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Physical fitness of schoolchildren in the Metropolitan Region of Santiago: comparative analysis between types of educational establishments

Condición física de escolares en la Región Metropolitana de Santiago: Análisis comparativo entre tipos de establecimientos educacionales

[*]Gabriela Salazar Rodríguez, [**]Fabián Vásquez Vergara, [*]Sofía Vásquez Osorio, [***]Jorge Torres Mejías
[*]University of Chile (Chile), [**]Finis Terrae University (Chile), [***]Santo Tomas University (Chile)

Abstract. Introduction: State and private subsidized schools usually have limited resources that may restrict the frequency and quality of physical activities offered in educational establishments. Objective: to compare the physical condition of schoolchildren between 6-14 years of age attending state, private subsidized and private schools in the boroughs of the Metropolitan Region of Santiago. Methods: we worked with a random sample by sex and age of 1656 schoolchildren aged 6-14 years. Anthropometry was measured (weight, height, arm circumference, waist circumference and skin folds). In addition, horizontal jump without impulse, grip strength and the distance covered in the six-minute walk test were measured. Results: there was a significantly higher proportion of obesity and waist circumference above the 90th percentile observed in students from state schools, compared to their peers from private and subsidized private schools. At the same time, girls in state schools had significantly lower physical performance, particularly in tests of grip strength and horizontal jump ($p < 0.01$). Conclusion: State and subsidized schools tend to face resource limitations that may restrict the frequency and quality of physical activities offered. This may lead to lower results in physical fitness tests and, therefore, to a higher prevalence of risk indicators for cardiovascular and metabolic diseases in these students. Therefore, it is urgent to increase the quantity and quality of daily exercise time and to stimulate participation in sports to prevent and promote cardiovascular health.
Keywords: physical fitness, educational establishments, schoolchildren.

Resumen. Introducción: los colegios estatales y particulares subvencionados, habitualmente tienen recursos limitados que pueden restringir la frecuencia y calidad de las actividades físicas ofrecidas en los establecimientos educacionales. Objetivo: comparar la condición física de escolares entre 6-14 años asistentes a escuelas estatales, particulares subvencionados y privados de las comunas de la región Metropolitana de Santiago. Métodos: se trabajó con una muestra aleatoria por sexo y edad, de 1656 escolares de 6-14 años. Se midió antropometría (peso, talla, circunferencia braquial, perímetro de cintura y pliegues cutáneos). Además, salto horizontal sin impulso, fuerza de agarre y la distancia recorrida en el Test de Marcha de seis minutos. Resultados: hubo una proporción significativamente mayor de obesidad y circunferencia de cintura superior al percentil 90 observada en los y las escolares de colegios estatales, en comparación con sus pares de colegios particulares subvencionados y privados. A su vez, significativamente, las niñas en colegios estatales exhiben un rendimiento físico menor, particularmente en pruebas de fuerza prensora y salto horizontal ($p < 0.01$). Conclusión: los colegios estatales y subvencionados tienden a enfrentar limitaciones de recursos que pueden restringir la frecuencia y calidad de las actividades físicas ofrecidas. Esto puede conducir a resultados inferiores en pruebas de condición física y, por lo tanto, a una mayor prevalencia de indicadores de riesgo para enfermedades cardiovasculares y metabólicas en estos estudiantes. Por lo tanto, es urgente elevar la cantidad y calidad del tiempo diario de ejercicio, estimular la participación en deportes para prevenir y favorecer la salud cardiovascular.
Palabras claves: condición física, establecimientos educacionales, escolares.

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Fabián Vásquez
fadavasquez@gmail.com

Introduction

In Chile, educational policy has been aiming to address inequalities in accessing quality education, including physical education. Nonetheless, recent studies indicate that gaps still exist, particularly in the most vulnerable areas of Santiago (Ministerio de Educación de Chile, 2020). State schools often face budget constraints and limited resources, thus providing fewer hours of physical education compared to subsidized private and fully private schools. For instance, private and some subsidized schools usually have more comprehensive sports facilities and well-structured programs that promote not only regular exercise but also participation in team sports and extracurricular activities (García-Hermoso & Marina, 2017). This disparity in infrastructure is clearly reflected in the physical condition of the students, where those attending schools with more resources have access to better facilities and more robust programs directly correlating with improvements in their physical fitness (Organization for Economic Co-operation and Development, 2019). Physical fitness, defined as the ability to perform daily tasks vigorously and decisively without excessive fatigue (Caspersen, Powell, & Christenson, 1985), is crucial not only for the health of schoolchildren but also for their academic performance. Research has shown that physically active students tend to achieve better academic results, partly due to the beneficial effects of exercise on cognitive function and concentration (Chomitz et al., 2009). Furthermore, regular physical activity helps improve mood and reduce stress levels, which can positively influence the educational environment and student motivation (Singh et al., 2012). Additional studies have demonstrated that access to adequate sports facilities is associated with lower rates of

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childhood obesity and better overall health in students (Sanchez & Martínez, 2019). Moreover, the quality of sports infrastructures can significantly influence the physical and mental health of schoolchildren (Torres & Fernandez, 2020).

The evaluation of the physical fitness of schoolchildren in the Metropolitan Region of Santiago presents a revealing view of the socioeconomic and infrastructure disparities in access to physical and nutritional education. For an in-depth examination of these issues, one can review how public policies could improve equity in physical education within Latin American contexts by addressing structural inequalities (Morales & Guzmán, 2022). Additionally, the evaluation of school physical activity programs shows promising long-term impacts on health and academic performance, suggesting that these interventions are crucial for the comprehensive development of boys and girls (Navarro & Ossa, 2020).

The aim of this research was to evaluate the physical fitness of schoolchildren aged 6-14 attending state, subsidized private, and private schools in local boroughs of the Metropolitan Region of Santiago.

Materials and Methods

Subjects: A random sample of 1656 schoolchildren from first to eighth grade from state schools (SS), private subsidized schools (PSS), and private schools (PS) in the boroughs of Cerro Navia, Macul, Providencia, Pedro Aguirre Cerda, Pudahuel, Quinta Normal, Santiago, San Miguel and Vitacura was studied, with a percentage distribution similar to that found in the urban Metropolitan Region (25% SS, 61% PSS and 14% PS).

Anthropometry:

1. Weight and Height: Measurements were taken with the child at the center of the balance

(SECA Ltd), wearing light clothing (without shoes, long trousers, sweaters, and shirts). Height was measured immediately afterward, with heels together, arms at the sides, and back against the scale.

(Seca 770, SECA®, Hamburg, Germany), with the head in the Frankfurt plane. Both measurements were performed according to standard procedure (National Health and Nutrition Examination Survey, 2007).

2. Skinfold thicknesses (mm) (triceps, biceps, suprailiac, and subscapular): Skinfolds were

assessed with a millimeter precision Lange Caliper (1 mm.), measured three times, and the average was taken with an accuracy of 0.3 mm (National Health and Nutrition Examination Survey, 2007).

2.1 Braquial circumference, was measured at the midpoint, calculated between the

Acromion and the olecranon, with the arm extended and relaxed, without de pressing the student's skin.

2.2 Triceps skinfold, measured by taking a fold at the midpoint between the acromion

and olecranon, on the back of the left arm.

2.3 Biceps skinfold, on the non-dominant arm, the middle front of the fat pad, above

the cubital fossa, and at the same level as the triceps skinfold.

2.4 Suprailiac skinfold, located a point on the upper part of the hip or iliac crest, and a

diagonal skinfold was used over the highest point of its arch.

2.5 Subscapular skinfold, one centimeter below the lower angle of the scapula, following the natural groove of the skin, then the fold is taken diagonally at a 45-degree angle to ensure the correct thickness measurement.

2.6 Waist Circumference, was measured with a fiberglass tape measure at the upper point of the iliac crest, ensuring that the tape did not compress the skin and was parallel to the floor. The measurement was taken at the end of a normal expiration.

3. Physical Fitness Tests:

3.1 Manual dynamometry or grip/pressure force measurement. The manual pressure force (kg) was measured with a digital dynamometer (TKK 5101 Grip-D; Takey Tokyo, Japan). Prior to the test, the size of the right hand was measured using the ruler-table and the optimal grip span was found (España-Romero et al., 2008). Hand size was measured as the maximum separation distance between the first and fifth fingers. For the measurement, the child was positioned standing, looking straight ahead, with the dominant arm hanging straight without touching the body. The child was encouraged to squeeze the dynamometer handle with maximum effort for 2 to 3 seconds. The test was repeated three times and the average force (kg) was recorded.

3.2 Horizontal jump without impulse / explosive lower body strength. This involved measuring the distance between the take-off and landing points after a jump (Espana-Romero et al., 2008). The child stood behind the take-off line, feet slightly apart. They were instructed to jump as far as possible, with knees bent and swinging arms to aid the jump, ensuring both feet landed together. The best of three attempts was recorded.

3.3 Six-Minute Walk Test. Following the ATS/ERS guidelines (2002), the test was performed indoors along a 30-meter flat, straight course. Participants were asked to walk, covering as much distance as possible in six minutes.

3.4 Heart rate. A reliable and precise indicator of exercise response intensity, was measured using a POLAR heart rate monitor, fitted to the student before the test, during three consecutive periods: a) Pre-Test, after three minutes sitting; b) Minute-by-minute during the test (without stopping the student's walk); c) Post-test, measuring recovery effort during each of the three minutes of rest (Caspersen, Powell, & Christenson, 1985).

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All procedures were approved in the Ethical Committee of the University.

Statistical methods

Numerical variables that showed a normal distribution were expressed as mean and standard deviation. T Student Test was utilized for testing the comparisons in normal distributions.

Chi-square test (χ^2). Determine significant difference when comparing groups of observed frequencies with expected frequencies and Kuskal-Wallis test to compare non-normal samples, of quantitative variable in three groups.

Analyses were performed using STATA version 18.0 and $p < 0.05$ determined statistical significance (StataCorp. 2023. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC.)

Results

Table 1 shows the anthropometric values and obesity of the schoolchildren according to the level of school dependence.

Schoolchildren from state schools have a significantly higher prevalence of obesity than those from other types of schools (private subsidized and private schools) ($p < 0.01$). Likewise, children from state schools have a significantly higher proportion of waist circumference above the 90th percentile compared to the other types of educational institutions ($p < 0.01$).

Table 1.
Anthropometric data and prevalence of obesity in schoolchildren according to level of school dependenc

	Weight[1] (kg)	Height[1] (cm)	Sum[1] Skinfolds (mm)	Obesity[1*] (%)	Waist circumference [1*] > P90 (%)
State school (n= 489)	40.6 ± 15	139.4± 14.1	52,4 ± 23,6	23,7	21,0
Private subsidized School (n= 941)	40.7± 13.9	141.9± 14.6	51,5 ± 23	18,4	15,9
Private School (n= 229)	39.7±11.9	141.6±13.6	49,6 ±23,8	14,6	12,7

[1*]X^2 $p < 0.01$

Table 2 demonstrations the results of physical fitness in the 6-minute test, horizontal jump and grip strength. A significantly higher jump was observed in students from private schools. At the same time, a significantly lower heart rate at 6 minutes and 3 minutes after rest in students from private schools versus those from state and private subsidized schools.

Table 2.
Physical condition and heart rate by educational establishment

	Horizontal jump[1*] (m)	Grip[1] strength/ Weight (m)	Distance[1] 6-minute test/ Height (m)	Pre heart[1] rate	Heart rate[1] (6-minute)	Recovery[1] heart rate 3-minute)
State school (n= 489)	1.2 ± 0.3	0.43 ± 0.09	462.6 ± 46.3	97.2 ± 10.7	171.1 ± 17.3	115.2 ± 15.8
Private subsidized school (n= 941)	1.2 ± 0.3	0.44 ± 0.09	463.5 ± 63.5	97.6 ± 10.9	171.4 ± 17.1	115.9 ± 14.8
Private school (n= 229)	1.6 ± 0.3	0.43 ± 0.09	451.9 ± 42.9	95.3 ± 9.4	168.17 ± 18.1	111.2 ± 14.2

[1]Kuskal-Wallis * $p < 0.01$ ** $p < 0.05$

Figure 1 includes physical fitness tests for girls, expressed in tertiles and by educational establishment. It was observed that girls attending state and private subsidized schools had a significantly higher proportion of lower grip strength (dynamometry) ($p < 0.01$) and horizontal jump (lower limb strength) ($p < 0.01$) compared to girls attending private schools. However, there were no significant differences in the distance covered ($p > 0.05$).

In boys, no statistically significant differences were found by type of school (Figure 2).

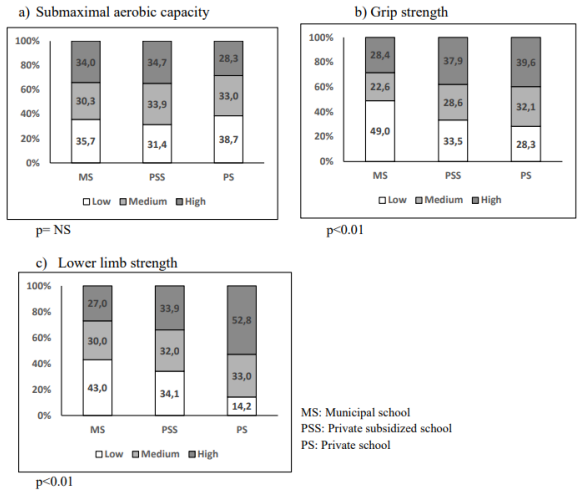

Figure 1. Physical condition of girls attending state, private subsidized and private

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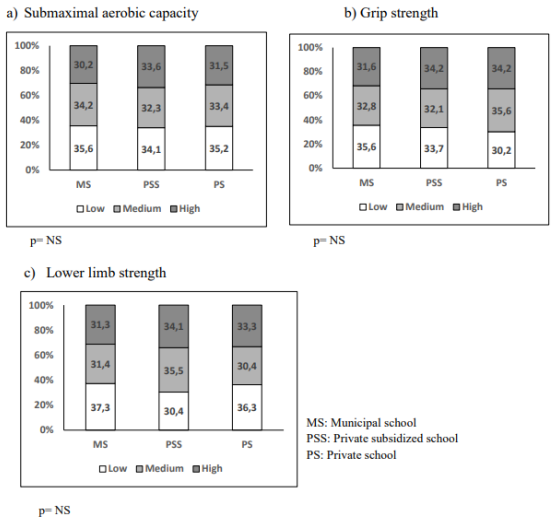

Figure 2. Physical condition of boys attending state, private subsidized and private schools

Discussion

The results indicate that schoolchildren in state schools in the Metropolitan Region of Santiago have a significantly higher prevalence of obesity compared to those in private and subsidized private schools. In addition, the higher waist circumference observed in students from state schools reflects a worrying trend that highlights structural problems in access to adequate nutrition and opportunities for physical activity (García-Hermoso et al., 2017; Singh et al., 2012). These indicators are alarming, as they suggest a predisposition to metabolic health problems at an early age in both sexes (Navarro & Ossa, 2020). These differences could be attributed to multiple factors, for example: lack of adequate infrastructure for sport, limited resources for health and physical education programs, and differences in family and community environment that influence eating and physical activity habits (Morales & Guzmán, 2022; OECD, 2019).

In this research, significantly girls from state schools exhibit lower physical performance, particularly in tests of grip strength and horizontal jump. This phenomenon suggests that interventions should be gender-sensitive to effectively address the specific needs of girls, potentially exacerbated by cultural stereotypes and less promotion of physical activity participation (España-Romero et al., 2008; Torres & Fernández, 2020). It is notable that differences in physical fitness by type of educational establishment are predominantly observed in the female sex, with girls in state and subsidized schools showing worse results compared with their counterparts in private schools. This phenomenon may reflect not only differences in physical resources but also in the focus and prioritization of physical activity for girls (Chomitz et al., 2009). The implications of these disparities are significant, affecting not only students' physical health but also their academic and emotional development. Physical inactivity and weight problems are linked to poorer academic outcomes and lower self-esteem, which can perpetuate cycles of social and educational disadvantage (Singh et al., 2012). The analysis of physical fitness in schoolchildren from state, private subsidized, and private schools in the Metropolitan Region of Santiago reveals significant differences that reflect the influence of the type of educational establishment on physical performance. The results of the 6-minute test, horizontal jump, and grip strength show superior performance in private school students compared to their peers in state and subsidized schools. Private school students not only showed better performance in the horizontal jump, but also presented a more efficient cardiac recovery, with a significantly lower heart rate both at 6 minutes of exercise and at 3 minutes of rest. These findings suggest better cardiovascular and muscular fitness, which can be attributed to more robust and consistent physical education programs (Caspersen et al., 1985; NHANES, 2007). Private schools often have better sports facilities and greater access to equipment and training materials (Sanchez & Martínez, 2019). Physical education programs in private schools may be more comprehensive and better integrated into the school curriculum, providing regular and systematic training (Chomitz et al., 2009). Fierro Saldaña and Rocuant Urzúa (2023), the study found that students from medium, medium-high, and high socioeconomic groups have a 38.88% higher chance of having a satisfactory physical condition compared to those from lower socioeconomic groups.

Students from higher socioeconomic backgrounds tend to have better physical conditions, emphasizing the need for policies that address these disparities to improve public health (Fierro Saldaña & Rocuant Urzúa, 2023).

Evidence points to the need for educational public policies that address gaps in the provision of physical education and health-related activities. Improving the quality and accessibility of physical education in state and subsidized schools could contribute significantly to reducing the observed disparities (Ministerio de Educación de Chile, 2020). However, it is a priority to address not only the quantity of physical education provided in schools, but also the quality and equity of these programs. It is crucial that state and private subsidized schools receive additional support to improve their physical education facilities and curricula, ensuring that all students, regardless of their socioeconomic background, have the same opportunities to develop the full potential of their physical fitness (Torres & Fernández, 2020).

Conclusions

Inequalities in physical fitness among schoolchildren from different types of schools in the Santiago Metropolitan

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Region make addressing disparities in physical fitness among schoolchildren in Santiago crucial to ensure that all children and adolescents can benefit from the positive effects of physical activity. It is imperative that future interventions and policies focus on creating a level playing field that allows all students access to the same opportunities to develop their physical and academic potential. It is imperative that public policies strengthen support for state schools by not only increasing the budget allocated to physical education, but also ensuring that these resources are implemented in a way that maximizes their impact. This includes specific programs designed to address nutrition, physical activity, and health education, tailored to local needs and with special attention to the most vulnerable populations.

Conflict of interest

The authors declare no conflict of interest.

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Datos de los/as autores/as y traductor/a:

Gabriela Salazar Rodríguez	gsalazar@inta.cl	Autor/a – Traductor/a
Fabián Vásquez Vergara	fadavasquez@gmail.com	Autor/a – Traductor/a
Sofía Vásquez Osorio	sofia.vasquez.o@ug.uchile.cl	Autor/a
Jorge Torres Mejías	jorge.torres@inta.cl	Autor/a