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ORIGINAL ARTICLE

Nutrimetry: BMI assessment as a function of development☆,☆☆

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Abstract
Background and objective: Adequate nutritional assessment is required to fight malnutrition (undernutrition and overfeeding) in children and adolescents. For this, joint interpretation of certain indicators (body mass index [BMI], height, weight, etc.) is recommended. This is done clinically, but not epidemiologically. The aim of this paper is to present ''nutrimetry'', a simple method that crosses anthropometric information allowing for bivariate interpretation at both levels (clinical and epidemiological).
Materials and methods: Data from 41,001 children and adolescents aged 0–19 years, taken from Mexico's National Health and Nutrition Survey 2012, were analyzed. Data crossed were BMI-for-age Z-scores (BAZ) with height-for-age Z-scores (HAZ) according to the World Health Organization (WHO) standards. Conditional prevalences were calculated in a 3 × 3 grid and were compared with expected values.
Results: This method identified subgroups in each BAZ category showing heterogeneity of the sample with regard to WHO standards for HAZ and nutritional status. According to the method, nutritional status patterns differed among Mexican states and age and sex groups.
Conclusion: Nutrimetry is a helpful and accessible tool to be used in epidemiology. It allows for detecting unexpected distributions of conditional prevalences, its graphical representation facilitates communication of results by geographic areas, and enriched interpretation of BAZ helps guide intervention actions according to their codes.

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Nutrimetría: evaluando el IMC en función del desarrollo

Resumen
Antecedentes y objetivo: Para combatir la malnutrición (desnutrición y sobrealimentación) en los niños y adolescentes se necesita una evaluación nutricional adecuada, y para ello se recomienda interpretar conjuntamente ciertos indicadores (índice de masa corporal [IMC], talla, peso, etc.). Clínicamente esto se realiza, pero epidemiológicamente no. El objetivo de este trabajo es presentar la «Nutrimetría», un método simple que cruza información antropométrica permitiendo una interpretación bivariada en ambos niveles (clínico y epidemiológico).
Materiales y métodos: Se analizaron datos de 41.001 niños y adolescentes de 0-19 años derivados de la Encuesta Nacional de Salud y Nutrición 2012 de México. Se cruzó la información de la puntuación Z del IMC para la edad (Z-IMC) con Z de talla para edad (Z-talla) según estándares de la Organización Mundial de la Salud (OMS). Se calcularon prevalencias condicionales del cruce en una rejilla de 3×3 celdas y se comparó con lo esperable.
Resultados: Se identificaron subgrupos en cada categoría del Z-IMC que permitieron apreciar heterogeneidad de la muestra respecto a los estándares de la OMS en estatura y estado nutricional. Según este método, los patrones nutricionales diferían entre estados mexicanos, edades y sexos.
Conclusión: Nutrimetría es una herramienta útil y accesible para ser usada en epidemiología. Permite detectar distribuciones inesperadas de las prevalencias condicionales, su representación gráfica facilita la comunicación de resultados por áreas geográficas y la interpretación enriquecida del Z-IMC ayuda a orientar sobre acciones de intervención de acuerdo a sus códigos.

Introduction

Imbalances between food intake and nutritional requirements demand special attention in childhood, because they give rise to malnutrition (undernutrition or overfeeding) and health and developmental problems that are highly prevalent among children worldwide (stunted growth in 24.5%, insufficient weight in 15%, emaciation in 7.7% and overweight in 6.3%).[1]

In Mexico, the prevalence of undernutrition is low in terms of insufficient weight (2.8%) and emaciation (1.6%), though the 1.5 million children (13.6%) with stunted growth continue to pose a public health challenge. Although the prevalence of overweight and obesity in children and adolescents has decreased, the problem remains: 9.8% in infants under 5 years of age, 34.4% in children between 5 and 11 years of age, 35% in adolescents between 12 and 19 years of age, and 69.4–73.0% in individuals over 20 years of age.[2]

In the face of this scenario, Mexico has adopted initiatives such as the Integral Nutritional Care Strategy (*Estrategia Integral de Atención a Nutrición* [EsIAN]), the National Crusade Against Famine (*Cruzada Nacional Contra el Hambre*), the National Strategy Against Obesity and Diabetes (*Estrategia Nacional contra la Obesidad y Diabetes*) and the taxing of fast/junk food and drink, in line with the maternal, nursing infants and small children nutrition plan of the World Health Organization (WHO). This plan focuses on the development of nutrition policies and programs around the world, monitored by means of indicators including the body mass index (BMI), which is used in 5 (reduction of stunted growth, anemia, low birth weight, overweight and emaciation) of its 6 objectives.[3]

Excluding periods of accelerated body growth, the BMI (kg/[height in m]^2), described in 1832 by Quetelet, shows that body growth normally increases as a function of the square of body height. In 1972 it was demonstrated that it exhibited strong correlations to independent measures of body fat. This led to its widespread use in defining obesity in adults.[4]

With the increase in infant body weight, and after it had been demonstrated that BMI adjusted for age and gender is a good indicator of adiposity in children, different groups developed their own reference values. For example, the International Obesity Task Force developed curves for subjects between 2 and 18 years of age to define overweight, obesity[5] and thinness[6]; the Centers for Disease Control and Prevention established percentile tables for subjects between 2 and 20 years of age in order to identify low weight, overweight and its risks,[7] and the WHO profiles describe ideal growth in infants (0–5 years),[8] children and adolescents (5–19 years) in terms of *Z*-scores.[9] Although these reference values differ, they offer practical tools for nutritional monitoring and screening.

The BMI is an indirect measure of body fat and unhealthy body weight[10] that is easy to calculate and interpret, and is used to estimate the prevalence of childhood obesity and to complement the evaluation of nutritional status in populations.[9] However, since the BMI is a corpulence indicator, not exclusively an adipose tissue indicator, it lacks sensitivity[11]; it does not give precise information about underlying body composition; it is unable to differentiate