

Motor skills, concentration, and cardiorespiratory capacity in school athletes and non-athletes Habilidades motrices, concentración y capacidad cardiorrespiratoria en escolares deportistas y no deportistas

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Abstract. Physical activity and sport are associated with significant benefits when practiced regularly, starting at school age. In Colombia, physical education classes are not taught to children in primary school. The Institute for Sport and Recreation (Instituto de Deportes y Recreación, INDER) enables access to systematic sport practice, guided by a professional, for children of public schools in Medellín, Colombia. Purpose: To identify differences in anthropometric variables, concentration, motor skills, and cardiorespiratory capacity between school-aged children who participate in a sport program and those who do not participate. Methods: The research design is cross-sectional. 290 schoolchildren of both sexes were evaluated with the GRAMI-2 test to verify motor skills, the test of Toulouse-Piéron to verify their ability to concentrate, and the Course-Navette test to verify their cardiorespiratory capacity. There are 141 evaluated students who belong to the Inderescolares program (10.1 ± 1.9 years, mean \pm SD) and 107 that do not belong to the program (9.5 ± 2.5 years, mean \pm SD). With this sample, a statistical power of 79% is achieved, and inferences can be made with a confidence level of 95%. Results: The results indicate no differences in anthropometric variables between children who participate in the sport program and those not participating. There were significant differences in three tasks and proportional differences in all six tasks of the GRAMI-2 test in favor of those children who participated. Cardiorespiratory capacity is also better in children who participate in the program, INDER Medellín. This pattern of improved performance in the participating children occurs in both boys and girls. Socioeconomic status could affect the performance of some tests that require a greater expenditure of energy. Conclusion: Schoolchildren between eight and 11 years of age who are not taught physical education classes at school but participate in a sport program obtain better performance in the tests to assess motor skills, concentration, and cardiorespiratory capacity than those who are also not taught physical education classes at school nor participate in a sport program.

Keywords: Physical Activity, Motor Skills, Concentration, Cardiorespiratory Capacity, Schoolchildren

Resumen. La actividad física y el deporte se asocian con importantes beneficios cuando se practican regularmente desde la infancia. En Colombia no se imparte clases de educación física a los niños en la escuela primaria. El Instituto de Deportes y Recreación (INDER) posibilita el acceso a la práctica deportiva sistemática, guiada por un profesional, a niños de escuelas públicas de Medellín, Colombia. Objetivo: Identificar las diferencias en variables antropométricas, en la capacidad de concentración, en las habilidades motrices y en la capacidad cardiorrespiratoria entre escolares que participan en un programa de formación deportiva y niños que no participan en el programa. Métodos: El diseño de investigación es transversal descriptivo. Se evaluaron 290 escolares de ambos sexos con el test GRAMI-2 para verificar la motricidad, con el test de Toulouse-Piéron para verificar la capacidad de concentración y con el test de Course-Navette para verificar la capacidad cardiorrespiratoria. Participaron 141 estudiantes que participan en el programa de práctica deportiva (10.1 ± 1.9 años, media \pm DE) y 107 que no participan (9.5 ± 2.5 años, media \pm DE). La muestra tiene un poder estadístico del 79% y se pueden hacer inferencias con un nivel de confianza del 95%. Resultados: Los resultados no indican diferencias en las variables antropométricas entre los niños que participan en el programa y los que no participan. Hubo diferencias significativas en tres tareas y diferencias proporcionales en las seis tareas de la prueba GRAMI-2 a favor de los niños que participan. La capacidad cardiorrespiratoria también es mejor en los niños que participan en el programa del INDER Medellín. Este patrón de mejor desempeño de los niños participantes se presenta tanto en niños como en niñas. El nivel socioeconómico podría afectar la realización de algunas pruebas que requieren un mayor gasto de energía. Conclusión: Los escolares entre ocho y 11 años, que no reciben clases de educación física en la escuela pero que participan en un programa de práctica deportiva, obtienen mejor desempeño en las pruebas para evaluar las habilidades motrices, la concentración y la capacidad cardiorrespiratoria que los niños que no reciben clases de educación física y tampoco participan en el programa de formación deportiva.

Palabras Claves: Actividad Física, Habilidades Motrices, Concentración, Capacidad Cardiorrespiratoria, escolares

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Introduction

Sports participation has increased significantly in recent years throughout the world, owing to the numerous benefits that it provides in the different dimensions of the human being (Sallis et al., 2000; Van Der Horst et al., 2007), and the popularization and motivational effect of major sporting events broadcasted by mass media (Mackintosh et al., 2015). Regular practice of physical activity and sports by young people is associated with significant short-term and long-term psychological and physiological benefits (Hacke et al., 2019; Sallis et al., 2000; Van Der

Horst et al., 2007).

The promotion of the practice of physical activity and sport is a topic of great discussion in the scientific literature (Donnelly et al., 2016; Trost et al., 2014) since sport is an effective tool to combat unhealthy lifestyles and create habits of sports practice beginning in childhood (Bocarro et al., 2012) because it helps to reduce excess body weight and its consequences, develop motor skills (Hacke et al., 2019; Wrotniak et al., 2006), benefit changes in blood pressure, (Oosterhoff et al., 2016) cognitive functioning (Donnelly et al., 2016; Hillman et al., 2008) and improve personal relationships (Herrero et al., 2021).

The attention that professional sports practice receives helps motivate young people to get involved in their practice (Mackintosh et al., 2015). Thanks to the skills acquired during sports practice, school-aged children have the opportunity to identify the demands of reality and choose the knowledge and skills that are useful to respond to these demands of both sports and daily life in changing contexts (Lleixà et al., 2010). Sports practice at school age could be decisive in the acquisition of practice habits that last a lifetime (Donnelly et al., 2016; Hacke et al., 2019; Hillman et al., 2008).

In Colombia, schools do not hire physical education teachers. Even in a law that dates back to 1994, the government provides that schools should hire a specific teacher for physical education. However, the government itself does not allocate the necessary resources; therefore, the law is not followed, and physical education is not taught in primary schools.

The city of Medellín has not been oblivious to this phenomenon. The Institute for Sport and Recreation (Instituto de Deportes y Recreación, INDER) cannot supersede the physical education classes, but it implements programs that could promote the practice of sports in children and young people. One of these programs is *Inderescolares*, which prepares children for competitive sports. Sports coaches are hired by INDER; they visit public schools and coach the children, those with the best performances represent their schools at sports festivals organized by INDER. The INDER provides infrastructure, sports equipment, uniforms, and the organization of sports festivals.

The INDER aims to contribute to the formation of the integral human being, strengthening its process of socialization and learning in principles such as peaceful coexistence, citizen culture, and nonviolence through sports methodologies that contribute to psychomotor and perceptivo-motor development. The *Inderescolares* program offers to schoolchildren from first to fifth classes a sports formation service carried out in mutual collaboration with the public schools. Participating children enroll voluntarily in the sport practice program for a specific sport like football, basketball, or volleyball. The offer is diverse and attends to most sports modalities. Participants can attend training sessions twice a week, and they can be selected to represent of their school in the sports festivals.

As is the case with many other programs (Grao-Cruces et al., 2015), so far there is no evidence to show the effectiveness of the program to promote the development of cognitive and motor skills of the participants, as well as the effects of the program on the aerobic physical capacity and body composition of schoolchildren.

In the present study, cognitive and motor skills, aerobic physical capacity, and body composition of participating and non-participating school children in the city of Medellín are evaluated to establish the effects of the program and to determine what are the differences that may arise between the participating and non-participating

schoolchildren.

From this study, it is possible we will be able to start to explore and build clues about the coaching process of the *Inderescolares* program on cognitive, motor skills, physical fitness, and body composition in a sports practice program for children who are not taught physical education but who are coached in a specific sport. In this way, it could be collected evidence about the impact of the *Inderescolares* program. In addition, improvement measures can be proposed and implemented, and it will be possible to adopt sports coaching strategies for the detection, selection, and development of sports talent that ultimately contribute to performance level and, in the long run, children's long-term commitment to sports.

Material and methods

Study design and setting

The research design is cross-sectional (Setia, 2016). Evaluations of motor skills, concentration, cardiorespiratory capacity, and body mass index (BMI) of children participating and non-participants in the *Inderescolares* program were carried out.

For this study, the *Inderescolares* group was formed with children from schools randomly selected among all the schools attended by the *Inderescolares* program. A control group with similar characteristics was selected from those children from the same schools but who were not participants in the *Inderescolares* program.

Study Sample, recruitment, and eligibility criteria

After applying the exclusion criteria, which was done a posteriori, 290 students took part in the study. Data for 248 participants are available. 141 evaluated students participate in the *Inderescolares* program (mean age 10.1 ± 1.9 years) compared to 107 who do not participate (mean age 9.5 ± 2.5 years). With this sample, a statistical power of 79% is achieved, and inferences can be made with a confidence level of 95% (CI).

The city of Medellín is administratively divided into six urban zones and five rural administrative districts. In the *Inderescolares* program, a total of 139 public schools located across these zones and districts are served; in each school, there is an *Inderescolares* group that has between 10 and 30 participating children. The sample of schoolchildren to be evaluated was selected in a stratified manner according to this distribution by zones and districts. Representative schools were chosen from each zone or district based on the number of schools in each zone. Due to accessibility issues within Medellín City's rural boundaries, only one school was chosen from the rural administrative districts. From each randomly selected school, an *Inderescolares* group and an equivalent group of non-*Inderescolares* schoolchildren in terms of age, sex, and socioeconomic status were chosen. Table 1 shows the number of groups evaluated according to the area.

Table 1.
Number of groups evaluated by zone

Zone	Quantity Groups Inder-schoolchildren	%	Selected Groups
1	33	24	2
2	21	15	2
3	38	27	3
4	19	14	1
5	6	4	1
6	14	10	1
San Antonio de Prado (rural)	8	6	1
Total	139	100	11

The selection criteria were participating in the Inderescolares program, being between eight and 11 years old, not suffering from pathologies or osteo-muscular lesions at the time of the evaluation, the parents signing the informed consent, and the participant signing informed assent. For each of the 11 Inderescolares groups selected, a group with the same number of children who do not participate in the Inderescolares program was selected. These children not participating in Inderescolares should also not be participating in sports processes in teams, clubs, or leagues.

Instruments

Motor skills were measured using the GRAMI-2 battery (motor skills test battery for primary school chil-

dren) (Ruiz et al., 2015; Ruiz-Perez et al., 2015); concentration was assessed using the *Toulouse-Piéron test* (Toulouse-Piéron, 2007); and cardiorespiratory capacity was measured using the *Course-Navette test* (García & Secchi, 2014; Leger et al., 1988).

Anthropometrics (Height/weight/BMI)

For height, a stadiometer with an accuracy of .1 mm (Model 206, Seca, Germany) was used, and for weight, a bioimpedance scale with an accuracy of .1 kg (HBF-516, OMRON, Japan) was used. BMI was calculated as weight (kg)/height (m²).

Test GRAMI-2

It is a motor test battery that consists of six tests and allows the assessment of the motor skills of schoolchildren between the ages seven and 12 years. The tests have good criteria for validity, reliability, and objectivity (Ruiz-Perez et al., 2015). The GRAMI-2 is easy to use and administer, it does not present many difficulties in understanding or memorizing the task for schoolchildren and its cost, both in the application and economic time, is minimal (Ruiz . et al., 2015). Table 2 shows a description of the tasks of the GRAMI-2 test.

Table 2
Description of the tasks of the GRAMI-2 test (Ruiz-Perez et al., 2015)

No.	Task	Description	Punctuation
1	30 meters running.	Speed running over a distance of 30 meters using the shortest possible time in its realization.	Time in seconds and tenths of a second to complete the distance.
2	Launch of 1 kg medicine ball.	Holding the ball with both hands at chest height, project it as far as possible.	Distance in cm reached.
3	Hop	Hopping a distance of 7 meters in the shortest possible time. The preferred leg will be used.	Time to complete the task (seconds and tenths of a second)
4	Lateral jumps	Side jumps with your feet together on a board divided in half by a ribbon. As many jumps as possible in a time of 15 seconds.	Number of correct jumps made.
5	Round-trip running	In a marked space of 9 meters, the student will run at maximum speed to pick up the first of the relays placed on the 9 m baseline and leave it behind the starting line. The same operation will be performed with a second relay.	Time to complete the test (seconds and tenths of a second).
6	Displacement on supports	Once the witness has been placed on the ground beyond the line, the test will be finished Displacement on two supports in a distance of 3 meters in the shortest possible time.	Time to complete the test (seconds and tenths of a second).

Test Toulouse-Piéron

The Toulouse-Piéron (T-P) test has a long history in the field of research and psychological practice in many different areas (clinic, human resources, neuropsychology, sports psychology, education, etc.) (Centro Editor de Psicología Aplicada CEPA, 1992; Montiel et al., 2006; Salazar & Montoya, 2006). The T-P test is a test that aims to measure perceptual and attentional skills (Morales et al., 2014; Vignola, 1971). Due to its characteristics, it is a task that demands great concentration and resistance to monotony. The test prototype available to the authors, was the 6^a edition, it contains 1600 graphic elements (squares that have a hyphen on one of their sides or edges) distributed in 40 rows. The task of the evaluation is to detect which of them is equal to the three models presented in the header of the sheet for 10 minutes. To do this, the participant must pay attention to the position in the dash of each square. Only a quarter of the stimuli (10 in

each row) are equal to one of the models (Toulouse-Piéron, 2007).

The main T-P score is the Global Attention and Perception Index (GAPI). This is the score traditionally obtained in the test and constitutes a measure of the perceptual and attentional capacity of those evaluated. This index relates the total number of correct answers (C) with the total errors (E) and omissions (O) and is calculated as follows:

$$GAPI = C - (E + O)$$

Test de Course-Navette

The 20-meter Course-Navette test with one-minute stages is the most widely used worldwide, in the areas of health as well as in school and sports (García & Secchi, 2014). This is due to the practicality of measurement, validity across a wide range of ages and populations, reliability, and sensitivity. However, the main reason for its

applicability is due to the original idea of running in a reduced space of 20 m without the need to use a running track. The validity, reliability, and objectivity of the Course-Navette had been verified by the formulator team itself (Leger et al., 1988) and later by many other researchers (García & Secchi, 2014).

Procedure

A bibliographic search was carried out to identify the assessment tests that met the requirements to be applied to Medellín schoolchildren, which were that the tests were generic to all sports because a specific test would not allow comparisons between groups of schoolchildren, that they were easy to apply and economical, that they would not need great infrastructure because few public schools have adequate spaces for the practice of sport.

The evaluators were trained, and two pilot tests were carried out with schoolchildren of the same age as those in the sample to identify practical problems that might arise. The main problem identified was the lack of a 35-meter space to carry out the 30-meter running test (Ruiz-Perez et al., 2015), therefore it was decided to replace the 30-meter test with the 20-meter running test. The evaluation of the students was carried out in the afternoon or the morning, according to the school hours of the participants. The order of application of the tests was as follows: (1) taking of socio-demographic variables; (2) measurement of anthropometric variables; (3) application of the Toulouse-Piéron test; (4) application of the GRAMI-2 test; and (5) application of the Course-Navette test.

For the application of the six tests of the GRAMI-2 test, the circuit method was used so that the evaluators could work simultaneously to optimize the available time. The group of evaluators managed to systematize the procedure to evaluate between 20 and 30 schoolchildren in about two hours and 30 minutes. Finally, according to the location of public schools, socioeconomic status was determined.

Statistical analyses

A review, cleaning, and purification of data were made to ensure the quality, accuracy, and validity of the information. Normality in the distribution of quantitative variables was verified using the Shapiro-Wilk normality test. If the results indicated the normal distribution assumptions were correct, mean and standard deviation (SD) were calculated; if the normal distribution was not verified, the median of the variable and its interquartile range (IQR) were calculated (Martínez-González et al., 2014).

To compare the results obtained in each test by schoolchildren who participate in the Inderescolares program with the results obtained by schoolchildren, who do not participate; the median was calculated, and the confidence interval was obtained at 95%. The Wilcoxon rank-sum test was applied to verify differences between groups for the continuous variables, such as the 6 tasks of the GRAMI-2 test, and the score achieved in the Toulouse-Piéron

test. For the comparison of the results of the Toulouse-Piéron test according to socioeconomic status, the Kruskal-Wallis test was applied (Cobo et al., 2007). All analyses were performed with R Statistical Software version 4.1.3 (The R Project for Statistical Computing, <https://www.r-project.org/>) and a statistical significance level of $p < .05$ was set.

Ethical considerations

The present study was approved by the ethics committee of the University Institute of Physical Education and Sport of the University of Antioquia with the category of “minimal risk”, according to Resolution 8430 of 1993 of the Ministry of Health in Colombia. The study also conforms to the ethical standards contemplated in the 2013 version of the Helsinki Declaration. Participants and their parents were guaranteed that their health, privacy, and constitutional rights would not be at risk. Informed consent was requested from the parents or legal guardians of the participants and informed consent from the participants themselves before the start of the study. Participants were informed that participation was voluntary and that they could withdraw from the study at any time without requiring a justification.

Results

Table 3 shows a comparison between age, anthropometric variables, and the results obtained in the six tests to assess motor skill and the Course-Navette test to assess cardiorespiratory capacity. The difference is more pronounced in the Course-Navette test.

Regarding the anthropometric variables weight, height, and BMI, there are no significant differences between schoolchildren who participate in the Inderescolares program and those who do not participate.

Table 3.

Comparison of age, anthropometric variables and motor skills and cardiorespiratory capacity according to participation

Variable	INDER group Median (IQR)	Control group Median (IQR)	CI 95% of difference
Age (yrs)	10.1 (1.9)	9.5 (2.5)	.02, .62*
Height (cm)	136.1 ± 9.1 ^W	135.1 ± 8.2 ^W	-1.20, 3.22
Weight (kg)	31 (9.5)	32 (11.0)	-2.00, 2.00
BMI (kg/m ²)	16.4 (2.9)	16.6 (1.8)	-1.25, .60
Round-trip running (s)	11.9 (1.7)	12.2 (2.0)	-.82, -.16*
Displacement on supports (s)	20.8 (5.2)	22.7 (6.5)	-2.32, .07
Hop (s)	2.9 (.5)	3.0 (.5)	-0.25, -.03
20-meter run (s)	4.1 ± .6 ^W	4.2 ± .6 ^W	-0.25, -.02*
Lateral jumps (#)	27.1 ± 6.3 ^W	25.1 ± 6.8 ^W	.38, 3.67*
Launch of 1 kg medicine ball (m)	3.5 ± .7 ^W	3.3 ± .7 ^W	.10, .45*
Course-Navette (stage)	3.5 (2.7)	2.5 (1.5)	.50, 1.20*

BMI: Body mass index; CI: Confidence interval; IQR: Interquartile range; * $p < .05$; ^Wmean ± ds

In the present study, motor skills, concentration, anthropometric variables, and cardiorespiratory capacity of children between eight and 11 years of age who participate in the Inderescolares program were evaluated. The results

were compared with those obtained in the same tests by an equivalent group of schoolchildren, who did not participate in the program. The results indicate that schoolchildren who participate in the Inderescolares program execute tests faster and more precisely in tests that require doing a task in the shortest possible time. The schoolchildren of the Inderescolares program also had a greater capacity of the cardiorespiratory system, measured with the Course Navette test, than the children of the same schools and with an equal social environment, who did not participate in the program.

Table 4.
Results of the Toulouse-Piéron test according to sociodemographic variables

	Groups	Median (IQR)	Value p
INDER	Yes	80 (19)	.006
	No	74 (23)	
Gender	Boys	79 (18.0)	.438
	Girls	76 (23.5)	
Socioeconomic status	1	77 (18.2)	.025
	2	74 (27.2)	
	3	80 (16.0)	
	4,5	81 (6.0)	

IQR: interquartile range

Schoolchildren participating in the Inderescolares program showed that they have a better ability to concentrate than those who do not participate. It was also discovered that students from status 3, 4, and 5 performed better than those from lower socioeconomic status (1, 2, and 3). There were not differences in the concentration ability of boys and girls, as the medians difference of points obtained in the T-P test was not significant (Table 4).

Discussion

In this study, motor skills, concentration, anthropometric variables, and cardiorespiratory capacity of boys and girls between eight and 11 years old participating in the Inderescolares program were evaluated, and the results were compared with those obtained in the same tests by an equivalent group of schoolchildren who did not participate in the program of INDER Medellín. The results indicate that the schoolchildren who participate in the Inderescolares program execute the tests in a faster and more precise way, where they must complete a task in the shortest possible time. It is possible because physical fitness is related to processing speed and decision-making ability (Donnelly et al., 2016). The schoolchildren of the Inderescolares program also had a greater capacity of the cardiorespiratory system, measured with the Course Navette test, than the children of the same schools with a social environment equal to those who did not participate in the program. It is an interesting finding because cardiorespiratory fitness has been associated with better brain function and cognition, academic achievement in physical-

ly active children (Donnelly et al., 2016; Guillamón et al., 2019a; Hillman et al., 2008; Szabo-Reed et al., 2019), motor skills (Guillamón et al., 2020) and reduce depression (Russo-Neustadt & Chen, 2005).

The results of this study are similar to those of a study (González et al., 2009), who applied the Ulrich Gross Motor Development test to assess motor skills in children aged 4-12 years and found higher values in those schoolchildren who practiced sports regularly, and they are also similar to another study (Poblete et al., 2013), who found less development of motor skills in schoolchildren who did not participate in extracurricular sports practice programs when evaluating the two types of schoolchildren with the Test of Gross Motor Development TGMD-2. Further Schoolchildren's motor skills was assessed using the Test of Gross Motor Development is related to their anthropometric measurements and physical fitness indicators (musculoskeletal and motor fitness) (Fazanes et al., 2022).

The students of the Inderescolares program demonstrated greater concentration than the non-participants when being evaluated with the Toulouse-Piéron test. This difference might be explained by the fact that exercise has advantageous effects on cognition as well as brain structure and function (Donnelly et al., 2016; Hillman et al., 2008) as well as by the link found between cardiorespiratory capacity and attention (Guillamón et al., 2019b). Socioeconomic status also determines differences in this area; the schoolchildren of high socioeconomic status obtained in the present study better results than those of low socioeconomic status. This disadvantage was also reported in other studies (Currie et al., 2008). In this sense, Hacke et al. (2019) proposed that children from low-income families could benefit from an early exercise program.

Inderescolares gives children a unique option for development across sports. Sport practice triggers healthy outcomes (Kaplan-Liss & Renna, 2009) it reduces the risk of developing heart disease, colon cancer, hypertension, and diabetes (Olshansky et al., 2005; Silva et al., 2015) and it has many health benefits like improving bone density, reducing the future risk of osteoporosis, reducing LDL cholesterol and increasing HDL cholesterol, improving strength, balance, and coordination; without forget, the benefits in children on psychosocial (Fazanes et al., 2022; Kaplan-Liss & Renna, 2009). Children in elementary school should have the opportunity to participate either in physical education or in sport practice (Donnelly et al., 2016). In Colombia, the government must supply this opportunity. Changes in public policy are required to increase physical activity in elementary schools (Donnelly et al., 2016) because the educational context is crucial for promoting the practice (Ordóñez & Blanco, 2022; Romero et al., 2022; Sánchez et al., 2022; Villa-Gonzalez et al., 2016).

The INDER program for public schools aims to meet the ACSM guidelines (Kaplan-Liss & Renna, 2009), a longitudinal study could allow more unbiased conclusions (Donnelly et al., 2016) about the effectiveness of the

schoolchildren's program. Another option is to conduct systematic assessments to adjust the program (Kaplan-Liss & Renna, 2009; Villa-Gonzalez et al., 2016) and obtain empirical data for analyses. The lack of adequate infrastructure for sports practice in public schools becomes a significant limitation in this and other studies that aim to assess the physical abilities and abilities of Medellín schoolchildren. Hacke et al. (2019) reported that lacking or inadequate infrastructure for sport practice also prevent an effective validation and follow-up process. The evaluation of cognitive, procedural, and attitudinal skills should be a regular procedure in each of the sports formation processes.

Another important limitation is due to the lack of more precise evaluation procedures since the field tests do not yet allow for complete standardization. It is also necessary to carry out research that develops standardization tables with which comparisons can be made to establish differences or similarities between boys and girls practicing sports and non-practitioners. Further studies should use technological aids to obtain more reliable data.

Conclusion

Schoolchildren between eight and 11 years of age, who participate in the Inderescolares program obtained better performance in the tests to assess motor skills, concentration, and cardiorespiratory capacity. The children who participate in the Inderescolares program do not present modifications in the anthropometric variables such as height, weight, and BMI. Differences in performance occur in both girls and boys when they are compared with their non-participating peers. Socioeconomic status could influence performance; those tests that require a physical effort with the manifestation of conditional capacities, such as the 20-meter run and the launch of a medicine ball, were best carried out by schoolchildren from the lowest socioeconomic status. Schoolchildren participating in the Inderescolares program showed that they have a better ability to concentrate than non-participants; superior results were also obtained by schoolchildren of the highest socioeconomic status.

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Authors' contributions

EA conceived of the study, participated in its design and coordination, gathered the information, and helped draft the manuscript. WGVS helped to conceive of the

study and took the data on the participants' motor skill, concentration, and cardiorespiratory capacity and helped to draft the manuscript. HM helped collect the data on the participants' motor skill, concentration, and cardiorespiratory capacity. DC carried out the data analysis of the participants' motor skill, concentration, and cardiorespiratory capacity, performed the statistical analysis, and helped to draft the manuscript. SP helped to conceive of the study and participated in its design and coordination. All authors read and approved the final manuscript and agreed with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

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