Bol Med Hosp Infant Mex. 2015;72(1):26–33

Boletín Médico del
Hospital Infantil de México

www.elsevier.es/bmhim

RESEARCH ARTICLE

ADIPOQ and *ADIPOR2* gene polymorphisms: association with overweight/obesity in Mexican children

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Received 22 December 2014; accepted 12 February 2015

KEYWORDS
Obesity;
Children;
Adiponectin;
ADIPOQ;
ADIPOR2

Abstract
Background: ENSANUT 2012 showed a combined prevalence of overweight and obesity of 34.4% in Mexican children. Single nucleotide polymorphisms (SNPs) of the *ADIPOQ* and *ADIPOR2* genes have been reported in many populations, but their association with obesity has not been confirmed in other studies. Our aim was to determine the association of SNPs from *ADIPOQ* and *ADIPOR2* genes with obesity in Mexican children.
Methods: A total of 2,634 children from 6 to 12 years old were enrolled in the study from four IMSS Units in Mexico City. We selected 1,469 unrelated children (745 normal weight and 724 overweight/obese). Phenotype characterization included anthropometric measurements, blood pressure, biochemical parameters, insulin concentrations and presence of acanthosis nigricans (AN). Analysis of the SNPs rs182052, rs266729, rs2241766, rs822393 of *ADIPOQ* and rs11061971 of *ADIPOR2* was carried out in the DNA samples.
Results: The study showed significant differences (p <0.05) between groups in waist circumference, blood pressure, presence of AN, insulin concentrations, HOMA-IR, fasting glucose and lipid parameters, being higher in obese children. No associations in *ADIPOQ* variants with the presence of overweight/obesity were found. The presence of the variant rs11061971 of *ADIPOR2* in children had a significant association with protection of overweight/obesity (OR 0.79, 95% CI 0.68-0.93, p = 0.003). Also, the log-additive model confirmed the association by codominant and dominant models (p <0.05).

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http://dx.doi.org/10.1016/j.bmhimx.2015.02.002

Conclusions: The presence of rs11061971 of *ADIPOR2* variant confers protection against obesity and could be used as a marker in Mexican children.

PALABRAS CLAVE
Obesidad infantil;
Adiponectina;
ADIPOQ;
ADIPOR2

Polimorfismos de los genes *ADIPOQ* y *ADIPOR2* y su asociación con sobrepeso/obesidad en niños mexicanos

Resumen
Introducción: ENSANUT 2012 mostró una prevalencia combinada de sobrepeso y obesidad en el 34.4% en niños mexicanos. Se han reportado polimorfismos de un solo nucleótido (SNP) de los genes *ADIPOQ* y *ADIPOR2* en varias poblaciones, pero su asociación con la obesidad ha sido controversial. El objetivo de este trabajo fue determinar la asociación de SNP de *ADIPOQ* y *ADIPOR2* con obesidad en una muestra de niños mexicanos.
Métodos: Un total de 2,634 niños de 6-12 años se inscribieron en el estudio en cuatro unidades del Instituto Mexicano del Seguro Social en la Ciudad de México. Se seleccionaron 1,469 niños no emparentados (745 peso normal y 724 sobrepeso/obesidad). Se les tomaron medidas antropométricas, presión arterial, parámetros bioquímicos, insulina y presencia de acantosis nigricans (AN). El análisis de los SNP (rs182052, rs266729, rs2241766, rs822393 de *ADIPOQ* y rs11061971 de *ADIPOR2*) se realizó en muestras de ADN.
Resultados: Se observaron diferencias significativas ($p < 0.05$) entre los grupos en la circunferencia de cintura, presión arterial, AN, insulina, HOMA-IR, glucosa en ayunas y parámetros lipídicos siendo elevados en los niños obesos. No se encontró asociación en variantes *ADIPOQ* con la presencia de sobrepeso/obesidad. La presencia de rs11061971 de *ADIPOR2* tuvo una asociación significativa con la protección de sobrepeso/obesidad (OR de 0.79; IC95% 0.68 a 0.93, $p = 0.003$). El modelo Log-aditivo confirmó la asociación de los modelos codominante y dominante ($p < 0.05$).
Conclusiones: La presencia de la variante rs11061971 de *ADIPOR2* confiere protección contra la obesidad, y podría utilizarse como marcador en niños mexicanos.

1. Introduction

Obesity is a public health problem that has increased dramatically in recent years, with epidemic proportions worldwide.[1–4] Obesity in Mexico is increased on average of 1.1 percentage points per year. The ENSANUT 2012 showed a combined prevalence of overweight and obesity of 34.4% in both sexes in children. It represents about 5,664,870 overweight and obese children in a national population.[5]

Many factors are associated with obesity in childhood, for example, lack of physical activity, diets with high content of carbohydrates and the genetic predisposition.[6,7] Previous studies have concluded that high concentration of adiponectin predict a lower prevalence of type 2 diabetes (T2D) in Mexican children[8] and that serum adiponectin can be a biomarker to predict metabolic syndrome in eutrophic and obese children.[9]

Adiponectin binds to its receptors (AdipoR1 and AdipoR2) for signaling actions. Adiponectin exhorts its effects through the sensitization of the body to the insulin[10,11] by activating numerous signaling molecules including adenosine monophosphate-activated protein kinase (AMPK), p38-MAPK, JNK, PPARα transcription factor and NF-κB in multiple tissues. These signals are transduced via the AdipoRs.[12,13] Mechanisms regulating the expression of AdipoRs appear to be complex and are governed by numerous factors.

The polygenic nature of obesity and the interactions of single nucleotide polymorphisms (SNPs) in overweight/obesity are not clear.[14] SNPs of the *ADIPOQ* gene have been reported in many populations; however, some of these associations with obesity could not be confirmed in other studies. The human *ADIPOR2* gene is generally not associated with serum adiponectin but is associated with insulin resistance and T2D risk in genetic association studies, but the mechanisms are not yet clear.[15–19]

The aim of present study was to determine the association of obesity with SNP variants rs182052, rs266729, rs2241766, rs822393 of *ADIPOQ* and the rs11061971 of *ADIPOR2* genes in Mexican children.