ELSEVIER

Archives of Medical Research 46 (2015) 214–220

Archives of Medical Research

ORIGINAL ARTICLE

Adiposity and Insulin Resistance in Children from a Rural Community in Mexico

Lourdes Barbosa-Cortes,[a] Miguel Angel Villasis-Keever,[b] Martha Del Prado-Manriquez,[c] and Mardia Lopez-Alarcon[a]

[a]*Unidad de Investigación Médica en Nutrición,* [b]*Unidad de Investigación en Epidemiología Clínica, Hospital de Pediatría,* [c]*Coordinación de Investigación en Salud, Centro Médico Nacional, Siglo XXI, Instituto Mexicano del Seguro Social, México, D.F., México*

Received for publication October 10, 2014; accepted March 30, 2015 (ARCMED-D-14-00566).

Background and Aims. The study of the incidence of overweight and obesity as well as body composition and insulin resistance in children from rural communities is scarce. The aims of the study were a) to characterize the adiposity and homeostasis model assessment of insulin resistance (HOMA-IR) in school-age children from a rural community and b) to determine factors associated with fat mass and HOMA-IR in this population.

Methods. A total of 41 school-aged children (15 males and 26 females; 9.9 ± 2.5 years old) from a Mexican rural community was studied. Trained observers had previously assessed the children's nutritional status during the first 6 months of life. Anthropometry, energy intake, physical activity, body composition and biochemical parameters were measured.

Results. The overall prevalence of overweight/obesity was 7.3%. The mean energy intake of children was below international recommendations (1,235 ± 400 kcal/day). A higher percentage of fat mass was observed in females (20.3 ± 8.5) than in males (14.1 ± 5.1) ($p = 0.006$). There were seven children with IR, but we did not observe a correlation between HOMA and BMI percentiles (Pearson's r = 0.09, $p = 0.57$). In a regression model, gender (females) was the primary factor associated with the percentage of fat mass. The growth velocity during the first 6 months of life was associated with HOMA-IR.

Conclusions. There is a low frequency of overweight and obesity in children from rural communities in Mexico. However, these children appear to have increased risk of adiposity and insulin resistance.

Key Words: Insulin resistance, HOMA-IR, Fat mass, Adiposity, Children, Rural community.

Introduction

During recent decades, the prevalence of overweight and obese children has been increasing worldwide. Although most reports of this phenomenon come from developed countries, studies in developing countries have reported the same trend (1). It has been estimated that the majority of affected children live in developing countries (~35 million); nevertheless the prevalence of overweight and obesity in developed countries is approximately double that in developing countries (2). Furthermore, the relative increase of overweight and obesity in the last two decades has risen in developing countries, particularly in those countries with rapid social economic transitions such as China, Brazil and Mexico (3).

Epidemiological studies have also demonstrated that the prevalence of overweight and obesity in children varies with age (lower prevalence in preschool children than in older children) and gender (increased prevalence in males compared to females) across the countries (1). However,

Address reprint requests to: Mardia Lopez-Alarcon, Unidad de Investigación Médica en Nutrición, Hospital de Pediatría 4° Piso, Centro Médico Nacional, Siglo XXI, Apartado Postal: C-029 C.S.P.I. Coahuila #5 Col. Roma, México, D.F., 06703 Mexico; Phone/Fax: (+52) (55) 56 27 69 44; E-mail: marsau2@prodigy.net.mx

0188-4409/$ - see front matter.
http://dx.doi.org/10.1016/j.arcmed.2015.03.010

with respect to socioeconomic status (SES), low-SES groups in industrialized countries and high-SES groups in developing countries are at higher risk than their counterparts (4−6). It is important to mention that most studies of the prevalence of overweight and obesity in children are based mainly on body mass index (BMI) or waist circumference (WC); therefore, they do not report details about adiposity measures such as body composition (7).

However, to understand the increased prevalence of overweight and obesity, numerous studies have examined other factors. Large birth size, low birth weight (LBW) and faster growth velocity during infancy are associated with childhood obesity. Notably, LBW or preterm infants with catch-up growth during early life exhibit more body fat, specifically higher abdominal distribution (8−10). In relation to feeding practices, several studies have demonstrated a protective effect of breastfeeding on the development of obesity (11−13). In addition, lack of recreation sites for physical activity, lack of grocery stores offering affordable fresh fruits and vegetables, and high density of fast food outlets are factors that may explain how low SES influences childhood weight, but studies in these types of populations are scarce (1,3,12).

Mexico has one of the highest prevalence of overweight and obesity worldwide. To identify strategies to reduce these rates, recent research has focused on pediatric populations (14). To date, most epidemiological studies have been based on the assessment of BMI, so little is known about body composition, particularly fat mass; nevertheless, factors associated with overweight and obesity have been consistent with the findings of investigations in populations with low SES (15). In addition, it is noteworthy that very few studies focused specifically on rural communities where not only are obesity rates are the lowest (16,17) but also undernutrition and obesity coexist (14). Children from these communities are more likely to be exposed to nutritional deficiencies during fetal and neonatal life that may change glucose-insulin metabolism, which is associated with the development of impaired glucose tolerance, insulin resistance and type 2 diabetes mellitus years later (18,19). However, information on these correlations in rural communities is lacking.

Therefore, this study had two objectives: a) to characterize the adiposity and homeostasis model assessment of insulin resistance (HOMA-IR) in school-age children from a rural community and b) to identify factors associated with fat mass and HOMA-IR in this population.

Materials and Methods

Original Study

As part of a larger community-wide longitudinal study, mothers and their infants born in San Mateo Capulhuac, a rural community situated in the Sierra Madre del Sur (~30 km from Mexico City) participated in diverse investigations mainly related to nutrition and breastfeeding. In the study, birth weight, birth length, growth velocity and nutrient intake from human milk during the first 6 months were prospectively measured. Subsistence farming was the mainstay of this population, and the predominant dietary staple was corn. Children from this community were generally breastfed for 1 year or more. More information regarding this population has been described previously (20−22).

Measurements at Birth

Birth weight and length data, as well as the weight and height during the first 6 months of life were obtained from the records acquired during previous investigations (20−22). Trained and standardized field workers conducted anthropometric measurements using standardized procedures at the community clinic. An electronic balance with 1-g precision (3862MP8; Sartorius, Gottingen, Germany) and a recumbent length board (Holtain Limited, Crymych, UK) were used. These measurements were repeated during follow-up at 6 months old. Mothers were 18−35 years old, free of chronic diseases, not taking medications including oral contraceptives, not using alcohol, and were recruited from a local prenatal clinic. Growth velocity was determined in grams as the result of the weight gain from birth to 6 months old.

Current Study

In this study we included pre-pubertal female and male children <12 years old. Of a total of 70 children from the original cohort, 20 were >12 years of age. We contacted 50 children and their mothers, and 41 agreed to participate. The Ethics Committee of the Mexican Institute of Social Security in Mexico City granted approval for this study. All participants and their parents signed written informed consent. Once the children and their mothers agreed to participate in the study, they were asked to go to the community clinic at 8:00 the next morning. Medical and dietary questionnaires were completed. All children were in good health, and none was receiving medication or vitamin supplementation.

There were no significant differences ($p > 0.05$) between mean birth weight, mean birth length and mean growth velocity of the children included in the current study and the children who did not participate (both children >12 years old and those who declined to participate). In addition, the proportion of male and female was not different between those who participated or not participated (36.6% and 63.4% Vs 43.3% and 55.7% for male and female respectively).

Fasting Laboratory Testing

Venous blood samples were collected from all participants after a 12-h overnight fast. Serum aliquots were separated