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CAN OSTEOPOROSIS BE PREVENTED OR REVERSED? NUTRITIONAL PROTOCOL FOR REVERSAL OF OSTEOPOROSIS WITHOUT MEDICATION SIDE-EFFECTS

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ABSTRACT
Osteoporosis is a common degenerative bone disorder currently affecting over 200 million people worldwide. It develops predominantly with age and affects mainly women due to hormonal imbalance post-menopause. However, lifestyle factors and malnutrition also plays a key role in the progression of the disease. The aim of this paper is to identify major causes of osteoporosis and how they affect the bone's structure and propose a protocol for the reversal, reduction or prevention of this degenerative bone disorder.

INTRODUCTION

Bone is a living tissue which is constantly remodelled to ensure optimum support and protection of an individual. The remodelling of bone relies on two major types of cells: osteoclasts and osteoblasts. Osteoclasts are responsible for bone resorption, i.e. breakdown of older bone to release minerals such as calcium into the blood stream. Osteoblasts antagonise the function of osteoclasts and are responsible for bone ossification, i.e. laying down new collagen matrix that contain minerals such as calcium, magnesium and other trace minerals to create healthier, stronger bone. The rate of activity of these cells is highly dependent on hormones such as parathyroid hormone, which is easily affected by cellular imbalance between calcium and magnesium [1,2]. Several types of diets exist in the world including Chinese, Asian and Western diets which include different types of foods prepared and consumed by different communities and ethnicities in their own manner. The Western diet refers to a diet that is high in refined sugars, saturated fats, dairy, red meats, 'empty' carbohydrates and low in fresh fruits, whole grains and vegetables [3] and is mainly consumed in developed countries such as the United Kingdom and America. It is highly malnourishing as it contains high levels of calcium [4] consumed from dairy products coupled with low levels of vitamin D due to lack of sunlight [5]. Clinical and pre-clinical research and development are focused mainly on drug treatment of osteoporosis rather than the alternatives. Medications such as risedronate [6] and alendronate [7] have shown increases in the bone mineral density; however, this change has not been significant enough when compared to the side-effects that are associated with such drugs. Glucocorticoids, commonly used to improve rheumatoid arthritis symptoms, have been known to cause secondary osteoporosis [8,9].

It has been reported [10] that proper nutrition is the key to preventing osteoporosis without needing medication later on in life. The current treatment for osteoporosis has shown to be ineffective in increasing bone mineral density [11] as during the course of treatment the bone mineral density only decreased leaving patients more vulnerable to fractures and then increased to the initial BMD.

Dietary Procedure

There are many known causes of osteoporosis including genetics [12], hormonal imbalance [13] [14] [15] [16], lifestyle factors such as smoking [17], drinking [18], exercise [19] [20] [21], diet containing high levels of sugar, calcium, sodium combined with low levels of magnesium, vitamin D and vitamin K. A diet that lacks vitamin D aids the chance of developing osteoporosis. Bone mineral density decreases when calcium in the body is depleted, possibly as a result of high sugar intake [47] by the individual, the body compensates by taking calcium from the bone. The current protocol focuses on one of the major causes of osteoporosis found in both males and females, i.e. high calcium intake with low magnesium intake caused by malnutrition in human beings [22].

A well-nourished diet contains a balance between minerals and vitamins such as vitamin D, obtained from sunlight, which is essential for absorption of calcium [23] [24]. However, lack of magnesium in the diet causes lack of calcium absorption as blood concentration of calcitonin, a naturally occurring hormone responsible for promoting calcium absorption decreases [25] [26]. Parathyroid hormones also decrease due to lack of magnesium resulting in an increase in the rate of osteoclast activity leading to increased bone resorption [27] [28].

Protocol

The protocol focuses on increasing the bone mineral density (BMD) by increasing the rate of osteoblast activity to create healthy bone. Potassium is a key element for cell membrane potentials and is therefore important in maintaining healthy bone formation. A healthy ion exchange through the cell membrane results in optimum nutritional uptake by the bone remodelling cells to provide a higher bone mineral density [29]. BMD is increased by re-establishing the lost balance between calcium and magnesium to the optimum ratio of 2:1 [30]. In the Western diet calcium is one of the key minerals along with sodium, chloride and potassium responsible for creating the positive and negative ionic concentrations that affect the optimum functionality of the cell membrane [31]. Majority of the Western diet suffers from imbalanced ratios of these elements at a cellular level resulting in bone cells working below optimum levels to create compromised bone formation. For patients suffering from osteoporosis and having high levels of calcium the initial stage of this protocol requires decreasing calcium levels in the body to acceptable optimum levels which may take about 3-5 months in order to increase magnesium concentration to optimum levels. It is also important to obtain acceptable levels of major as well as trace minerals [32] as shown in Table 1 [33]. Carbon, boron, copper, fluoride, phosphorus, germanium-132, iodide and selenium, lithium, manganese, nickel, silicon, betaine (trimethylglycine), vanadium, strontium, zinc, and vitamin D [34] and vitamin K [35] [36] from diet are some of the known trace minerals essential for bone health. Boron [37] [27] is known to increase bone strength by ensuring calcium and magnesium is not excreted through the urine. Copper is responsible for increasing collagen cross-linkage by osteoblasts during the bone remodelling cycle. Another essential trace mineral that is responsible for bone health during the early bone formation stages is known as silicon [38]. It is deposited in the collagen mesh in the earlier stages and is later replaced by calcium. Silicon supplements also decrease osteoclasts resulting in an overall increased bone mineral density. Manganese is found mostly in the bones and ensures healthy bone and synovial fluid and cartilage formation. Selenium and iodine [39] are also essential for bone growth and development. Selenium has shown to have a positive effect on bone formation, i.e. on osteoblast proliferation, however, the mechanism is yet to be confirmed. Hypothyroidism and hyperthyroidism are two conditions related to the thyroid gland that lead to low bone density and are affected by the function of the thyroid gland. Iodine ensures proper function of the thyroid gland so that bone quality is not compromised. Zinc [40] is important for bone mineralization by promoting collagen mesh synthesis. Vanadium [41] aids the process of osteogenesis, i.e. osteoblast proliferation to create stronger and healthier bone. Strontium deals with the bone remodelling cycle and reduces osteoclast activity. Fluoride [42], a mineral obtained easily through drinking water in many countries including UK increases osteoid formation and increases trabecular bone density. Lithium [43] is another trace mineral, which when used in excess leads to hyperparathyroidism. This results in increased urinary calcium via leaching. Phosphorus [44] combines with calcium to create hydroxyapatite, the inorganic constituent of the bone matrix essential for bone mineralization. Like fluoride, germanium-132 [45] reduces trabecular bone loss and increases bone strength while acting as an antioxidant to protect bone-remodelling cells.

The next stage is to determine whether the ratio of calcium:magnesium (2:1) is correct and confirmed via blood tests and once the correct ratio has been achieved, then the follow up stage requires the individual to focus on maintaining the correct ratio from diet.

Limitation

This study is based on the existing literature and focuses on the effect of nutrition on BMD, however, there are other lifestyle and genetic factors that also play a vital role in the development of the osteoporosis disorder. While several aspects of this study can be applied to the real world, but several implications would be observed for public health policy makers, health practitioners and nutritionists. Application of the protocol could prove to be difficult in the modern Westernized era where fast food is easily available and contributes to a significant proportion of the nutrition consumed.

Table 1. Role of Trace Minerals and Vitamins [33].

Mineral	*Role*	*Optimum Dose/day*
Boron	Maintain bone strength	2-3 mg
Calcium	Transmits nerve impulses, muscle contraction, blood clotting and is a major constituent of bone	1000 mg
Copper	Promotes collagen cross-linkage	0.9 mg
Fluoride	Delays mineralization of bone and increases osteoid formation	Male: 4 mg Female: 3 mg
Iodine	Prevent ineffective function of thyroid gland	0.15 mg
Lithium	Excess use causes calcium leaching by hyperparathyroidism	0.6 - 1.2 mmol/l
Manganese	Ensures healthy development of bone	Male: 2.3 mg Female: 1.8 mg
Phosphorus	Important for bone mineralization	700 mg
Potassium	Important for maintenance of optimum cell membrane potential	4700 mg
Selenium	Antioxidant which prevents oxidative stress on osteoblasts	0.005 mg
Silicon	Important for bone growth and development	9 – 14 mg
Sodium	Increases bone remodelling	1500 mg
Strontium	Important for bone remodelling	-
TriMethylglycine (betaine)	Protects cells, proteins and enzymes	-
Vanadium	Aids osteogenesis	0.5 – 1.0
Vitamin A	Important for bone health but excess can cause increase in osteoclast activity	Male: 0.9 mg Female: 0.7 mg
Vitamin C	Maintain bone mass by promoting bone remodelling cells	Male: 90 mg Female: 75 mg
Vitamin D	Affects PTH and calcium absorption	0.05 mg
Vitamin K	Improves bone health by affecting calcium balance	0.03 mg
Zinc	Stimulates osteoblasts and promotes bone mineralization	Male: 11 mg Female: 8 mg

CONCLUSIONS

If an individual follows a balanced diet that constitutes of minerals and nutrients important for bone metabolism, regardless of age or gender, it is possible to prevent and possibly reverse osteoporosis in patients. However, the current diet of individuals, children and adults, depletes the bone of the important minerals it requires. This leads to a higher number of patients suffering from this degenerative disease later on in life thus increasing demand for pharmaceutical medications for "treatment" which have been reported to be ineffectual in fulfilling their purpose of increasing BMD without causing substantial harm to the individual [46].

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