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Phosphate decreases urine calcium and increases calcium balance: a meta-analysis of the osteoporosis acid-ash diet hypothesis.

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BACKGROUND:

The acid-ash hypothesis posits that increased excretion of "acidic" ions derived from the diet, such as phosphate, contributes to net acidic ion excretion, urine calcium excretion, demineralization of bone, and osteoporosis. The public is advised by various media to follow an alkaline diet to lower their acidic ion intakes. The objectives of this meta-analysis were to quantify the contribution of phosphate to bone loss in healthy adult subjects; specifically, a) to assess the effect of supplemental dietary phosphate on urine calcium, calcium balance, and markers of bone metabolism; and to assess whether these affects are altered by the b) level of calcium intake, c) the degree of protonation of the phosphate.

METHODS:

Literature was identified through computerized searches regarding phosphate with surrogate and/or direct markers of bone health, and was assessed for methodological quality. Multiple linear regression analyses, weighted for sample size, were used to combine the study results. Tests of interaction included stratification by calcium intake and degree of protonation of the phosphate supplement.

RESULTS:

Twelve studies including 30 intervention arms manipulated 269 subjects' phosphate intakes. Three studies reported net acid excretion. All of the meta-analyses demonstrated significant decreases in urine calcium excretion in response to phosphate supplements whether the calcium intake was high or low, regardless of the degree of protonation of the phosphate supplement. None of the meta-analyses revealed lower calcium balance in response to increased phosphate intakes, whether the calcium intake was high or low, or the composition of the phosphate supplement.

CONCLUSION:

All of the findings from this meta-analysis were contrary to the acid ash hypothesis. Higher phosphate intakes were associated with decreased urine calcium and increased calcium retention. This meta-analysis did not find evidence that phosphate intake contributes to demineralization of bone or to bone calcium excretion in the urine. Dietary advice that dairy products, meats, and grains are detrimental to bone health due to "acidic" phosphate content needs reassessment. There is no evidence that higher phosphate intakes are detrimental to bone health.