

## protein for bone health: a focus beyond calcium

### Introduction

Adequate nutrition is critical for the development and maintenance of healthy bones. The role of micronutrients such as calcium and vitamin D in bone health has been well established.<sup>1</sup> A growing body of scientific evidence further indicates that dietary protein may be as important as calcium and vitamin D for bone health and the subsequently for the prevention of osteoporosis. However, the net effect of protein intake on bone health is a complex subject that includes factors such as overall food intake, dietary protein level, the source of protein, calcium intake, weight loss, dietary acid/base balance and the interactions between protein and other nutrients.<sup>1,2,3,4</sup>

### Some bone basics: a focus on protein

Focusing now on bones specifically, protein constitutes about 50% of bone volume. Bone maintenance requires a continuous supply of dietary protein since several amino acids released during bone resorption cannot be recycled during new protein synthesis owing to their existing cross-linking.<sup>1</sup>

Interestingly, a more recent review of scientific literature on the impact of protein on bone health concludes that the optimal level of protein intake for bone health is likely higher than was previously recommended.<sup>4</sup>

### Supporting evidence

A number of studies – mostly focusing on older individuals – confirm the importance of adequate dietary protein intake for bone health.

- Elderly men and women who consumed 70 to 83 and 66 to 81 g protein per day respectively (particularly animal protein), appeared to be protected against the loss of bone mineral density.<sup>5</sup>
- Menopausal women (aged between 55 and 69 years) the intake of dietary protein at an average level of 10.85g/MJ, of which 7.96 g/MJ were from animal sources, was associated with a reduced incidence of hip fractures.<sup>6</sup>
- A randomised control feeding study of healthy postmenopausal women (aged between 50 and 80 years) revealed that calcium absorption from a low-calcium diet improved slightly following a moderate increase in dietary protein intake (increased from 10% to 20% of total energy intake).<sup>7</sup>
- Among elderly women a higher protein intake (in the ranges 66 to 87 g / day, as well as the 87 + g / day range) was associated with optimised bone mass.<sup>8</sup>
- A higher total protein intake (for women 17.0% compared to 15.9% of total energy; for men 15.3% compared to 15.2% of total energy) was associated with a reduced hip fracture risk in individuals between 50 and 69 years.<sup>9</sup>
- Total and animal protein consumption (71.2 g/day ± 24.8) by women between 55 and 92 years of age and men (73.8 g/day ± 23.4) was significantly associated with improved skeletal health.<sup>10</sup>

### Did you know?

- Scientific evidence has shown that dietary protein intake may have a positive impact on bone health in both young and older individuals.<sup>1</sup>
- Dairy products – especially milk – provides a combination of high-quality protein, calcium and phosphorus in a ratio that is optimal for skeletal growth and development.<sup>1</sup>

A significant association was also found between long-term dietary protein intake and positive changes in bone strength in healthy youth between 6 and 18 years of age.<sup>14</sup>

Studies without specific age focus have also investigated the relationship between protein intake and bone health. The major findings of these studies include:

- With regard to the link between protein intake and the fraction of urinary calcium of bone origin, it has been shown that low-protein diets (1.0 g/kg or 66.5 ± 2.3 g/day) cause a reduction in intestinal calcium absorption. The finding suggests that a high-protein diet (2.1 g/kg or 136.4 ± 4.9 g/day) may cause a significant reduction in the fraction of urinary calcium of bone origin.<sup>14</sup>
- The combination of increased daily protein intake (increased from 0.78 g/kg to 1.55 g/kg) and reduced carbohydrate intake, may result in higher bone growth factor levels and reduced bone resorption. This favourable effect may be attributed to the stimulating effect of dietary protein on insulin-like growth factor-1, which is a hormone that stimulates bone formation.<sup>13</sup>
- Protein supplementation (with the supplement containing 90% milk proteins) is associated with improved healing of fractures and the prevention of bone loss in patients who suffered recent hip fractures.<sup>14</sup>

Interestingly, a recent systematic review of the relationship between dietary protein and bone health<sup>15</sup> points out that despite protein being beneficial to bone health, the benefit may not necessarily translate to reduced fracture risk in the long term – confirmation of the complexity of the relationship.

### What about dairy?

The daily intake of dairy products supports bone health by providing a good source of calcium as well as high-quality protein and phosphorus. Dairy, further also provides these nutrients in a ratio that is optimal for skeletal growth and development.<sup>16,17</sup> From this point of view milk is a unique protein source as it contains about 36 mg calcium per 1 g protein.<sup>1</sup>

Several studies found further evidence in support of the role of dairy in bone health:

- Among post-menarcheal girls (average age 16.6 years old), milk contributes to bone health (described in terms of lumbar bone mineral content as well as bone mineral density) by providing a major source of calcium in combination with protein, phosphates, magnesium and other unidentified nutrients.<sup>18</sup>
- A diet rich in dairy-derived protein and calcium, as provided by consuming 500 ml milk, 200 g yoghurt, 30 g cheddar cheese and 50 g skim milk powder per day, minimises bone turnover in overweight adults between 20 and 65 years of age (BMI 27 to 40) during weight loss.<sup>19</sup>
- A recent literature review concluded that dairy products like milk and yoghurt are likely to be beneficial for bone health, predominantly in white women younger than 30 years old.<sup>20</sup> Certain test populations (e.g. males and ethnic minorities) remain underrepresented in such studies, which complicates generalising findings for the human population on the whole.<sup>1</sup>

### Conclusion

In addition to calcium and vitamin D, adequate intake of dietary protein may be recommended for the promotion of bone health and the prevention of osteoporosis. Owing to the interaction between calcium and protein, both should be consumed at adequate levels to optimise the beneficial effects on bone health.<sup>4</sup> Dairy products – especially milk – have a very favourable nutrient ratio for bone health, particularly with regard to its high calcium-protein ratio. This reiterates the importance of including milk and dairy in the daily diet for optimal nutrition and bone health.



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# Dairy

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It can be expected that further research will shed more light on this complex relationship between dietary protein and bone health.

## The role of dairy in bone health

The daily intake of dairy products supports bone health by providing a good source of calcium as well as high-quality protein and phosphorus. Dairy, further also provides these nutrients in a ratio that is optimal for skeletal growth and development.<sup>16,17</sup> From this point of view milk is a unique protein source as it contains about 36 mg calcium per 1 g protein.<sup>1</sup>

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