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Long-term high urinary potential renal acid load and low nitrogen excretion predict reduced diaphyseal bone mass and bone size in children.

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BACKGROUND:

Longitudinal diet assessment data in children suggest bone anabolic effects of protein intake and concurrent catabolic effects of dietary acid load. However, studies using valid biomarker measurements of corresponding dietary intakes are lacking.

OBJECTIVE:

The aim of the study was to examine whether the association of long-term dietary acid load and protein intake with children's bone status can be confirmed using approved urinary biomarkers and whether these diet influences may be independent of potential bone-anabolic sex steroids.

METHOD:

Urinary nitrogen (uN), urinary net acid excretion (uNAE), and urinary potential renal acid load (uPRAL) were quantified in 789 24-h urine samples of 197 healthy children who had at least three urine collections during the 4 yr preceding proximal forearm bone analyses by peripheral quantitative computed tomography. uPRAL was determined by subtracting measured mineral cations (sodium + potassium + calcium + magnesium) from measured nonbicarbonate anions (chloride + phosphorus + sulfate). In a subsample of 167 children, dehydroepiandrosterone metabolites were quantified by gas chromatography-mass spectrometry. Multivariable regression models adjusted for age, sex, pubertal stage, forearm muscle area, forearm length, and urinary calcium were run with uN and/or uPRAL or uNAE as predictors.

RESULTS:

uN was positively associated with bone mineral content, cortical area, periosteal circumference, and strength strain index. uPRAL (but not uNAE) showed negative associations with bone mineral content and cortical area ($P < 0.05$), both with and without adjustment for the dehydroepiandrosterone-derived sex steroid androstenediol.

CONCLUSIONS:

In line with dietary assessment findings, urinary biomarker analyses substantiate long-term positive effects of protein intake and concomitant negative effects of higher dietary acid load on bone status of children, independent of bone-anabolic sex steroid action.