

### Relationships Between 25-Hydroxyvitamin D, Parathyroid Hormone, and Bone Mass in 4-Year-Old Children in Dhaka, Bangladesh

Dante Wong,<sup>1</sup> Shaila Shanta,<sup>2</sup> Farzana Fariha,<sup>2</sup> Alison Dasiewicz,<sup>3</sup> Jennifer Harrington,<sup>4</sup> Abdullah Al Mahmud,<sup>2</sup> Steven Abrams,<sup>5</sup> Tahmeed Ahmed,<sup>2</sup> Daniel Roth,<sup>3</sup> and Karen O'Callaghan<sup>3</sup>

<sup>1</sup>The Hospital for Sick Children; <sup>2</sup>International Centre for Diarrhoeal Disease Research, Bangladesh; <sup>3</sup>Hospital for Sick Children; <sup>4</sup>Women's and Children's Health Network and University of Adelaide; and <sup>5</sup>Dell Medical School at the University of Texas at Austin

**Objectives:** Elevated serum parathyroid hormone (PTH) concentration was incidentally observed in a high proportion of children in a study in Dhaka, Bangladesh. We explored potential correlates of elevated PTH by estimating the association of PTH with 25-hydroxyvitamin D (25(OH)D) and associations of 25(OH)D and PTH with bone outcomes.

**Methods:** Data were obtained from the BONE and mUScle health in Kids study (BONUSKids; NCT03537443). Total-body less head (TBLH) bone mineral content (BMC) and areal bone mineral density (aBMD) were measured by dual-energy X-ray absorptiometry (DXA). Serum PTH and 25(OH)D were analyzed by chemiluminescent immunoassay and liquid chromatography-tandem mass spectrometry, respectively. BONUSKids participants (n = 642) with DXA, PTH and 25(OH)D data at 4 years were included. Associations between 25(OH)D, PTH and bone outcomes were estimated using unadjusted linear and

two-phase linear spline regression models. Model fit was compared using AIC.

**Results:** Among the 534 children who met inclusion criteria, 43% were vitamin D deficient (< 30nmol/L) and 30% had PTH > 6.9pmol/L. A non-linear inverse relationship was observed between 25(OH)D and PTH. Model fit was optimized with an inflection point at 25nmol/L, above which the association attenuated (< 25nmol/L: -0.16pmol/L per 1nmol/L change in 25(OH)D [95%CI -0.23, -0.10]; ≥ 25nmol/L: -0.02pmol/L [95% CI -0.04, -0.008]). 25(OH)D was positively linearly associated with TBLH BMC (0.39g per 1nmol/L change in 25(OH)D [95%CI 0.10: 0.69]) and aBMD (0.0004g/cm<sup>2</sup> per 1nmol/L change in 25(OH)D [95% CI 0.0002, 0.0006]). There was no significant association between PTH and TBLH BMC. The non-linear association between PTH and TBLH aBMD was negative at PTH > 4pmol/L (< 4pmol/L: 0.002g/cm<sup>2</sup> per 1pmol/L change in PTH [95% CI -0.006, 0.01], ≥ 4pmol/L: -0.002g/cm<sup>2</sup> [95% CI -0.0038, -0.0002]).

**Conclusions:** The non-linear inverse association of PTH with 25(OH)D supports the hypothesis that vitamin D deficiency contributed to elevated PTH in this population. Although 25(OH)D was associated with bone outcomes, the magnitude of the association was similar at 25(OH)D concentrations below and above 25nmol/L. PTH was inconsistently associated with bone outcomes, suggesting single measurements of PTH may not be a useful marker of bone health in this setting.

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