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The relationship between the number of weekly physical education classes with morphological, physical, motor and executive functions profiles: a cross-sectional study

Physical Education class morphological, physical, motor and executive functions

Clase de educación física morfológicas, físicas, motrices y función ejecutiva

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RESUMEN

Introducción: La Educación Física Escolar se presenta como un interesante instrumento en la mejora de los dominios de las funciones físicas, motoras y ejecutivas en los niños. Estudios recientes indican la relación positiva de un mayor comportamiento motor y aptitud física con ganancias en las capacidades de la función ejecutiva, todas estas capacidades se pueden desarrollar en Educación Física Escolar. Se conoce el beneficio de la Educación Física Escolar en el desarrollo infantil, pero aún es necesario investigar si el número de clases de Educación Física Escolar puede influir en estos aspectos. **Objetivo:** Verificar el efecto del número de clases de educación física en la escuela sobre indicadores antropométricos, físicos, motores y cognitivos. **Métodos:** se trata de un estudio descriptivo transversal. Se realizaron tres visitas aleatorias a las instalaciones de la escuela para aplicar los instrumentos de investigación, divididas en tres bloques. 1) Prueba de cancelación de atención y Prueba de carriles A y B (aplicada colectivamente); 2) Prueba de recuperación intermitente - nivel 1 (Yo-Yo IR1); 3) Prueba de anamnesis, composición corporal y Körperkoordination für Kinder (KTK). **Resultados:** los niños que participaron en dos clases semanales de Educación Física en la escuela lograron valores más bajos de composición corporal y mayores dominios motores y flexibilidad cognitiva en comparación con los niños que asistieron solo a una clase semanal. **Conclusión:** el número de clases de educación física en las que se inserta el niño mostró influir en la composición corporal, aptitud cardiorrespiratoria, coordinación motora y flexibilidad cognitiva. Se trata de un estudio descriptivo transversal, que no permitió extrapolar los resultados en una situación de causa y efecto, pero demostró que el número de clases de educación física escolar que se ofrecen a los niños puede interferir con la capacidad de aptitud cardiorrespiratoria, coordinación motora y flexibilidad cognitiva e índices antropométricos más bajos.

Palabras clave: Educación Física Académica; Coordinación motriz; aptitud cardiorrespiratoria; Función ejecutiva.

ABSTRACT

Introduction: School Physical Education presents itself as an interesting instrument in the improvement of physical, motor, and executive functions domains in children. Recent studies indicate the positive relationship of increased motor behavior and physical fitness with gains in executive function capacities, all these capacities can be developed in School Physical Education. It is known about the benefit of School Physical Education in child development, but it is still necessary to investigate whether the number of School Physical Education classes can influence these aspects. **Objective:** To verify the effect of the number of physical education classes in school on anthropometric, physical, motor and cognitive indicators. **Methods:** this is a descriptive cross-sectional study. Three random visits were carried out on the school premises to apply the research instruments, divided into three blocks. 1) Attention cancellation test and Test of lanes A and B (collectively applied); 2) Intermittent recovery test - level 1 (Yo-Yo IR1); 3) Anamnesis, body composition and Körperkoordination für Kinder (KTK) test. **Results:** children who participated in two weekly Physical Education classes at school achieved lower values of body composition and greater motor domains and cognitive flexibility compared to children who attended only one weekly class. **Conclusion:** the number of physical education classes in which the child is inserted showed to influence body composition, cardiorespiratory fitness, motor coordination and cognitive flexibility. This is a descriptive cross-sectional study, which did not allow extrapolating the results in a situation of cause and effect, but it demonstrated that the number of school physical education classes offered to children can interfere with the capacity of cardiorespiratory fitness, motor coordination and cognitive flexibility and lower anthropometric indices.

Keywords: Scholar Physical Education; motor coordination; cardiorespiratory fitness; executive function.

RESUMO

Introdução: A Educação Física Escolar se apresenta como um instrumento interessante na melhoria dos domínios físico, motores e das funções executivas em crianças. Estudos recentes indicam a relação positiva do aumento do comportamento motor e da aptidão física com ganhos nas capacidades das funções executivas, todas estas capacidades podem ser desenvolvidas na Educação Física Escolar. Sabe-se sobre o benefício da Educação Física Escolar no desenvolvimento infantil, mas, ainda é necessário investigar se o número de aulas de Educação Física Escolar pode influenciar nestes aspectos. **Objetivo:** Verificar o efeito do número de aulas de educação física escolar nos indicadores antropométricos, físicos, motores e cognitivos. **Métodos:** trata-se de um estudo transversal descritivo. Foram realizadas três visitas aleatórias nas dependências da escola para aplicação dos instrumentos de pesquisa, divididos em três blocos. 1) Teste de atenção por cancelamento e Teste das faixas A e B (aplicadas coletivamente); 2) Teste de recuperação intermitente - nível 1 (Yo-Yo IR1); 3) Anamnese, composição corporal e teste de Körperkoordination für Kinder (KTK). **Resultados:** as crianças que participaram de duas aulas semanais de Educação Física na escola alcançaram valores mais baixos de composição corporal e maiores domínios motores e flexibilidade cognitiva em relação às crianças com apenas uma aula semanal. **Conclusão:** o número de aulas de educação física escolar em que a criança está inserida mostrou influenciar a composição corporal, aptidão cardiorrespiratória, coordenação motora e a flexibilidade cognitiva. Trata-se de um estudo transversal descritivo, não permiti extrapolar os resultados em situação de causa e efeito, mas, demonstrou que o número de aulas de educação física escolar ofertada a crianças pode interferir nas capacidades de aptidão cardiorrespiratória, coordenação motora e flexibilidade cognitiva e menores índices antropométricos.

Palavras chave Educação Física Escolar; coordenação motora; aptidão cardiorrespiratória; função executiva.

Physical Education class, physical and executive functions

INTRODUCTION

The increase of sedentary behavior among children and adolescents are a global public health concern. This adverse scenario is one of the main causes of overweight and obesity, hampering physical and mental health of this population. Therefore, schools are implementing programs to increase the level of physical activity in the pediatric population (Becerra et al., 2013; Reigal-garrido et al., 2014). However, only 0,03% of Brazilian schools are inserted in active schools program, which besides having a Physical Education Teacher, still has a infrastructure for the practice of physical activities, open to the community (Relatório Nacional de Desenvolvimento Humano do Brasil, 2017).

Valorization of physical activities, exercises and sports practice for health, are required to attenuate pediatric sedentary behavior and, consequently, reducing the risk of chronic degenerative diseases through the lifespan (Mazzocante et al., 2012, 2013). Current guidelines are primarily concerned with the total amount of physical activity practiced by children and adolescents to achieve at least 60 minutes of daily physical activity (World Health Organization, 2010).

The increase in this practice may result in benefits on body fat. Pereira et al (2016), demonstrated that a 8-week program of incentive to increase the level of physical activity, can reduce 5% of fat participants (Pereira et al., 2016). Motor benefits were also observed in a study after 7 months of games and physical exercise interventions in children aged from 6 to 10 years during School Physical Education classes twice a week with significant improvement in the motor coordination, spatio-temporal perception, selective attention and executive function (Cardeal et al., 2013). Moreover, the improvement of cardiorespiratory fitness is also a key role of the increase of physical activity which is already evidenced (Koutsandréou et al., 2016).

Besides physical benefits, the practice of moderate to vigorous physical activity may also beneficiates brain function (Becerra et al., 2013;

Charles H. Hillman et al., 2009; Reigal et al., 2016; Rosas et al., 2019; Yu et al., 2021). Koutsandre'ou et al (2016) verified that 10 weeks of motor and cardiovascular tasks could improve working memory of children, which is an important cornerstone of the cognitive function. (Koutsandréou et al., 2016). Thus, this effect may result in several benefits of the academic performance, which has gained strength in Education. Exercise is among the five most important pillars for healthy cognitive aging (Schoentgen et al., 2020)

In order to improve cognitive benefits, it is necessary to consider the type, intensity and duration of physical activity practiced (Antunes et al., 2006). Noteworthy, Walking (Charles H. Hillman et al., 2009), running, sportive games (Calleja-Reina, M., Rueda, J. M., Barbosa, A., 2021; Mazzocante et al., 2020; Pesce et al., 2016), play games (Brito et al., 2017), physical education (Pesce et al., 2016; Reloba-Martínez et al., 2017; Rosas et al., 2019), in a moderate to vigorous intensity (acute and chronic) are important interventions to improve the working memory (Pesce et al., 2009), attention (Dominguez-González et al., 2018; Reigal, Moral-Campillo, Morillo-Baro, et al., 2020), inhibitory control (Drollette et al., 2014), language process (Scudder et al., 2014), arithmetic (Chaddock-Heyman et al., 2015) and academic performance (Donnelly & Lambourne, 2011). Taken together, the aforementioned domains are closely related to executive function (Adele Diamond, 2012, 2014; Adele Diamond & Lee, 2011). Therefore, studies that investigate the relation between scholar Physical Education and executive functions could be relevant for scholar public, parents, family members, faculty, and school directors (Alesi et al., 2019; Diamond & Lee, 2011; Rosas et al., 2019; Zumaquero et al., 2015).

Executive function is understood as a series of cognitive abilities that allow the performance of voluntary and self-organized actions aiming behavioral interactions. This condition requires

adjustment and planning, in order to respond to the new and complex situations demanded by the environment. Furthermore, competence is defined by the cognitive control of mental functions, determined by the ability to self-regulate and to deal with actions that require complex behaviors, decision making, abstract thinking, discipline and planning. Therefore, it is a crucial factor on multiple life skills, including motor, academic, social, and affective performances (Diamond, 2014; Otero et al., 2014; Rosenberg, 2015; Santana et al., 2017).

Children who are offered physical exercises during childhood have greater executive control over their non-exercising peers, among the most prevalent physical exercise sites in childhood and adolescence, we currently have physical education at school and sports initiation, interesting areas for the physical, motor and cognitive development, but with different objectives (Baumeister et al., 2008; Budde et al., 2008; Diamond & Lee, 2011; Güngör, 2014; Hillman et al., 2014; Wang et al., 2013).

The scholar Physical Education appears to be a relevant intervention in the development and enhancement of motor and physical performance. Considering motor coordination and cardiorespiratory fitness important variables that pay a significant role in executive function. It is rationale to infer that scholar Physical Education could be a significant strategy to influence in cognitive domains, including the executive function. Pesce et al (2016) verified the effect of 6 months of scholar Physical Education classes in the inhibitory control of children from 5 to 10 years. After the intervention children that performed the classes of Physical Education presented an increase of the inhibitory control when compared to those from control group. Moreover, Rosas et al. (2019), also verified an improve of executive functions following interventions with scholar Physical Education. Furthermore, this increase in executive function was maintained through 8 months after the end of the intervention. These studies suggest a key role

of Physical Education classes in cognitive domains.

Therefore, in Physical Education classes, the child will learn to develop and improve his basic movement skills through exercises, games and different activities to expand his motor repertoire and executive function (Diamond & Lee, 2011; Reigal et al., 2019; Rosas et al., 2019).

Although a plethora of studies have shown that the improvement of physical fitness and motor coordination are associated with better executive function, whether the number of Physical Classes may impact in these factors above still lacking. Therefore, the objective of the present study is to verify the effect of the number of physical education classes on physical and cognitive aspects of children.

MATERIAL AND METHODS

Subjects

This is a study with a cross-sectional design of inferential character, with a non-probabilistic sample selection of the intentional type, all recruitment was carried out by verbal invitation from the researcher and assisted by the school directors. 147 students aged 7 to 10 years, of private and public education schools of the Federal District of Brazil. The children were separated into three groups in relation to the amount of Physical Education classes within the curriculum, in this way, 41 children had Physical Education classes twice a week (TPEG), 78 children had one Physical Education and swimming classes once a week (SPEG) and 28 children had only one Physical Education class per week (PEG). The classes were carried out by different teachers, their respective teaching applications were not controlled or guided by the researchers, only the relationship of different compositions of the number of Physical Education classes in schools was observed. The applied content, volume and intensity of activities prescribed in school Physical Education classes were not controlled.

Physical Education class, physical and executive functions

All participants presented the terms of assent and free and informed consent signed by the parents or guardians. The study was approved by the Ethics and Research Committee of the Catholic University of Brasilia (n° 2,071,564).

The inclusion criteria adopted were the absence of diagnosis of neurological and psychiatric pathologies, not present orthopedic pathology that could interfere in physical tests, not using medications that alter the senses or cognition and did not have a history of school disapproval by and anamnesis with children and their parents. The anamnesis was carried out by an interview to ensure the inclusion criteria of the study.

General procedures

All groups had school Physical Education classes within the teaching curriculum, in the same academic period as the other subjects. The classes lasted approximately 50 minutes, using the contents related to games and games, rhythm and movement, motor coordination: fundamental skills and sports initiation, but it is not possible to indicate the number of classes, intensity and volumes applied to each listed content. After anamnesis, the assessment of the physical, anthropometric, and cognitive profile was randomly applied (tests) on 3 different days: 1) Attention cancellation test and trail A and B tests (applied collectively); 2) Intermittent Recovery Test - level 1 (Yo-Yo); 3) body composition and the Körperkoordination für Kinder (KTK) test.

Anthropometric assessment

The anthropometric measurements were performed by measuring waist (CC) and hip circumference (Sanny, TR4010, Brazil), body mass using an electronic scale (Welmy, 6155, Brazil). stature by stadiometer (Sanny, ES2040, Brazil), from it, body mass index was calculated and skinfold by adipometer (Lange, Skinfold Caliper, USA).

Sum of the skinfolds (Σ DC) was calculated for body fat percentage (CG), with the equation proposed by Slaughter et al. (A. M. H. Slaughter et al., 2013; M. Slaughter et al., 1988). The

techniques adopted for anthropometric measurement variables followed the procedures described by Petroski (Petroski et al., 1995).

Cardiorespiratory fitness and motor coordination

Yo-Yo intermittent recovery level 1 was used for cardiorespiratory fitness measurement, which consists of running as much time as possible in a round trip, with a distance of 16 meters for children from 6 to 9 years old (Ahler et al., 2012) and 20 meter for more than 9 years old (Andersen et al., 2008) and the track width was 1.3 meters, as described by Ahler et al., (2012). The increase in test intensity is determined by a sound whistle, with a gradual increase in intensity and, consequently, a decrease in the time between sound stimuli, with a rest interval of 10 seconds. The end of the test was determined when the volunteer failed to reach 16 or 20 meters, respectively. To guarantee the performance of the races at the speeds corresponding to each stage, one of the evaluators participated in the race to ensure that the ideal pace was maintained, and the capacity determined in meters covered.

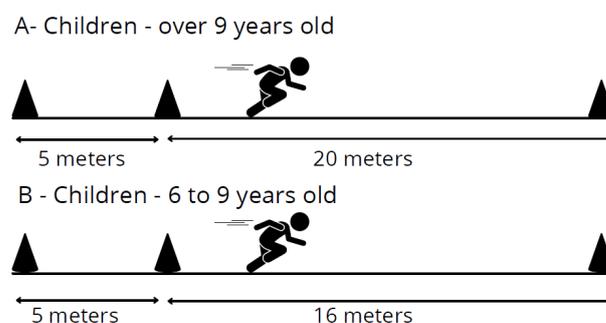


Figure 1 - Displays the visual organization of the Yo-Yo intermittent recovery level 1 application. Figure created by the author.

For motor coordination, Körperkoordinationstest für Kinder test (KTK), composed of four tasks: 1) balance beam; 2) unipodal jumps; 3) Transference of platform; and 4) lateral jumps as described elsewhere (Gorla, JI, Araújo PF, 2009; Hoeboer et al., 2016). The test was already applied in Brazilian children (Mazzoccante et al., 2019;

Mazzoccante et al., 2020; Moreira et al., 2019; Ré et al., 2017).

Trail making A and B

Trail making test A evaluate working memory and it consists of two stages, one containing letter and another containing numbers, both randomly arranged. The test consists of connecting the points in alphabetical order and ascending numerical order, respectively. Trail making test B evaluate cognitive flexibility and it is composed of letters and numbers, arranged randomly on the same paper, in which the task is to link letters and numbers alternately in numerical and alphabetical orders. Furthermore, to assess the processing speed of children, was subtracted trail B with A (trail making B-A) as described by previous studies (Montiel & Seabra, 2008; Seabra & Dias, 2012). The test is already applied and validated to Brazilian children (Almeida et al., 2018; Capovilla & Dias, 2008; Carvalho et al., 2020; Coelho et al., 2015; Mazzoccante et al., 2019; Mazzoccante, Corrêa, et al., 2020; Seabra, Alessandra Gotuzo; Dias, 2012; Souza et al., 2020). All children were already literate, a criterion that can interfere with the test.

Attention cancelation test

In order to evaluate children attention, was performed an Attention cancelation test as described by Montiel and Capovilla, 2007 (Montiel & Seabra, 2008), composed by three tasks, with one minute for each one (Seabra & Dias, 2012). In all tests, the children must scratch all figures related to another previously determined.

In the first part of the test, the target figure is indicated at the top of the paper, appearing randomly 50 times, and arranged in 15 lines in a total of 300 figures. In the second part the target stimulus consists of a pair of geometric figures that appear randomly 7 times, arranged in 15 lines. In the third part of the test the target stimulus changes and varies from two to six times each line. The tests were evaluated according to the total number of correct answers, errors and

absences as described by Seabra e Dias (Seabra & Dias, 2012). The test is already applied and validated to Brazilian children (Almeida et al., 2018; Capovilla & Dias, 2008; Carvalho, Quintas, Assis, & Seabra, 2020; Fonseca, Lima, Ims, & Coelho, 2015).

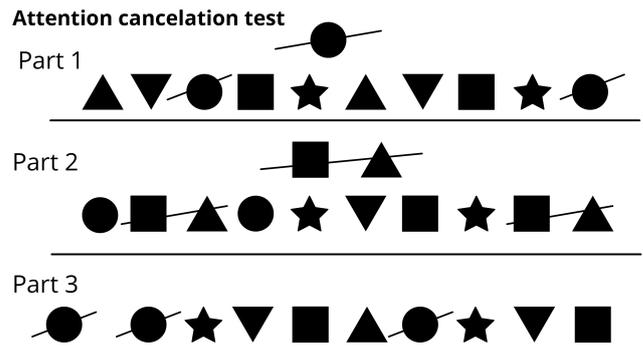


Figure 2 - Attention cancelation test as illustration.

Attention and executive function

Executive function was established by the mean results of children performance in cancelation attention test, trail making A, trail making B e trail making B-A.

Statistics analysis

Descriptive statistics with mean values and standard deviation were performed. The normality of the data was tested using the Shapiro-Wilk test. For the comparison of the anthropometric, physical, motor and cognitive variables among the groups with different classes of Physical Education, the ANOVA One way test was used with Tukey post hoc. The significance level of the study was $p \leq 0.05$. The software used was the Statistical Package for the Social Sciences (SPSS), version 23.0.

RESULTS

All children perform all tests without any interurrence or physical injures in the process.

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As verified in table 1, SPEG and TPEG presents lower values of body mass, stature, body mass index and subscapular fold and in relation to PEG ($p < .01$). Furthermore, SPEG presents lower waist circumference and %body fat in relation to PEG ($p < .01$) and lower age and hip circumference in relation to PEG and TPEG ($p < .01$).

Table 1.
Anthropometric variables of children from all groups.

Variables	PEG (n=28)	TPEG (n=41)	SPEG (n=78)
Age (years)	8.5±1.3	8.8±0.8	7.6±1.2 ^c
Body mass (kg)	38.8±14	25.9±7 ^a	25.7±5.7 ^a
Stature (m)	1.41±0.12	1.32±0.1 ^a	1.27±0.08 ^a
Body mass index (kg.m ²⁽⁻¹⁾)	18.9±3.9	14.8±2.2 ^a	15.9±2 ^a
Waist Circumference (cm)	62.9±10.3	59.5±6.9	56.4±5.8 ^a
Hip circumference (cm)	75.9±11.6	72.5±9	67.2±6.9 ^c
Triceps fold (mm)	15.2±6	14.6±5.2	13.5±5.9
Subscapular fold (cm)	13±6	8.4±4.6 ^a	8.1±5.3 ^a
Sum of skin folds (cm)	27.46±11.4	23.67±8.9	23.65±8.73
Body fat (%)	24.8±8.6	20.8±7	19.4±7.7 ^a

PEG, Physical Education class once a week group; TPEG, Physical Education class twice a week group; SPEG, Physical Education and swimming classes once a week; ^a $p < .01$ in relation to PEG; ^b $p < .01$ in relation to SPEG; ^c $p < .01$ in relation to PEG and TPEG.

In addition, the results of the performance of the cardiorespiratory and motor coordination tests are described in table 2. PEG presented higher values ($p < .01$) in relation to the SPEG group in the lateral jump and motor quotient scores and in comparison to TPEG in the single-jump, side-jump and balance beam tests. The TPEG group presented higher KTK scores for the motor quotient score compared to the SPEG and PEG groups.

The performance in the cancellation attention and Trail making tests are described in table 3. The results only differed in the tests of trails B and executive function, which TPEG presented greater performance in tracks B and executive function in relation to the SPEG and greater performance in the trail B compared to the PEG.

Table 2.
Cardiorespiratory fitness and motor coordination of children.

Variables	PEG (n=28)	TPEG (n=41)	SPEG (n=78)
Yo-Yo IRI performance (m)	275.1±126.3	258±66.2	372.2±264.2 ^b
Balance Beam (score)	85.8±10.4	76.3±10.1 ^d	88.2±11.3
Unipodal Jump (score)	93.4±12.5	85.1±11.2 ^a	88.3±15.6
Lateral Jump (score)	103±18.9	85.7±19.5 ^a	92.6±14.6 ^a
Transference of Platform (score)	82.9±13.4	70.1±11.6 ^a	69.4±11.1 ^a
Motor quociente (escore)	88.7±11.4	98.2±9.8 ^d	82.1±13

PEG, Physical Education class once a week group; TPEG, Physical Education class twice a week group; SPEG, Physical Education and swimming classes once a week; ^a $p < .01$ in relation to PEG; ^b $p < .05$ in relation to TPEG; ^c $p < .01$ in relation to PEG and TPEG; ^d $p < .01$ in relation to SPEG and PEG.

Table 3.
Children performance in cognitive tests.

Variables	PEG (n=28)	TPEG (n=41)	SPEG (n=78)
TAC total (score)	101.9±18.4	102.4±13.3	105.2±21.7
Trail A (score)	98.3±18.7	103.1±8.8	102±16.3
Trail B (score)	105.5±14.9	119.8±13.7 ^a	108.6±12.5
Trail B-A (score)	108.3±16.5	112.2±18.04	109.3±15.9
Attention (score)	100.1±11.8	102.7±7.4	103.4±14.9
Executive function (score)	103.5±9.81	105.4±13.1	105.9±10.6

PEG, Physical Education class once a week group; TPEG, Physical Education class twice a week group; SPEG, Physical Education and swimming classes once a week ^a $p < .01$ in relation to SPEG.

DISCUSSION

The main results of the present study suggest a better body composition for children who practice physical education twice a week and who practice once a week with a swimming lesson. setting up two physical exercise classes per week appears to be more effective for the maintenance of body composition compared to the performance of one class per week. When we emphasize the results of motor and cognitive coordination in their referred scores that adjust the performance of the task to age. it is noticed that the children of the TPEG group obtained greater performances of motor

coordination and cognitive flexibility in comparison to the PEG and SPEG groups.

A key finding of our study is that children who practiced physical activities a greater number of times in the week obtained better motor coordination and also greater cognitive flexibility. this finding may be due to the children's development being linked to the biological factors and their acquired experiences. nonetheless. these results should be interpreted with caution since it is a cross-sectional study. We encourage further investigations on the intensity and volume of the Physical Education class and how it could be associated with executive function.

It is known that a greater number of motor experiences lived by the child may act directly on the development of other components. Childhood could be considered as a propitious moment to achieve greater ascent in the global development. including the capacity of plasticity and constant mutability of its organism and the provided influences by the experiences of the environment (Diamond, 2000, 2007; Erickson et al., 2015; Michel, 2012). Among these experiences. stands out the physical exercise as a potent stimulator of the development of all the physical. motor and cognitive capacities (Adele Diamond, 2012; Esteban-Cornejo et al., 2015; Mazzoccante et al., 2019; Pesce et al., 2016; Reigal, Moral-Campillo, Mier, et al., 2020). The experiences lived in childhood can affect the whole development throughout life (Luz et al., 2015; Michel et al., 2018).

Possibly. not Only the number of classes could be the unique factor that influence in our results. As demonstrated by other studies. changes in executive function are sensitive to the modulation of motor coordination. Therefore. children with higher motor coordination are likely to present better domains of executive function as well (Geertsen et al., 2016; Mazzoccante et al., 2020; Schmidt et al., 2017). Similar results can be found in longitudinal studies (Ishihara & Mizuno, 2018). in which working memory was higher in children practice tennis 4 times per week when

compared to children that practice only for 2 times per week following a 12-week of tennis intervention. In another study (Koutsandr eou et al., 2016). when comparing the effect of 10 weeks of intervention on working memory in children aged 9 to 10 years. divided into three groups. the first experimental group (development of cardiorespiratory fitness). the second group experimental (activities fine and gross motor) and the third group was control. The results showed that both experimental groups were interesting in increasing performance in the working memory test in comparison to the initial time the interventions and the control group did not show any alteration. in addition. only the children (group motor coordination) obtained higher performance of working memory compared to the same moment in the control group.

Pesce et al. (2016) observed an increase in the inhibitory control following 6 months of scholar Physical Education. one time per week. in children aged from 5 to 10 years. Moreover. Rosas et al. (2019) found an increase of the executive function following 3 months of scholar Physical Education 3 times per week when compared to children submitted to one class of recreation. Noteworthy. even after the end of the intervention. the superior executive function was maintained in the children from intervention group for 8 months.

Childhood is considered the most propitious moment to reach greater domains of the overall and cognitive development. This is likely due to the child at 6 years of age has about 95% of the adult brain volume and will reach an exacerbated increase in formation and synaptic density approximately at 9 to 11 years. This condition occurs at different times for each area of brain region (Diamond, 2007; Hillman et al., 2014; Johnson, 2001; Lenroot & Giedd, 2006). Therefore. the enhancement of these domains early in the childhood may lead to important neural adjustment through the lifespan.

In addition. besides the responses arising from the increase in cardiovascular fitness. there is the

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stimulation of motor competence. that is. greater motor competence will result in an improvement in the performance of the executive function. this fact occurs by the following process: the human brain is highly plastic and adaptive to the demands that are imposed. an improvement that is very evident in the increase in the complexity of the motor repertoire expressed by the child. this relationship is facilitated by the interrelationship between the neural pathways of the cerebral regions. acting during a complex motor task to be similar to the regions involved in the process of the executive function. such as the regions of the cerebellum. motor cortex. parietal cortex and prefrontal cortex. which in turn the cerebellum is responsible for the organization of complex motor task in activities requiring automation and timing. is responsible for the tasks of self-regulation and attention. by the main demands of executive function. the interaction of this two brain regions is well evident in complex motor tasks that require motor and cognitive processing in its realization. it is highlighted that the mechanism explained above is one of the explanations of the interaction between motor and cognitive aspect. emphasizing that the brain has in its activity several active regions simultaneously. occurring greater predominance of brain activity of one in comparison to the other regions (Diamond, 2000, 2007; Michel, 2012).

The number physical education classes seems fundamental to provide better answers about the cognitive flexibility of children. but believed among the models of classes it is observed those that can provide greater and / or better answers on the improvement of the executive function are those involving the requirement of motor complexity in their achievement. this degree of complexity and / or novelty of the motor task required by physical exercise will provide better interaction between the physiological and neural benefits related to plasticity and brain activity. involving motor task action and jointly. this integrated action will provide the specific adaptations between the areas of the brain responsible for motor and cognitive abilities.

providing better answers about the executive function (Budde et al., 2008; Diamond, 2000; Diamond & Lee, 2011; Rosenberg, 2015).

The present study presents some limitations. such as: the impossibility of exemplifying the main neural mechanisms responsible for the results and their transverse nature does not allow us to make a relation of cause and effect. but the tests used prove to be valid and plausible in measuring the domains of executive function for children and adolescents (26). Another factor to emphasize is not having evaluated the maturational stage of children. however. it is believed that they are not in the maturational period because they observe that the older children are 10 years old. The impact of sexual maturation will influence all study variables. not just cognitive ability.

Although the present study lacks information related to possible mechanisms involved in the results. we suggest that scholar Physical Education may possibly be associated with a better physical and cognitive function among children. Therefore. the greater opportunity for motor experience may be a relevant factor to offer the child in providing greater chances of beneficial development of cognitive flexibility and motor coordination. Our findings highlight the biological importance of school Physical Education classes in the educational context of children. This can be a well-explored instrument in the current school scenario to benefit physical. motor. and executive functions development.

In summary. our findings demonstrated that school Physical Education classes may act on anthropometric. motor and executive profiles. indicating that the number of classes can be indicative of greater motor and cognitive domains.

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