

# Migration and nutritional status of Tarahumara schoolchildren from Chihuahua State (México)

Zuliana Paola Benítez-Hernández<sup>1</sup> | María de Lourdes De la Torre-Díaz<sup>1</sup> |

Mónica Cervantes-Borunda<sup>1</sup> | Rosa Patricia Hernández-Torres<sup>1</sup> |

María Dolores Cabañas<sup>2</sup> | Noemí López-Ejeda<sup>2,3</sup> | María Dolores Marrodán<sup>2,3</sup>

<sup>1</sup>Academic Group for Physical Activity, Education and Health (ref.C-27), Physical Culture Faculty, Autonomous University of Chihuahua, Chihuahua 31009, México

<sup>2</sup>Research Group EPINUT (ref.920325), Medicine Faculty, Complutense University of Madrid, Madrid 28040, Spain

<sup>3</sup>Department of Zoology and Physical Anthropology, Faculty of Biological Sciences, Complutense University of Madrid, Madrid 28040, Spain

## Correspondence

María Dolores Marrodán,  
Department of Zoology and Physical Anthropology, Faculty of Biological Sciences, Complutense University of Madrid, Jose Antonio Novais Street, n°12, 8th floor, 28040 Madrid, Spain.  
Email: marrodan@ucm.es

## Abstract

**Objective:** The Tarahumara ethnic group is composed of indigenous people from the Sierra Madre Occidental of Mexico. Conditions of isolation and poverty compel them to migrate to the city in search of better opportunities. This work aims to explore the influence of migration on the growth and nutritional status of Tarahumara schoolchildren.

**Methods:** One hundred Tarahumara students were analyzed (50 rural with a mean age of  $9.78 \pm 1.25$  years; 50 urban aged  $10.0 \pm 1.04$  years), comparing anthropometric indicators and body composition (*T*-Student, *U*-Mann–Whitney Tests).

**Results:** Twenty percent of rural girls and 35% of rural boys showed stunted growth compared to only 9% of the urban girls (no stunted growth among urban boys). Migrants showed greater body size, skinfold thickness, and fat percentage. Weight excess, understood as an increase in the prevalence of overweight and obesity, was detected in 17.8% of urban boys and 13.6% of urban girls compared to 10.0% of boys and 3.3% of girls of the rural series.

**Conclusion:** Migration reduces stunting and increases adiposity.

## KEYWORDS

Tarahumara, children, anthropometry, nutritional status, migration

## 1 | INTRODUCTION

The Tarahumara are an indigenous group in northern Mexico. They inhabit the Sierra Madre Occidental that runs through Chihuahua State and southeastern Durango and Sonora, where they share territory with the Tepehuanes, Pimas, and Guarijíos. The Tarahumara are the largest indigenous group in that region, and therefore the territory is also called the Sierra Tarahumara (Balcáza, Pasquet, & de Garine, 2009). They call themselves “Rarámuris” which means “walk runners,” from the roots: rar (foot) and muri (running). According to the National Commission for the Development of Indigenous Peoples (CDI, 2010), they are one of the most marginalized ethnic

minorities in the country. They live in dispersed settlements in high mountains with extreme weather conditions and with limited access to education and health care. The basis of their diet consists of corn and beans that they sow, and which are generally supplemented with potatoes, pumpkin, and chili. It is also common for them to gather wild fruits and hunt wild turkeys, field mice, squirrels, and river fish. Chicken, goat meat, and eggs are occasionally part of their diet, especially during family and community celebrations (Peña Reyes, Cárdenas Barahona, Lamadrid, Del Olmo Calzada, & Malina, 2009). The steep terrain and the remoteness of the few schools that provide the Tarahumara children with an education (called indigenous shelters) place great physical demands on them.

According to the last General Population and Housing Census published by the Institute of Statistics and Geography (INEGI 2010), in the state of Chihuahua 124,947 Tarahumara indigenous people were recorded, of whom just over 5,000 had moved to urban environments, fleeing poverty, and looking for better opportunities for work and survival. These recent migrants have been integrated into indigenous settlements in the state's main cities, such as Chihuahua, Ciudad Juárez, Cuauhtémoc, Camargo, Delicias, and Jimenez. Their eating and exercise habits have changed dramatically due to migration and it is expected that this transition will be reflected in their growth and nutritional condition. The aim of the present article is to explore this situation by comparing a small sample of Tarahumara students living in the city of Chihuahua with their peers who remain in the rural mountain settlements.

## 2 | METHODS

This article is a preview of a research project that is being developed by the Academic Group for Physical Activity, Education and Health at the Autonomous University of Chihuahua (Mexico) and the EPINUT Research Group (ref. 920325) from the Complutense University of Madrid (Spain). This project was approved by the Ethical Committee of the Doctor Salvador Zubirán General Hospital of Chihuahua, and it was supported by the Department of Indigenous Educational Services of the State of Chihuahua (SEECH), and the Directorate of the National Commission for the Development of Indigenous Peoples (CDI) of the Republic of Mexico. The information collected respected all Mexican laws, and all parents or legal guardians were asked to sign informed consent forms.

The sample consists of 100 Tarahumara schoolchildren of both sexes from 6 to 14 years old (50 rural with a mean age of  $9.78 \pm 1.25$  years old, and 50 urban aged  $10.0 \pm 1.04$  years). The rural sample comes from the Ignacio León Ruiz Indigenous Shelter in the town of Agua Zarca-Guachochi, in the Sierra Tarahumara. The urban participants who were born or have resided for more than three years in the city of Chihuahua come from the Gabriel Teporaca and Primaria Indígena Cuitláhuac schools located in the city of Chihuahua. The inclusion criteria for both series were that the four grandparents of the participants must belong to the Tarahumara ethnicity and their families must still speak their own indigenous language.

In line with the criteria of the International Society for the Advancement of Kinanthropometry (ISAK) and with approved anthropometric material (Marfell-Jones, Olds, Stewart, & Carter, 2006), measurements were taken of weight (kg), height (cm), circumference of arm, calf and umbilical waist (cm), bicondylar width of the humerus and

femur (cm), and skinfold thickness of biceps, triceps, subscapular, suprailiac, and calf (mm). Using these measurements Body mass index (BMI), Body fat percentage (%BF), fat mass (FM), and fat free mass (FFM) were calculated. For %BF the Siri equation was used (Siri, 1961), after calculating body density from the skinfold values (Brook, 1971; Durnin & Rahaman, 1967).

Growth status was established using the indicator height-for-age. Children were considered to have stunted growth when this measure was below the cutoff point corresponding to the fifth percentile of the Centers for Disease Control and Prevention reference (CDC, 2000) for each sex and age. To evaluate nutritional status, the BMI cutoff points from the same reference were used to determine underweight (<10th p), normal weight (11th to 84th p), overweight (85th to 94th p), and obesity (> 95th p).

After verifying the normality of the variables (Kolmogorov–Smirnov test), comparisons were performed using Student's *t*-test or the Mann–Whitney *U* test. Statistical processing was performed using SPSS v.21.0 software.

## 3 | RESULTS

A high percentage of delayed growth was found among the rural children (20.0% of girls and 35.0% of boys) while among the urban students only 9.0% of girls showed low height-for-age. The study found that 10.0% of rural boys and 3.3% of rural girls were underweight and this nutritional status was also found in 9.1% of urban girls but not in urban boys. On the other hand, 10.7% of boys and 9.1% of girls in the urban sample were overweight compared to 5% of rural boys (no rural girls were overweight). Obesity was present in 7.1% of urban boys and 4.5% of urban girls, compared to 5% of boys and 3.3% of girls in the rural context.

The presence of sexual dimorphism was checked by examining anthropometric variables in children from both samples and no significant results were found for any body size variables. In terms of body composition variables, there were significant sexual differences ( $P < 0.05$ ) for bicep, subscapular, and suprailiac skinfold thickness. Although, due to small sample size, the results presented are shown for each sample without separation by sex.

As can be seen in Table 1, the Tarahumara schoolchildren living in the city have a larger body size that is reflected in their mean values of weight, height, BMI, circumferences, and bicondylar diameters. There is also a contrast in body composition, as mean values for subcutaneous fat are significantly lower in the rural series. Greater levels of adiposity in the urban schoolchildren are also reflected by their higher percentage of body fat. Conversely, musculoskeletal differences expressed by fat free mass did not reach statistical significance.

**TABLE 1** Anthropometric indicators of size and body composition in Tarahumara schoolchildren from urban (city of Chihuahua) and rural areas (Agua Zarca, Sierra Tarahumara towns)

	Rural (N = 50) Mean ± S.D.	Urban (N = 50) Mean ± S.D.	P
Age (years)	9.78 ± 1.25	10.0 ± 1.04	NS
Weight (kg)	30.3 ± 6.34	35.6 ± 10.7	<0.001
Height (cm)	133.1 ± 9.1	139.9 ± 12.9	<0.001
Umbilical waist circumference (cm)	62.54 ± 5.28	66.30 ± 6.21	<0.05
Arm circumference (relaxed) (cm)	19.50 ± 2.06	21.14 ± 3.23	<0.05
Arm circumference (flexed & tensed) (cm)	20.55 ± 2.09	21.84 ± 3.37	<0.05
Calf circumference (cm)	25.23 ± 2.35	27.48 ± 3.32	<0.001
Humerus bicondylar width (cm)	5.42 ± 0.55	5.68 ± 0.62	<0.05
Femur bicondylar width (cm)	7.79 ± 0.52	8.24 ± 0.72	<0.001
Bicipital skinfold (mm)	4.17 ± 2.09	6.14 ± 2.95	<0.001
Tricipital skinfold (mm)	7.58 ± 3.36	10.27 ± 4.01	<0.001
Subscapular skinfold (mm)	6.31 ± 2.69	8.69 ± 4.97	<0.05
Suprailiac skinfold (mm)	5.72 ± 3.53	8.55 ± 5.19	<0.05
Calf skinfold (mm)	8.00 ± 2.90	10.60 ± 5.28	<0.05
Body mass index (kg/m <sup>2</sup> )	16.95 ± 1.87	17.95 ± 2.91	<0.001
Body fat percentage	13.55 ± 6.62	19.73 ± 5.61	<0.001
Fat mass (kg)	4.31 ± 2.76	7.48 ± 4.30	<0.001
Fat free mass (kg)	26.06 ± 4.75	28.47 ± 7.18	NS

NS: Not significant.

#### 4 | DISCUSSION

The most recent National Survey of Health and Nutrition (Gutierrez et al., 2012) highlighted that chronic malnutrition affects 44.3% of Mexican indigenous children and that anemia and micronutrient deficiencies reach a prevalence four times greater in those communities compared to the general population. Some authors have studied these aspects in the Tarahumara group, reporting between 10% and 30% of children with stunting and child malnutrition (Balcáza et al., 2009; Monárrez-Espino, Martínez, Martínez, & Greiner, 2004; Peña Reyes et al., 2009). Moreover, studies conducted on other migrant indigenous groups in Mexico, such as the Chontal and Nahua from Oaxaca and Ixtaczoquitlán from Veracruz, have been alarming in terms of the increase in obesity and its metabolic complications in these communities (Herrera-Huerta, García-Montalvo, Méndez-Bolaina, López-López, & Valenzuela, 2012; Malina, Peña-Reyes, Bali-Chávez, & Little, 2013).

Despite the small sample size, these preliminary results are in line with all of these observations. They emphasize that migration to the urban environment affects the process

of growth, increasing body size and especially increasing adiposity. Data corresponding to diet, exercise, and sleep habits, and the genetic profile of Tarahumara schoolchildren are being analyzed in a larger sample, which will allow for a more detailed interpretation of this phenomenon.

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#### AUTHOR CONTRIBUTIONS

MDC, MCB y MDM designed the study, MCB and RPHT provided necessary logistical support, ZPBH, MLTD and

RPHT collected the data, NLE y ZPBH analyzed the data and ZPBH, MDM and NLE drafted the manuscript.

## CONFLICT OF INTEREST

None.

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