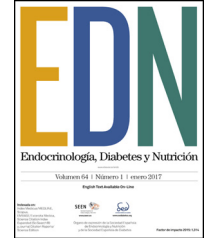




Endocrinología, Diabetes y Nutrición

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ORIGINAL ARTICLE

Body composition in a population of school adolescents: A comparison of simple anthropometric methods and bioelectrical impedance[☆]

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Received 16 January 2017; accepted 30 May 2017

KEYWORDS

Anthropometric measurements;
Bioelectrical impedance;
Body composition;
Schoolchildren

Abstract

Objectives: To report the anthropometric characteristics and body composition and to analyze the potential sex-based differences in Spanish schoolchildren and adolescents living in Granada and Ceuta. To estimate body fat percentage using regression equations and bioelectrical impedance to check for sex differences. An additional objective was to see whether the body fat percentages obtained by these two methods were similar.

Methods: A cross-sectional study including 1518 children and adolescents (aged 9–16) from 12 primary and secondary schools in Ceuta and Granada. The nutritional status of the subjects was assessed and their body fat percentage was calculated.

Results: There was a strong sexual dimorphism, with higher prevalence rates of overweight in boys and obesity in girls. Girls had higher mean body fat levels regardless of the measuring method used ($p < 0.001$). Correlation between bioelectrical impedance analysis and regression equations was high ($r = 0.830$), as was the internal correlation coefficient ($ICC > 0.75$). A Bland–Altman comparison showed a high agreement between bioelectrical impedance and Behnke and Lohman equations.

Conclusions: Specific equations considering subject sex and age should be used to estimate body density. Regardless of the method used, girls had higher body fat percentages. The Behnke and Lohman equations, combined with BIA, were found to be the most accurate methods for measuring body density in the study population.

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[☆] Please cite this article as: Tovar-Galvez MI, González-Jiménez E, Martí-García C, Schmidt-RioValle J. Composición corporal en escolares: comparación entre métodos antropométricos simples e impedancia bioeléctrica. Endocrinol Nutr. 2017. <http://dx.doi.org/10.1016/j.endinu.2017.05.011>

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<http://dx.doi.org/10.1016/j.endien.2017.10.005>

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PALABRAS CLAVE

Antropometría;
Impedanciometría
bioeléctrica;
Composición
corporal;
Escolares

Composición corporal en escolares: comparación entre métodos antropométricos simples e impedancia bioeléctrica

Resumen

Objetivos: Describir características antropométricas, composición corporal y verificar posibles diferencias entre sexos en escolares de Granada y la Ciudad Autónoma de Ceuta. Estimar el porcentaje de grasa corporal mediante ecuaciones de regresión e impedanciometría bioeléctrica, verificar posibles diferencias entre sexos. Comparar valores de porcentaje de grasa corporal estimados por ambos métodos para verificar su similitud.

Métodos: Estudio transversal sobre 1.518 escolares (9-16 años), pertenecientes a doce centros educativos de Ceuta y Granada. Se realizó una valoración del estado nutricional mediante antropometría e impedanciometría bioeléctrica, se procedió al cálculo del porcentaje de grasa corporal.

Resultados: Se observa un marcado dimorfismo sexual, con mayor prevalencia de sobrepeso entre chicos y de obesidad en chicas. Las chicas presentan valores medios de grasa corporal superiores, con independencia del método de estimación utilizado ($p < 0,001$). La correlación entre impedanciometría bioeléctrica y las ecuaciones de regresión fue elevada ($r = 0,830$), al igual que el coeficiente de correlación interna ($CCI > 0,75$). La prueba de Bland-Altman muestra una elevada concordancia entre impedanciometría bioeléctrica y las ecuaciones de Behnke y Lohman.

Conclusiones: Resulta conveniente utilizar ecuaciones específicas para el cálculo de la densidad corporal que contemplen el sexo y la edad de los sujetos. Independientemente del método utilizado para calcular el porcentaje de grasa corporal, las chicas poseen valores de grasa corporal más elevados. Sugerimos utilizar las ecuaciones de Behnke y Lohman junto a la BIA como métodos preferentes en las poblaciones estudiadas.

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Introduction

Analysis of body composition is an essential part of the assessment of nutritional status.¹ However, the obtainment of precise results in the adult population is complex, since a constant body composition cannot be assumed.² Among the safest and most reliable methods for analyzing body composition, mention must be made of neutron activation analysis, magnetic resonance (MR), hydrostatic weighing, plethysmography, dual-energy X-ray absorptiometry (DEXA), anthropometry and bioelectrical impedance analysis (BIA).^{3,4} Of all these techniques, anthropometry and BIA are the least complex options for application to children and adolescents.⁵ In this regard, the World Health Organization (WHO)⁶ considers anthropometry to be a useful tool for examining changes in body composition, being applicable to large populations thanks to its noninvasive nature and low cost. In this sense, regression equations have been developed in which the combination of different anthropometric parameters and variables allows us to estimate total body fat percentage (% TBF).⁷ The use of these equations is limited, however, since age group-specific body density conversion formulas must be applied.⁸

On the other hand, BIA measures the impedance or resistance to electrical current flow through the body fluids contained fundamentally in the lean and fatty tissues.

Impedance is low in lean tissue, which contains mainly intracellular fluids and electrolytes, and is high in adipose tissue – being proportional to total body water.⁹ In the same way as anthropometry, BIA is a rapid, portable, noninvasive and inexpensive method involving scant technical difficulty. It is also safe, since it makes use of a constant alternating current with an intensity of 800 A and a frequency of 50 kHz, and does not stimulate the electrically excitable tissues of the body.¹⁰ Different authors recommend the use of BIA in epidemiological studies for estimating % TBF.^{11,12}

Since predictive regression equations and BIA are analytical methods based on very different technical principles, some investigators advise caution when interpreting and comparing the results obtained.^{13–15} On the other hand, since the regression equations have been developed from different populations, interpretation of the results is complex. Considering the above, the present study was carried out to describe the anthropometric characteristics referred to body composition and to explore possible differences between the genders in a population of school children and adolescents in the city of Granada and the Autonomous City of Ceuta (Spain). In turn, % TBF was estimated using regression equations and BIA, with the evaluation of possible gender differences. Lastly, comparisons were made of the % TBF values using BIA versus each regression equation, with a view to assessing their similarity.

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