

ORIGINAL RESEARCH COMMUNICATION

# Risk factors for low serum 25-hydroxyvitamin D concentrations in otherwise healthy children and adolescents<sup>1,2,3</sup>

Francis L Weng, Justine Shults, Mary B Leonard, Virginia A Stallings and Babette S Zemel

<sup>1</sup> From the Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA (FLW); the Department of Biostatistics and Epidemiology, Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, PA (FLW, JS, and MBL); and the Divisions of Nephrology (MBL) and Gastroenterology, Hepatology and Nutrition, The Children's Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, PA (BSZ and VAS)

**Background:** Serum 25-hydroxyvitamin D [25(OH)D] concentrations serve as a biomarker for vitamin D stores. Prior studies have not examined the risk factors for low vitamin D concentrations in a multiethnic sample of US youth across a broad age range.

**Objective:** The objective was to determine the prevalence of and factors associated with low concentrations of 25(OH)D in children and adolescents.

**Design:** Serum 25(OH)D concentrations were measured in 382 healthy children aged 6-21 y living in the northeastern United States. Dietary and supplemental vitamin D intake was assessed by interview. Fat and lean mass were assessed by dual-energy X-ray absorptiometry. Multivariable ordinal logistic regression was used to determine factors associated with decreased concentrations of 25(OH)D.

**Results:** The median concentration of 25(OH)D was 28 ng/mL (interquartile range: 19-35 ng/mL), and 55% of subjects had 25(OH)D concentrations <30 ng/mL. 25(OH)D concentrations were inversely correlated with parathyroid hormone concentrations (Spearman's  $r = -0.31$ ,  $P < 0.001$ ) but were not significantly correlated with 1,25-dihydroxyvitamin D concentrations. In the multivariable model, older age ( $P < 0.001$ ), black race [odds ratio (OR): 14.2; 95% CI: 8.53, 23.5], wintertime study visit (OR: 3.55; 95% CI: 2.29, 5.50), and total daily vitamin D intake <200 IU (OR: 1.58; 95% CI: 1.02, 2.46) were associated with low vitamin D concentrations. Fat and lean mass were not independently associated with vitamin D status in this healthy-weight sample.

**Conclusion:** Low serum 25(OH)D concentrations are prevalent in otherwise healthy children and adolescents in the northeastern United States and are related to low vitamin D intake, race, and season.

**Key Words:** Vitamin D • 25-hydroxyvitamin D • children • adolescents • 1,25-dihydroxyvitamin D • parathyroid hormone

This article has been cited by other articles:

This Article

- ▶ [Full Text](#)
- ▶ [Full Text \(PDF\)](#)
- ▶ [Purchase Article](#)
- ▶ [View Shopping Cart](#)
- ▶ [Alert me when this article is cited](#)
- ▶ [Alert me if a correction is posted](#)
- ▶ [Citation Map](#)

Services

- ▶ [Similar articles in this journal](#)
- ▶ [Similar articles in PubMed](#)
- ▶ [Alert me to new issues of the journal](#)
- ▶ [Download to citation manager](#)
- ▶ [Get Permissions](#)

Citing Articles

- ▶ [Citing Articles via HighWire](#)
- ▶ [Citing Articles via Google Scholar](#)

Google Scholar

- ▶ [Articles by Weng, F. L.](#)
- ▶ [Articles by Zemel, B. S.](#)
- ▶ [Search for Related Content](#)

PubMed

- ▶ [PubMed Citation](#)
- ▶ [Articles by Weng, F. L.](#)
- ▶ [Articles by Zemel, B. S.](#)

Agricola

- ▶ [Articles by Weng, F. L.](#)
- ▶ [Articles by Zemel, B. S.](#)

**The American Journal of CLINICAL NUTRITION**[▶ HOME](#)

A. C. Looker, C. M Pfeiffer, D. A Lacher, R. L Schleicher, M. F. Picciano, and E. A Yetley  
Serum 25-hydroxyvitamin D status of the US population: 1988-1994 compared with 2000-2004  
Am. J. Clinical Nutrition, December 1, 2008; 88(6): 1519 - 1527.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**The American Journal of CLINICAL NUTRITION**[▶ HOME](#)

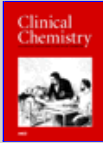
A. C. Bergqvist, J. I Schall, V. A Stallings, and B. S Zemel  
Progressive bone mineral content loss in children with intractable epilepsy treated with the ketogenic diet  
Am. J. Clinical Nutrition, December 1, 2008; 88(6): 1678 - 1684.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**Clinical Journal of the American Society of Nephrology**[▶ HOME](#)

R. P. Heaney  
Vitamin D in Health and Disease  
Clin. J. Am. Soc. Nephrol., September 1, 2008; 3(5): 1535 - 1541.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**Journal of Nutrition**[▶ HOME](#)

B. Hintzpeter, C. Scheidt-Nave, M. J. Muller, L. Schenk, and G. B. M. Mensink  
Higher Prevalence of Vitamin D Deficiency Is Associated with Immigrant Background among Children and Adolescents in Germany  
J. Nutr., August 1, 2008; 138(8): 1482 - 1490.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**Clinical Chemistry**[▶ HOME](#)

S. Mark, K. Gray-Donald, E. E. Delvin, J. O'Loughlin, G. Paradis, E. Levy, and M. Lambert  
Low Vitamin D Status in a Representative Sample of Youth From Quebec, Canada  
Clin. Chem., August 1, 2008; 54(8): 1283 - 1289.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**ARCHIVES OF PEDIATRICS & ADOLESCENT MEDICINE**[▶ HOME](#)

A. J. Rovner and K. O. O'Brien  
Hypovitaminosis D Among Healthy Children in the United States: A Review of the Current Evidence  
Arch Pediatr Adolesc Med, June 1, 2008; 162(6): 513 - 519.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

**The American Journal of CLINICAL NUTRITION**[▶ HOME](#)

A. J Rovner, V. A Stallings, J. I Schall, M. B Leonard, and B. S Zemel  
Vitamin D insufficiency in children, adolescents, and young adults with cystic fibrosis despite routine oral supplementation  
Am. J. Clinical Nutrition, December 1, 2007; 86(6): 1694 - 1699.  
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)