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NUTRITION

Commit to protein for strong bones.

A diet containing rich amounts of dairy protein can help protect bone health during ageing.

By Aaron Fanning.

Introduction

There is a global trend to ageing populations. These demographic changes are being seen first in Germany and Japan, but the number of people over 60 years of age globally will surpass two billion by 2050 (United Nations, 2015) with over billion living in Asia.

Enjoying a long active life is a goal of many people, but unfortunately, with increasing age comes a reduction in physical capacity, particularly from the fifth decade of life onwards. This decline in physical capacity is due to reduced function of most tissues such as heart, lung, as well as bone and muscle (Stein & Moritz, 1999).

The rate of decline is largely dependent on lifestyle factors such as smoking, alcohol consumption, physical activity levels and especially diet. If the decline is too quick due to poor lifestyle, it can result in reduced mobility. Early intervention to improve lifestyle determinants of functional capacity can slow the rate of decline and ensures a greater chance of maintaining health and mobility well into older age.

Osteoporosis is a skeletal disorder of compromised bone strength that increases the risk of bone fracture (NIH Consensus Development Panel, 2001).

Osteoporotic fracture may have a significant impact a person's quality of life, with consequences ranging from disability and chronic pain to increased risk of death (Johnell & Kanis, 2006). Rates of osteoporotic fractures are also projected to substantially increase (Odén et al, 2015), due to the rapidly ageing population - especially within wider Asia – increasing the overall burden of disease on the population.

BONE AS A CRITICAL TISSUE TO ENABLE HEALTHY AGEING

Bone is a complex living tissue that is critical to healthy ageing. It is often perceived as inert but its activity is ceaseless, responding rapidly to coordinate homeostasis throughout the lifespan, constantly turning over, and with specialised cells that breakdown bone, while others are synthesising new bone. Bone is a specialised connective tissue – that connects other tissues together. Bone forms the structure to the body, and has an impressive strength to weight ratio (Dempster, 2004). When bone acts as a lever, it not only supports muscle's movement but can withstand the lifting of weights more than three times the person's total bodyweight, as well as protecting soft tissue and organs.

Bone is a composite material with a collagen (a protein) framework, which is filled with minerals such as calcium, and growth factors. Bone needs a consistent dietary supply of bone building minerals (calcium, magnesium, phosphorus, boron, zinc, copper and manganese), protein and vitamins D and K to maintain the reserves in the bone (Anderson et al, 2012) as well as other nutrients and energy to maintain its structural integrity. This is especially important at a young age, with recommendations highlighting the promotion of peak bone mass development in the critical period for bone accretion from childhood, right through to late adolescence to maximise bone mass. In later adult life, maintenance of a healthy lifestyle, especially weight bearing exercise and a nutrient rich diet will help reduce the risk of fracture.

PROTEIN TO SUPPORT THE MAINTENANCE OF STRONG BONES

Adequate consumption of dietary calcium and other bone nutrients is a common public health message to help maximise and maintain bone mass, and reduce risk of fracture in older age (Weaver et al, 2016). Low bone mineral density (BMD), an important component of bone strength, is a major risk factor for the attributable fracture risk from falls (Sànchez-Riera et al, 2014). Another aspect to bone strength is the quality of the bone, especially the structure of the bone, both from the collagen and the distribution of the minerals throughout.

Protein makes up 50% of bone volume, and over 30% of its weight (Heaney, 2007) being one of the most protein dense tissues in the body. With continual bone turnover, there needs to be a consistent supply of quality dietary protein to provide the essential amino acids to synthesise new structural bone proteins. The rate that bone synthesises protein is similar in magnitude to the rate seen in muscle. This nutritional sensitivity is evidenced after a protein containing meal which substantially increases the rate of protein synthesis in bone (Babraj et al, 2005). Dietary protein has a variety of anabolic effects on bone. Protein regulates the production of the growth factor IGF-1. Which helps stimulate the formation of new bone (Darling & Lanham-New, 2012). IGF-1 also plays a role in the mineralisation of the bone matrix. Dietary protein also increases calcium absorption from the gut, helping to regulate calcium balance (Darling & Lanham-New, 2012).

Inadequate protein intake is known to impact bone health (Darling & Lanham-New, 2012), so it's essential to provide adequate levels of protein daily to support health, however, with a number of groups recommending older adults should be consuming higher levels of protein (Bauer et al, 2013; Deutz et al, 2014), it is important to understand the impact of this on bone health.

COMBINING PROTEIN AND CALCIUM INTAKE TO SUPPORT HEALTHY AGEING

Previously, higher protein intake was thought to have a negative impact on bone health due to the observation that higher protein diets are associated with an increase in calcium excreted from the body (Allen et al, 1979; Margen et al, 1974; Chu et al, 1975; Johnson et al, 1970). The assumption was that the increase in calcium excretion would result in a negative bone mineral balance, impacting bone strength and ultimately osteoporosis and fracture risk. This increase in calcium excretion was thought to be driven by increased calcium breakdown in the bone to buffer the acid load resulting from oxidation of sulphur containing amino acids in dietary protein (Massey, 1998). Conflicting study results have meant the source of the increased calcium lost in the urine with a high protein diet, and therefore higher acid load, remains unconfirmed (Cao & Nielson, 2010).

However, what is known is that protein also increases the bioavailability of calcium (Zhao et al, 2005; Kerstetter et al, 2004; Kerstetter et al, 2005). It is suggested that an almost complete compensation of calcium loss in the urine occurs by increased intestinal absorption in healthy adults (Fenton et al, 2009). This increase in calcium absorption appears to help balance the overall calcium metabolism so higher protein consumption does not negatively impact BMD, but in fact appears to provide a small beneficial impact on BMD (Darling et al, 2009).

Another mechanism for the positive influence of protein on bone is mediated through protein helping conserve muscle mass (Meng et al, 2009). It is known that muscle mass declines in a similar pattern to the declines seen with bone over the lifetime, in a process known as sarcopenia (Cruz-Jentoft et al, 2010), and that consumption of higher amounts of protein is protective of muscle mass (Houston et al, 2008). By maintaining higher muscle mass, there are potentially greater forces being exerted on bone, improving bone health. Protein and calcium intake of older adults should be carefully considered in prevention or treatment of both osteoporosis and sarcopenia.

Dairy products, such as milk, yoghurt and cheese, are a natural fit in a diet to improve intakes of both protein and calcium, containing these and other important bone nutrients. Many dietary guidelines from around the world (Food and Agriculture Organisation, 2016) recommend adequate dairy consumption to meet the recommended intakes daily of calcium. Dairy is also an excellent source of high quality protein (Rutherford et al, 2015). Dairy protein has been shown to stimulate muscle protein synthesis (Mitchell et al, 2015) and recent data indicates that higher dairy protein intake is protective against bone fractures in men (Langsetmo et al, 2016).

Conclusion

In conclusion, a diet containing rich amounts of dairy products - including milk, yoghurt and cheese – can help protect bone health during ageing. In addition, high quality dairy protein ingredients allow the production of dairy fortified foods and beverages that bring the quality of dairy protein and calcium into novel everyday foods.

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