analesdepediatría

www.analesdepediatria.org

ORIGINAL ARTICLE

# Hypovitaminosis D and associated factors in 4-year old children in northern Spain☆

Ana Cristina Rodríguez-Dehli[a,*], Isolina Riaño-Galán[a,b], Ana Fernández-Somoano[b,c], Eva María Navarrete-Muñoz[b], Mercedes Espada[e], Jesús Vioque[b,d], Adonina Tardón[b,c]

[a] *Servicio de Pediatría, Hospital San Agustín, Avilés, Asturias, Spain*
[b] *CIBER de Epidemiología y Salud Pública (CIBERESP), Madrid, Spain*
[c] *IUOPA-Área de Medicina Preventiva y Salud Pública, Departamento de Medicina, Universidad de Oviedo, Oviedo, Asturias, Spain*
[d] *Departamento de Salud Pública, Universidad Miguel Hernández, Elche, Alicante, Spain*
[e] *Unidad de Química Clínica, Salud Pública Laboratorio de Bilbao, Bilbao, Spain*

Received 28 October 2015; accepted 9 February 2016

**KEYWORDS**
Vitamin D;
Sun exposure;
Intake;
Dietary supplements

**Abstract**
*Introduction:* Vitamin D is an essential prohormone in calcium and phosphorus homeostasis. Recent studies show a high frequency of insufficiency/deficiency of vitamin D in the general population worldwide. Our objective was to estimate the prevalence of circulating vitamin D [25(OH)D3] deficiency and insufficiency in children and examine the associated factors.
*Material and methods:* A total of 283 children, participants in the cohort INMA-Asturias, were studied. The 25(OH)D3 concentrations were quantified by high performance liquid chromatography. The prevalence of deficiency [25(OH)D3 < 20 ng/mL] and insufficiency [20–29.9 ng/mL] of vitamin D was estimated. Distribution of 25(OH)D3 for month of extraction of specimen, ingestion, and other factors were analysed.
*Results:* The mean 25(OH)D3 was 20.1 ng/mL (range 2.7–49.8), with 8.8% ≥30 ng/mL, 38.5% from 20 to 20.9 ng/mL, and 52.7% < 20 ng/mL. Seasonal variation was found, with lower values in winter. There was no relationship between plasma levels and intake of vitamin D (median 2.7 μg/day, range 0.81–12.62), time outdoors (mean 3 h, range: 0:21–6:55), or BMI or gender, but there was one found with the mother's levels during gestation.
*Conclusions:* There is a high prevalence of vitamin D deficiency/insufficiency in children at 4 years. Solar exposure might not be enough in our region. Healthy children should be encouraged to follow adequate outdoor activities with associated sun exposure. Due to the deficit of intake in childhood, recommendations are needed about a varied diet with vitamin D-containing

☆ Please cite this article as: Rodríguez-Dehli AC, Riaño-Galán IR, Fernández-Somoano A, Navarrete-Muñoz EM, Espada M, Vioque J, et al. Hipovitaminosis D y factores asociados a los 4 años en el norte de España. An Pediatr (Barc). 2017;86:188–196.

* Corresponding author.
*E-mail address:* crdehli@yahoo.es (A.C. Rodríguez-Dehli).

foods in this age group, especially during the winter, and assessing the need of vitamin D supplementation in children at risk.


**PALABRAS CLAVE**
Vitamina D;
Exposición solar;
Ingesta;
Suplementos dietéticos

**Hipovitaminosis D y factores asociados a los 4 años en el norte de España**

**Resumen**
*Introducción:* La vitamina D es una prohormona esencial en la homeostasis del calcio y el fósforo. Estudios recientes muestran una elevada frecuencia de insuficiencia/deficiencia de vitamina D en población general a nivel mundial. Nuestro objetivo ha sido estimar la prevalencia de deficiencia e insuficiencia de vitamina D sérica [25(OH)D3] y examinar sus factores asociados en la infancia.
*Material y métodos:* Se ha estudiado a 283 niños participantes en la cohorte INMA-Asturias. Se determinó la 25(OH)D3 mediante cromatografía líquida de alta resolución. Se han estimado las prevalencias de deficiencia ([25(OH)D3 < 20 ng/ml) e insuficiencia (20-29,9 ng/ml) de vitamina D y se ha analizado la distribución de 25(OH)D3 por mes de extracción, ingesta y otros factores.
*Resultados:* La 25(OH)D3 media fue 20,1 ng/ml (rango 2,7-49,8). El 8,8% tenía 25(OH)D3 $\geq$ 30 ng/ml, el 38,5% entre 20-20,9 ng/ml y el 52,7% < 20 ng/ml. Se halló variación estacional con menores valores en invierno. No se encontró relación entre los niveles plasmáticos y la ingesta de vitamina D (mediana 2,7 μg/día, rango 0,81-12,62), el tiempo al aire libre (mediana 3 h, rango: 0:21-6:55), el índice de masa corporal, ni el sexo, pero sí con los niveles de sus madres durante la gestación.
*Conclusiones:* Existe una elevada prevalencia de deficiencia/insuficiencia de vitamina D a los 4 años. La exposición solar podría no ser suficiente en nuestra región. Se deberían promover actividades al aire libre con una adecuada exposición a la luz solar. Dado el déficit de ingesta en la infancia, es necesario hacer recomendaciones de una alimentación variada rica en vitamina D en este periodo especialmente durante el invierno, valorando la necesidad de suplementar con vitamina D en los niños de riesgo.


## Introduction

Vitamin D, the sun vitamin, is known for its importance in bone health. But this is just the tip of the iceberg, as it is also associated with other health benefits, including decreasing the risk of chronic pathologies such as autoimmune, neurologic or cardiovascular disease or cancer, among others.[1–7]

Low levels of vitamin D during pregnancy and childhood are associated with an increased risk of complications in pregnancy and foetal growth and development (preeclampsia, gestational diabetes, small for gestational age, impaired foetal neurologic development, etc.),[8,9] as well as severe asthma, decreased response to corticosteroids, type 1 diabetes, rheumatoid arthritis, cancer and cardiovascular disease,[3,5,10,11] not to mention, of course, the resurgence of rickets.[12]

Recent population-based studies have found a high prevalence of low serum levels of vitamin D [25(OH)D3] worldwide, including in children.[13,14]

There is no universal consensus on the optimal 25(OH)D3 serum levels needed to achieve an adequate bone mineralisation, and there is even less agreement on the levels required for the other functions of this prohormone.[15–17] Thus, while the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) and the Institute of Medicine (IOM) of the United States define sufficiency as levels of 20 ng/dL and greater, the Endocrine Society (Holick et al., 2011) defines deficiency as less than 20 ng/mL (50 nmol/L), insufficiency as 20–29 ng/mL (50–74 nmol/L) and sufficiency as 30 ng/mL or more (75 nmol/L). There are also studies that claim that disturbances in calcium absorption and low bone mineral density are associated with levels below 32 ng/mL.[18] In this study, we applied the criteria of the Endocrine Society.

Our aim was to estimate the prevalence of serum vitamin D deficiency and insufficiency and examine the factors associated with vitamin D deficiency and insufficiency in children aged 4 years in the Asturias cohort of the INMA Project (Infancia y Medio Ambiente [Childhood and Environment]).

## Materials and methods

### Sample under study

We analysed data for 283 children in the Asturias cohort of the Universidad de Oviedo that is part of the INMA Project.[19] The INMA Project is a prospective population-based cohort study whose primary objective is to study