

# Screening Adolescents at Risk for Vitamin D Deficiency: A Retrospective Study

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## ABSTRACT

Clinical practice guidelines differ on screening recommendations and definitions for adequate vitamin D levels. A chart review of 32 overweight/obese adolescents showed that 91% had low vitamin D levels based on the Endocrine Society definition of sufficient levels ( $\geq 30$  ng/mL), whereas only 56% were low based on the American Academy of Pediatrics definition of sufficient levels ( $>20$  ng/mL). Nurse practitioners should routinely inquire about exercise, healthy diet, and outdoor activities to identify those at risk for low vitamin D. A consensus in recommendations for vitamin D screening and sufficient serum levels would be beneficial for nurse practitioners for early recognition and consistency in care.

**Keywords:** adolescents, obesity, risk factors, screening, vitamin D

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## INTRODUCTION

Vitamin D status is important in childhood and adolescence through its role in regulation of calcium and phosphorus metabolism. Deficiency during childhood can cause skeletal deformities such as rickets.<sup>1</sup> Because peak bone mass is achieved during the adolescent years, it also has a major influence on risk of osteoporosis during adulthood.<sup>1</sup> At any age, vitamin D deficiency ( $< 20$  ng/mL) is associated with multiple chronic conditions, including obesity, hypertension, type 2 diabetes, abnormal lipids, arterial thickening, and increased risk of severe asthma and allergy symptoms.<sup>2-8</sup> For example, a large study of children with persistent asthma noted that those with vitamin D deficiency ( $< 20$  ng/mL) had significantly poorer lung function than those with insufficient (21–29 ng/mL) or sufficient levels ( $\geq 30$  ng/mL).<sup>8</sup>

To prevent deficiency in adolescents, a daily intake of 600 IU of vitamin D is recommended.<sup>7</sup> The primary source of vitamin D is exposure to sunlight.<sup>3</sup> Other effects on vitamin D synthesis in the skin include seasonal variation of the sun's angle, timing of sun exposure, latitude, skin pigmentation, and sunscreen use.<sup>7</sup>

Risk factors associated with low vitamin D status include dark skin pigmentation, particularly people of African American and Latino ethnicity, and chronic diseases involving the liver, intestines

(eg, celiac disease), and kidneys.<sup>1</sup> Other risk factors, such as obesity and diet poor in vitamin D, are modifiable by maintaining a healthy weight, vitamin D supplementation, and incorporation of vitamin D-rich diet that includes oily fish and eggs and fortified foods such as milk, orange juice, yogurt, and cereals.<sup>7</sup>

Recently, researchers found that obese children have similar vitamin D bioavailability (defined as vitamin D available in serum) compared with healthy weight children, but have decreased amounts of vitamin D-binding proteins.<sup>9</sup> Without the vitamin D-binding proteins, the bioavailable vitamin D cannot be utilized. The vitamin D-binding protein levels are inversely related to obesity and can be negatively affected by increased insulin resistance.<sup>9</sup> Thus, obese adolescents of ethnic minority with darkly pigmented skin are at increased risk for low vitamin D.<sup>6</sup>

The Endocrine Society and the American Academy of Pediatrics (AAP) differ on recommendations for adequate vitamin D levels and screening recommendations (see Table).<sup>7,10</sup> The Endocrine Society and AAP both recommend screening in those on certain medications, with genetic conditions, or with illnesses that affect absorption. However, the Endocrine Society recommends vitamin D serum levels of  $\geq 30$  ng/mL and screening of obese adults and children and those of African American or Hispanic descent, whereas the AAP suggests  $> 20$  ng/mL and

**Table. Comparison of Vitamin D Screening Recommendations and Target Levels**

	Screening Recommendations	Sufficient Serum Levels	Abnormal Serum Levels
American Academy of Pediatrics <sup>10</sup>	Those with conditions associated with reduced bone mass, including genetic conditions, chronic illness, eating disorders, endocrine conditions, certain medications, or with recurrent low-impact fractures	> 20 ng/mL	Deficient: ≤ 20 ng/mL
Endocrine Society <sup>7</sup>	Obese children and adults (body mass index > 30 kg/m <sup>2</sup> ), African Americans or Latinos, those with malabsorptive disorders or kidney or liver failure, or those on certain medications such as anticonvulsants	≥ 30 ng/mL	Insufficient: 21-29 ng/mL; deficient: ≤ 20 ng/mL

Both the American Academy of Pediatrics and the Endocrine Society recommend serum circulating 25-hydroxyvitamin D [25(OH)D] for screening.

recommends against screening obese people, African Americans, or Hispanics if otherwise healthy.<sup>7,10</sup> Differences in screening recommendations and definition of sufficient levels may confuse nurse practitioners. In 2012, the principal investigator's pediatric primary care office incorporated vitamin D screening with lipid screening for obese adolescents.<sup>11</sup> The purpose of this study was to explore vitamin D deficiency prevalence among overweight/obese adolescents and to compare the results based on the 2 clinical practice guidelines.

## METHODS

### Design and Sample

Once institutional review board approval for the study was obtained, a retrospective descriptive study was completed at 1 pediatric office in the midwestern United States. The inclusion criteria included 10- to 18-year-old overweight/obese adolescents, who completed well-child exams and had vitamin D results in the medical record from March 1 to October 31, 2012, which resulted in a sample size of 32.

Data collected included age, gender, body mass index (BMI) percentile, systolic and diastolic blood pressure, self-reported ethnicity, insurance (private or public), daily multivitamin, serum 25-hydroxyvitamin D, hemoglobin A<sub>1c</sub> or fasting blood glucose, total cholesterol, high-density lipid, low-density lipid, tri-glycerides, and prior documented history of impaired glucose metabolism or hypertension.

For comparison, vitamin D results were categorized by Endocrine Society and AAP classifications. Age- and

gender-specific BMI percentiles were determined using charts of the United States Centers for Disease Control and Prevention.<sup>12</sup> Blood pressure and lipid panel results were categorized based on the pediatric guidelines of the National Heart, Lung and Blood Institute.<sup>11</sup> Glucose level results were classified according to American Diabetes Association criteria.<sup>13</sup>

### Data Analysis

Data were entered into Excel, imported into SPSS version 20.0 (IBM Corporation, Armonk, NY), then analyzed. Descriptive statistics were used to summarize the frequencies of the variables, and chi-square analyses were used to determine any differences between those with sufficient and low vitamin D results. The nonparametric Mann-Whitney *U* test was conducted to compare differences in vitamin D levels between white non-Hispanic and black non-Hispanic adolescents.

## RESULTS

The mean age of the 32 children in the sample was 13.7 (standard deviation [SD] 1.7) years; 59% (*n* = 19) were female; and the mean BMI was 98th percentile. Fifty-three percent (*n* = 17) were black non-Hispanic, 38% were white non-Hispanic, and 3% were Hispanic. Eleven (34%) children had elevated blood pressure at the visit and 3 (9.4%) had a history of hypertension. There was no daily multivitamin intake or previous history of glucose intolerance documented.

Vitamin D levels ranged from 9 to 60 ng/mL. The mean vitamin D level was 21.6 (SD 10.7) ng/mL and

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