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RESEARCH ARTICLE

Fitness indicators in Mexican schoolchildren with overweight and obesity[☆]



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KEYWORDS

Schoolchildren;
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Abstract

Background: The components of physical fitness are important as indicators of health in schoolchildren. The main objective of this study was to analyze the differences in the components of fitness among overweight/obese school-age children and children with ideal weight. **Methods:** Components of physical condition, anthropometric variables and blood pressure were measured in 491 schoolchildren from the city of Chihuahua, Mexico. Descriptive statistics with analysis of variance and frequency measurements were performed. Only the students who performed all the tests were included.

Results: From the sample, 45% (n=205) were females and 55% (n=251), with a mean age of 8.8 ± 1.8 and 8.9 ± 1.9 years, respectively. Overweight or obesity was present in 39% of the schoolchildren. Waist circumference showed 15.6% of schoolchildren in the ≥ 90 th percentile, and regarding blood pressure about 13.1% of the children were classified with some form of hypertension. Schoolchildren with normal weight showed greater flexibility ($p=0.007$), more arm flexions repetitions ($p=0.000$), and abdominal pushups ($p=0.000$), and less time in the speed test ($p=0.008$) when compared to schoolchildren with obesity.

Conclusions: In the present study, we observed that schoolchildren with overweight and obesity have a significantly lower performance in physical tests. Therefore, the different aspects of physical condition evaluated can serve as immediate indicators of potential health risks for overweight children.

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PALABRAS CLAVE

Escolares;
Obesidad;
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Salud

Indicadores de condición física en escolares mexicanos con sobrepeso y obesidad**Resumen**

Introducción: Los componentes de la condición física son de importancia como indicadores de salud en los escolares. El objetivo principal de este estudio fue analizar las diferencias en los componentes de condición física entre escolares que se encuentran en su peso ideal y los que presentan sobrepeso/obesidad.

Métodos: Participaron 491 escolares de primaria, de la ciudad de Chihuahua, México. Se midieron componentes de la condición física, variables antropométricas y presión arterial. Se realizó estadística descriptiva, análisis de varianza y medidas de frecuencia, incluyendo sólo a los escolares que realizaron todas las pruebas.

Resultados: El 45% (n=205) de la muestra fueron niñas y el 55% (n=251) niños. La edad en años de las niñas fue de 8.8 ± 1.8 , y de los niños 8.9 ± 1.9 . El 39% de los escolares presentaron sobrepeso u obesidad. La circunferencia de cintura mostró 15.6% de escolares con un percentil ≥ 90 , y en la presión arterial aproximadamente 13.1% de los niños es clasificado con algún tipo de hipertensión. Los escolares con peso normal mostraron significativamente mayor flexibilidad ($p=0.007$), más repeticiones en la flexión de brazos ($p=0.000$) y abdominales ($p=0.000$), así como menor tiempo en la prueba de velocidad ($p=0.008$) al compararlos con los escolares que presentan obesidad.

Conclusiones: Los escolares con sobrepeso y obesidad de la presente investigación tienen un menor desempeño significativo en las pruebas físicas comparado con los que se encuentran en su peso ideal, por lo que los diferentes aspectos de la condición física evaluados pueden servir como indicadores inmediatos de los posibles riesgos de salud para los niños con exceso de peso. © 2016 Hospital Infantil de México Federico Gómez. Publicado por Masson Doyma México S.A. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Anthropometric measurements in children and adolescents are used as health indicators. By calculating the weight in kilograms over the height in squared meters, the body mass index (BMI) can be determined. This index can be used to classify people with mild, moderate or severe malnutrition, as well as overweight or obesity¹. On the other hand, waist circumference allows a percentile classification that can be used to estimate metabolic risk in children and adolescents².

There is conclusive evidence linking childhood overweight and obesity with a deficient physical condition, as well as accumulation of abdominal adipose tissue^{3,4}; therefore, it is important to study and analyze anthropometric variables and the components of fitness⁴.

The relationship between a good physical condition and good health is conclusive; cardiorespiratory capacity, strength, speed, flexibility, among other characteristics, contribute significantly to the good performance of a subject's cardiovascular, musculoskeletal, neuromuscular and metabolic systems³⁻⁵. For this reason, it is necessary to analyze the components of the physical condition as health indicators. However, standardized tests, with validity and reliability, must be used to perform this analysis^{5,6}.

Arterial hypertension is a cardiovascular risk factor that is mainly present in adults, and is uncommon in children. However, in the last decades, an increase in the prevalence in this disease has been observed, mainly in children with

obesity^{7,8}. Prevalence rates of hypertension in children and adolescents have increased recently⁹. In Latin America, an increase of approximately 10.2% has been reported, considering this disease as a public health issue^{8,9}; therefore, we included measurements and analysis of arterial blood pressure for the present study.

Childhood overweight and obesity are considered public health issues that have increased¹⁰⁻¹². In Mexico, according to the National Health and Nutrition surveys, school-age children show an increase in the prevalence of overweight and obesity, with a national mean value of 26.9% in 1999 to 34.4% in 2012, which is already an issue that must be addressed through relevant interventions^{11,12}. If this trend continues, these school-age children will present serious health problems in adulthood, which will negatively affect their productivity and cause an unsustainable healthcare expenditure for the government, leading to a sick and disabled country¹³.

Educational, political, and public health strategies to address the issue of childhood obesity in the United States have focused on improving the physical condition of the school children through physical education, school-based sports, the promotion of active lifestyles and implementation of national standards for physical condition^{14,15}. The present study shows the results of a study conducted in schoolchildren from two public primary schools. The main objective was to analyze differences in the components of physical condition by comparing school-age children with overweight/obesity against children with ideal weight.

2. Methods

We performed a cross-sectional study, taking convenience samples of two public primary schools from the city of Chihuahua, Mexico, where the school's principal and parents agreed to participate. We invited all school-age children from first to sixth grade, resulting in a sample of 491 students, of whom only 251 males and 205 females were analyzed ($n=456$). The rest did not comply with measurements. Parents or guardians of the students were informed of the purposes of the study and signed the letter of consent. Any school child with a medical condition that restrained him/her from participating in the study, or those from which the informed consent was not obtained, were excluded.

The anthropometric indicators measured in this study were weight or body mass, height and waist circumference. BMI and waist circumference percentile of the sample according to age and gender were determined. For BMI classification, the leaderboards of the World Health Organization (WHO) were considered, which can be found in the "FOOD AND NUTRITION TECHNICAL ASSISTANCE" (FANTA III) 2012¹. To determine the percentile of the waist circumference, the tables from the Consensus for the Definition of Metabolic Syndrome in Children and Adolescents of the International Federation of Diabetes 2007 (IDF)² were used.

As part of a health indicator, the study included measurement and classification of arterial blood pressure (AP) based on the fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents⁸, developed by the Department of Health and Human Services of the United States and revised in 2005. A pediatric aneroid sphygmomanometer was used to measure AP.

In order to measure and classify the physical condition, a part of the battery of physical tests called *The*

Presidential Physical Fitness Award, which were developed by the President's Council on Fitness, Sports and Nutrition and the Department of Health and Human Services of the USA¹⁴ were used. The physical tests included for this study were abdominal exercises (crunches), arm flexions, flexibility, speed and agility (shuttle and run). To classify the results in the physical tests, the 85th percentile was considered as an excellent performance, a score \geq 50th percentile and \leq 85th, as good performance, and a score $<$ 50th percentile was considered as poor performance¹⁴.

For data analysis, the statistical program SPSS version 18.0 was used to perform descriptive statistics, analysis of variance and frequency measurements.

3. Results

Descriptive results in [Table 1](#) show that, according to the average obtained from all the variables studied, there are only significant differences in the physical tests when comparing males and females. Frequency measurements and percentages for school-age children ([Table 2](#)) show that 39% of schoolchildren are overweight or obese; 9.6% have mild malnutrition; 2%, moderate malnutrition, and only 9%, severe malnutrition.

Waist circumference measurements ([Table 3](#)) show that approximately 30% of school children were $>$ 50th percentile, and 15.6% were classified in the \geq 90th percentile. Systolic and diastolic arterial pressure ([Table 4](#)) measurements showed that 12% and 13% of the schoolchildren considered in the study, respectively, were classified as having some form of hypertension.

[Table 5](#) shows that approximately 58.6% of schoolchildren were classified with poor performance in flexibility, 91.4% in arm flexions, 97.1% in abdominal crunches and 98.0% in speed. In [Table 6](#), the main differences are observed when comparing schoolchildren with obesity against normal-weight children; however, some differences can also be

Table 1 Descriptive results and main differences in the variables studied in school-age children classified by gender.

Variables	Females (n = 205)		Males (n = 251)		ANOVA <i>p</i>
	Mean	SD	Mean	SD	
General characteristics					
Age (years)	8.8	1.8	8.9	1.9	0.434
Height (cm)	134.2	12.5	134.2	12.0	0.965
Weight (kg)	34.1	11.4	34.2	12.0	0.897
BMI (kg/m ²)	18.6	4.4	18.6	4.5	0.961
Waist (cm)	64.1	11.1	63.9	11.0	0.879
Blood pressure (mmHg)					
Systolic	99.6	16.1	97.9	17.0	0.283
Diastolic	63.8	11.5	63.6	12.3	0.820
Physical tests					
Flexibility (cm)	25.3	6.9	23.2	6.1	0.001*
Arm flexion (repetitions)	1.9	2.7	4.9	5.8	0.000*
Abdominal crunches (repetitions)	9.1	6.9	12.2	8.3	0.000*
Speed (seconds)	15.0	1.9	14.5	2.1	0.005*

BMI, body mass index; SD, standard deviation.

* main differences.

Table 2 Frequencies and percentages for body mass index classification.

Body mass index Classification	Females (n = 205)		Males (n = 251)		Total (n = 456)	
	n	%	n	%	n	%
Mild malnutrition	23	11.2	21	8.4	44	9.6
Moderate malnutrition	2	1	7	2.8	9	2
Severe malnutrition	2	1	2	0.8	4	0.9
Normal	96	46.8	125	49.8	221	48.5
Overweight	46	22.4	37	23.5	83	18.2
Obesity	36	17.6	59	14.7	95	20.8
Overweight and obesity	82	40	96	38.2	178	39

Table 3 Frequencies and percentages according to waist circumference classification.

Waist circumference Classification (IDF, 2007)	Females (n = 205)		Males (n = 251)		Total (n = 456)	
	n	%	n	%	n	%
≤ 50th percentile	133	64.9	176	70.1	309	67.8
> 50th percentile and < 75th percentile	15	7.3	18	7.2	33	7.2
> 75th percentile and < 90th percentile	22	10.7	21	8.4	43	9.4
≥ 90th percentile	35	17.1	36	14.3	71	15.6

IDF, International Diabetes Federation.

Table 4 Frequencies and percentages according to arterial blood pressure classification.

Blood pressure Classification	Females (n = 205)		Males (n = 251)		Total (n = 456)	
	n	%	n	%	n	%
Systolic						
Grade 1 hypertension	17	8.3	22	8.8	39	8.6
Grade 2 hypertension	10	4.9	8	3.2	18	3.9
Hypertension	27	13.2	30	12	57	12.5
Pre-hypertension	17	8.3	21	8.4	38	8.3
Normal	161	78.5	200	79.7	361	79.2
Diastolic						
Grade 1 hypertension	24	11.7	29	11.6	53	11.6
Grade 2 hypertension	2	1	8	3.2	10	2.2
Hypertension	26	12.7	37	14.8	63	13.8
Pre-hypertension	19	9.3	23	9.2	42	9.2
Normal	160	78	191	76.1	351	77

observed by comparing overweight schoolchildren against normal-weight children, as well as overweight against obese.

4. Discussion

In the present study, some anthropometric and fitness indicators, and arterial blood pressure measurements of school-age children with obesity/overweight and schoolchil-

dren with normal weight were determined. The main objective was to analyze the differences in fitness between these groups. Anthropometric results show a 39% prevalence of overweight and obesity for schoolchildren in this study; similar results were found in a study involving 321 school-age children from 6 to 14 years that attended an outpatient family medicine practice in the family medical unit (UMF) No. 32 of the Mexican Social Security Institute (IMSS) in Guadalupe, Nuevo León, Mexico¹⁵.

Table 5 Frequencies and percentages according to physical tests performance classification.

Physical test Classification	Females (n = 205)		Males (n = 251)		Total (n = 456)	
	n	%	n	%	n	%
Flexibility						
Excellent	20	9.8	30	12	50	11
Good	60	29.3	79	31.5	139	30.5
Poor	125	61	142	56.6	267	58.6
Arm Flexion						
Excellent	2	1	11	4.4	13	2.9
Good	2	1	24	9.6	26	5.7
Poor	201	98	216	86.1	417	91.4
Abdominal crunches						
Good	3	1.5	10	4	13	2.9
Poor	202	98.5	241	96	443	97.1
Speed and agility						
Good	3	1.5	6	2.4	9	2
Poor	202	98.5	245	97.6	447	98

Table 6 Differences in fitness indicators among school-age children with overweight/obesity and normal subjects.

BMI Test	Normal Mean	OW Mean	OB Mean	Normal vs OW <i>p</i>	Normal vs OB <i>p</i>	OW vs OB <i>p</i>
FLEX (cm)	25.2	23.8	23	0.098	0.007*	0.459
AF (rep)	4.5	2.8	1.4	0.010*	0.000*	0.006*
ABD (rep)	12.5	10.5	6.6	0.050*	0.000*	0.000*
SP (s)	14.5	14.7	15.1	0.342	0.008*	0.209

*main differences. BMI, body mass index; FLEX, flexibility; AF, arm flexion; ABD, abdominal; SP, speed; rep, repetition; OW, overweight; OB, obesity.

Waist circumference measurements in this study revealed that 15.6% of schoolchildren were classified in the ≥ 90 th percentile; hence, it is possible to consider this percentile as an indicator of metabolic syndrome and cardiovascular risk¹⁶⁻¹⁸.

Regarding arterial blood pressure, we found in this study that between 12% and 13% of schoolchildren were classified with some form of hypertension, which is consistent with some other studies^{19,20}. However, as these results are not conclusive for this primary school community, a pediatric medical diagnosis would be necessary.

The more relevant results of our study show alarming percentages of poor performance in the physical tests applied, with 58.6% of schoolchildren of both genders classified with poor performance in flexibility, 91.4% with poor performance in arms strength, 97.1% with poor performance in abdominal strength and 98% with poor performance in the speed and agility tests. Although significant differences in the average of the physical tests can be observed by comparing males with females, the percentages by gender show that there is a great similarity in terms of classification. For this reason, we can establish that both males and females show

a predominant poor performance on physical tests. Similar results were found in a study carried out in a primary school in Mexico City^{21,22}. In this regard, consistent results in adolescents and children have been found, with significant differences between males and females, but with a high percentage of schoolchildren of both genders rated as having a poor physical condition²³⁻²⁵.

It is undeniable that physical condition has a close relationship with health, overweight, obesity, and lifestyle of schoolchildren, as some studies reveal^{24,25}. In the present study, we establish that there is a poor performance regarding physical condition in schoolchildren, so physical education would be of great importance to improve these aspects; however, international policies concerning physical education and health at present are not consistent with national policies²⁶⁻²⁸. For this reason, an intervention is necessary, in which different sectors of the local community could be involved in order to improve the physical condition and health of boys and girls, as well as a multidisciplinary team to achieve better results.

Another important finding in the present study reveals that there are significant differences in the results of the

physical tests. When comparing schoolchildren with a normal BMI against those with obesity, we can observe that the latter had a worse performance in flexibility, abdominal strength, arm strength and speed/agility tests, these being consistent with the results of others studies carried out in Portuguese and Spanish schoolchildren^{29,30}. Because of this, we can establish that improving physical condition of the schoolchildren could be of relevance to decrease and solve the problem of obesity in school-age boys and girls.

As a conclusion, schoolchildren with overweight and obesity in this study have a significant worse performance on physical tests; consequently, the different aspects of fitness evaluated here may serve as immediate indicators of potential health risks for children with overweight.

The search for intervention strategies involving a multidisciplinary work linked with professionals of physical education, psychology, nutrition, nursing and pediatrics, as well as different sectors of the society could be of great relevance to improve the physical condition and health of schoolchildren throughout the country.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Conflict of interest

The authors declare no conflict of interest of any nature.

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