential for synthesis of vitamin D from the sun. (Sato et al 2005)

Research is showing further benefits for vitamin D. A study reported in the 'Journal of Bone and Mineral Research' looked at the specific receptors for vitamin D in human muscle tissue, and studies showed increased muscle

strength and reduced falls in the elderly. A double-blind, randomised controlled trial was undertaken with 122 elderly women, concluding that: "a single intervention with vitamin D plus calcium over a 3-month period reduced the risk of falling by 49% compared with calcium alone". (Bischoff et al 2003)

Vitamin K

Vitamin K-dependent proteins have been identified in bone, cartilage and dentine, including osteocalcin, a major non-collagenous protein incorporated in the bone matrix during bone formation. The Framingham Heart Study data showed a decreased incidence of hip fractures with those recording a higher dietary intake of vitamin K. (Booth et al 2000)
Vitamin K is also an essential co-factor involved in blood clotting: patients taking anticoagulants such as Warfarin are instructed not to consume large quantities of foods rich in vitamin K. Vitamin K1 is found in a wide variety of foods, with green leafy vegetables being particularly high. Bacteria in the gastrointestinal tract, especially the colon, provide a source of vitamin K2, it is also found in a small number of foods. Natto fermented soy bean is especially rich, research in Japan with post menopausal women found that a high intake of Natto may help prevent post-menopausal bone loss. (Ikeda et al 2006) The research is unclear if this is directly due to vitamin K, as Natto is also high in phyto-oestrogens, which have also been linked to improved bone density.

Magnesium

Between 55% and 60% of magnesium is found in the bone, forming a major structural part. Magnesium found in the outer layers of the bone is that thought to be drawn on when dietary intake is low. Magnesium regulates the transport and metabolism of calcium, and is necessary for the proper functioning of muscle. (Gropper et al 2005)

Flavonoids and Carotenoids

Phyto-estrogens have been found to have a beneficial effect on bone density in post-menopausal women maintaining bone density and reducing fractures. (Zhang et al 2007) Supplemental levels at 90mg per day demonstrated an increase in bone mineral density of the lumber spine. Ilich et al 2000)

Carotenoid research undertaken in 2003 found beneficial effects for fruit and vegetable consumption and bone health. Bone mass of total body and lumbar spine were positively related to lycopene intake in men, and to lycopene and lutein/zeaxanthin intake in premenopausal women. In addition, a positive association of lumbar spine bone mass with dietary Beta-carotene intake was observed in post-menopausal women. (Wattanapenpaiboon et al 2003)

Omega 3 & 6
The essential fatty acids omega 3 and 6 assist in maintaining bone, increasing calcium absorption and reducing calcium loss.

Other important nutrients:

B6 helps maintain the balance of sodium and potassium and promotes the normal functioning of the nervous and musculoskeletal systems.

Boron & Molybdenum: Small amounts are required by enzymes required for bone growth: boron is believed to be involved in the prevention of calcium loss and bone demineralisation.

Copper is involved in the production of collagen, assisting in the use of vitamin C and the formation of bone tissue.

Iron is an enzyme co-factor for bone formation and the development of collagen.

Manganese is a constituent of enzymes involved in bone metabolism.

Phosphorus is an essential bone-forming element; depletion of phosphorus leads to impaired mineralisation. A balance is required, as high dietary phosphorus is understood to be detrimental for bone, especially if combined with a low calcium diet. (Virpi et al 2006)

Potassium, in particular that found in fruit and vegetables along with its bicarbonate buffers, is seen to promote an alkaline environment and preserve calcium in the bones. By preserving calcium in bones, which might otherwise be mobilised to maintain normal pH, potassium-rich foods may help prevent osteoporosis. (MacDonald et al 2005)

Zinc is an enzyme co-factor for bone mineralisation and the development of collagen.

Supplements to consider:
We would recommend that you ensure a good multivitamin formulation is in place to ensure the whole spectrum of nutrients are available to the body. For many, this should be sufficient alongside healthy diet and exercise to maintain good skeletal structure. For those with increased requirements, and/ or existing bone deterioration, additional products can be included to meet the individual requirements.

Multi Formulae:

4110/4111	Cyto Gold
4107/4108	Foundation Formulae
3310/3311	Wholefood Multi
4007	Antioxidant Plus CoQ10
5511	Biofood CMB Plus

Vitamins & Minerals:

1902/1903	Vitamin C Extra
3305	Wholefood Calcium
5565/5595	Biofood Magnesium

Nutritional Supplements:

3230	Phyto-Flavone
3209	Phytoshield
2162/2163	Glucosamine Hydrochloride, or
2167	Vegan Glucosamine Hydrochloide
4031	H Formula
1160	Lem-O-3, or
1155/1161	High Strength Fish Oil Capsules
1216-1218	Organic Flaxseed Oil, or
4219	Flaxseed Oil Capsules
1163	Krill Oil

Pre & Pro Biotics

3220/3221	Cyto-Biotic Active
4134	Fos-a-Dophilus
4140/4141	Probiotic Plus

References

Heike A Bischoff, Hannes B Stahelin, Walter Dick, Regula Akos, Margrith Knecht, Christian Salis, Matthias Nebiker, Robert Theiler, Michael Feifer, Bettina Begerow, Robert A Lew, and Martin Conzelmann *"Effects of Vitamin D and Calcium Supplementation on Falls:A Randomized Controlled Trial"* Journal of Bone and Mineral Research Volume 18, Number 2, 2003 18:343–351)

MJ Bolland, PA Barber, RN Doughty, B Mason, *"Vascular events in healthy older women receiving calcium supplementation."* British Medical Journal, 2008 - February 2; 336(7638): 262–266.

Sarah L Booth, Katherine L Tucker, Honglei Chen, Marian T Hannan, David R Gagnon, L Adrienne Cupples, Peter WF Wilson, Jose Ordovas, Ernst J Schaefer, Bess Dawson-Hughes and Douglas P Kiel *"Dietary vitamin K intakes are associated with hip fracture but not with bone mineral density in elderly men and women."* American Journal of Clinical Nutrition, Vol. 71, No. 5, 1201-1208, May 2000

Luigi Gennari, MD, and John P. Bilezikian, MD. *"Osteoporosis in Men: Pathophysiology and Treatment"* Current Rheumatology Reports 2007, 9:71–77

I. J. Griffin, P. M. Davilaand S. A. Abrams *"Non-digestible oligosaccharides and calcium absorption in girls with adequate calcium intakes."* British Journal of Nutrition (2002), 87, Suppl. 2, S187–S191

Gropper Sareen s. Smith Jacl L, Groff James L. *"Advanced Nutrition and Human Metabolism"* Wadsworth Cengage Learning, Belmont 2005 5th edition

Robert P. Hanzlik, Stephen C. Fowler, and Daniel H. Fisher. *"Relative Bioavailability of Calcium from Calcium Formate, Calcium Citrate, and Calcium Carbonate."* The Journal of Pharmacology and Experimental Therapeutics Vol. 313, No. 3 1217–1222, 2005

Yukihiro Ikeda, Masayuki Iki, Akemi Morita, Etsuko Kajitay Sadanobu Kagamimori, Yoshiko Kagawaz and Hideo Yoneshima. *"Intake of Fermented Soybeans, Natto, Is Associated with Reduced Bone Loss in Postmenopausal Women: Japanese Population-Based Osteoporosis."* Journal of Nutrition. 136: 1323–1328, 2006.

Ilich Jasminka PhD, Kerstetter Jane E PhDRD *"Nutrition in Bone Health Revisited: A Story Beyond Calcium."* Journal of the American College of Nutrition, Vol19, No6, 715-737. (2000)

Graeme Jones, Malcolm D Riley, Susan Whiting. *"Association between urinary potassium, urinary sodium, current diet, and bone density in prepubertal children."* Am.J.Clin. Nutr. 2001;73:839-44

Sundeep Khosla, Shreyasee Amin, and Eric Orwoll *"Osteoporosis in Men."* Endocrine Reviews 29(4):441–464. 2008

Inga Klimczak, Maria Maecka, Mirosawa Szlachta and Anna Gliszczyñska-Swiglo. *"Effect of storage on the content of polyphenols, vitamin C and the antioxidant activity of orange juices."* Journal of Food Composition and Analysis Volume 20, Issues 3-4, May 2007, Pages 313-322

Christian Linden, Henrik G Ahlborg, Jack Besjakov, Per Gardsell, and Magnus K Karlsson. *"A School Curriculum–Based Exercise Program Increases Bone Mineral Accrual and Bone Size in Prepubertal Girls: Two-Year Data From the Pediatric Osteoporosis Prevention (POP) Study."* Journal of Bone and Mineral Research.Volume 21, Number 6, 2006

Robert R. McLean, M.P.H., Paul F. Jacques, D.Sc., Jacob Selhub, Ph.D., Katherine L. Tucker, Ph.D., Elizabeth J. Samelson, Ph.D., Kerry E. Broe, M.P.H., Marian T. Hannan, D.Sc., L. Adrienne Cupples, Ph.D., and Douglas P. Kiel, M.D. *"Homocysteine as a Predictive Factor for Hip Fracture in Older Persons."* N Engl J Med 2004;350:2042-9.

Helen M MacDonald, Susan A New, William D Fraser, Marion K Campbell, and David M Reid. *"Low dietary potassium intakes and high dietary estimates of net endogenous acid production are associated with low bone mineral density in premenopausal women and increased markers of bone resorption in postmenopausal women."* Am J Clin Nutr 2005;81:923–33.

Y Sato, J Iwamoto, T Kanoko, K Satoh. *"Amelioration of Osteoporosis and Hypovitaminosis D by Sunlight Exposure in Hospitalized, Elderly Women With Alzheimer's Disease: A Randomized Controlled Trial."* J Bone Miner Res, 2005 Aug;20(8):1327-33.

Deborah E. Sellmeyer, Monique Schloetter, Anthony Sebastian. *"Potassium Citrate Prevents Increased Urine Calcium Excretion and Bone Resorption Induced by a High Sodium Chloride Diet."* The Journal of Clinical Endocrinology & Metabolism 87(5):2008–2012

Laura E.Targownik MD MSHS, Lisa M. Lix PhD, Colleen J. Metge PhD, Heather J Prior MSc Stella Leung MSc, William D. Leslie MD. *"Use of proton pump inhibitors and risk of osteoporosis related Fractures."* Canadian Medical Association Journal 2008;179(4):319-26

Katherine L Tucker, Kyoko Morita, Ning Qiao, Marian T Hannan, L Adrienne Cupples, and Douglas P Kiel. *"Colas, but not other carbonated beverages, are associated with low bone mineral density in older women: The Framingham Osteoporosis Study."* Am J Clin Nutr 2006;84: pg 936-942

Virpi E. Kemi, Merja U. M. Karkkainen and Christel J. E. Lamberg-Allardt. *"High phosphorus intakes acutely and negatively affect Ca and bone metabolism in a dose-dependent manner in healthy young females."* British Journal of Nutrition (2006), 96, 545–552

Naiyana Wattanapenpaiboon PhD, Widjaja Lukito PhD, Mark L Wahlqvist AO, MD, and Boyd JG Strauss PhD, MD. *"Dietary carotenoid intake as a predictor of bone mineral density."* Asia Pacific J Clin Nutr 2003;12 (1): 467-473

Connie M Weaver. *"The growing years and prevention of osteoporosis in later life."* Proceedings of the Nutrition Society (2000), 59, 303–306 303

Susan J. Whiting, PhD, Jennifer L. Boyle, MSc, Angela Thompson, PhD, Robert L. Mirwald, PhD, and Robert A. Faulkner PhD, *"Dietary Protein, Phosphorus and Potassium Are Beneficial to Bone Mineral Density in Adult Men Consuming Adequate Dietary Calcium."* Journal of the American College of Nutrition, Vol. 21, No. 5, 402–409 (2002)

Grace Wyshak *"Teenaged Girls, Carbonated Beverage Consumption, and Bone Fractures."* PhD Arch Pediatr Adolesc Med. 2000;154:610-613

Ge Zhang, Ling Qin, and Yinyu Shi. *"Epimedium-Derived Phytoestrogen Flavonoids Exert Beneficial Effect on Preventing Bone Loss in Late Postmenopausal Women: A 24-Month Randomized, Double-Blind and Placebo-Controlled Trial."* Journal of Bone and Mineral Research Volume 22, Number 7, 2007. pg1072-1079

CYTOPLAN LTD.
Unit 8 Hanley Workshops, Hanley Road,
Hanley Swan, Worcestershire. WR8 0DX.
t: 01684 310099
f: 01684 312000
e: info@cytoplan.co.uk
www.cytoplan.co.uk