Crianças praticantes de artes marciais possuem melhor coordenação motora, atenção e função executiva

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Resumo

Introdução: Ao observarmos os esportes, temos a arte marcial como prática importante para atuar no desenvolvimento das capacidades físicas, motoras e cognitivas da criança. Assim, é possível utilizar as modalidades de artes marciais para o desenvolvimento de forma ampla. Objetivo: Verificar a influência das artes marciais na composição corporal, coordenação motora, atenção e flexibilidade cognitiva em crianças de 7 a 11 anos. Métodos: A amostra do estudo foi composta por 51 alunos de Brasília, com idade entre 7 e 11 anos, sendo 23 praticantes de artes marciais - Grupo de Esportistas (GE) (9,3 ± 2,3) e 28 praticantes de modalidades esportivas - Grupo Controle (GC) (8,1 ± 1,7). Foram aplicados os seguintes testes: Anamnese, teste de trilhas A e B, teste de atenção por cancelamento (TAC), avaliação antropométrica e teste KTK. Resultados: O grupo esportivo obteve melhor coordenação motora, maior velocidade para processar informações e executá-las em relação ao grupo não praticante. Conclusão: podemos sugerir através dos resultados a importância da modalidade para o desenvolvimento da motriz e cognitivo, e não apenas aprendizado técnico.

Palavras-chave: Composição corporal; Coordenação motora; Função executiva; Artes marciais.

Children practitioners of martial arts have better motor coordination, attention and executive function

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Abstract

Introduction: When we observe sports, we have the martial art as a fundamental tool to act in the development of the physical, motor and cognitive capacities of the child. Thus, it is possible to use the martial arts modalities for development in a broad way. Objective: To verify the influence of martial arts on body composition, motor coordination, attention and cognitive flexibility in children aged 7 to 11 years. Methods: The study sample consisted of 51 students from Brasília, aged 7 to 11 years old, of whom 23 were practicing martial arts - Group of Sportsmen (GE) (9.3 ± 2.3) and 28 practitioners of sports modalities - Control Group (CG) (8.1 ± 1.7). The following tests were applied; Anamnesis, A and B track test, attentional cancellation test (TAC), anthropometric evaluation and the KTK test. Results: The sports group obtained a better motor coordination, a greater speed to process information and execute it in relation to the non-practicing group. Conclusion: We can suggest through the results the importance of the modality for motor and cognitive development, and not just technical learning.

Keywords: Body composition; Motor coordination; Children; Executive function; Martial arts.

Los niños practicantes de artes marciales tienen mejor coordinación motora, atención y función ejecutiva

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Resumen

Introducción: Cuando observamos deportes, tenemos al arte marcial como herramienta fundamental para actuar en el desarrollo de las capacidades físicas, motrices y cognitivas del niño. Por lo tanto, es posible utilizar las modalidades de las artes marciales para el desarrollo de una manera amplia. Objetivo: Verificar la influencia de las artes marciales en la composición corporal, la coordinación motora, la atención y la flexibilidad cognitiva en niños de 7 a 11 años. Métodos: La muestra del estudio estuvo compuesta por 51 alumnos de Brasilia, con edades entre 7 y 11 años, de los cuales 23 practicaban artes marciales - Grupo de Deportistas (GE) (9,3 ± 2,3) y 28 practicantes de modalidades deportivas - Grupo Control (GC) (8,1 ± 1,7). Se aplicaron las siguientes pruebas; Anamnesis, test de seguimiento A y B, test de cancelación atencional (TAC), evaluación antropométrica y test KTK. Resultados: El grupo deportivo obtuvo una mejor coordinación motriz, una mayor rapidez para procesar información y ejecutarla en relación al grupo no practicante. Conclusión: Podemos sugerir a través de los resultados la importancia de la modalidad para el desarrollo motor y cognitivo, y no sólo el aprendizaje técnico.

Palabras clave: Composición corporal; Coordinación motriz; Niños; Función ejecutiva; Artes marciales.

Introduction

Nowadays, sedentary behavior has become one of the most worrying conditions for health maintenance factors, which affects an increasing number of children and adolescents. The main reasons for this involvement come from a lower level of physical activity due to the convenience offered by technological resources, as well as the increased of violence in large cities, the practicality of highly industrialized foods, shorter time for family relationships and highly busy routines resulting in less time spent physical and motor stimuli for children and adolescents, rendering them unable to provide adequate conditions for motor, physical and cognitive growth and development (Diamond, 2000, 2014).

Childhood and adolescence are a crucial period for a good motor, physical, affective and cognitive development. Generally, this stimulus comes from school Physical Education classes, sports initiation and the practice of street games (Ding, Chen, Zou, & Tian, 2015). Both gross and fine motor skills are essential at this stage of biological development, enabling the acquisition of high levels of motor competence. In contrast, stimuli must occur at adequate doses, respecting the phase of motor development, usually provided by the practice of physical exercise and motor experience (Bardid et al., 2016). Thus, motor coordination not only has an interrelatedness with biological growth but also seems to play a positive association with aerobic, neuromuscular and cognitive performance (Ding et al., 2015; Laukkanen, Pesola, Havu, Sääkslahti, & Finni, 2014; Oberer, Gashaj, & Roebers, 2018).

Highlighting sports initiation, it have a unique stimuli in providing elements for the acquisition and development of social, physical, cardiorespiratory and motor skills (Bardid et al., 2016; Hoeboer et al., 2016); Moreover, its practice can contribute to the development of cognitive and academic domains due to some factors: i) the integration of motor action and cognitive response in decision making, strategy and adverse situations requested by sport (Tudos, Predoiu, & Predoiu, 2015); ii) structural changes provided by increased cardiovascular fitness, which result in increased nutrient blood supply, brain oxygenation, and information response speed; iii) the increase in motor competence is associated with the increase in cognitive capacity, this fact is due to the interrelationship between the cerebellum and prefrontal cortex regions (Chaddock, Neider, Lutz, Hillman, & Kramer, 2012; Diamond, 2000; Sigmundsson, Englund, & Haga, 2017).

Thus, the sport seems to be an essential factor to academic and cognitive performance; This action takes place mainly in the domains of executive function, whose mission is the self-regulation of cognitive responses, divided into three fields: inhibitory control, working memory and cognitive flexibility (Diamond, 2014). Inhibitory control is the ability to control attention and behavior in a given situation, where there is an internal or external distraction and to focus on what matters. Working memory is the ability to manipulate information in mind, store it and use it in a near period. Cognitive flexibility is the ability to think creatively and adapt to the changing demands of the environment where the child interacts (Diamond, 2014). Among the physical activities that act directly on the development of motor, physical and cognitive abilities, martial arts may be a potential strategy to achieve this goal (Diamond, 2000, 2014).

The practice of martial sport, during childhood, can provide the learning of motor coordination control, such as the affective and social control.

This modality challenge the children to deal with situations that will imply the need of good motor, emotional and cognitive domains; in this perspective, researches in the field of martial art with motor aspect and its relation to executive function can contribute to highlight the relation between physical skills in executive function (Fong, Fu, & Ng, 2012; Gleser et al., 1992; Johnstone & Marí-Beffa, 2018; Lamarre & Nosanchuk, 1999; Skelton, Glynn, & Berta, 1991).

Diamond and Lee (Diamond & Lee, 2011), demonstrated that martial art is one of the unique interventions in developing in particular focus, self-control, and discipline, essential elements for a good executive functionin (Mikheev, Mohr, Afanasiev, Landis, & Thut, 2002; Schlaffke et al., 2014); However, there are still few investigative studies of the effects of martial arts practice during childhood on attention and executive function. Thus, this study aims to analyze the influence of martial arts on motor coordination and cognitive aspects in children aged 7 to 11 years.

Materials and Methods

Experimental design

The present study is an observational research of case-control, where the control group are children who do not practice martial arts and the case group, children exposed to the experience of martial art.

The selection of the place of performance and recruitment of the study members were made for convenience and all participants had the informed consent and consent signed by their parents or guardians, as well as all the requirements stipulated by CNS 510/16, thus being approved under opinion 2,071,564 issued by the Ethics and Research Committee of the Catholic University of Brasilia (nº 2.071.564).

Subjects

Fifty-five students from public and private schools in the city of Brasilia, Federal District, aged 7 to 11 years participated in the study, 23 of them practicing martial arts (karate (n = 5), judô (n = 3) and jiu-jitsu (n = 15)) - Martial Arts Practitioners Group (GPA) (9.3 ± 2.3 years) and 28 non-sports practitioners - Control Group (CG) (8.1 ± 1.7 years). As inclusion criteria, the study assumed that children should be regularly enrolled in the Federal District official school system, participate twice a week in physical education classes, and in the case of GPA, they should attend martial arts classes at least once a week, at least three previous months. As exclusion criteria, it was defined; the absence of diagnosis of neurological and/or psychiatric disorders, no problems that prevented participation in physical tests, no use of drugs that altered the senses or cognition, and no history of school failure.

Procedures

The researchers made two visits to apply the research instruments, which were conducted at random, and without the knowledge of the group in which the children fit (GPA or GC), this visit was mediated within the school

premises and followed the flow represented by Figure 1. The school environment was adapted to perform the tests that were performed by the same evaluators.

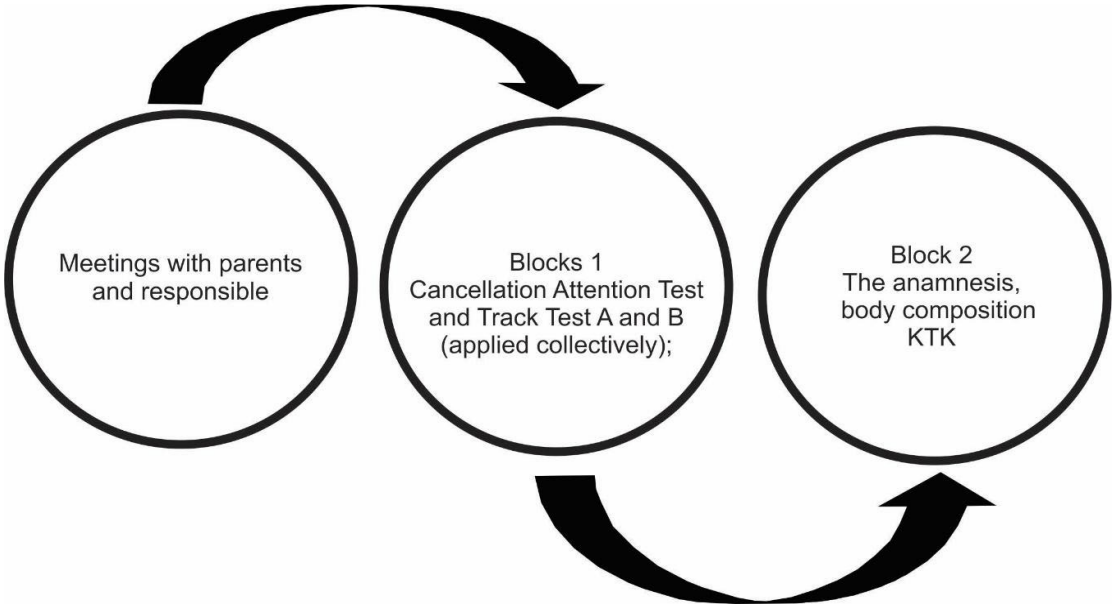

Figure 1. Flowchart of procedures assumed for data collection of the study.

Anamnesis

It was conducted in an interview format, in which the evaluator applied a questionnaire to ensure the exclusion criteria of the study, such as schooling, history of failure and medication use.

Trail making A and B tests

Trail making test A, requires perceptual tracking of a sequence and speed performance. This consists of two sheets, one containing letters and one sheet containing numbers, both arranged at random. The test consists of connecting the points in alphabetical order and ascending numerical order, respectively. The trail making test B requires both components, but also divided attention. The test is composed of a sheet containing letters and numbers, arranged randomly on the same sheet, in which the task is to link letters and numbers alternately in numerical and alphabetic orders. Both tests had their performance established within a maximum of one minute for each test.

For the analysis of trail A, the sequence number was measured, and, in trail B, the sequence, connections, and sum of both (sequences and connections) were measured (Seabra, Alessandra Gotuzo; Dias, 2012).

The assessment of the performance rating in the Trail A and B test was determined according to the criteria established by Seabra and Dias, 2012 (Seabra A & Dias N, 2012), which separates the groups based on the performance achieved in the test and the categorized score for the test, dividing them into five classifications: very high; high; average; low; very low.

Cancellation Attention Test (TAC)

TAC was applied as described by Seabra e Dias, 2012 (Seabra A & Dias N, 2012), composed of three parts, lasting a maximum of one minute each. In all tests, the participant's task is to mark all stimuli equal to the target stimulus (symbols) previously determined.

In the first part of the test, the target figure is indicated at the top of the sheet, appearing randomly 50 times and arranged in 15 lines for a total of 300 figures. In the second part, the target stimulus is composed of a pair of randomly appearing 7-fold geometric figures arranged in 15 lines. In the third part of the test, the target stimulus changes and ranges from two to six times per line. The tests were evaluated according to the total number of hits, errors, and absences (Seabra A & Dias N, 2012).

The assessment of the TAC was determined according to the criteria established by Seabra and Dias, 2012 (Seabra, Alessandra Gotuzo; Dias, 2012), which separate the groups based on the performance achieved in the test and the categorized score for age, dividing them into five classifications: very high; high; average; low; very low (Seabra A & Dias N, 2012).

Body composition assessment

Anthropometric assessment and body composition were performed by measuring waist and hip circumference using a metal tape (Sany, TR4010, Brazil), body mass by electronic scale (Welmy, 6155, Brazil), and skinfold thickness. By adipometer (Lange, Skinfold Caliper, USA). For fat percentage (% G), the equation proposed by Slaughter et al. (Slaughter et al., 2013). The techniques adopted for the measurement of anthropometric variables followed the procedures described by Petroski, 1995 (Petroski, Pires-Neto, & Neto, 1995).

Körperkoordinationstest für Kinder test (KTK)

The KTK is made up of four tasks, 1) balance beam: walking backward along three decreasing beams, 2) single-jump: jumping over rising obstacles, 3) platform transfer: moving sideways on planks wooden for 20 seconds and 4) side jumps: jump with both legs side to side for 15 seconds.

The evaluation of the coordinative capacity was performed by the motor quotient (QM), derived from the gross values obtained in each KTK task and its sum resulted in the total QM, classified in five CM levels with reference to the total QM score values; good overall motor coordination; regular overall motor coordination; inadequate overall motor coordination; and disturbance in overall motor coordination (Hoeboer et al., 2016).

Statistics

The results of quantitative data were expressed as mean and standard deviation, while categorical variables were presented as absolute and relative frequency. Data normality was tested using the Shapiro-Wilk test. For the comparison of motor coordination values, cancellation attention tests, and Trails A and B between groups, Student's t-test was used. The significance level of the study was $p \leq 0.05$ and the software used was duly registered

SPSS version 23, and the researcher responsible for the statistical analyses did not have any contact with the analyzed sample. The effect size was calculated by D. Cohen, with the assistance of GPower 3.1 software for Windows.

Results

Anthropometric characteristics and body composition are presented in Table 1. The sports practiced by children are: karate (n = 5), judo (n = 3) and jiu-jitsu (n = 15). Observing the results, children practicing martial sports obtained higher values in the variables; body mass (p = 0.01) and WC (p = 0.01) in relation to children in the control group.

Table 1. Anthropometric characteristics and body composition of the group of children practicing martial arts and control group.

Variables	GPA (n=23)	GC (n=28)	value
Age (years)	8.57±1.75	8.07±1.74	0.32
Body mass (kg)	34.61±10.26	27.66±8.21	0.01
CC (cm)	63.39±8.07	56.71±5.84	0.01
CQ (cm)	73.43±9.72	68.07±8.17	0.37
Triciptal skinfold (mm)	15.61±5.92	13.63±4.2	0.16
Subescapular skinfold(mm)	8.57±1.75	8.07±1.74	0.32
Body fat (%)	34.6110.26	27.66±8.21	0.01

WC - Waist Circumference; HC - Hip Circumference; GPA: Martial Arts Practitioner Group; CG: control group. For statistical differences p≤0.05.

The results of motor coordination for the KTK test are shown in Table 2. Children who practiced martial sports obtained higher values in the variables; monopedal jump score (p = 0.001), lateral jump score (p = 0.001), sum of motor quotient (p = 0.01) and motor quotient score (p = 0.001) compared to the control group.

Table 2. Mean values and standard deviation of motor variables, measured by the KTK test in the group of children practicing martial arts and control group.

Variáveis	GPA (n=23)	GC (n=28)	*p* value	Ef
Balance beam (sc)	86.13±12.54	86.13±9.79	0.99	0.267
Monopedal jump (sc)	104.19±15.89	80.52±14.32	0.001	1.565
Lateral jump (sc)	104.76±22.46	84.33±14.42	0.001	1.082
Platform transfer (sc)	71.89±14.96	71.04±12.52	0.82	0.059
Motor quocient (sc)	106.08±16.88	89.96±10.77	0.001	1.139
∑ KTK	366.92±47.71	322.02±38.37	0.001	1.037

∑ KTK - Sum of KTK motor quotient; sc - score; GPA: Martial Arts Practitioner Group; CG: control group. For statistical differences p≤0.05.

Table 3 presents the results of the attention and executive function tests. It was observed that children practicing martial arts obtained higher scores in the trail B (sequence) (p = 0.01), trail B connections (p = 0.01), trail B sum (p = 0.01), trail B score (p = 0.03), trail B-A difference (p = 0.01), trail B-A score (p = 0.01) and executive function (p = 0.01) relative to the control group.

Table 3. Mean values and standard deviation of the cancellation attention test scores and trails A and B of the martial arts and control groups.

Variables	GPA (n=23)	GC (n=28)	p value	Ef
Total TAC (sum)	70.78±14.87	59.39±20.61	0.03	0.634
Total TAC (score)	107.69±11.1	102.31±19.15	0.02	0.344
Trail A (sum)	23.17±1.9	22.29±2.43	0.15	0.41
Trail A (score)	95.09±30.73	93.04±25.57	0.79	0.073
Trail B (sequence)	12.53±5.48	6.48±4.14	0.01	1.452
Trail B (connections)	12.25±4.58	6.26±4.09	0.01	1.380
Trail B (sum)	24.78±9.96	12.74±8	0.01	1.333
Trail B (score)	115.26±15.52	97.29±23.52	0.03	0.903
Trail B-A (difference)	-10.65±5.48	-15.8±4.63	0.01	1.015
Trail B-A (score)	119.74±15.97	98.93±19.58	0.01	1.165
Executive function (score)	109.4±11.05	96.76±11.98	0.01	1.097

GPA: Martial Arts Practitioner Group; CG: control group. For statistical differences p≤0.05

Discussion

The results of the present study showed that children who practiced martial arts had higher values of motor coordination, cognitive flexibility, cognitive processing speed, and executive function than children who did not practice martial arts.

Fong, et al., 2012 (Fong, Tsang, & Ng, 2012), observed the effect of Tae-Kwon-Do and school physical education classes on 5-11 year-olds on self-regulatory ability over a one-semester period, and found higher responses on mathematical calculation tasks and of self-regulation on affective components, social interaction, attention and behavior in practicing Tae-Kwon-Do children compared to practicing children of school physical education.

In this sense Lo et al (2019) (Leung et al., 2019) observed the effect of 8 weeks of judo practice on 12- to 16-year-old children and adolescents on cognitive flexibility, showed that judo practitioners had better responses and lower rate of errors on cognitive flexibility tests compared to non-practicing adolescents, pointing to the possible influences of martial arts practice on executive function, but in children these effects of martial arts are still not well described, and the results of this study generate a portfolio to contribute to the analysis of the impact of martial arts practice. During childhood, under cognitive flexibility, cognitive processing speed and executive function.

Not only Martial Arts, but also other modalities are responsible for enabling the best motor, cognitive and social development, as presented in the works of Ribeiro, et al., 2018 (Ribeiro, David, Barbacena, Rodrigues, & França, 2012) and Estevan, et al., 2018 (Estevan et al., 2018). However, other works show the relevance of martial arts specifically in the maturation and joint improvement of cognitive, motor and social aspects (Lopes et al., 2017; Seabra A & Dias N, 2012). Thus, martial art stands out as a unique component in providing improvements in the physical, motor, and executive development of children, as shown in the study results.

Dias, 2018, Santos, et al., 2017 and Berti, et al., 2019 (Berti et al., 2019; de Preux & Guerra, 2006; Menezes, Dias, Trevisan, Carreiro, & Seabra, 2015), these peculiarities are due to the high variability of techniques involved in fighting learning, generating neural rearrangement, altering synaptic speed and motor control efficiency.

The development of children and adolescents happens simultaneously between the affective, social, physical, motor, cognitive aspects, and each element can be influenced and influence each other, as the results of the present study demonstrate. Childhood presents itself as the most opportune moment to influence, observe and improve these relationships. Due to this period of development, the brain is extremely plastic, malleable and changeable to the implications of the experiments provided by the environment. Among the possible positive experiences that enhance the overall development of children in sports as a powerful influence on the development of physical, motor and cognitive abilities, which will determine their abilities in adulthood (Chaddock et al., 2012;

Diamond, 2014; Diamond & Lee, 2011; Erickson et al., 2015; Khan & Hillman, 2014; Pratt, Leonard, Adeyinka, & Hill, 2014) .

The practice of martial art has been shown to act beneficially on the physical, motor, and cognitive abilities, which stands out as a unique activity in acting on the cognitive self-regulation abilities of children because the technical improvement of martial sport is intimately related to behavior. Relationship that is evident due to the culture involved in this sport practice, which advocates the physical, motor, emotional, behavioral and cognitive evolution along the practitioner's development (Diamond & Lee, 2011). Thus, the insertion of martial art practice within schools may be a relevant strategy to act beneficially on the physical, cognitive, affective and social development of children and adolescents (Gleser et al., 1992).

Conclusions

Tests to compare groups of martial arts practitioners and non-practitioners showed that the presence of extracurricular fighting practice resulted in better motor coordination scores, attention, and cognitive flexibility compared to students who did not practice martial arts outside school hours.

The practice of martial arts did not affect body composition in relation to non-practicing children. It is suggested that other studies be performed with the same parameters evaluated; however, there is the addition of analysis of the total volume of sports activity performed throughout the week, maturational evaluation, and type of sport practiced.

Authors' contributions

Conceptualization, José Luiz Queiroz; Data curation, Rafaello Pinheiro Mazzoccante and Hugo de Luca Corrêa; Formal analysis, Rafaello Pinheiro Mazzoccante; Funding acquisition, Marcos de Andrade Ferreira; Investigation, Hugo de Luca Corrêa; Methodology, José Luiz Queiroz and Marcos de Andrade Ferreira; Project administration, Rafaello Pinheiro Mazzoccante and Marcos de Andrade Ferreira; Resources, Leonardo Pereira; Supervision, Rafaello Pinheiro Mazzoccante and Leonardo Pereira; Writing – original draft, Rafaello Pinheiro Mazzoccante; Writing – review & editing, Leonardo Pereira

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