Received: 13 January 2025 | Revised: 15 April 2025 | Accepted: 21 April 2025

DOI: 10.1111/ijpo.70021

ORIGINAL RESEARCH

Pediatric OBESITY WILEY

Geographic and ethnic inequalities in total and central obesity, and physical fitness among preschool children: Insights from the PREFIT project

Cristina Cadenas-Sanchez[1] | Jorge R. Fernández-Santos[2] | Mairena Sánchez-López[3] | Natalia García-Corada[4] | Diego Moliner-Urdiales[5] | Nuria Romero-Parra[6,7] | Manuel A. Rodriguez Perez[8] | Pere Palou[9] | Cecilia Dorado-García[10] | German Vicente-Rodríguez[11] | Francisco B. Ortega[12] | David Jiménez-Pavón[13,14]

[1]Department of Cardiology, Stanford University, Palo Alto, California, USA

[2]Galeno Research Group, Department of Physical Education, School of Education, University of Cádiz, Spain

[3]Universidad de Castilla-La Mancha, Health and Social Research Center, Spain

[4]Department of Physical Activity and Sport Sciences, Faculty of Education and Sport, Deusto University, Bilbao, Spain

[5]LIFE Research Group, Universitat Jaume I, Castellon, Spain

[6]LFE Research Group, Department of Health and Human Performance, Faculty of Physical Activity and Sport Sciences, Universidad Politécnica de Madrid, Madrid, Spain

[7]Department of Physiotherapy, Occupational Therapy, Rehabilitation and Physical Medicine, Faculty of Health Sciences, Universidad Rey Juan Carlos, Madrid, Spain

[8]SPORT Research Group (CTS-1024), CIBIS Research Center, Department of Education, University of Almeria, Spain

[9]Department of Education, University of the Balearic Islands, Spain

[10]Department of Physical Education and Research, Institute of Biomedical and Health Sciences (IUIBS), University of Las Palmas de Gran Canaria, Spain

[11]GENUD "Growth, Exercise, NUtrition and Development" Research Group (EXER_GENUD S72_23R), Faculty of Health and Sport Science (FCSD), Instituto Agroalimentario de Aragón -IA2-, University of Zaragoza, CIBER of Physiopathology of Obesity and Nutrition (CIBERObn), Madrid, Spain

[12]Faculty of Sport and Health Sciences, University of Jyväskylä, Finland

[13]MOVE-IT Research Group, Department of Physical Education, Faculty of Education Sciences and Biomedical Research Innovation Institute of Cádiz, University of Cádiz, Spain

[14]CIBER of Frailty and Healthy Aging (CIBERFES), Madrid, Spain

Correspondence
Cristina Cadenas-Sanchez, Department of Physical and Sports Education, Faculty of Sport Sciences, University of Granada, Carretera de Alfacar s/n, 18071, Granada, Spain.
Email: cadenas@ugr.es

Funding information
European Union, Grant/Award Number: CB16/10/00477; European Union's Horizon 2020 research and innovation programme, Marie Sklodowska Curie, Grant/Award Number: 101028929; Ramón y Cajal, the

Summary

Background and objectives: Obesity and physical fitness are known to be influenced by various geographic factors and ethnicity in children. However, there is limited evidence on the level to which these factors can influence very early in life, at preschool age. This study aimed to describe and compare total and central obesity and physical fitness according to geographic factors and ethnicity in preschoolers.

Methods: This cross-sectional study included 3179 preschoolers (4.6 ± 0.9y, 52.8% boys). Geographic factors (location and type of area: rural/urban) were assessed based on the school setting, while ethnicity was determined through parental self-

Spanish Ministry of Economy and Competitiveness, Grant/Award Number: RYC-2011-09011; Biomedical Research Networking Center on Frailty and Healthy Aging (CIBERFES); FEDER; European Association for the Study of Obesity - Novo Nordisk Foundation, Grant/Award Number: NNF23SA0083955

report. Total and central obesity and physical fitness (cardiorespiratory fitness, muscular strength, speed-agility, balance) were assessed using the PREFIT battery.

Results: Preschoolers from southern regions of Spain presented higher total obesity along with lower performance in cardiorespiratory fitness and lower-limb muscular strength compared to their northern peers ($p \leq 0.017$). However, they demonstrated greater levels of upper-limb muscular strength and balance ($p < 0.001$). Preschoolers from rural areas of Spain showed higher central obesity but better fitness performance compared to those from urban areas ($p \leq 0.004$). White and African preschoolers showed lower levels of total and central obesity than Latin preschoolers ($p \leq 0.003$) and performed better in upper-limb muscular strength and speed–agility compared to Asian or Latin preschoolers ($p \leq 0.037$).

Conclusion: This study highlights significant physical health inequalities among preschoolers based on geographical factors and ethnic backgrounds. These findings underscore the need for targeted public health strategies to address socioeconomic and environmental determinants of early-life health disparities.

KEYWORDS

body mass index, cardiorespiratory fitness, muscular strength, preschoolers, rural, speed-agility, urban, waist circumference

1 | INTRODUCTION

Childhood obesity has escalated worldwide, becoming a significant public health concern.[1,2] Conversely, robust and consistent evidence supports the notion that physical fitness is a powerful marker of health in children.[3,4] Addressing obesity and physical fitness as determinants of health during early childhood, particularly in preschool ages from 3 to 5 years of age, is of utmost importance due to this critical stage of physical and neural development.[5]

Obesity and fitness levels seem to be influenced by various geographical factors, including the location (i.e. north or south) and type of area (i.e. rural or urban). The World Health Organization European Childhood Obesity Surveillance Initiative in school children found a north–south inequality in the prevalence of overweight/obesity and central obesity, with lower prevalence observed in northern regions compared to their southern counterparts.[6,7] Similarly, when examining the fitness levels of preschool children, authors concluded that children from southern Europe outperformed their northern peers in most fitness tests, except for lower-limb muscular strength.[8] When looking at type of area (rural vs. urban), half of the studies in preschoolers showed higher total and/or central obesity in those from rural areas compared to urban areas.[9,10] Yet, the remaining half did not observe any significant difference.[11,12] Exploring fitness levels in preschoolers, Torres-Luque et al.[11] concluded that those from urban areas performed better in speed tests than their counterparts from rural areas. Additionally, the difference in favour of the urban area was also observed in lower-limb muscular strength for girls.[11] Nevertheless, the limited evidence in preschool children and the small sample size in both location and type of area warrant the need for further investigation.

Childhood obesity is disproportionately prevalent among children from ethnic minority groups.[13,14] Importantly, there is inequality in childhood obesity prevalence across racial and ethnic groups. Black and Hispanic children and adolescents have a higher prevalence of obesity compared to their non-Hispanic White and Asian or Asian American counterparts,[14,15] putting them at an elevated risk for obesity-related chronic diseases.[14,16] The factors contributing to the variations in childhood obesity prevalence among different groups are multifaceted, likely encompassing genetics, physiology, culture, socioeconomic status and environment.[14] While the low level of fitness in ethnic minorities has been proposed as a key contributor to health inequalities in children,[15,17,18] information about children, particularly preschoolers, remains limited.

Therefore, the objective of this study was to describe and compare total and central obesity and physical fitness according to geographical factors and ethnicity in preschool children from different locations in Spain.

2 | METHODS

2.1 | Study design and participants

This study was performed under the PREFIT project (http://profith.ugr.es/prefit).[19–22] The main aim of this project was to assess the fitness and anthropometric characteristics of preschool children from

10 different cities/towns (hereinafter cities when referring to both) geographically distributed across Spain.[19–21] This study was approved by the Review Committee for Research Involving Human Subjects (ref. 845), according to the Declaration of Helsinki.

Out of 4338 preschool children and their parents that were invited to participate in the PREFIT project, a total of 3198 provided written informed consent and agreed to participate (73.7% of participation rate). Finally, after excluding 19 children for different reasons (e.g., motor or cerebral disease had a cold, or did not understand the indications), a total of 3179 preschool children (4.6 ± 0.9 years, 1678 boys, 52.8%) participated in the PREFIT project (Figure S1A). More information about methodological issues can be found elsewhere.[19,20]

2.2 | Measurements

2.2.1 | Total and central obesity

Weight and height (SECA, Germany) were measured without shoes and with light clothes. Body mass index was calculated (kg/m^2), providing a measure of total obesity. The prevalence of underweight, normal weight, overweight or obesity status was calculated using the cutoffs from the World Obesity Federation (WOF) and World Health Organization (WHO).[23,24] Waist circumference (cm) was measured at the level of the umbilicus zone in the horizontal plane, serving as an indicator of central obesity. Waist-to-height ratio was also calculated, and the prevalence of central obesity was computed using the 0.5 cutoff.[25]

2.2.2 | Physical fitness

Fitness was measured by the PREFIT battery,[22] which is known to be reliable and feasible in preschool children.[19,26]

Cardiorespiratory fitness (laps) was assessed with the PREFIT 20 m shuttle run test. This test consisted of running back and forth between two lines (20 m apart) following an audio signal. Two modifications were performed from the original version[27]: (1) the test started at 6.5 km/h (0.5 km/h increments every minute), and (2) two evaluators ran with preschool children in order to guide them to maintain the pace. The test was finished when they could not reach the line according to the audio signal on two consecutive occasions or when they stopped due to fatigue.

Muscular strength was assessed by two different tests: handgrip strength (kg, upper-limbs muscular strength) and standing long jump (cm, lower-limbs muscular strength). The handgrip strength test consisted in squeezing as much as possible for 2–3 s (TKK 5001, Tokyo).[28,29] Standing long jump test consisted in jumping forward as far as possible with the feet separated at the shoulders' width.

Speed-agility (s) was assessed with the PREFIT 4 × 10 m shuttle run test. This test consisted of running four times back and forth (10 m apart) as fast as possible. This test was adapted to preschool children, and instead of using sponges, children had to touch the evaluator's hand, who was placed on each line.

Static balance (s) was measured by the one-leg stance test. Children stood on one leg and bent the other leg approximately 90°, maintaining the balance position with eyes open for as long as they could. The test finished when the child could not continue in the required position.

2.2.3 | Geographic factors: location and type of area

Based on the city location, out of the 10 provinces included in this project, we selected only those from the north ($n = 2$, i.e. Vitoria-Gasteiz and Zaragoza), and those from the south ($n = 4$, i.e. Almería, Cádiz, Granada and Las Palmas de Gran Canaria) of Spain for north–south comparison. The remaining cities ($n = 4$; i.e. Castellón de la Plana, Cuenca, Madrid and Palma de Mallorca) were not included due to their location (i.e. central).

They type of area (i.e. rural or urban) was categorized based on the population size. Then, a rural area was considered a town with a population size of less than 15 000 inhabitants, while an urban area is a city with a population size equal to or greater than 15 000 inhabitants.[30]

2.2.4 | Ethnicity

Parents self-reported the country where their offspring were born. Then, each country was grouped into different population categories based on the Spanish Council for the elimination of racial or ethnic discrimination. Lastly, the recoded population categories were used for classifying children's ethnicity as White (i.e. Spanish, Roma population from Spain, midwestern European, east European population), African (i.e. Sub-Saharan and Maghreb population), Asian (i.e. Asian-oriental and Indian-Pakistani population) and Latin (i.e. Afro-Latin/Afro-Caribbean and Andean-Latin American population).

2.3 | Statistical analysis

Descriptive information by different cities, geographical location, type of area and ethnicity is presented as mean and standard deviation for continuous variables, and number of cases for categorical variables.

2.3.1 | Geographic factors: location and type of area

To examine geographical differences in total and central obesity, and fitness, two approaches were performed. First, an untargeted approach was conducted using Moran's I index to assess spatial autocorrelation.[31] This index provides how related the values of a variable

TABLE 1 Descriptive characteristics of the study sample for all participants and stratified by city.

	All ($n = 3179$)	Almería ($n = 280$)	Cádiz ($n = 283$)	Castellón ($n = 260$)	Cuenca ($n = 260$)	Granada ($n = 401$)	Las Palmas ($n = 258$)	Madrid ($n = 254$)	Mallorca ($n = 278$)	Vitoria ($n = 619$)	Zaragoza ($n = 286$)
Sex (*n*)											
Boys	1678	144	152	137	130	232	142	118	144	318	161
Girls	1501	136	131	123	130	169	115	136	134	301	125
Age (years)	4.6 ± 0.9	4.4 ± 0.8	4.4 ± 0.9	4.5 ± 0.8	4.4 ± 0.9	4.9 ± 0.8	4.7 ± 0.8	4.5 ± 0.9	4.5 ± 0.8	4.7 ± 0.9	4.5 ± 1.0
Weight (kg)	19.0 ± 3.8	19.0 ± 4.1	18.7 ± 3.8	18.7 ± 3.7	18.4 ± 3.5	20.0 ± 4.2	19.4 ± 3.8	18.4 ± 3.4	18.9 ± 3.9	19.1 ± 3.4	18.7 ± 3.5
Height (cm)	106.9 ± 7.5	106.6 ± 7.6	106 ± 7.8	106 ± 7.4	105 ± 7.2	109 ± 7.4	107.7 ± 7.2	106 ± 7.1	106.3 ± 7.4	107.8 ± 7.3	106.5 ± 7.8
Total obesity											
Body mass index (kg/m^2)	16.5 ± 1.8	16.6 ± 1.9	16.5 ± 1.7	16.6 ± 1.7	16.6 ± 1.8	16.6 ± 2.1	16.6 ± 1.8	16.3 ± 1.7	16.5 ± 1.7	16.4 ± 1.5	16.4 ± 1.7
Body mass index (*z*-score)	0.00 ± 1.0	0.05 ± 1.1	0.01 ± 1.0	0.04 ± 1.0	0.04 ± 1.0	0.06 ± 1.2	0.06 ± 1.0	−0.12 ± 0.9	0.04 ± 1.0	−0.06 ± 0.9	−0.06 ± 1.0
Central obesity											
Waist circumference (cm)	53.2 ± 5.0	52.8 ± 5.6	51.9 ± 4.9	51.5 ± 4.3	54.5 ± 5.0	54.0 ± 5.7	54.1 ± 5.3	53.0 ± 4.7	53.3 ± 5.3	53.7 ± 4.3	51.9 ± 4.3
Waist-to-height ratio	0.50 ± 0.1	0.50 ± 0.1	0.49 ± 0.1	0.49 ± 0.0	0.52 ± 0.0	0.49 ± 0.1	0.50 ± 0.1	0.50 ± 0.1	0.50 ± 0.1	0.50 ± 0.1	0.49 ± 0.1
Physical fitness											
Cardiorespiratory fitness (laps)	20.0 ± 11.6	17.6 ± 9.1	16.5 ± 10.1	15.3 ± 8.5	24.9 ± 14.0	26.5 ± 12.5	15.5 ± 8.9	17.0 ± 10.5	21.8 ± 10.4	20.6 ± 11.6	21.3 ± 12.4
Upper-limbs muscular strength (kg)	7.0 ± 2.5	6.4 ± 2.4	6.6 ± 2.3	7.3 ± 2.4	6.3 ± 2.1	8.1 ± 2.5	7.3 ± 2.3	7.4 ± 2.4	6.9 ± 2.2	6.7 ± 2.5	7.1 ± 2.9
Lower-limbs muscular strength (cm)	73.6 ± 22.2	62.9 ± 21.2	72.6 ± 21.3	78.4 ± 23.2	71.1 ± 20.9	73.9 ± 21.0	69.1 ± 21.4	75.0 ± 25.4	77.8 ± 18.0	75.2 ± 22.1	78.1 ± 23.8
Speed-agility (s)	16.8 ± 2.5	17.6 ± 2.7	17.2 ± 2.6	18.5 ± 2.5	16.9 ± 2.3	15.7 ± 1.9	15.8 ± 2.1	17.4 ± 2.8	16.6 ± 2.4	16.5 ± 2.2	16.9 ± 2.7
Balance (s)	13.9 ± 17.2	11.6 ± 12.6	12.2 ± 18.1	12.9 ± 11.7	14.2 ± 17.5	22.7 ± 30.1	16.1 ± 14.5	15.1 ± 16.5	9.3 ± 8.1	12.4 ± 13.5	10.3 ± 10.3

Note: Values are presented as means and standard deviation, unless otherwise indicated. Cardiorespiratory fitness was evaluated by PREFIT 20 m shuttle run test, muscular strength was assessed by the handgrip strength test (upper-limbs) and standing long jump test (lower-limbs), speed-agility was evaluated by the PREFIT 4 × 10 m shuttle run test, and balance was evaluated by the one-leg stance test.

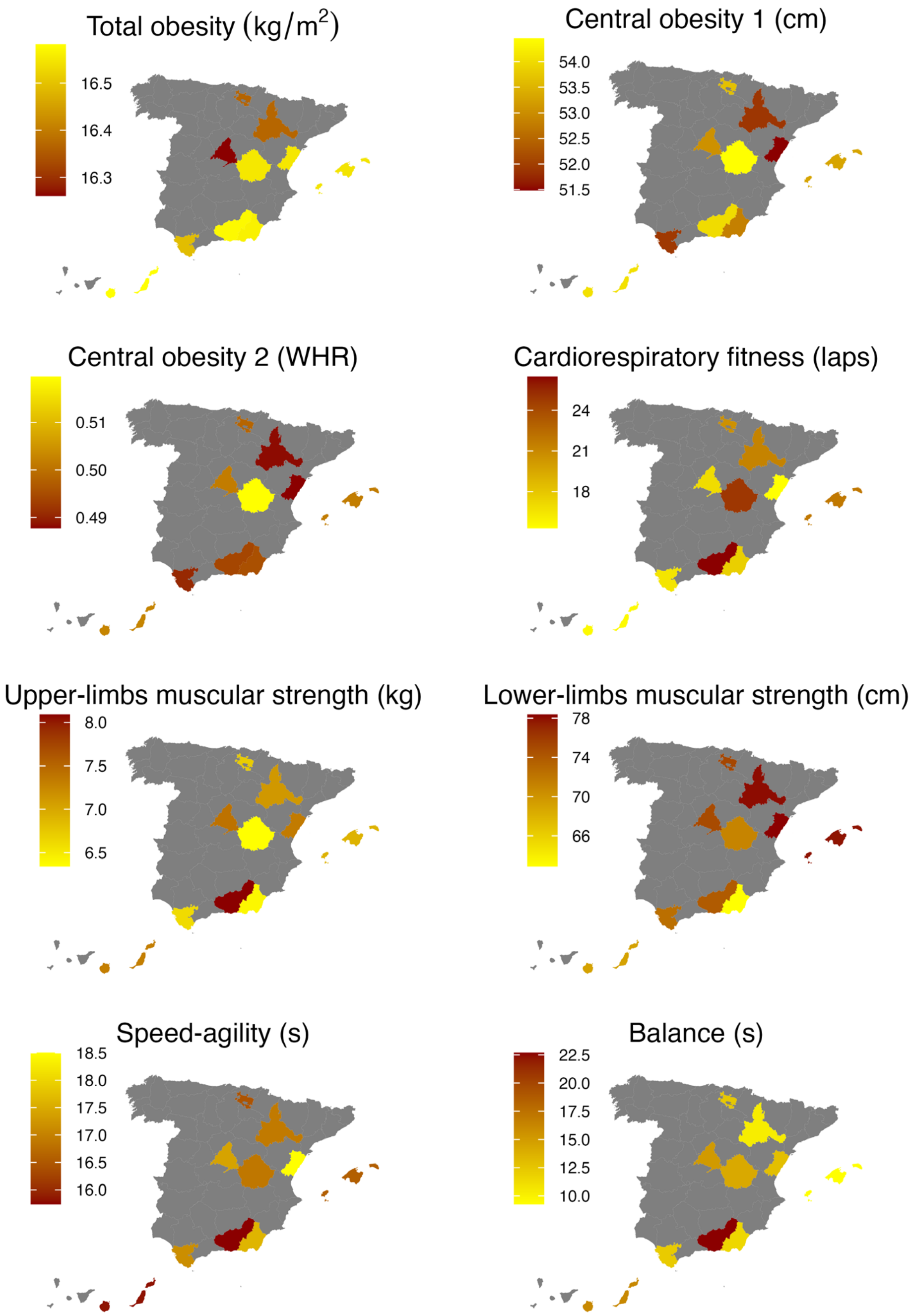

FIGURE 1 Geographical map of the mean score for total and central obesity, and physical fitness components across different cities. Total obesity was evaluated by the body mass index. Central obesity was assessed by waist circumference (central obesity 1) and waist-to-height ratio (WHR, central obesity 2). Cardiorespiratory fitness was evaluated by the PREFIT 20 m shuttle run test, muscular strength was assessed by the handgrip strength test (upper-limbs) and standing long jump test (lower-limbs), speed-agility was evaluated by the PREFIT 4 × 10 m shuttle run test, and balance was evaluated by the one-leg stance test. In the PREFIT 4 × 10 m shuttle run test, lower scores (less seconds in running the fixed distance) indicate a better performance (children are faster and more agile). Darker colours represent better performance, while lighter colours indicate poorer performance.

are based on the locations where they were measured. Given no spatial correlation was found (Table S1), we applied a targeted approach by conducting chi-square tests for categorical analysis and one-way analysis of covariance for continuous variables to compare total and central obesity, and fitness levels between cities located in the north and south of Spain. We also examined potential differences between the included sample and the non-included sample (i.e. children from the central location) using one-way analysis of variance. Additionally, we investigated the differences in total and central obesity, and fitness between rural and urban areas using one-way analysis of covariance. As part of our exploratory analyses, we calculated the percentiles for each child based on age- and sex-specific reference

TABLE 2 Differences in total and central obesity, and physical fitness of the study sample stratified by location (i.e. north and south) and type of area (i.e. rural and urban).

	Location					Area				
	North		South			Rural		Urban		
	N	Mean ± SE	*N*	Mean ± SE	*p**	*N*	Mean ± SE	*N*	Mean ± SE	*p**
Total obesity										
Body mass index (kg/m^2)	902	16.4 ± 0.1	1222	16.6 ± 0.1	**0.017**	466	16.5 ± 0.1	2710	16.5 ± 0.1	0.886
Body mass index (*z*-score)	902	−0.06 ± 0.9	1222	0.04 ± 1.1	**0.017**	466	0.00 ± 1.1	2710	−0.00 ± 1.0	0.886
Central obesity										
Waist circumference (cm)	903	53.1 ± 0.1	1221	53.2 ± 0.1	0.602	466	54.0 ± 0.2	2710	53.0 ± 0.1	**<0.001**
Waist-to-height ratio	903	0.50 ± 0.1	1221	0.50 ± 0.1	0.829	466	0.51 ± 0.1	2710	0.50 ± 0.1	**<0.001**
Physical fitness										
Cardiorespiratory fitness (laps)	888	20.8 ± 0.3	1169	19.7 ± 0.3	**0.010**	453	24.8 ± 0.4	2647	19.2 ± 0.2	**<0.001**
Upper-limbs muscular strength (kg)	899	6.9 ± 0.1	1222	7.2 ± 0.1	**<0.001**	466	7.3 ± 0.1	2707	7.0 ± 0.1	**0.001**
Lower-limbs muscular strength (cm)	901	76.2 ± 0.5	1214	70.1 ± 0.5	**<0.001**	464	74.1 ± 0.8	2699	73.6 ± 0.3	0.510
Speed-agility (s)	894	16.6 ± 0.1	1210	16.5 ± 0.1	0.243	460	16.1 ± 0.1	2691	16.9 ± 0.1	**<0.001**
Balance (s)	896	11.7 ± 0.5	1219	16.4 ± 0.5	**<0.001**	466	15.8 ± 0.7	2698	13.5 ± 0.3	**0.004**

Note: SE, Standard error. Values are presented as adjusted means and SE. North and south were categorized based on the city location (i.e. north: Vitoria-Gasteiz and Zaragoza; south: Almería, Cádiz, Granada, and Las Palmas de Gran Canaria). Rural and urban were classified based on the population size (rural <15 000 inhabitants, urban ≥15 000 inhabitants). Cardiorespiratory fitness was evaluated by PREFIT 20 m shuttle run test, muscular strength was assessed by the handgrip strength test (upper-limbs) and standing long jump test (lower-limbs), speed-agility was evaluated by the PREFIT 4 × 10 m shuttle run test, and balance was evaluated by the one-leg stance test. In the PREFIT 4 × 10 m shuttle run test, lower scores (less seconds in running the fixed distance) indicate a better performance (children are faster and more agile). Bold values indicate significant differences between groups ($p < 0.05$).
*The *p* value was obtained from the analysis of covariance (ANCOVA), which was adjusted for age, sex, body mass index (only for physical fitness analyses) and height (only for waist circumference).

standards for body mass index (>95th),[32] waist circumference (≥90th),[32] and fitness (≥50th).[20] Subsequently, we conducted chi-square analyses to examine whether differences in total and central obesity, and fitness exist considering location and type of area.

2.3.2 | Ethnicity

To investigate ethnicity differences in total and central obesity, and fitness, we performed chi-square tests for categorical variables and one-way analyses of covariance for continuous variables. We further examined potential differences between the participants included in the analyses and those who were not included (i.e. participants for whom the country of birth was not reported) using one-way analyses of variance. Moreover, we also explored differences between ethnicity based on the age- and sex-specific percentiles. In exploratory analyses, we further examined the differences among White and other underrepresented groups (i.e. African, Asian and Latin).

2.3.3 | Covariates

Age, sex, body mass index (only for fitness) and height (only for waist circumference) were considered as confounding variables. We also examined parental education, parental occupation and ethnicity. However, since these additional factors did not change the results, they were not included in the final analysis.

Statistical analyses and graphics were conducted using the SPSS (v.22.0) and R (v. 4.2.2) software.[33] Statistical significance was set at $p < 0.05$.

3 | RESULTS

The study sample's descriptive characteristics are summarized in Table 1. Figure 1 presents a geographical map with visual representations of the mean total obesity, central obesity and fitness components across cities. The extended version of results can be found in Appendix S1.

3.1 | Geographic factors: location and type of area

Descriptive characteristics of the preschoolers by location and type of area can be found in Table S2A. Table 2 presents a comprehensive analysis of total and central obesity, and fitness differences among the study participants, stratified by location and type of area after adjusting for potential confounders. Briefly, preschoolers from the south presented higher total obesity, lower performance on cardiorespiratory fitness and lower-limb muscular strength compared to their

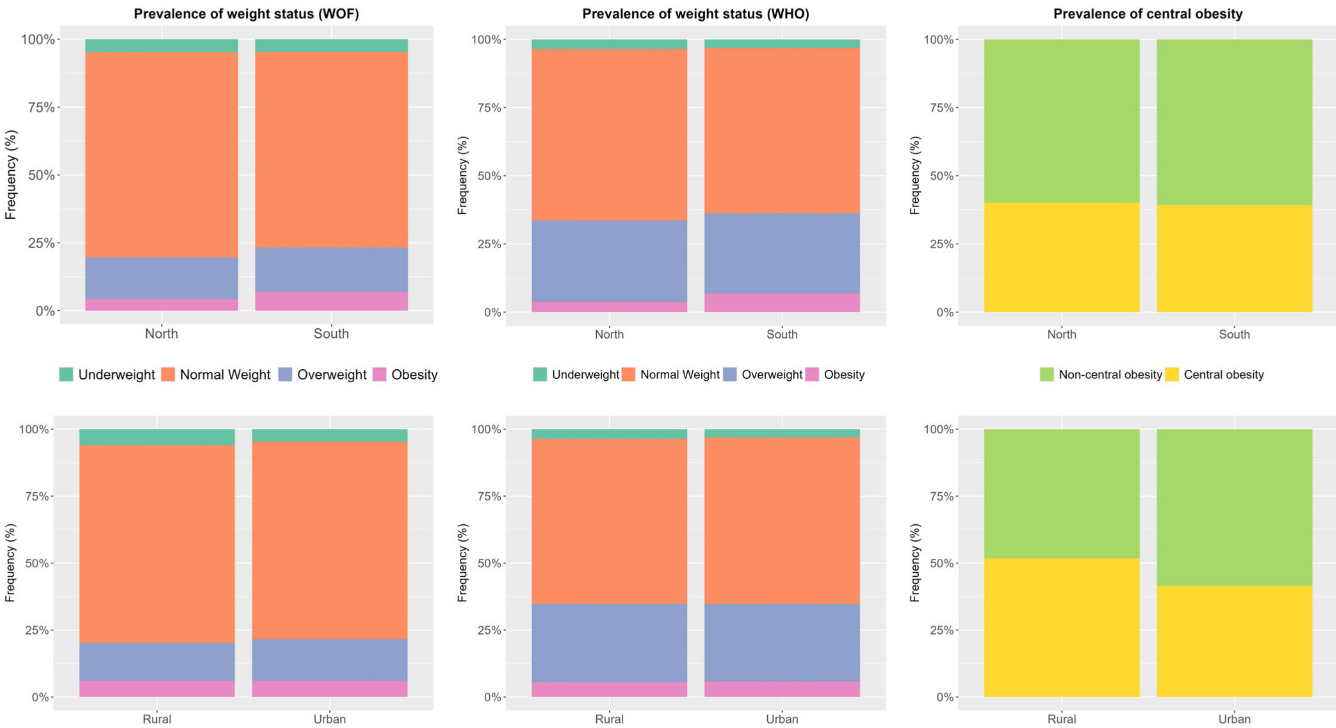

FIGURE 2 Prevalence of weight status based on World Obesity Federation (WOF) and World Health Organization (WHO) and prevalence of central obesity stratified by location (i.e. north and south) and type of area (i.e. rural and urban). The prevalence of underweight, normal weight, overweight or obesity status was calculated using the cutoffs from the World Obesity Federation (WOF) and World Health Organization (WHO).[23,24] The prevalence of central obesity was computed using the 0.5 cutoff.[25] North and south were categorized based on the city location (i.e. north: Vitoria-Gasteiz and Zaragoza; south: Almería, Cádiz, Granada and Las Palmas de Gran Canaria). Rural and urban were classified based on the population size (rural < 15 000 inhabitants, urban ≥ 15 000 inhabitants). Chi-square analyses showed significant differences in the prevalence of weight status (WHO) by location (i.e. north and south) ($p = 0.022$), and the prevalence of central obesity by type of area (i.e. rural and urban) ($p < 0.001$). A borderline non-significant difference was observed in the prevalence of weight status (WOF) by location (i.e. north and south) ($p = 0.056$). Data from the histograms are presented in Table S2G.

peers from the north ($p \le 0.017$). However, they demonstrated greater levels of upper-limb muscular strength and balance ($p < 0.001$). Differences between included and non-included samples can be found in Table S2B. Regarding the area classification, preschoolers living in rural regions showed higher central obesity and greater fitness performance (Table 2, all $p \le 0.004$). Figure 2 depicts the prevalence of weight status and central obesity by location and type of area. Overall, preschoolers from the south presented ~3% higher rates of obesity weight status than those from the north ($p \le 0.056$). The prevalence of central obesity was significantly 10% greater in rural compared to urban areas ($p < 0.001$).

As part of our exploratory analyses, we compared the sex- and age-specific percentiles and observed notable differences between the north and south regions (Figure S1B,C) and rural and urban areas (Figure S1D,E).

3.2 | Ethnicity

Descriptive characteristics of the preschoolers based on ethnicity (i.e. White, African, Asian and Latin) can be found in Table S2C. Table 3 presents the total and central obesity, and fitness differences observed among ethnic groups. We observed that White and African preschoolers exhibited lower body mass index and waist circumference compared to Latin preschoolers ($p \le 0.003$). Additionally, in terms of upper-limbs muscular strength, children classified in the White and African ethnicities demonstrated higher levels than those of Asian ethnicity ($p \le 0.017$). Moreover, preschoolers categorized as White showed faster performance in speed-agility than those Latin participants ($p = 0.037$). Differences between included and non-included samples by location can be found in Table S2C. Figure 3 shows that both Asian and Latin preschoolers presented higher prevalence rates of obesity compared to their White and African counterparts, irrespective of the criteria used. The rates were 17.6% and 20% for Asian and Latin children, respectively, in contrast to 6% and 2% for White and African preschoolers, respectively ($p \le 0.038$). Asian and Latin preschoolers showed 15%–53% higher rates of central obesity compared to their White and African counterparts ($p = 0.001$).

As an exploratory analysis, we further categorized ethnicity into White and other underrepresented groups (Table S2D for descriptive characteristics and Table S2E for examining differences in total and central obesity and fitness). We also compared the sex- and age-specific percentiles among the White, African, Asian and Latin

TABLE 3 Differences in total and central obesity, and physical fitness of the study sample stratified by ethnicity (i.e. White, African, Asian and Latin).

	White		African		Asian		Latin		
	N	Mean ± SE	*N*	Mean ± SE	*N*	Mean ± SE	*N*	Mean ± SE	*p**
Total obesity									
Body mass index (kg/m^2)	2093	16.5 ± 0.1[a]	51	16.2 ± 0.2[b]	17	16.4 ± 0.4	20	17.9 ± 0.4[a,b]	**0.003**[a] **0.001**[b]
Body mass index (*z*-score)	2093	0.02 ± 1.0[a]	51	−0.17 ± 0.8[b]	17	−0.02 ± 1.2	20	0.81 ± 1.4[a,b]	**0.003**[a] **0.001**[b]
Central obesity									
Waist circumference (cm)	2093	53.3 ± 0.1[a,c]	51	51.6 ± 0.6[b,c]	17	54.4 ± 1.0	20	57.4 ± 0.9[a,b]	**<0.001**[a] **<0.001** **0.024**[c]
Waist-to-height circumference	2091	0.50 ± 0.1[a,c]	51	0.48 ± 0.0[b,c]	17	0.51 ± 0.1	20	0.53 ± 0.0[a,b]	**<0.001**[a] **<0.001**[b] **0.035**[c]
Physical fitness									
Cardiorespiratory fitness (laps)	2060	19.4 ± 0.2	50	19.7 ± 1.3	17	14.5 ± 2.2	19	19.5 ± 2.1	0.182
Upper-limbs muscular strength (kg)	2091	6.9 ± 0.1[d]	50	7.2 ± 0.2[e]	17	5.7 ± 0.4[d,e]	20	6.2 ± 0.4	**0.017**[d] **0.011**[e]
Lower-limbs muscular strength (cm)	2084	72.5 ± 0.4	51	73.3 ± 2.3	17	66.4 ± 4.0	19	76.2 ± 3.8	0.330
Speed-agility (s)	2084	16.8 ± 0.1[a]	51	17.0 ± 0.3	17	17.1 ± 0.4	19	17.9 ± 0.4[a]	**0.037**[a]
Balance (s)	2086	13.6 ± 0.3	50	8.5 ± 2.3	19	14.0 ± 3.9	20	6.2 ± 3.6	0.161

Note: SE, standard error. Values are presented as adjusted means and SE. White, African, Asian, and Latin participants were classified based on the country where the preschool children were born. Then, each country was grouped in different population categories, and recoded as White (i.e. Spanish, Roma population from Spain, midwestern European, and east European population), African (i.e. Sub-Saharan, Maghreb), Asian (i.e. Asian-oriental, Indian-Pakistani), and Latin (Afro-Latin/Afro-Caribbean, and Andean-Latin American). Cardiorespiratory fitness was evaluated by PREFIT 20 m shuttle run test, muscular strength was assessed by the handgrip strength test (upper-limbs) and standing long jump test (lower-limbs), speed-agility was evaluated by the PREFIT 4 × 10 m shuttle run test, and balance was evaluated by the one-leg stance test. In the PREFIT 4 × 10 m shuttle run test, lower scores (less seconds in running the fixed distance) indicate a better performance (children are faster and more agile). Bold values indicate significant differences between groups ($p < 0.05$).

*The *p* value was obtained from the analysis of covariance (ANCOVA), which was adjusted for age, sex and body mass index (only for physical fitness analyses) and height (only for waist circumference). (a) Statistical difference between White versus Latin ethnicity. (b) Statistical difference between African versus Latin ethnicity. (c) Statistical difference between White versus African ethnicity. (d) Statistical difference between White versus Asian ethnicity. (e) Statistical difference between African versus Asian ethnicity.

ethnicities (Figure S1F,G). The results for the White and other under-represented groups can be found in Figure S1H,I.

4 | DISCUSSION

The main findings of this study provide valuable insights into the determinants of health of preschoolers from different locations, areas and ethnic groups. Firstly, preschool children from the southern regions presented higher total obesity, along with lower performance in cardiorespiratory fitness and lower-limb muscular strength, compared to their northern peers. However, they demonstrated greater levels of upper-limb muscular strength and balance. Moreover, when considering the type of residential area, preschoolers from rural areas showed higher central obesity but better fitness performance compared to those from urban areas. Secondly, significant differences were observed among ethnic groups, with White and African preschoolers showing lower levels of total and central obesity than Latin preschoolers and performing better in strength and speed-agility compared to Asian or Latin preschool children. These findings underscore the need to explore the underlying socioeconomic and environmental factors shaping these disparities. Understanding the role of physical activity opportunities, dietary habits and healthcare access could inform targeted early-life obesity prevention strategies.

4.1 | Geographic factors: location and type of area

Currently, the available information on preschoolers, comparing total and central obesity, reveals a north–south inequality. At the European level, a recent meta-analysis showed the presence of a north–south gradient in the prevalence of overweight/obesity across children and adolescents.[34] At the national level, there is also evidence supporting a north–south inequality favouring youths in the northern regions.[35] Our study supports that these differences exist at very early ages. However, it is important to note that geographic factors, such as

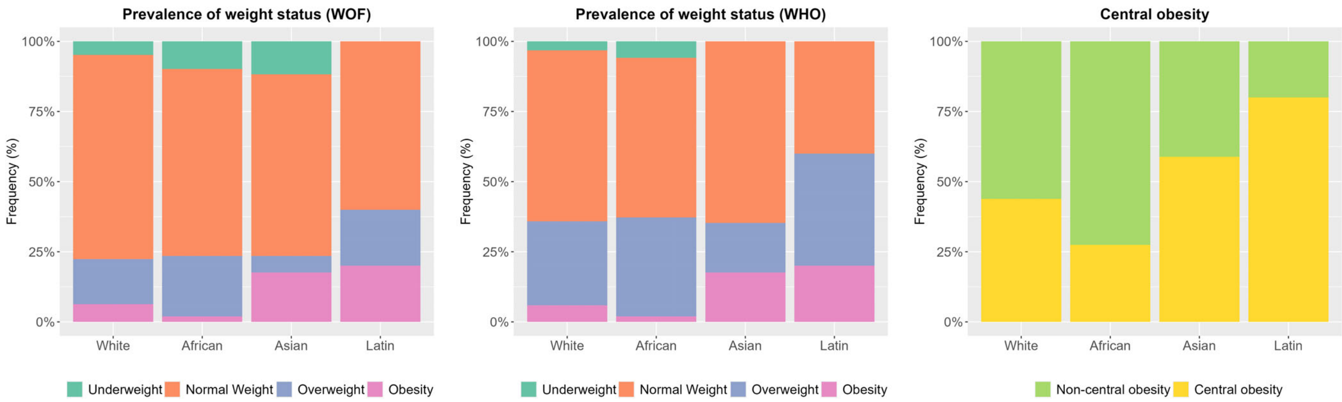

FIGURE 3 Prevalence of weight status based on World Obesity Federation (WOF) and World Health Organization (WHO) and prevalence of central obesity stratified by ethnicity (i.e. White, African, Asian and Latin). The prevalence of underweight, normal weight, overweight, or obesity status was calculated using the cutoffs from the World Obesity Federation (WOF) and World Health Organization (WHO).[23,24] The prevalence of central obesity was computed using the 0.5 cutoff.[25] White, African, Asian and Latin participants were classified based on the country where the preschool children were born. Then, each country was grouped in different population categories and recoded as White (i.e. Spanish, Roma population from Spain, midwestern European, and east European population), African (i.e. Sub-Saharan, Maghreb), Asian (i.e. Asian-oriental, Indian-Pakistani), and Latin (Afro-Latin/Afro-Caribbean, and Andean-Latin American). Chi-square analyses showed significant differences in the prevalence of weight status (WOF and WHO) and central obesity by ethnicity (weight status WHO, $p = 0.027$; weight status WOF, $p = 0.038$; and central obesity, $p = 0.001$). Data from the histograms are presented in Table S2H.

differences in access to healthcare, environmental influences and socio-economic conditions, may influence these disparities. Therefore, it emphasizes the need to draw attention to the factors influencing the initial 2 years of life that contribute to variations as children enter the preschool stage. In terms of fitness, we observed that preschoolers from the south outperformed in terms of upper-limb muscular strength and balance, but not in cardiorespiratory fitness and lower-limb muscular strength, than those from the north, consistent with prior research in preschoolers.[8] However, it is important to note that contrary to previous findings in Europe, we did not observe a similar advantage in cardiorespiratory fitness among preschoolers from the south compared to their northern peers.[8] The observed discrepancy might be attributed to differences in sample size, the inclusion of several cities between the north and south regions, or variations in environmental factors such as air quality or regional diets. Geographic biases, like the inclusion of regions with differing socio-economic conditions, may have also contributed to these inconsistencies. Interestingly, evidence from children and adolescents showed an inverse pattern, with northern Europe being fitter.[35,36] It is important to note that our analyses, which include adjustments for potential confounders such as body mass index, reveal that the results remain unaffected. Therefore, it appears that body weight is not significantly influencing performance in weight-bearing tests (i.e. cardiorespiratory fitness and lower-limbs muscular strength) as previously observed.[8,37] Further exploration of behavioural trends and reasons for changes from preschool to adolescence is warranted.

In regards to the type of area, the literature available shows inconclusive findings.[9–12] In line with our results, two studies[11,12] found no significant differences in total obesity, while two others[9,10] examining this variable in US preschoolers reported significant differences, favouring greater adiposity in those from rural regions. Central obesity has been less studied. Our findings indicate that preschoolers living in rural areas presented greater central obesity than those from urban areas, which contrasts with the study of Torres-Luque et al.[11] on preschool children in Spain. The inconsistency in results may be attributed to differences between or within countries in rural and urban settings, including variations in lifestyle, food environment and access to health services. Regarding fitness, we found that children living in rural areas outperformed their urban counterparts in most fitness tests. This contrasts with a previous study where better speed-agility and lower-limbs muscular strength were observed in preschoolers from urban areas.[11] However, caution is needed when comparing the results, as the fitness tests used were different, and cardiorespiratory fitness was not measured in that study. In comparison to a previous study in children and adolescents from Spain,[38] our findings are consistent with theirs in terms of cardiorespiratory fitness and muscular strength. The higher fitness levels observed in preschool children from rural areas, in contrast to urban areas, could be explained by sociocultural differences, as rural settings often provide more opportunities for physical activity, with fewer barriers and greater community support for active lifestyles.

4.2 | Ethnicity

Ethnic inequalities in childhood obesity have been relatively underexplored,[13,14] particularly in preschoolers.[13] Our study provides new evidence on total and central obesity inequalities during early childhood. Specifically, we observed that White and African preschoolers showed lower total and central obesity compared to Latin preschool children, and African preschoolers also showed lower central obesity than their White peers. These findings are in agreement with previous research in older children, where higher obesity prevalence was observed in Latin children compared to other ethnic groups examined.[14,15] Considering fitness, we also observed that White preschoolers showed better performance in upper-limb muscular strength and speed-agility than their Asian and Latin counterparts, respectively. In addition, African preschoolers also reflected better upper-body muscular strength compared to Asian preschool children. It is important to note that limited information is available in preschoolers, and thus, comparisons need to be done with older children. Existing literature primarily focuses on cardiorespiratory fitness, with White children showing higher maximum oxygen uptake values than Asian, Black or American Indian children.[17,18] Moreover, Toselli et al.[15] concluded that Eastern Europeans typically showed the highest strength values compared to Africans, Asians and Latin Americans. Overall, it is plausible to hypothesise that the interaction among individual differences, encompassing genetics, physiology, culture, environment and socioeconomic status,[13,14] may contribute to the observed ethnic inequalities in both obesity and fitness. Socioeconomic status, in particular, appears to be a significant factor that might influence these inequalities, especially between White and Latin children.[13] However, in our study, adjusting for socioeconomic status confounders such as parental education and occupation did not alter the findings, suggesting that socioeconomic status may not yet have a significant impact at early ages. Nonetheless, it is important to remain cautious with this hypothesis, as socioeconomic factors become more influential in later childhood and adolescence. Moreover, it is of special interest to consider parental behaviour in this age range, as it is clearly stated that a more active and healthier behaviour from parents will affect the children's behaviour.[39,40] Lastly, it is also important to recognize that ethnic disparities in health outcomes can be influenced by differences in access to healthcare, education, and nutrition, or the underrepresentation of certain ethnic groups in the sample. Further research is needed to explore and better understand the underlying factors contributing to these differences.

4.3 | Limitations and strengths

This study has certain limitations that warrant consideration. First, the relatively small number of participants in some of the ethnic groups is a limitation of this study, and our results should be confirmed or contrasted in larger and more diverse sample. Second, the absence of other adiposity markers (i.e. fat mass or fat free mass) accurately measured with gold standard methods, along with the reliance on body mass index and waist circumference as the sole measures of obesity, presents a limitation, as these measures may not fully capture obesity in young children and may lead to misclassification. Third, the lack of studies in preschool children evaluating fitness with valid tests, attributed to logistical challenges inherent in this age group, represent another limitation. Nevertheless, it is important to emphasize that these tests have demonstrated reliability and maximal effort in terms of heart rate in preschoolers (except for balance).[19,26] Fourth, the decision to group participants by north/south and rural/urban categories rather than using a more complex multilevel regression model based on spatial autocorrelation could be seen as a limitation. Although Moran's I analysis showed no significant spatial clustering, which led us to use these categorical groups, the lack of spatial variation in our data may limit the generalizability of our findings. Lastly, dietary habits were not assessed in this study, which could provide additional insights into the observed disparities in obesity and fitness.

5 | PERSPECTIVE

This study reveals significant determinants of health inequalities among preschoolers based on geographical factors and ethnic backgrounds. Our findings indicate that southern preschoolers showed higher total obesity, better upper-limb muscular strength and balance, and lower cardiorespiratory fitness and lower-limb muscular strength. Additionally, children from rural areas show higher central obesity but potential fitness advantages. Lastly, ethnic inequalities indicate varying obesity and fitness levels. Further investigation to understand the underlying environmental, cultural and socioeconomic factors driving these disparities is needed. Future research could benefit from GIS-based analysis to enhance spatial representation and better capture geographic disparities in obesity and fitness. Identifying modifiable determinants (e.g. access to physical activity opportunities, dietary patterns and healthcare resources) could help shape more effective early-life obesity prevention strategies. Tailoring interventions to address these specific disparities may be crucial in mitigating long-term health risks. Longitudinal studies are warranted to assess whether these inequalities persist or change over time, providing valuable insights for sustainable public health policies.

FUNDING INFORMATION

We thank the participation of the preschoolers, parents, and teachers in this study. The PREFIT project takes place thanks to the funding linked to the Ramón y Cajal grant held by FBO (RYC-2011-09011). CC-S is supported by a grant from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska Curie grant agreement no. 101028929, and the European Association for the Study of Obesity – Novo Nordisk Foundation (NNF23SA0083955). DJ-P is supported by the Biomedical Research Networking Center on Frailty and Healthy Aging (CIBERFES) and FEDER funds from the European Union (CB16/10/00477). Funding for open access charge: Universidad de Granada/CBUA.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data is not available for sharing since we did not obtain children's parents consent to widely share the data nor was it included in the IRB protocol.

ORCID

Cristina Cadenas-Sanchez https://orcid.org/0000-0002-4513-9108

REFERENCES

1. Jacobs DRJ, Woo JG, Sinaiko AR, et al. Childhood cardiovascular risk factors and adult cardiovascular events. *N Engl J Med*. 2022;386(20):1877-1888. doi:10.1056/NEJMoa2109191
2. Mattsson N, Rönnemaa T, Juonala M, Viikari JSA, Raitakari OT. Childhood predictors of the metabolic syndrome in adulthood. The cardiovascular risk in Young Finns study. *Ann Med*. 2008;40(7):542-552. doi:10.1080/07853890802307709
3. Raghuveer G, Hartz J, Lubans DR, et al. Cardiorespiratory fitness in youth: an important marker of health: a scientific statement from the American Heart Association. *Circulation*. 2020;142(7):e101-e118. doi:10.1161/CIR.0000000000000866
4. Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obes (Lond)*. 2008;32(1):1-11. doi:10.1038/sj.ijo.0803774
5. Liu W, He MZ, Dambach P, et al. Trends of overweight and obesity among preschool children from 2013 to 2018: a cross-sectional study in Rhine-Neckar County and the City of Heidelberg, Germany. *BMC Public Health*. 2022;22(1):941. doi:10.1186/s12889-022-13302-w
6. WHO European Childhood Obesity Surveillance Initiative (COSI). World Health Organization. 2022.
7. Taxová Braunerová R, Kunešová M, Heinen MM, et al. Waist circumference and waist-to-height ratio in 7-year-old children-WHO childhood obesity surveillance initiative. *Obes Rev off J Int Assoc Study Obes*. 2021;22(Suppl 6):e13208. doi:10.1111/obr.13208
8. Cadenas-Sanchez C, Nyström C, Sanchez-Delgado G, et al. Prevalence of overweight/obesity and fitness level in preschool children from the north compared with the south of Europe: an exploration with two countries. *Pediatr Obes*. 2016;11(5):403-410. doi:10.1111/ijpo.12079
9. Montgomery M, Johnson P, Ewell P. A comparative analysis of rural versus urban preschool Children's sugar-sweetened beverage consumption, body mass index and parent's weight status. *SAGE Open Nurs*. 2022;8:23779608221082962. doi:10.1177/23779608221082962
10. Contreras DA, Martoccio TL, Brophy-Herb HE, et al. Rural–urban differences in body mass index and obesity-related behaviors among low-income preschoolers. *J Public Health Oxf Engl*. 2021;43(4):e637-e644. doi:10.1093/pubmed/fdaa162
11. Torres-Luque G, Hernández-García R, Ortega-Toro E, Nikolaidis PT. The effect of place of residence on physical fitness and adherence to mediterranean diet in 3–5-year-old girls and boys: urban vs. rural. *Nutrients*. 2018;10(12):1855. doi:10.3390/nu10121855
12. Robatsch J, Voitl P, Diesner-Treiber SC. A cross-sectional, exploratory survey on health-relevant free-time activities and body mass index in preschool children in urban and rural settings of Austria. *BMC Pediatr*. 2021;21(1):495. doi:10.1186/s12887-021-02972-x
13. Isong IA, Rao SR, Bind MA, Avendaño M, Kawachi I, Richmond TK. Racial and ethnic disparities in early childhood obesity. *Pediatrics*. 2018;141(1): e20170865. doi:10.1542/peds.2017-0865
14. Caprio S, Daniels SR, Drewnowski A, et al. Influence of race, ethnicity, and culture on childhood obesity: implications for prevention and treatment: a consensus statement of shaping America's health and the Obesity Society. *Diabetes Care*. 2008;31(11):2211-2221. doi:10.2337/dc08-9024
15. Toselli S, Belcastro MG. Participation in sports, body composition, and fitness characteristics in children according to ethnic background. *Scand J Med Sci Sports*. 2017;27(12):1913-1926. doi:10.1111/sms.12843
16. Dixon B, Peña MM, Taveras EM. Lifecourse approach to racial/ethnic disparities in childhood obesity. *Adv Nutr*. 2012;3(1):73-82. doi:10.3945/an.111.000919
17. Nightingale CM, Donin AS, Kerry SR, et al. Cross-sectional study of ethnic differences in physical fitness among children of south Asian, black African-Caribbean and white European origin: the child heart and health study in England (CHASE). *BMJ Open*. 2016;6(6):e011131. doi:10.1136/bmjopen-2016-011131
18. Bowser J, Martinez-Donate AP, Carrel A, Allen DB, Moberg DP. Disparities in fitness and physical activity among children. *WMJ*. 2016;115(5):245-250.
19. Cadenas-Sanchez C, Martinez-Tellez B, Sanchez-Delgado G, et al. Assessing physical fitness in preschool children: feasibility, reliability and practical recommendations for the PREFIT battery. *J Sci Med Sport*. 2016;19(11):910-915. doi:10.1016/j.jsams.2016.02.003
20. Cadenas-Sanchez C, Intemann T, Labayen I, et al. Physical fitness reference standards for preschool children: the PREFIT project. *J Sci Med Sport*. 2019;22(4):430-437. doi:10.1016/j.jsams.2018.09.227
21. Cadenas-Sanchez C, Intemann T, Labayen I, et al. Prevalence of severe/morbid obesity and other weight status and anthropometric reference standards in Spanish preschool children: the PREFIT project. *Pediatr Res*. 2020;87(3):501-510. doi:10.1038/s41390-019-0325-8
22. Ortega FB, Cadenas-Sánchez C, Sánchez-Delgado G, et al. Systematic review and proposal of a field-based physical fitness-test battery in preschool children: the PREFIT battery. *Sports Med Arthrosc Rehabil Ther Technol*. 2015;45(4):533-555. doi:10.1007/s40279-014-0281-8
23. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes*. 2012;7(4):284-294. doi:10.1111/j.2047-6310.2012.00064.x
24. WHO Multicentre Growth Reference Study Group. WHO child growth standards based on length/height, weight and age. *Acta Paediatr Suppl*. 2006;450:76-85. doi:10.1111/j.1651-2227.2006.tb02378.x
25. Garnett SP, Baur LA, Cowell CT. Waist-to-height ratio: a simple option for determining excess central adiposity in young people. *Int J Obes (Lond)*. 2008;32(6):1028-1030. doi:10.1038/ijo.2008.51
26. Cadenas-sánchez C, Alcántara-moral F, Sánchez-delgado G, et al. Evaluación de la Capacidad Cardiorrespiratoria en niños de Edad Preescolar: adaptación del Test de 20m de Ida y Vuelta. *Nutr Hosp*. 2014;30(6):1333-1343. doi:10.3305/nh.2014.30.6.7859
27. Leger LA, Mercier D, Gadoury C, Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. *J Sports Sci*. 1988;6(2):93-101. doi:10.1080/02640418808729800
28. Cadenas-sanchez C, Sanchez-delgado G, Lo M, Martinez-tellez B. Reliability and validity of different models of TKK hand dynamometers. Published Online, 1–9. 2013.
29. Sanchez-Delgado G, Cadenas-Sanchez C, Mora-González J, et al. Assessment of handgrip strength in preschool children aged 3 to 5 years. *J Hand Surg Eur Vol* Published Online. 2015;40:1-7. doi:10.1177/1753193415592328
30. Young L, Peel R, O'Sullivan B, Reeve C. Building general practice training capacity in rural and remote Australia with underserved primary care services: a qualitative investigation. *BMC Health Serv Res*. 2019;19(1):338. doi:10.1186/s12913-019-4078-1
31. Moran PAP. Notes on continuous stochastic phenomena. *Biometrika*. 1950;37(1–2):17-23. doi:10.1093/biomet/37.1-2.17
32. Vanlancker T, Schaubroeck E, Vyncke K, et al. Comparison of definitions for the metabolic syndrome in adolescents. The HELENA Study. *Eur J Pediatr*. 2017;176(2):241-252. doi:10.1007/s00431-016-2831-6
33. RC T. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Published online; 2018.
34. Garrido-Miguel M, Cavero-Redondo I, Álvarez-Bueno C, et al. Prevalence and trends of overweight and obesity in European children from 1999 to 2016: a systematic review and meta-analysis. *JAMA Pediatr*. 2019;173(10):e192430. doi:10.1001/jamapediatrics.2019.2430

35. Ortega FB, Ruiz JR, Labayen I, et al. Health inequalities in urban adolescents: role of physical activity, diet, and genetics. *Pediatrics*. 2014;133(4):e884-e895. doi:10.1542/peds.2013-1665
36. Ortega FB, Leskošek B, Blagus R, et al. European fitness landscape for children and adolescents: updated reference values, fitness maps and country rankings based on nearly 8 million test results from 34 countries gathered by the FitBack network. *Br J Sports Med*. 2023;57(5):299-310. doi:10.1136/bjsports-2022-106176
37. Artero EG, España-Romero V, Ortega FB, et al. Health-related fitness in adolescents: underweight, and not only overweight, as an influencing factor. The AVENA study. *Scand J Med Sci Sports*. 2010;20(3):418-427. doi:10.1111/j.1600-0838.2009.00959.x
38. Chillón P, Ortega FB, Ferrando JA, Casajus JA. Physical fitness in rural and urban children and adolescents from Spain. *J Sci Med Sport*. 2011;14(5):417-423. doi:10.1016/j.jsams.2011.04.004
39. Wilk P, Clark AF, Maltby A, Tucker P, Gilliland JA. Exploring the effect of parental influence on children's physical activity: the mediating role of children's perceptions of parental support. *Prev Med*. 2018;106:79-85. doi:10.1016/j.ypmed.2017.10.018
40. Jiménez-Pavón D, Fernández-Alvira JM, Te Velde SJ, et al. Associations of parental education and parental physical activity (PA) with children's PA: the ENERGY cross-sectional study. *Prev Med*. 2012;55(4):310-314. doi:10.1016/j.ypmed.2012.07.011

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Cadenas-Sanchez C, Fernández-Santos JR, Sánchez-López M, et al. Geographic and ethnic inequalities in total and central obesity, and physical fitness among preschool children: Insights from the PREFIT project. *Pediatric Obesity*. 2025;e70021. doi:10.1111/ijpo.70021