Gómez Jiménez, J.E.; Pico Fonseca, S.M.; Bueno Fernández, E. y Pachón, H. (2013) Comparando la condición física entre niños colombianos y referencias cubanas / Physical fitness in colombian children versus cuban references. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 13 (52) pp. 687-702. Http://cdeporte.rediris.es/revista/revista52/artcomparacion394.htm

ORIGINAL

PHYSICAL FITNESS IN COLOMBIAN CHILDREN VERSUS CUBAN REFERENCES

COMPARANDO LA CONDICIÓN FÍSICA ENTRE NIÑOS COLOMBIANOS Y REFERENCIAS CUBANAS

Gómez Jiménez, J.E.[1]; Pico Fonseca, S.M.[2]; Bueno Fernández, E.[3] & Pachón, H.[4]

[1] Bachelor's degree in Physical Culture, Colombia, jorge_gomez_cu@yahoo.es
[2] Bachelor's degree in Nutrition and Dietetics, Centro Internacional de Agricultura Tropical (CIAT), Colombia, saydamile@hotmail.com
[3] Doctorate in Physical Culture, Universidad de Cienfuegos, Cuba, ebueno@ucf.edu.cu
[4] Doctorate in Nutrition and Master of Public Health, Centro Internacional de Agricultura Tropical (CIAT), Colombia, helena.pachon@emory.edu

Spanish-English translator: Pachón, H. helena.pachon@emory.edu

ACKNOWLEDGEMENTS

We thank CIAT's Freddy Escobar Pinto for logistical support; directors and teachers from participating schools; participating school children and their parents; the professionals who gathered the data (Juan Manuel Campos Burbano, Alexandra Colorado Restrepo, Carlos Armando Hoyos Espítia, Adriana Marcela Villota, Yeimmy Sofia Meneses, Arlen Mosquera Hoyos, Yenny Patricia Ordoñez Muñoz and Beatriz Elena Serna Londoño); Antonio Alba for his contributions to the data-collection training; Blas Yoel Juanes Giraut and Carlos Manuel Cañedo for help with data analysis and crafting the manuscript; Alfredo Hernandez Toledo for managing the databases; Marlene Rosero for editing the Spanish text; and the Canadian government for financial support through the AgroSalud project (CIDA 7034161).

Clasificación UNESCO / UNESCO Classification: 5899 Educación Física y Deportiva / Physical Education and Sports.
Clasificación del Consejo de Europa / European Council Classification: 4. Educación física y deporte comparado / Comparative physical education and sports.

Recibido 20 junio de 2011 **Received** June 20, 2011

Aceptado 2 de octubre de 2013 **Accepted** October 2, 2013

ABSTRACT

The purpose of this study was to evaluate the physical fitness of children from a rural municipality in Cauca department, Colombia, and to compare results with Cuban references. Using a non-experimental cross-sectional descriptive design, eight tests were applied to 310 children from Cauca, aged 4-9 years. For the eight tests, measurements corresponding to the mean, stratified by sex and age, were calculated and compared with means of a Cuban reference. As a general conclusion, Cuban children of both sexes are more rapid and have greater leg strength than Caucanos, while the latter proved to have more arm and abdomen strength, as well as more resistance, than the Cuban children.

KEY WORDS: Norms, physical fitness, physical fitness tests, school children.

RESUMEN

El propósito del estudio fue evaluar el nivel de condición física de niños y niñas en un municipio rural del departamento del Cauca, Colombia, y compararlo con referencias cubanas. Con un diseño no experimental transversal descriptivo, se aplicaron ocho pruebas a 310 niños de Cauca, entre 4 y 9 años. Para las ocho pruebas se establecieron las medidas que correspondían a la media de la muestra, estratificadas por sexo y edad, y éstas se compararon con las medidas que corresponden a la media en una referencia cubana. Como conclusión general, se llegó a comprobar que los cubanos de ambos sexos son más rápidos y fuertes de piernas que los caucanos, mientras que estos últimos resultaron ser más fuertes de brazos y abdomen, y más resistentes que los cubanos.

PALABRAS CLAVE: Normativas, condición física, pruebas de eficiencia física, escolares.

1. INTRODUCTION

Currently there is a consensus among physical activity professionals about the importance of physical education. It is important for introducing sports to children and for promoting their multilateral development: their capacities, abilities and skills[1-4]. Factors which justify the use of sports introduction in physical activity are as follows[4]:

1. Characteristics of educational sports. Sports introduction in the school setting does not focus on competitive aspects, but rather contribute to the student's integral education.
2. Characteristics of the students. As of third grade in primary school, there's a great advance in children's cognitive, social, emotional and motor-development levels; this allows them to begin educational sports.
3. Socio-cultural value of sports. School should be used to develop positive values that sports promote. Sports are a manifestation of a country's culture (5).
4. Relationship with physical education curriculum. Introduction to sports is included in the physical education curriculum.

Evaluating children's aptitudes and capabilities as they begin playing sports has a two-fold purpose[6]. First, it assures they will have future success in competitive sports. Second, it avoids frustration among those children who begin sports but who lack the abilities to play them.

Several factors must be taken into account in working with children. For example, care must be taken to adapt work to children's structures and possibilities. Further, there must be a didactic intentionality that ensures the scientific characteristic of sports introduction as part of their multilateral development.

All of the above leads to a number of questions. What is the developmental potential of students who participate in physical education classes? How to address sports introduction in physical education, with a scientific base? What actions should be undertaken to ensure a role for physical education in this important process?

Physical fitness tests or motor-performance test can help address these questions. Physical fitness tests are often implemented massively by physical education teachers in schools. These tests allow the classification of children based on their motor potential and anthropometry. The classification, in turn, permits an adequate initiation in sports[7].

Despite the aforementioned, in several countries around the world, and in Colombia in particular, there are no references that recognize children's developmental potential to play sports. This potential is age-, sex-and sport-specific. Therefore, it is necessary to carry out studies that allow orienting sports introduction for different ages and sexes, starting with the development of norms.

The general objective of this project was to evaluate physical fitness in girls and boys from Cauca department in Colombia. Specific objectives were as follows: (1)

describe the girls' and boys' physical fitness vis-à-vis eight tests and (2) compare the results achieved by the Colombian children with a Cuban reference.

2. MATERIALS AND METHODS

2.1. Study design and ethical approval

A non-experimental, cross-sectional, descriptive study was completed. All measures reported were gathered at one point in time in 2009.

Ethical approval for the conduct of a broader study was provided by the University of Antioquia's (Colombia) Human Research Bioethics Committee. The larger study evaluated the impact of a food-based intervention on school children's food security[8], nutritional status and neuropsychological parameters. Written consent was obtained from school directors and children's parents. Further, oral assent was obtained from each child. The informed consent process included ethical principles for medical research on human subjects of the Helsinki Declaration[9].

2.2. Population and sample

Children who participated in the study attended 1 of 12 schools in a rural municipality in the Cauca department in Colombia. Children attended pre-school, first, second or third grade of primary school. The selection of the children was a multi-step process. Twenty seven of the 84 schools in the municipality were invited to participate based on proximity to the highway and participation in the national government's school-feeding program; 13 accepted and written consent was obtained from the schools' directors. Informed consent forms were sent to the parents of all children in kindergarten through 3rd grade in these schools (n=1049); 416 were signed. In a screening phase, 412 of these children were measured for weight, height and hemoglobin. Based on the results, 310 children from 12 schools were selected for inclusion in the study because they were between 4 and 10 y, attended kindergarten through 3rd grade, and did not attend a school located at more than 2000 meters above sea level, where the study maize could not be grown (Figure 1). Physical fitness tests were applied to 310 children.

A Cuban methodology for assessing physical fitness in school children was implemented (see below). Therefore, the Colombian data were compared with a Cuban reference that reports data on girls and boys 6-16 years of age from 14 provinces[10].

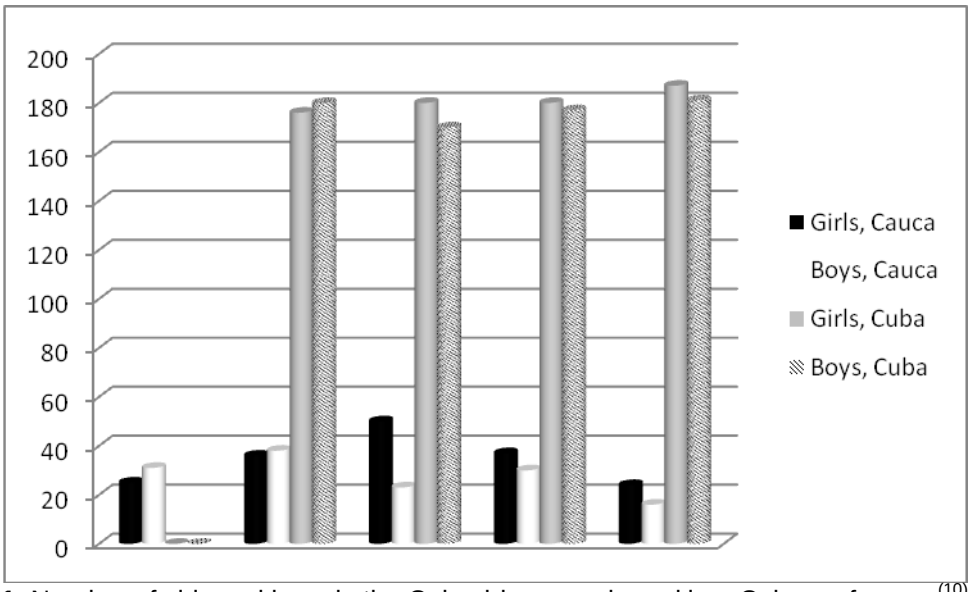


Figure 1. Number of girls and boys in the Colombian sample and in a Cuban reference[10], by sex and age group.

2.3. Physical fitness assessment

To reduce measurement error, the norms for gathering the variables reported were strictly adhered to[11-12]. Data-collection instruments were piloted and implemented by the same personnel. Two members of the research team had previous experience in studies gathering anthropometric measures, and in the assessment of physical fitness in children, respectively.

In most cases, all tests were applied in one day, except for the 400-m run, which was applied on the following day. The measures were applied in this order: weight, height, flexibility, 30-m run, push ups, sit ups, standing long jump, and 400-m run. Each of these tests is described in turn.

Children's weight and height was measured with light clothing and bare feet. Children were positioned as follows: standing, heels together, relaxed shoulders and arms, erect torso, and head in the Frankfort plane. The foot races were completed in a grassy field where the distances were measured by data-collection personnel. All data were collected on specially designed forms.

2.3.1. Weight. A measure of total body mass. Weight was measured in kilograms with an OMRON digital balance having a 0.05 kg precision. Children stood in the center of the scale, without support, making contact with the scale's three plates, and without moving. Weight was measured in duplicate. If measurements differed by more than 0.2 kg, a third measure was taken. Prior to weighing, children were taken to the bathroom to void their bladders.

2.3.2. Height. A measure of maximum body length. Height was measured in centimeters with a SECA-brand tape measure having a 1 mm precision affixed to a wooden structure. Children stood with their heels together and at a 45° angle, with their buttocks, back and calves in contact with the back surface of the instrument, and ensuring that the Frankfort Plane was maintained. The mobile part of the height board was placed on the top of the child's head, and the child's head was aligned with the Frankfort Plant. The height measurement was taken twice; if these differed by more than 1 mm, a third measure was taken.

2.3.3. Flexibility. A measure of the hip's flexibility. Children sat with their back and head rested against a wall. The balls of their feet were placed against a 30 cm bench. Children placed one hand over the other and extended them outward, parallel with the floor--the 0 position of the scale was moved to this point. Slowly, children stretched forward as far as possible and held their final position for 2 seconds. This stretching movement was completed twice and the longest distance was registered in centimeters.

2.3.4. Speed. Refers to the capacity to run 30 m in the least amount of time possible. Girls and boys ran 30 meters with shoes on or barefoot, per their preference. Children began the race from an up-right position. The time it took to complete the 30 meters was measured with a 0.01-second precision.

2.3.5. Push ups. A measure of upper-body strength. Children lay on the ground, face down, arms bent, hands by their arm pits, fingers facing forward, head aligned with the trunk, and eyes affixed on the ground. Boys supported themselves on their toes and girls on their knees, with their lower legs crossed. Data-collection personnel ensured that with every push up, the body was maintained in a straight plane. All push ups completed were counted until either the child's form devolved or the child could not continue.

2.3.6. Sit ups. A measure of children's abdominal strength. Children lay on the ground, face up, feet were 30 cm away from buttocks, knees bent at a right angle, and arms crossed across their chest. Children's ankles were secured by a member of the data-collection team. All sit ups were counted until either the child's form devolved or the child could not continue.

2.3.7. Standing long jump. A measure of the strength of children's lower extremities. A flat, non-slippery surface, at least 3 meters long and 1 meter wide was identified and marked in centimeters. Children stood behind the starting line and then jumped forward, the greatest distance possible. Children were shown to move their arms backward and then forward, with the jump coinciding with the forward arm motion. Both feet left the floor at the same time to initiate the jump. The distance between the starting line and the heel closes to the line was

measured in centimeters. Children jumped twice; the longest distance was recorded.

2.3.8. Resistance. A measure of children's aerobic capacity. Resistance was measured in the time (minutes and seconds) it took children to traverse 400 m. A level, grassy field was measured by the data-collection team using a 50-m tape measure. Children were told they could walk or run, but they needed to complete the 400-m distance.

2.4. Statistical analyses

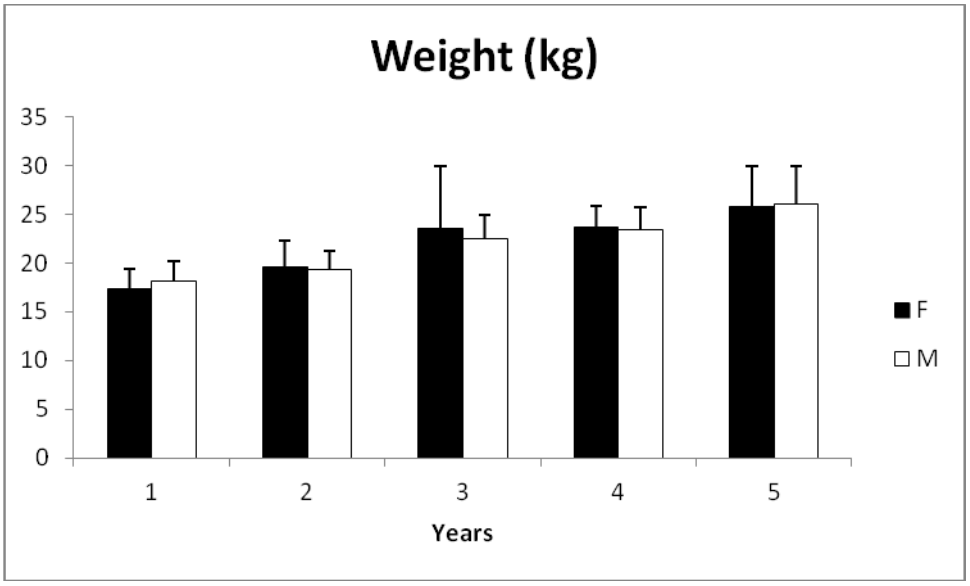
For specific objective 1, descriptive statistics were completed, including the Kolmogorov-Smirnov test to assess the distribution of the data. For specific objective 2, Student's t-test for independent samples was used to compare the age- and sex-specific mean score on 5 physical fitness tests between Colombian data and a Cuban reference. Statistical Package for Social Sciences (SPSS, version 17.0) was used to complete objective 1 and GraphPad software was used for objective 2.

3. RESULTS AND DISCUSSION

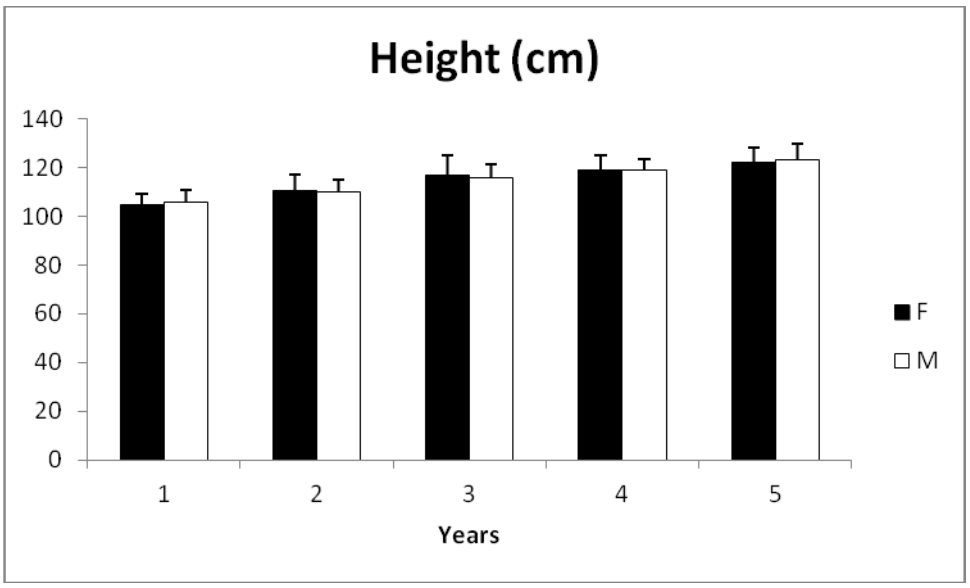
3.1. Descriptive statistics

Figure 2 shows the mean and standard deviation for all of the variables gathered in the Cauca school children. All variables had a normal distribution ($P<0.05$, Kolmogorov-Smirnov test).

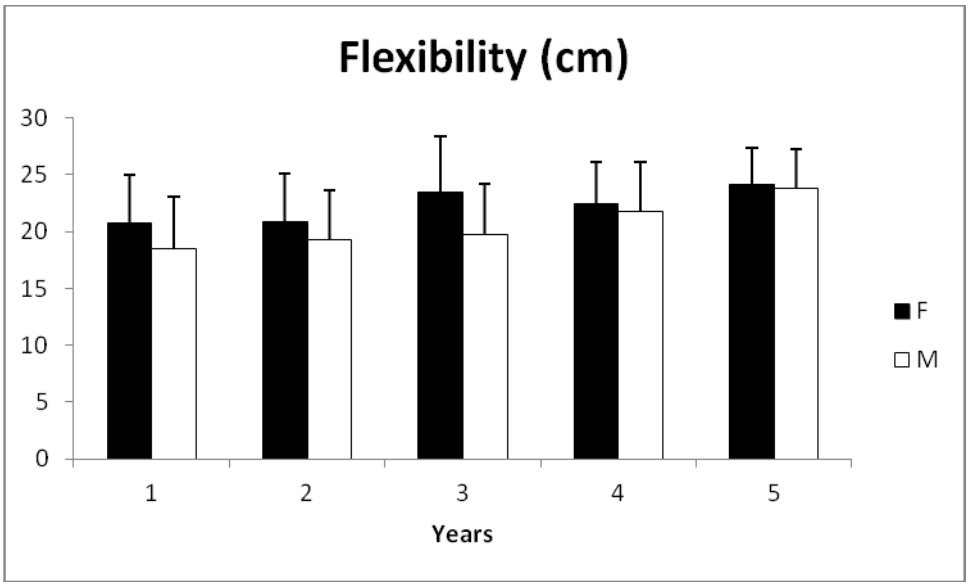
a)



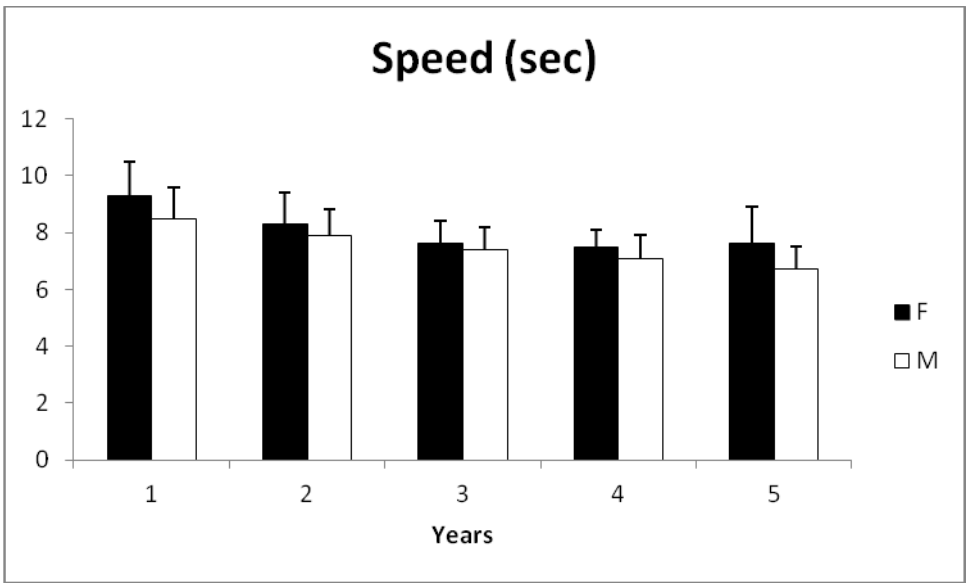
b)


Height (cm)
140
120
100
80
60
40
20
0
1
2
3
4
5
Years
F
M

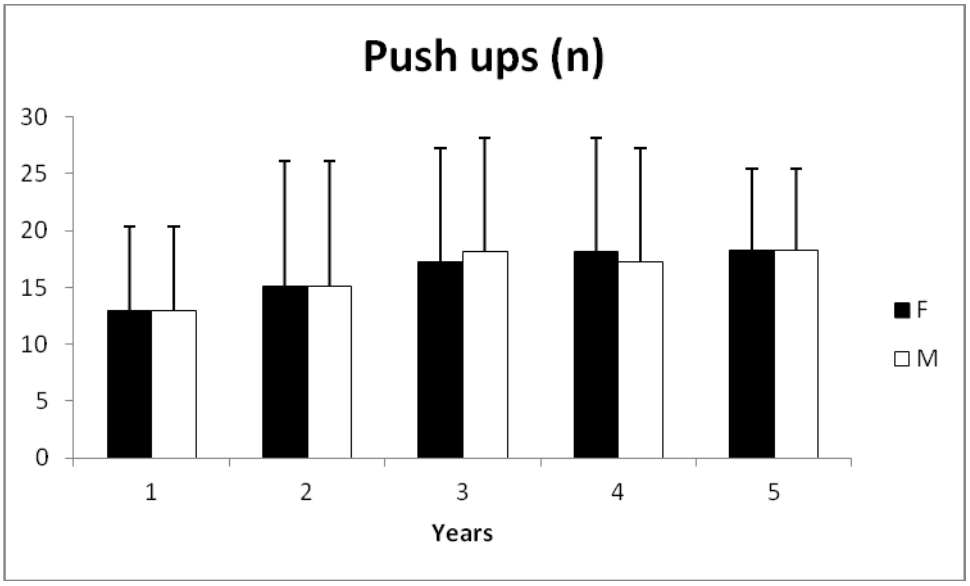
c)


Flexibility (cm)
30
25
20
15
10
5
0
1
2
3
4
5
Years
F
M

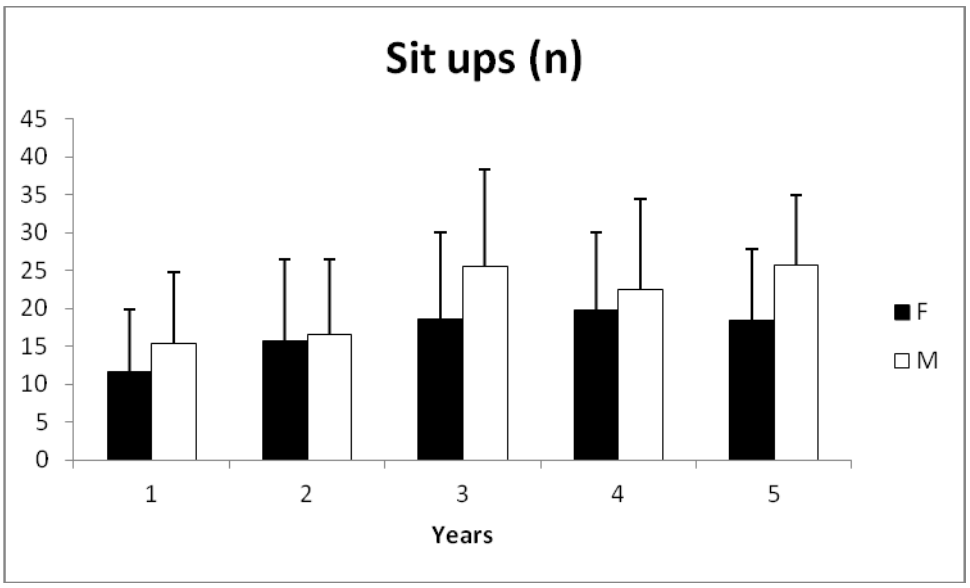
d)


Speed (sec)
12
10
8
6
4
2
0
1
2
3
4
5
Years
F
M

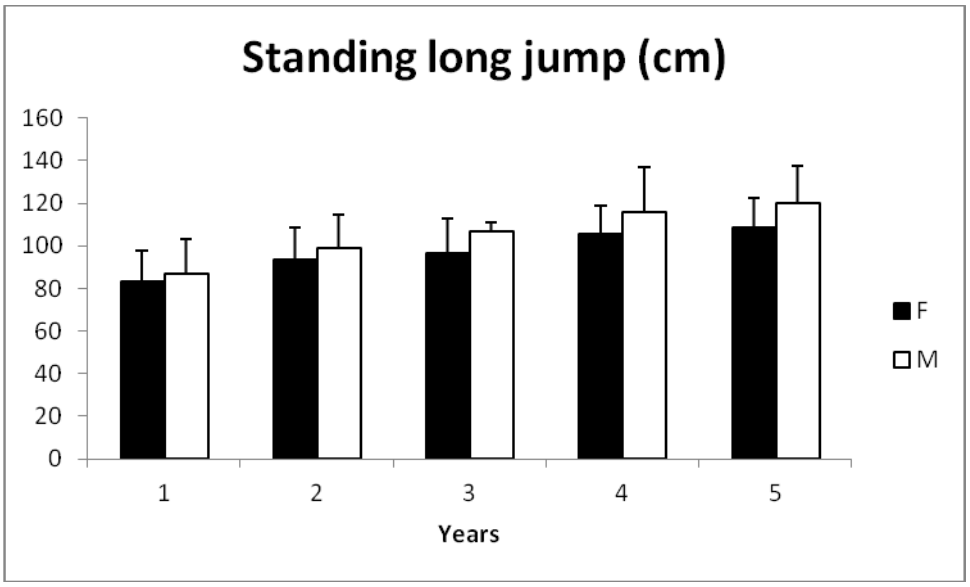
e)


Push ups (n)
30
25
20
15
10
5
0
1
2
3
4
5
Years
F
M

f)


Sit ups (n)
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
Years
F
M

g)


Standing long jump (cm)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
Years
F
M

h)

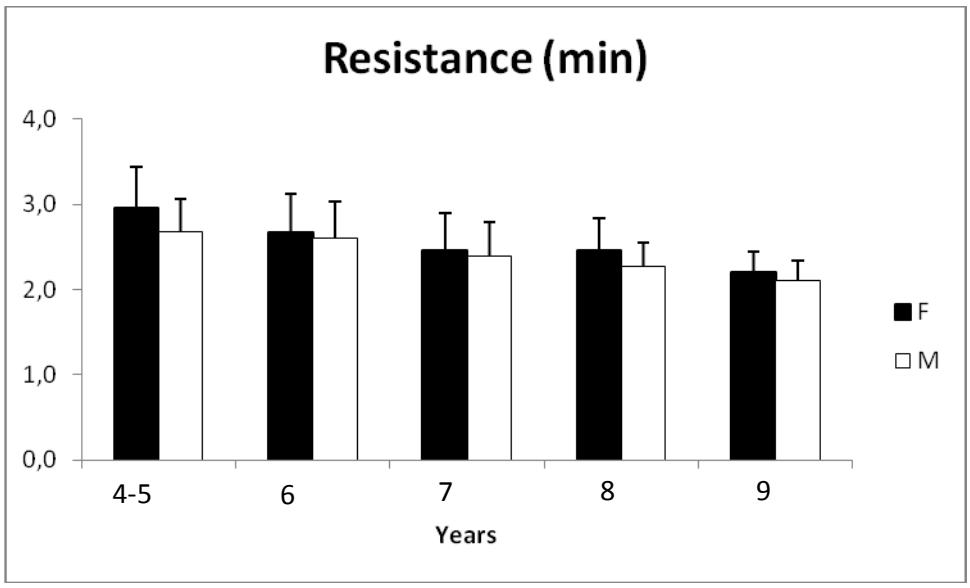


Figure 2. Mean and SD for 8 physical fitness tests applied to girl (F) and boy (M) school children in Cauca aged 4-9 years of age (n=310): a) weight in kilograms, b) height in centimeters, c) flexibility in centimeters, d) speed in seconds, e) number of push ups, f) number of sit ups, g) standing long jump in centimeters and h) resistance in minutes.

Colombian girls and boys weighed less than school children around the world. Children from Cauca weighed less than similarly aged boys and girls from Mexico[13-14], the USA[15-16], Senegal[17] and Mozambique[18]. Compared with Taiwanese children the same trend was seen in 9-y girls and boys[20]. However, 7-y Cauca boys and girls weighed the same as 7-y Taiwanese boys and girls. Thirty-year data indicate that 9-y Cauca boys weighed more than indigenous Mexican boys[20]. More contemporary Mexican data show the opposite trend[13-14]. A nationally representative Belgian survey reports results based on girls' weight[21]. Not surprisingly, heavier Belgian girls 7-9 y weighed more than same-aged Cauca girls; these, in turn, weighed more than thinner Belgian girls 7-9 y.

The Cauca girls and boys were shorter than school children from other countries: Mozambique[18], Belgium[21], Mexico[13-14], USA[15-16], Taiwan[19] and Senegal[17]. The only exception was observed in rural Mexican boys measured between 1968 and 1979[20]; 9-y Cauca boys were taller than the Mexican boys.

Six of eight studies completed worldwide indicate that Cauca girls and boys lack flexibility. School children from Mexico[22], USA[23-24], Canada[25], Mozambique[18] and Belgium[21] flexed a greater distance than Cauca children. In a study completed with children from a private school in Bogota, Colombia, boys 7-9 y had the same flexibility as similarly aged Cauca boys[26]. Brazilian boys 7-15 y had the same or less flexibility (18.7 cm) as Cauca boys 4-9 y[27]. Brazilian girls 7-15 y had

the same or higher flexibility (22.3 cm) as Cauca girls 4-8 y and less flexibility (24.1 cm) than Cauca girls 9 y of age.

Cauca children took longer to run 30 m than school children from other countries. This was evident when Cauca data were compared to those from school children in USA[15], Mexico[22], Papua New Guinea[28] and Senegal[17]. In these countries, children ran 32 or 33 m; in the Cauca study, children ran 30 m. In all cases, the mean time to complete the run was lower in all of the countries compared with the Cauca data.

Data from Canada, Colombia and the Philippines indicate that Cauca girls and boys have greater arm strength. Cauca boys completed a greater number of push ups than boys from Bogota[26] and the Philippines[29]. Cauca boys 4-9 y completed the same or more push ups than Canadian boys 11-12 y measured in 1981[25]. In comparison, Cauca girls 4-5 y completed 18.2-18.3 push ups on average; this is similar to the mean number of push ups completed by 11-12 y Canadian girls in 1981 (18.0) and greater than the mean number completed by them in 1988 (16.9).

Several studies assessed the number of sit ups completed by school children. However, these were not methodologically similar to the present study. For this reason, it was not possible to compare the Cauca results with those from other countries.

Cauca children's lower-extremity strength is lower than that of school children globally. Children from the USA[15], Brazil[27], Mozambique[18], the capital of Colombia[30] and Belgium[21] jumped a greater distance than the Cauca girls and boys. In two cases, younger (5-7 y) Cauca children jumped a greater distance than similarly aged children from Papua New Guinea[28] and Senegal[17]. Compared with Mexican boys and girls (from both urban and rural areas), Cauca children 7-9 y jumped a longer distance[22].

For resistance, there are contradictory results when the Cauca data are compared to data and a reference from the USA (both from the 1980s). Cauca girls and boys 6-7 y completed the 400-m run in the same time as USA children, per national data published in 1989[23]. However, the 85th percentile (data not shown) of Cauca girls and boys 6-7 y was slower than the USA 1985 reference (85th percentile) for children of the same age[24].

There are several factors that limit the comparability of data obtained from the current study and those from other countries. These include the variability in ages, socioeconomic conditions, nutritional status and others.

3.2. Comparison between Cauca and Cuba

Six-year Cuban boys ran 30 m faster than similarly aged Cauca boys (P=0.05). Cuban girls ran 30 m faster than Cauca girls 6-9 y of age (P=0.05). For push ups, Cauca boys 6, 8 and 9 y of age and Cauca girls 7 y of age completed more than Cuban boys and girls of the same age. In terms of sit ups, Cauca boys 7-9 y and Cauca girls 6-9 y completed more than Cuban children of the same age.

For standing long jump, the Cuban boys 6-9 y jumped a greater distance than Cauca boys. Cuban girls 7-8 y jumped longer than Cauca girls. Cauca children displayed greater resistance than Cuban children; this was true for both sexes and all age groups.

Table 1. Comparison between Cauca school children (n=310) and a Cuban reference[10] for 5 physical fitness tests (mean/SD).

Test	Study*	Age (years)			
		6	7	8	9
Girls					
Speed (sec)	Cauca	8.3/1.1	7.6/0.8	7.5/0.6	7.6/13
	Cuba	7.6/1.8	7.3/2.2	7.0/2.7	6.8/2.4
	Comparison§	<0.01	0.99	0.99	<0.01
Push ups (n)	Cauca	15.1/11	17.2/10	18.2/10	18.3/7.1
	Cuba	11.0/15.0	10.0/8.7	11.1/7.2	11.9/7.7
	Comparison§	0.15	<0.01	0.96	0.98
Sit ups (n)	Cauca	15.7/10.7	18.5/11.6	19.7/10.4	18.4/9.4
	Cuba	13.0/19.6	11.1/8.9	13.1/9.6	14.0/8.4
	Comparison§	<0.01	0.98	0.98	<0.01
Standing long jump (cm)	Cauca	93.6/14.9	96.6/16.3	106/13.1	109/13.6
	Cuba	97.8/27.4	109.5/23.4	114.7/17.8	119.9/22.7
	Comparison§	0.38	0.01	0.01	0.06
Resistance (min)	Cauca	2.7/0.5	2.5/0.4	2.5/0.4	2.2/0.3
	Cuba	3.6/0.8	3.5/0.8	3.4/0.7	3.6/0.9
	Comparison§	<0.01	<0.01	<0.01	<0.01
Boys					
Speed (sec)	Cauca	7.9/0.9	7.4/0.8	7.1/0.08	6.7/0.8
	Cuba	7.1/1.2	7.0/1.8	6.6/1.8	6.7/2.2
	Comparison§	<0.01	<0.01	0.98	1
Push ups (n)	Cauca	15.1/11	18.2/10	17.2/10	18.3/7.1
	Cuba	9.0/5.6	10.1/5.9	10.9/6.0	12.0/7.3
	Comparison§	<0.01	0.96	<0.01	<0.01

Test	Study*	Age (years)			
		6	7	8	9
Sit ups (n)	Cauca	16.6/9.8	25.5/12.8	22.5/11.9	25.7/9.2
	Cuba	10.0/6.7	11.0/7.2	14.1/10.0	16.9/10.9
	Comparison§	0.99	<0.01	<0.01	<0.01
Standing long jump (cm)	Cauca	99/15.8	107/4.2	116/20.7	120/17.5
	Cuba	109/17.5	119/17.7	128/21.0	135/19.1
	Comparison§	<0.01	<0.01	<0.01	<0.01
Resistance (min)	Cauca	2.6/0.4	2.4/0.4	2.3/0.3	2.1/0.2
	Cuba	3.5/0.9	3.5/0.9	3.2/0.7	3.0/0.7
	Comparison§	<0.01	<0.01	<0.01	<0.01

* Cauca refers to the current study and Cuba refers to a Cuban reference[10].
† Does not apply.
§ P-value based on Student's t-test for independent samples, comparing Cauca values with Cuban references.

4. CONCLUSIONS

To our knowledge, this is the first study completed in rural Colombian school children using an extensive number of physical fitness tests. These tests were adopted from the Cuban context, where they are applied annually and massively. Compared with contemporary and historical data from several countries around the world (including Cuba), the tendency was for Cauca children to weigh less, be shorter, have less flexibility, be slower in running 30 meters, complete more push ups and to jump less distance. Because of methodological differences, it was not possible to compare the number of sit ups completed in Cauca with most countries around the world. However, comparing the number of sit ups with a Cuban reference, we find that Cauca children complete more and thus have greater abdominal strength. With most of the international studies cited, there were contradictory conclusions in Cauca children's resistance. Comparing the time it took to run 400 m, the Cauca children ran this distance in less time than the mean time listed in a Cuban reference.

5. REFERENCES

1. Incarbone O. (2010) Iniciación deportiva y educación física en la edad escolar de 6 a 12/13 años. Edición Stadium. España.

2. López A, Vega C. (2001) Tendencias contemporáneas de la clase de educación física. Cuadernos IMCED. Serie pedagógica 26. Michoacán.

3. Blázquez Sánchez D. (1993) Fundamentos de educación física para enseñanza primaria. Edición Inde. Barcelona.

4. Fuentes Guerra F. (2003) El deporte en el marco de la Educación Física. Edición Wanceulen. Sevilla.

5. Contreras O. (2001) Iniciación deportiva. Edición Síntesis. Madrid.

6. Cuadro Noa H. (2002) La selección de talentos deportivos para la iniciación hacia el deporte élite. Instituto Superior de Cultura Física "Manuel Fajardo". Holguín, Cuba.

7. Navarro Y. (2008) Localización de alumnos con potencialidades para la práctica deportiva en edades 10-11 años en La Ferrolana, La Sierpe, El Jíbaro y Las Nuevas. Master's thesis. Cuba.

8. Pico Fonseca SM, Pachón H. (2012) Factores asociados con la seguridad alimentaria en un municipio rural del norte del Cauca, Colombia. Archivos Latinoamericanos de Nutrición, 62(3):227-233.

9. Asociación Médica Mundial (AMM). (1964) Principios éticos para las investigaciones médicas en seres humanos (en línea). Finlandia. Downloaded from: http://www.bioetica.uchile.cl/doc/helsink.htm

10. Pila H. (1989) Estudio sobre normas de capacidades motrices y sus características en la población cubana. Doctoral thesis. Instituto Superior de Cultura Física de la Habana. Cuba.

11. INDER. (2010) Indicaciones preliminares para el curso 2010-2011. Instituto Nacional de Educación Física, Deporte y Recreación. Cuba.

12. Pila H. (2003) Selección de talentos para el deporte, 27 años de experiencia en Cuba, metodología de las pruebas. Revista Digital Efdeportes N° 65.

13. Peña Reyes ME, Cárdenas Barahona EE, Cahuich MB, Barragán A, Malina RM. (2002) Growth status of children 6-12 years from two different geographic regions of Mexico. Annals of Human Biology, 29:11-25.

14. Peña Reyes ME, Bali Chavez G, Little BB, Malina RM. (2010) Community well-being and growth status of indigenous school children in rural Oaxaca, southern Mexico. Economics and Human Biology, 8:177-187.

15. Katzmarzyk PT, Malina RM, Beunen GP. (1997) The contribution of biological maturation to the strength and motor fitness of children. Annals of Human Biology, 24:493-505.

16. Eisenmann JC, Katzmarzyk PT, Arnall DA, Kanuho V, Interpreter C, Malina RM. (2000) Growth and overweight of Navajo youth: Secular changes from 1955 to 1997. International Journal of Obesity, 24:211-218.

17. Benefice E, Malina R. (1996) Body size, body composition and motor performance of mild-to-moderately undernourished Senegalese children. Annals of Human Biology, 23:307-321, 1996.

18. Prista A, Ribeiro Maia JA, Damasceno A, Beunen G. (2003) Anthropometric indicators of nutritional status: Implications for fitness, activity, and health in school-age children and adolescents from Maputo, Mozambique. American Journal of Clinical Nutrition, 77:952-959.

19. Huang Y-C, Malina RM. (1995) Secular changes in the stature and weight of Taiwanese children, 1964-1988. American Journal of Human Biology, 7:485-496.

20. Malina RM, Little BB, Buschang PH. (1991) Estimated body composition and strength of chronically mild-to-moderately undernourished rural boys in southern Mexico. Med Sport Sci, 31:119-132.

21. Malina RM, Beunen GP, Claessens AL, lefebre J, Vanden Eynde B, Renson R, Vanreusel B, Simons J. (1995) Fatness and physical fitness of girls 7 to 17 years. Obesity Research, 3:221-231.

22. Peña Reyes ME, Tan SK, Malina RM. (2003) Urban-rural contrasts in the physical fitness of school children in Oaxaca, Mexico. American Journal of Human Biology, 15:800-813.

23. Malina RM. (2007) Physical fitness of children and adolescents in the United States: Status and secular change. Medicine and Sport Science, 50:67-90.

24. President's Council on Fitness, Sports and Nutrition. (2010) The President's Challenge: Physical activity & fitness awards program 2010-2011. US Department of Health and Human Services. Washington DC.

25. Fortier MD, Katzmarzyk PT, Malina RM, Bouchard C. (2001) Seven-year stability of physical activity and musculoskeletal fitness in the Canadian population. Medicine and Science in Sports and Exercise, 33:1905-1911.

26. Tovar Mojica G, Gutiérrez Poveda J, Ibáñez Pinilla M, Lobelo F. (2008) Sobrepeso, inactividad física y baja condición física en un colegio de Bogotá, Colombia. Archivos Latinoamericanos de Nutrición, 58(3):265-273.

27. Carvalho Dumith S, Viana Ramires V, Alves Souza M, Souza Moraes D, Godoy Petry F, Soldera Oliveira E, Viana Ramires S, Hallal PC. (2010) Overweight/obesity and physical fitness among children and adolescents. Journal of Physical Activity and Health, 7:641-648.

28. Malina RM, Little BB, Shoup RF, Buschang PH. (1987) Adaptive significance of small body size: Strength and motor performance of school children in Mexico and Papua New Guinea. American Journal of Physical Anthropology, 73:489-499.

29. Solon FS, Sarol Jr. JN, Bernardo ABI, Solon JAA, Mehansho H, Sanchez-Fermin LE, Wambangco LS, Juhlin KD. (2003) Effect of a multiple-micronutrient-fortified fruit powder beverage on the nutrition status, physical fitness, and cognitive performance of schoolchildren in the Philippines. Food and Nutrition Bulletin, 24:S129-S140.

30. Arsenault JE, Mora-Plazas M, Forero Y, Lopez-Arana S, Jáuregui G, Baylin A, Gordon PM, Villamor E. (2011) Micronutrient and anthropometric status indicators are associated with physical fitness in Colombian schoolchildren. British Journal of Nutrition, Feb:1-12.

Número de citas totales / Total references: 30 (100%)
Número de citas propias de la revista / Journal's own references: 0 (0%)