REVISTA NEUROCIÊNCIAS

Original

Elderly attention improvement after a physical aerobic exercise

Melhora da atenção de idosos após exercício físico aeróbio

Mejora de la atención de los mayores tras el ejercicio físico aeróbico

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Resumo

Introdução. A diminuição do desempenho cognitivo é uma das principais alterações decorrentes do processo de envelhecimento e o exercício físico pode ser uma intervenção eficaz para minimizar essa redução do comprometimento cognitivo. **Objetivo.** investigar os efeitos do exercício físico aeróbico (aula de dança) no desempenho da atenção concentrada em idosos. **Método.** Participaram deste estudo 25 idosos (24 mulheres) com 68,5±6,7 anos, 65,0±11,3kg e 149,1±6,25cm. Para avaliar os efeitos do exercício físico aeróbico no desempenho da atenção concentrada, foi aplicado o Teste de Atenção de Toulouse-Piéron (velocidade atencional, precisão da atenção e resistência à fadiga atencional) antes e após um único exercício físico aeróbico (aula de dança) com os participantes. O teste t pareado de Student foi realizado para comparar o desempenho atencional antes e após o exercício físico. **Resultados.** Após o exercício físico, houve melhora na velocidade atencional (84,0±36,3 vs. 109,4±37,8; $p<0,05$), acurácia atencional (4,8±5,7 vs. 2,5±1,9; $p<0,05$) e resistência à

fadiga atencional (-154,6±95,5 vs. -103,7±98,9; p<0,05) nos idosos. **Conclusão**. Uma única sessão de exercício físico aeróbico da aula de dança melhorou o desempenho da atenção concentrada em idosos, o que poderia melhorar a concentração e o desempenho das atividades em seu cotidiano.
Unitermos: envelhecimento; cognição; dança

Abstract

Introduction. Decreasing cognitive performance is one of the main changes due to the aging process and physical exercise could be an effective intervention to minimize this reduction in cognitive impairment. **Objective.** to investigate the effects of physical aerobic exercise (dance class) on concentrated attention performance in the elderly. **Method.** Twenty-five elderly subjects (24 women) aged 68.5±6.7years, 65.0±11.3kg, and 149.1±6.25cm participated in this study. To evaluate effects of physical aerobic exercise on concentrated attention performance, the Toulouse-Piéron Attention Test (attentional speed, attention accuracy, and attentional fatigue resistance) was applied before and after a single physical aerobic exercise (dance class) with participants. Student's paired t-test was performed to compare attentional performance before and after physical exercise. **Results.** After physical exercise, there was an improvement in attentional speed (84.0±36.3 vs. 109.4±37.8; p<0.05), attentional accuracy (4.8±5.7 vs. 2.5±1.9; p<0.05) and attentional fatigue resistance (-154.6±95.5 vs. -103.7±98.9; p<0.05) in the elderly subjects. **Conclusion**: A single session of physical aerobic exercise of dance class improved concentrated attention performance in the elderly, which could improve concentration and activity performance in their daily lives.
Keywords: aging; cognition; dance

Resumen

Introducción. La disminución del rendimiento cognitivo es uno de los principales cambios debido al proceso de envejecimiento y el ejercicio físico podría ser una intervención eficaz para minimizar esta reducción del deterioro cognitivo. **Objetivo.** investigar los efectos del ejercicio físico aeróbico (clase de baile) en el desempeño de la atención concentrada en ancianos. **Método.** Veinticinco ancianos (24 mujeres) de 68,5±6,7años, 65,0±11,3kg y 149,1±6,25cm participaron en este estudio. Para evaluar los efectos del ejercicio físico aeróbico sobre el rendimiento de la atención concentrada, se aplicó el Test de Atención de Toulouse-Piéron (velocidad atencional, precisión de la atención y resistencia a la fatiga atencional) antes y después de un solo ejercicio físico aeróbico (clase de baile) con los participantes. Se realizó la prueba t de Student pareada para comparar el rendimiento atencional antes y después del ejercicio físico. **Resultados.** Después del ejercicio físico hubo una mejora en la velocidad atencional (84,0±36,3 vs. 109,4±37,8; p<0,05), precisión atencional (4,8±5,7 vs. 2,5±1,9; p<0,05) y resistencia a la fatiga atencional (-154,6±95,5 vs. -103,7±98,9; p<0,05) en los sujetos de edad avanzada. **Conclusión**: Una sola sesión de ejercicio físico aeróbico de clase de baile mejoró el rendimiento de la atención concentrada en los adultos mayores, lo que podría mejorar la concentración y el rendimiento de la actividad en su vida diaria.
Palabras clave: envejecimiento; cognición; danz

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INTRODUCTION

Aging is a human natural process leading to biological and psychological changes[1] and cognitive impairment is one

of the main changes observed[2]. Cognition understands all phases of the information process, such as attention, perception, memory, reasoning, problem-solving, and learning and psychomotor ability (reaction time, movement speed and performance)[3].

Attention is a relevant cognitive variable that allows correct stimulus perception and information processing[4] enabling the identification and memorizing of environment stimulus[5]. Therefore, attentional impairment due to the aging process could influence daily activity management – such as preparing meals, taking medications, shopping, self-care of health-related problems – and could lead to a reduction in the quality of life and limit social life in the elderly[1].

Despite an attentional and cognitive ability decrease due to the aging process, a single physical aerobic exercise bout at moderate intensity may improve cognitive performance functions, such as selective attention, processing speed, and short-term memory[6,7]. Therefore, physical exercise can improve attention and allow any task to be performed more independently, besides having a positive effect on functional capacity[1]. The cognitive function improvement due to physical exercise can be attributed to cerebral blood and nutrients flow increase, and a rise in neurotransmitter activity[8,9], improving brain function, increasing neural metabolism and cerebral functionality, and improving cognitive performance[10]. The magnitude of cognitive responses to physical exercise depends on the

nature of the task (type of cognitive task) and characteristics of the physical exercise bout[3].

Several studies have demonstrated the beneficial effects of physical exercise on attention in children, young adults, and elderly after an aerobic exercise bout, which improved selective attention[11], sustained attention[12], divided attention[11] and the visual attention of the elderly[13]. However, information about physical exercise bouts and concentrated attention (the ability to select a source of information at a given time and keep the focus on that target stimulus) in the elderly is limited[14]. Improvement of concentrated attention was observed in young adults due to a multimodal exercise bout (stretching, strength, balance and coordination exercise and walking)[15] and in elderly subjects due to a chronic response to a circuit training[16] and aerobic training[17,18].

Therefore, physical exercise seems to improve concentrated attention in young adults due to a single exercise bout, and in the elderly population due to a chronic physical training response. However, we did not find any paper that investigated the effects of an acute aerobic exercise bout on concentrated attention in elderly people. Although the aging process may influence cognition and exercise responses, an improvement in concentrated attention could be expected after a single bout of aerobic exercise in elderly subjects. The aim of study was to investigate the effects of a single aerobic exercise bout on concentrated attention in the elderly.

METHOD

Twenty-five elderly subjects (24 women and 1 man) aged 68.5±6.7years, 65.0±11.3kg, and 149.1±6.25cm participated in this study. Subjects were physically active and were engaged in exercise three times per week developed by the Center for Studies and Research in Physical Activity (NEPAF/UFMA) – *Projeto Movimentação*. This study was approved by the Research Ethics Committee of the Federal University of Maranhão (# 61856516.5.0000.5087). Each volunteer was invited to participate, and all procedures were carried out in accordance with the ethics council. All participants were elderly (>60 years old), had good visual acuity (with or without aid of glasses) and had the ability to respond to the protocols used.

Experimental Design

To evaluate the effect of physical exercise on concentrated attention, the Toulouse-Piéron Attention test[19,20] was applied immediately before and after an exercise bout.

Initially, a physical screen was performed, and body mass and height were accessed. Body mass was measured with a minimum of clothes using a digital scale (Incoterm, Brazil), height was evaluated by a portable stadiometer. A familiarization with the Toulouse-Piéron Attention test was also carried out, and all procedures of the experimental situation were explained.

Attention assessment

Concentrated attention evaluation was performed through the Toulouse-Piéron Attention test[19], adapted to a Brazilian Portuguese version[20]. The Toulouse-Piéron Attention test evaluates the following components of concentrated attention: attentional speed (work performance, corresponding to the number of signals correctly indicated along during a 10 min test), attention accuracy (ability to concentrate, corresponding to quotient between the sum of the omitted and incorrectly indicated signals by the number of signals correctly indicated – lower quotients indicate better levels of attention precision) and attentional fatigue resistance (corresponding to evolution of effective performance – number of signals correctly indicated, less signals incorrectly indicated and omitted over 10 min test[20].

After arriving, participants remained at rest for 5 min before the experimental situation. All remained seated on a chair in front of an individual table with good lighting (a researcher remained nearby), and the attention test sheet[19,20] was provided along with a pen and some guidelines on how to perform the test. Participants were instructed to mark the largest number of symbols that are equal to two symbols shown at the top of the test sheet over a 10 min test. If a wrong marking was made at any symbol, participants could make a circle around the wrongly marked symbol and could continue the test.

Physical exercise protocol

The physical exercise protocol was set as an aerobic exercise bout of 60 min and composed of a warm-up (5 min), collective dance class (50 min), and a cold down activity (5 min). Heart rate was continuously monitored by a bluetooth heart rate chest monitor (Polar H10, Finland) and Polar Beat app and exercise intensity was calculated through the percentual of maximum heart rate calculated by the ratio of mean exercise heart rate and maximum heart rate estimated[21]. The mean exercise intensity of exercise protocol was 63.8±9.4% of maximum heart rate. Attentional test was performed immediately before and after the exercise protocol.

Statistical analysis

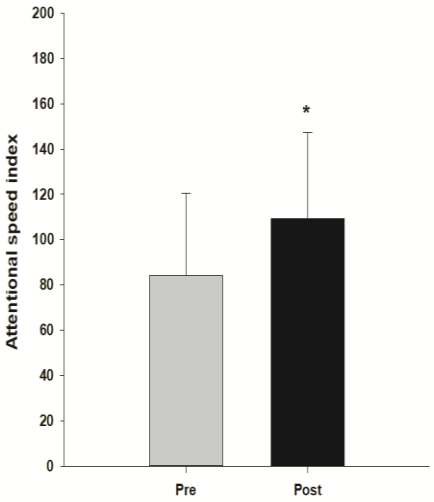
All data were tested to normal distribution (Shapiro–Wilk test) and homoscedasticity (Levene test). To compare concentrated attention before and after the exercise bout, a paired Student's t-test was performed. All results are presented as mean ± standard deviation and a significance level of $p<0.05$ was set. Sigma Plot (14) was used to analyze all data.

RESULTS

After the physical exercise session, an increase in the number of correctly marked symbols (attentional speed) was observed from 84.0±36.3 to 109.4±37.8 ($p<0.05$; Figure 1). The accuracy and attentional fatigue resistance index

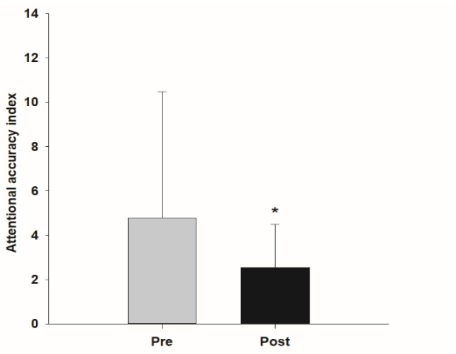
reduced after the exercise bout, indicating an improvement in ability to concentrate attention (4.8±5.7 vs. 2.5±1.9; $p<0.05$; Figure 2), and on-task test performance (-154.6±95.5 vs. 103.7±98.9, $p<0.05$; Figure 3).

Figure 1. Attentional speed.



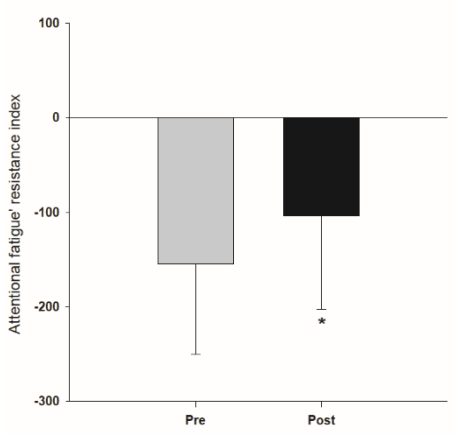
* = Difference between pre vs. post exercise ($p<0.05$).

Figure 2. Attentional accuracy.



* = Difference between pre vs. post exercise ($p<0.05$).

Figure 3. Attentional fatigue resistance.



* = Difference between pre vs. post exercise ($p<0.05$).

DISCUSSION

The aim of this study was to investigate the effect of an aerobic exercise bout on elderly people's concentrated attention and an improvement in concentrated attention (attentional speed, attentional accuracy and attentional fatigue resistance) was found after the exercise bout. Our results confirm our initial hypothesis that an exercise bout (acute effect) would improve elderly people's concentrated attention and corroborate other results of improved concentrated attention in young adults after a multimodal exercise bout[15]. The present study looks to be the first work to demonstrate an improvement in elderly concentrated attention (attentional speed, attentional accuracy, and attentional fatigue resistance) after a single bout of aerobic exercise (group dance exercise bout).

Furthermore, our results corroborate previous data of physically active elderly participants having a better attentional speed, attentional accuracy, and attentional fatigue resistance than sedentary elderly people[22]. These results together suggest that a single physical exercise bout (acute effect) and an aerobic training program (chronic effect) could improve concentrated attention. Attention improvement can allow greater concentration and execution of routine or exceptional actions, such as: financial management; driving and riding on a bus; shopping; preparing meals; using the phone or other communication devices; managing medications and performing domestic tasks[23]. Thus, concentrated attention could provide the elderly with greater independence to perform their day-to-day activities, and thus lead a better quality of life.

Concentrated attention improvement found in the present study may be related to the increases in cerebral blood flow and to the increase in the supply of oxygen and nutrients[9], mainly in the prefrontal brain regions[24]. Moreover, attentional improvements may be associated with increased excitation levels of the central nervous system, due to the higher concentration of brain catecholamines, β-endorphin and dopamine[25] related to the increase in catecholamine concentration during physical exercise and greater permeability of the blood–brain barrier[26], allowing a high passage of these neurotransmitters to the brain. All these responses could lead to an increase in prefrontal brain activity and in executive functions, such as attention[27].

Previous electroencephalogram studies suggest that physical exercise increases brain activity, decreasing the time it takes to perceive, identify, and respond to a stimulus[28].

However, the duration of the effect of moderate aerobic exercise on concentrated attention is still unknown. The present study did not evaluate such parameters. On the other hand, we did not find any study that evaluated this duration of effect, only one study was found in adolescents[29] that found that the effect of Cooperative High-Intensity Interval Training on concentration lasted up to two hours. after exercise. Thus, a study is needed to analyze how long this improvement in concentrated attention is maintained as a result of moderate aerobic exercise.

Regarding, the elderly participants' concentrated attention improvement after aerobic training (chronic effect) was associated with changes in hormonal secretions related to neuronal growth, such as insulin-related growth factor (insulin growth factor I – IGF-I), endothelial growth factor (vascular endothelial growth factor – VEGF), and neuronal growth factors such as the BDNF (brain-derived neurotrophic factor), which contribute to the maintenance of brain function and the promotion of neural plasticity[16,18] and an increase in new brain capillaries, neurogenesis and the emergence of new synaptic connections[30].

Regular dance class, which involves a memorization of a predefined choreography of sequenced steps, and requires attention, memory and planning to perform dance choreography, could lead to an improvement in attention due

to the dance attention requirement[18]. However, although our study also involves dance activities and found an improvement in concentrated attention too, our results could be addressed to the acute effects of physical exercise on concentrated attention. Because it uses only a single exercise bout and the elderly participants did not need memorize the dance choreography, because they only followed the activities proposed by the researcher. So, the physical exercise involved in the dance class bout, and not the memorization of the choreography, as proposed by Quadros Junior[18], may be related to the improvement in concentrated attention in elderly people.

CONCLUSION

A single bout of aerobic exercise, composed of dance group activities, improved the elderly participants' concentrated attention, and could improve concentration and task performance and promote a greater independence for the elderly in daily activities.

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