160 - PHYSICAL EXERCISE AND ITS IMPLICATIONS ON COGNITIVE FUNCTION: A SYSTEMATIC REVIEW

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INTRODUCTION

The number of elderly people is increasing worldwide, indicating, thus, an increase in life expectancy. According to the Brazilian Institute of Geography and Statistics (IBGE, 2004), life expectancy in developing countries will reach 82 years for men and 86 years for women by 2050. This increase is due to economic, social and cultural evolution, besides other biological and behavioral aspects which intervene in the aging process (SMETHURST, 2008). Aging is a continuous process which leads to a progressive decline in all physiological processes. Accordint to Nahas (2001), aging is a gradual, universal, and irreversible process, but it is influenced by genetic, environmental and behavioral determinants. Behavioral factors include personal determinants, which affect the functional decrease and development of psychological diseases. Therefore, an active and healthy lifestyle can delay age-related morpho-functional alterations (NÓBREGA et al., 1999).

BLSA (1998) has demonstrated health benefits in the elderly who perform regular exercise programs, including physiological benefits, such as cardiorespiratory improvements, maintenance of muscle and bone mass, coordination and balance; as well as psychological benefits, such as improvement in mental and cognitive health, besides social benefits. An active and healthy lifestyle leads to a normal aging.

Organic systems tend to decrease with aging, leading to a disability in several physiological reactions. In the Nervous System, this decrease causes damages, reducing the number of spinal cord axons by 40%, and about 10% of nervous conduction velocity. However, it seems that aging causes more damage in the cognitive phase rather than in the motor phase (SMETHURST, 2008).

The time of task performance is longer for older than younger people performing the same physical activity levels; however, when comparing active/sedentary young people and active/sedentary old people, the reaction time is lower in active individuals. This suggests that regular physical activity improves central processing, that is, the cognitive performance, at any age (MCARDLE et al., 2003).

Some risk factors related to the increase in cognitive impairment were identified. These include age, gender, family history, head trauma, educational level, smoking habits, alcoholism, mental stress, nutritional aspects and socialization (ANTUNES, 2006). Nevertheless, besides the decrease of these risk factors, several studies have observed improvement in cognitive functions with exercise.

According to Antunes (2006), physical activity increases oxygen transportation to the brain, thus, playing an important role in the improvement of cognitive functioning and for a healthy lifestyle.

As the population gets older, interventions for the improvement of quality of life of the elderly is fundamentally important. Many studies have shown the benefits of exercise in the prevention and treatment of chronic degenerative diseases, as well as in several systems of the human body. However, only a few have addressed the effects of exercise in the central nervous system and in the prevention of Cognitive Functions with aging. Hence, this study will help to provide more knowledge on this issue. Thus, the main objective of this study is to perform a systematic review of studies addressing the beneficial effects of exercise on cognitive functions in aging.

METHODS AND PROCEDURE

A systematic literature review was performed in Scielo, Lilacs, PubMed, Medline and Bireme. Original, randomized and review studies were selected. The following keywords were used for the search: cognitive function, exercise, physical activity/ aging. All exercise modalities at any intensity, duration or frequency were considered. The limits elderly/middle-aged, humans, free full texts were included. Sixty hundred and twenty manuscripts were found at baseline in the databases cited above. After the inclusion of limits, this number was reduced to 75, and only 07 met the inclusion criteria for this review. Among them, 4 were field studies (randomized), written in English, 1 literature review, 1 comparative study, and 1 systematic review.

Studies associating cognitive function with some disease, published before 1999, and with restricted access were excluded. Free full texts, published between 1999 and 2009 were included. Randomized studies using human sample and age ranging from 46 to 85 years were also included. They were all related to exercise and cognitive function in aging.

The aspects analyzed in each randomized manuscript were: publication date, sample size/gender/age, exercise modality and intensity, time and length of sessions, assessment methods, aspects of cognitive function and the main results. In review papers, we observed publication year, modality, type and exercise intensity, aspects of the cognitive function, and the main results. For the systematization of the study, a table was built for better identification of these aspects, maximizing the discussion of the results.

RESULTS AND DISCUSSION

From the database research, only 8 manuscripts met all the inclusion criteria. Most of them (n=5) were extracted from PubMed and were international. Three were reviews from Scielo and Medline. The latter was also written in English. All manuscripts were published between 2003 and 2008. Randomized studies presented distinct characteristics: two of them performed an 11- and 25-year cross-sectional study and the others were cross-sectional, lasting from 3 to 6 months. The sample ranged from 29 to 7982 elderly, most of them female.

Two studies, Zlomanczuks, et al. (2006) and Oken et al. (2006), addressed the relationship between physical activity and cognitive functions by comparing training and control groups. The first examined strength and endurance training in 33 women aged 57-72 over a 3-month period. The second analyzed Yoga and walking in 135 healthy men and women aged 65-85 years, over a 6-month period. Strength and endurance training were performed three times a week, with each session lasting 45 minutes. In the Yoga study, 3 groups were randomly divided into: yoga group, walking group and control group. The first 2 groups underwent 1 Yoga or 1 walking session per week, for 90 minutes. These elderly were encouraged to practice the modality which

was performed in their homes.

The results of both studies were similar to the Test Stroop scores, used for assessment of cognitive measures over attention, showing no significant difference between training and control group after the intervention. However, better improvements in short-term memory were found in 28 women who performed strength and endurance training. Nevertheless, the majority of women from the control group, 5 out of 8, had a decrease in the face-name test scores, which evaluates short-term memory. Thus, these studies suggest that besides the benefits of physical fitness and quality of life, improvement in cortical plasticity associated with short-term memory after an exercise training program is found.

Two longitudinal studies were found. Both analyzed the effects of physical activity on performance and maintenance of cognitive function during aging in British civil servants. Manoux et al., (2005), analyzed physical activity (PA) levels during a week according to frequency, duration and intensity. These levels were identified by self-administrated questionnaires during the 6 phases of the study, between 1985-2001. In phases 1, 3 and 5, besides the physical activity questionnaire, the participants performed clinical examinations and answered about quality of life. In phase 5, the evaluation of cognitive functioning was included, as shown in the table, as well as a new classification of physical activity levels through energy costs (MET/week). (PA) levels were classified in: Low < 3 METs; Medium from 3 to 6 METs and Vigorous > 6 METs. To achieve reliable results, the covariates were included in the analysis, by dividing the groups by similar characteristics and level of (PA) for further relation with cognitive assessment. The results showed that those with low levels of (PA) at baseline, obtained lower scores on the cognitive test (AH 4-I), which measures fluid intelligence. Thus, this indicates a positive impact on cognitive functioning of the civil servants who presented higher levels of (PA) during 11 years of the study.

Weuve et al. (2004) addressed the relation between walking and cognitive function in a cross-sectional study. The sample included 16466 women with ages ranging from 30 and 55 years, however, only 16382 women, aged 70-81 years, concluded all six tests. A questionnaire on medical and health history was applied. Physical activity questionnaires were answered every two years, in which PA and leisure PA time were identified, and the equivalent in MET/week. At baseline, cognitive assessment was performed by telephone interview (TICS), controlled and evaluated by the Mini-Mental State Examination (MEEM), and further, other tests were included. From the results of all six cognitive testing, an average of the global score was constructed. The sample was adjusted according to the influence factors and then the cognitive assessment was related. In order to establish the relation of walking intensity, it was divided in quartiles according to the energy expenditure in MET-hours/wk. The best scores were achieved by women in the third and fourth quartiles, (4.3 to 8.5 MET/ 1.5 to 2.8 hours/wk) and (> 8.5 MET/ > 2.8hours/wk), respectively. This result shows that the women who performed higher levels physical activity in long-term had higher levels of cognitive function and less decline.

In a comparative study, Colcombe et al. (2003) verified the relationship between the increases in cardiorespiratory fitness and the cognitive functioning in two studies. In study 1, medical assessment, ergometric test and the 1-mile walk test were performed in 41 healthy older adults. After, cognitive testing and magnetic resonance were carried out. In study 2, 29 participants, with ages ranging from 58 to 77 years, underwent the same tests cited above, as well as the aerobic training for the exercise group. The aerobic exercise group of study 2 walked for 45 min/ 3 times per week at an intensity of 60-70% HR reserve, for 6 months. The results of the tests before and after training demonstrated that the aerobic exercise group showed a significantly greater level in attentional control areas. By the comparison of both studies, a significant increase in cardiovascular fitness correlated with greater cognitive performance was verified.

In the review papers, similar results were found, strengthening the evidences. Hanna et al., (2006) have reported that moderate-intensity exercise promotes a faster cognitive processing, improving attention, reasoning, memory and mood, similarly to acute sessions of submaximal exercise. This confirms the findings of Maaik's (2009) systematic review, which reports that 8 out of 11 manuscripts included show that aerobic training provides cognitive improvements, including: motor function, visual and auditive attention, and velocity of information processing. Antunes et al. (2006) have stated that in intense exercise with anaerobic demands, the cognitive is affected in a different way, leading to an improvement in the short-term memory and a reduction in interpretation and reasoningabilities. Yet, long-term moderate exercise is harmful to memory and velocity of answers. All studies included herein, with exception of Oken et al, (2006), several benefits on cognitive function promoted by physical activity were found. Such positive influences are exposed by McAuley and Rudolph (1995) and Mello (2005), as a consequence of cerebrovascular integrity, increase of oxygen transportation to the brain, synthesis and degradation of neurotransmissors, as well as a reduction in the blood viscosity and control of metabolic rates.

FINAL CONSIDERATIONS

Most of the results showed that the improvement in cardiovascular fitness increases the cognitive performance, especially in attentional measures, short-term memory, reasoning and reaction time.

It was observed that long-term moderate levels of physical activity (independent on the modality), help to maintain fluid intelligence in aging. Besides preserving these functions, physical activity decreases the risk of mental disorders (ANTUNES, 2006).

The longitudinal studies, however, maximize the discussion, because they related long-term investigation and also adjusted the factors that could confound the results. All 8 manuscripts were published between 2003 and 2008, demonstrating a growing concern with the topic and the progress on this issue. Nevertheless, further investigation is necessary to specify the type/intensity relationship of intensity of physical activity on the cognitive functioning, and in each phase of the information processing: perception, learning, memory, attention, reasoning and problem solving.

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PHYSICAL EXERCISE AND ITS IMPLICATIONS ON COGNITIVE FUNCTION: A SYSTEMATIC REVIEW

ABSTRACT

Physical activity contributes to healthy aging, decreasing the risk of development of chronic degenerative diseases. There is a positive association between exercise and cognitive function. The objective of this study is to identify the benefits of physical activity on cognitive functions in aging. In this systematic review, a literature search was performed in Scielo, Lilacs, PubMed, Medline and Bireme databases. After the inclusion of limits, 620 manuscripts were reduced to 75, and only 07 met the inclusion criteria. They were published between 2003 and 2008. In each manuscript, the following aspects were taken into consideration: publication date, sample size/gender/age, exercise modality and intensity, time and length of sessions, assessment methods, aspects of cognitive function, highlighting the main results. Most of the results showed that the improvement in cardiovascular fitness increases the cognitive performance, especially in attentional measures, short-term memory, reasoning and reaction time. In addition, long-term moderate physical activity levels (independent on the modality) help to maintain fluid intelligence with aging. Thus, further investigation is necessary to address the mode-intensity relationship of exercise, by associating with cognitive functioning, and in each phase of information processing: perception, learning, memory, attention, reasoning and problem solving.

KEYWORDS: cognitive function, exercise, physical activity, aging

EXERCICE PHYSIQUE ET SES IMPLICATIONS AU NIVEAU DES FONCTIONS COGNITIVES: UNE RÉVISION SYSTÉMATIQUE

RÉSUMÉ

L'activité physique contribue à un vieillissement de qualité, en diminuant le risque de développement de maladies chronico-dégénératives. Une association positive, entre l´exercice physique et les fonctions cognitives, peut être détachée. L´objectif est d´identifier les rapports bénéfiques de l'exercice physique au niveau des fonctions cognitives dans la phase de vieillissement. Il s'agit d'une étude de révision systématique, où l´on a cherché des articles indexés dans les bases de données Scielo, Lilacs, PubMed, Medline et Bireme. 620 articles ont été trouvés, néanmoins, avec l'inclusion de limites établies, ce résultat a été réduit à 75 articles, où seulement 7 ont présenté les critères pour être analysés dans cette révision, publiés dans la période de 2003 à 2008. Les aspects observés dans chaque article ont été: la période de publication, dimension/type/catégorie de l'échantillon, la modalité et l´intensité de l'exercice, le temps et la durée des sections, les méthodes utilisées pour l´évaluation et les aspects de la fonction cognitive, en soulignant les principaux résultats trouvés. La plupart des résultats indiquent que l'amélioration de l'aptitude cardiovasculaire reflète une avancée de la performance cognitive, spécialement au niveau des mésures d'attention, de mémoire à court terme, de raisonnement et de temps de réaction. Et que des niveaux modérés d'activités physiques (indépendamment de la modalité) réalisés à long terme, aident à préserver l'intelligence fluide au vieillissement. Ceci étant, l´on a besoin de plus amples recherches dans le but de spécifier le rapport entre le genre et l´intensité de l'exercice physique, en créant un lien avec le fonctionnement cognitif, et à chaque phase du traitement d'informations: la perception, l´apprentissage, la mémoire, l´attention, le raisonnement et la solution de problèmes.

MOTS-CLÉS: la fonction cognitive, l´exercice physique, l´activité physique, le vieillissement.

EJERCICIO FÍSICO Y SUS IMPLICACIONES EN LAS FUNCIONES COGNITIVAS.
UNA REVISIÓN SISTEMÁTICA

RESUMEN

La actividad física contribuye a un envejecimiento con calidad, disminuyendo el riesgo de desarrollar enfermedades crónico degenerativas. Se puede destacar una asociación positiva entre ejercicio físico y funciones cognitivas. El objetivo es identificar las relaciones de los beneficios del ejercicio físico con las funciones cognitivas en la fase del envejecimiento. Se trata de un estudio de revisión sistemática donde se buscaron artículos indexados en las bases de datos Scielo, Lilacs, PubMed, Medline y Bireme. Se encontraron 620 artículos, pero con la inclusión de los límites establecidos, ese resultado se minimizó a 75 artículos, donde solamente 07 presentaron los criterios para que fuesen analizados en esta revisión, publicados en el periodo de 2003 a 2008. Los aspectos observados en cada artículo fueron: periodo de publicación, tamaño/género/franja de edad de la muestra, modalidad e intensidad del ejercicio, tiempo y duración de las secciones, métodos utilizados para la evaluación y aspectos de la función cognitiva, destacando los principales resultados encontrados. La mayoría de los resultados indican que la mejoría de aptitud cardiovascular refleja un avance del desempeño cognitivo, especialmente en medidas de atención, memoria a corto plazo, raciocinio y tiempo de reacción y, además, qué niveles moderados de actividad física (independiente de la modalidad), realizados a largo plazo ayudan a conservar una inteligencia fluida en el envejecimiento. De este modo, son necesarias más investigaciones para especificar la relación tipo-intensidad del ejercicio físico con respecto al funcionamiento cognitivo y en cada fase del procesamiento de la información: percepción, aprendizaje, memoria, atención, raciocinio y solución de problemas.

PALABRAS CLAVES: función cognitiva, ejercicio físico, actividad física, envejecimiento

EXERCÍCIO FÍSICO E SUAS IMPLICAÇÕES NAS FUNÇÕES COGNITIVAS:
UMA REVISÃO SISTEMÁTICA

RESUMO

A atividade física contribui para um envelhecimento com qualidade, diminuindo o risco do desenvolvimento de doenças crônico-degenerativas. Pode-se destacar uma associação positiva entre exercício físico e funções cognitivas. Objetiva-se identificar as relações de benefícios do exercício físico nas funções cognitivas na fase de envelhecimento. Trata-se de uma estudo de revisão sistemática onde se buscou artigos indexados nas bases de dados Scielo, Lilacs, PubMed, Medline e Bireme. Encontrou-se 620 artigos, entretanto, com a inclusão dos limites estabelecidos esse resultado foi minimizado para 75 artigos, onde apenas 07 apresentaram os critérios para serem analisados nessa revisão, publicados no período de 2003 a 2008. Os aspectos observados em cada artigo foram: período de publicação, tamanho/gênero/faixa etária da amostra, modalidade e intensidade do exercício, tempo e duração das seções, métodos utilizados para avaliação e aspectos da função cognitivos, destacando os principais resultados encontrados. A maioria dos resultados indica que a melhoria da aptidão cardiovascular reflete em um avanço do desempenho cognitivo, especialmente em medidas de atenção, memória de curto prazo, raciocínio e tempo de reação. E que níveis moderados de atividade física (independente da modalidade), realizados em longo prazo ajuda a preservar a inteligência fluida no envelhecimento. Assim sendo, necessita-se de maiores investigações no sentido de especificar a relação tipo-intensidade do exercício físico fazendo uma articulação com o funcionamento cognitivo, e em cada fase do processamento de informação: percepção, aprendizagem, memória, atenção, raciocínio e solução de problemas.

PALAVRAS-CHAVE: função cognitiva, exercício físico, atividade física, envelhecimento.

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