

Dietary protein increases intestinal calcium absorption and improves bone balance: An hypothesis

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Abstract. Since increasing dietary protein increases urinary calcium, it is hypothesized that high protein diets increase bone resorption and decrease bone mineral density (BMD). However, most cross-sectional studies with BMD or rates of bone loss as the principal outcome, indicate that high protein diets are associated with higher (not lower) BMD and slower (not faster) rates of bone loss. Three recent diet-controlled isotopic calcium studies showed no net loss of calcium from bone during high protein diets in humans. In 1 of these 3 studies, we showed that a high protein diet increased urinary calcium by increasing intestinal calcium absorption. Importantly, during the high protein diet, there was a significant reduction in the fraction of urinary calcium of bone origin and a trend toward a reduction in the rate of bone turnover. All of the 3 isotopic studies suggest that higher protein diets actually improved calcium retention. Based on these data, we suspect that adults who naturally consume a moderately low protein diet are at risk for accelerated bone loss. In this review, we develop the hypothesis that a high protein diet has salutary effects on the skeleton, in part because it increases intestinal calcium absorption. © 2006 Elsevier B.V. All rights reserved.

Keywords: Dietary protein; Parathyroid hormone; Intestinal calcium absorption; Bone mineral density; Osteoporosis

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doi:10.1016/j.ics.2006.08.027

1. Introduction

Osteoporosis and low bone mineral density (osteopenia) affect almost 44 million Americans over the age of 50 years and this number is expected to grow to 52 million by 2010 [1]. It is known that environmental factors, such as nutrition, play a key role in skeletal health. Dietary calcium and vitamin D are the focus of most nutrition studies, while the impact of dietary protein on bone homeostasis is less well understood. Summarized below are data supporting the traditional hypothesis that high protein diets are detrimental to bone health. Experimental data (acute and long-term intervention, and cross-sectional studies in humans) supporting the alternative hypothesis that a high protein diet is beneficial for the skeleton will also be discussed along with potential mechanisms. This review will focus on one of these mechanisms, i.e., the effect of increasing dietary protein on intestinal calcium absorption.

2. The effect of dietary protein on urinary calcium

Eighty-five years ago, Sherman [2] first observed that feeding a high meat diet to humans increased urinary calcium. Fig. 1 summarizes data from 26 clinical intervention trials [3] in adults where dietary protein was manipulated and urinary calcium was measured [3]. There is a clear, highly significant, positive relationship between protein intake and urinary calcium. These data establish that dietary protein is an important regulator of urinary calcium.

3. Dietary protein and bone: the controversy

3.1. Are high protein diets 'bad' for the skeleton?

The data in Fig. 1 raise the obvious question, where does the additional urinary calcium originate? Three potential sources are: the diet, intestine, and bone (or any combination of these). In most of the experiments summarized in Fig. 1, dietary calcium was controlled, so

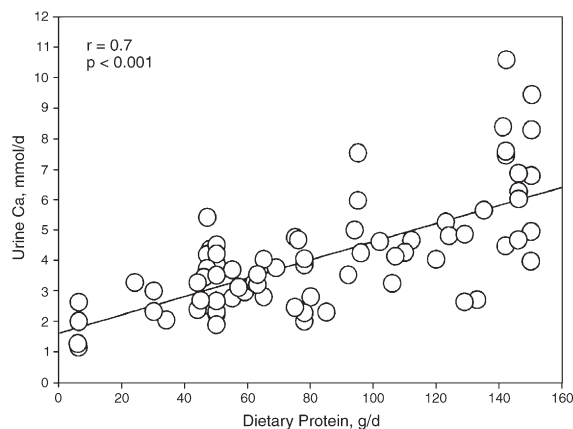


Fig. 1. Meta-analysis of 26 nutrition intervention trials where dietary protein was manipulated and urinary calcium measured [3].

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