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Effect of physical activity on cognitive functions in elderly

Wpływ aktywności fizycznej na funkcje poznawcze w podeszłym wieku

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Słowa kluczowe: funkcje poznawcze, osoby starsze, aktywność fizyczna, trening.

Key words: cognitive function, elderly, physical activity, training.

Streszczenie

Wstęp. Plastyczność mózgu dotyczy najczęściej osób młodych. Niemniej jednak uznaje się, że aktywność fizyczna wpływa na ośrodkowy układ nerwowy; jego strukturę i niektóre funkcje.

Cel. Ukazanie wpływu wpływ treningu fizycznego na funkcje poznawcze i jego ochronna rola w obniżaniu ryzyka wystąpienia zaburzeń poznawczych i demencji w starszym wieku.

Materiały i metody. Analiza publikacji z bazy EBSCO, używając słów kluczowych: funkcje poznawcze, osoby starsze, aktywność fizyczna, trening.

Wyniki. Przegląd danych sugeruje korzystne wyniki aktywności fizycznej na funkcje poznawcze oraz obniżenie ryzyka wystąpienia zaburzeń poznawczych i otępienia.

Jednakże, powinno być przeprowadzone więcej badań z użyciem standaryzowanych testów zaburzeń poznawczych. Ponadto metodologia aktywność fizyczna powinna być bardziej precyzyjnie opisywana; wskazując rodzaj, częstotliwość i intensywność wysiłku fizycznego.

Wnioski. Badania wykazują, że plastyczność kory dotyczy osób w każdym wieku. Dodatkowo, u osób starszych zmiany struktur i funkcjonowania mózgi nie muszą powodować gorszych wyników. Umiarkowana aktywność fizyczna może powodować lepsze funkcjonowanie poznawcze uczestników, niezależnie od wieku.

Abstract

Introduction. Brain plasticity refers mostly young people. However, it is recognized that physical activity affects the central nervous system; its structure and some of the features.

Purpose. Show the influence of the effect of exercise training on cognitive function and its protective role in reducing the risk of cognitive impairment and dementia in old age.

Materials and methods. Analysis of publications in the EBSCO database using keywords: cognitive function, elderly, physical activity, training.

Results. Review of the data suggests positive results of physical activity on cognitive function and reduce the risk of cognitive impairment and dementia. However, it should be performed more tests using standardized tests of cognitive disorders. In addition, the methodology of physical activity should be more accurately described; indicating the nature, frequency and intensity of physical activity.

Conclusions. Studies show that cortical plasticity affects people of all ages. In addition, the elderly change the structure and functioning brains do not necessarily lead to worse results. Moderate physical activity can lead to better cognitive functioning of participants, regardless of age.

Introduction

Brain state constantly changes its structure and functions. Researchers calls these phenomenon a "plasticity"[1]. Changes correlated with aging are in morphological, (structural) level [2] what influence on brain cognitive functions. Researchers [3] shows decreased cognitive functioning and its correlation with lower quality of life. However, reduction of cognitive functions is not the same in every case. First, people are varied in cognitive abilities *per se* [4]. Second, active social life seems to play crucial role in prevention of age-related changes [5-6]. Third, it is probably that other organs have indirect influence on brain, and thus, on cognitive functions as well. Some [7] reports that lungs wellness affects positively on mental state. Additionally, other [8] claims that enhanced glycemic control in elderly have positive impact on brain functions. Moreover, good heart and arteries condition [9] improves cognitive abilities in consequence.

The main target of this article is to reveal how physical activity influence on cognitive functions in elderlies. Pelkonen et al. [10] collected information about lungs condition and physical activity of 429 men for 10 years, 275 men for 20 years, and 186 men for 25 years. Studies show positive correlation between pulmonary function and physical activity. Others [11] agreed with statement, that physical activity (with medium to high intensity) is associated with decreased lung function decline. Schmidt et al. [12] describe precisely how physical training affects on cerebral and cardio-vascular system, and in consequence, on cognitive functions. Physical activity indirectly enhances angiogenesis- new capillaries sprouting from pre-existing vessels, and arteriogenesis- increment in the diameter of already existing arterial vessels [12]. Improved cerebral blood flow causes greater brain nutrition (oxygen intake and metabolism). Some [13] reports crucial role of gene-factor in cognitive functioning decline correlated with aging. Additionally, [13] shows differences between men and women in examined participants. Interestingly, cognitive reserve theory by Stern [14] as resourcefulness to improve or maximize performance due to diversity of recruitment of brain networks, which presumably mirroring the use of backup cognitive strategies. The above-mentioned researches shows that brain plasticity in

elders do not refer to brain structure and functions decline only. However, physical training can improve cognitive functioning on the basis of Cognitive Skill Transfer theory, which refers to the fact that participating in one cognitive training can improve results in another [15]. We propose, that most types of physical activity, for example team sports, ball games, can be attributed as a cognitive training *per se*.

Analysis of selected manuscripts

Effect of physical activity on cognitive function of elderly people

Colcombe et al. [16] described eighteen researches concerning the effect of exercise on the cognitive functions of elderly people. They separated three age groups: *young-old* (55–65), *middle-old* (66–70), and *old-old* (71), not concerning health nor mental state of participants. Studies suggest an effect of physical activity type. Elderlies who performed mixed resistance and aerobic training had greater cognitive functions improvement compared with an aerobic training only. Moreover, attendance in training programs which had comparatively shorter duration resulted at least as much profit as moderate training, however longest training programs caused greatest results. Last but no least, brief bouts of exercise had rather small influence on cognitive functions, we suggest that researchers often describe physical training methods not sufficiently, what can lead to irrelevant conclusions in meta-analysis. Noteworthy, subjects in the middle-old category presumably achieve greatest results [16]. Colcombe et al. [16] categorized cognitive tests as a four types; executive, controlled, spatial and speed. In every type, significantly better results presents an exercise group (under regime of mixed and cardiovascular training type as well) than control. This type of cognitive tests categorization is absent in another mentioned manuscripts.

Effect of physical activity on cognitive function with mild cognitive impairment and dementia

Unlike above- mentioned researches, Gates et al. [17] applies to elders with mild cognitive impairment, 69- 95 years old. Four of analyzed researches included aerobic training, one of them compared resistance group with aerobic group, another one concerned effects of low intensity walking with aid or hand and face exercises. Additionally, single studies [17] contained analysis of tai-chi effects, resistance training only, low intensity walking, and high intensity aerobic training compared with low intensity. Four manuscript describe results of mixed; resistance and balance or aerobic training. Duration of single bouts of training ranged between 30 to 90 minutes. Frequency varied from two to four bouts per week, and duration of interventions ranged from 6 to 52 weeks. The intensity of resistance training varied from high in the resistance training trial to low to moderate intensity in the resistance and balance or aerobic types of training. In three researches aerobic exercise was performed with high or moderate intensity

[17].

MMSE, ADASCog, and CAMCOG, were used to describe entire cognitive functioning. “Fluid” type of intelligence was examined by subtests of the WAIS-R [17-19]. The most common measured was executive function, followed by memory and information processing. Only one research described the time duration between last bout of exercise and assessment (3 to 7 days), which is a presumably essential factor. Dehydration which can occur after training likely influence on cognitive test performance [20].

Gates et al. [17] reports that the effect of aerobic exercise is exclusively related to verbal fluency and no other executive function. Whereas aerobic exercise did not improve memory in any research, two manuscripts report that resistance training resulted in great significant effects on memory [17].

Noteworthy, a prior meta-analysis suggest largest profit occur in researches with groups under ten subjects, while examining cognitively impaired adults [17].

Heyn et al. [21] analyzed researches about elderlies with mild cognitive impairment and dementia. Participants included into 30 analyzed studies varied from 66 to 91 years old. The single bout session duration varied from 20 to 150 minutes with 45 minutes of medium duration. Frequency ranged between 1 to 6 sessions per week. Duration of whole training varied from 2 to 112 weeks, with 23 weeks in average. 17 from 30 studies used walking and isotonic exercises. The other researches were based on mixed types of training. Three researches contained chair exercises, another three studies based on aerobic dance class format. Two studies incorporated resistance training only, another two researches used home-based exercise programs: one intervention included stationary cycling mixed with another exercises, and the another training programs were skill-based functional exercise programs [21]. The results supply data about efficiency of physical exercise for elder people with dementia and similar cognitive impairments [21].

These two above-mentioned manuscripts concerned about elder people with mild cognitive impairment, had similarities in their references; Colcombe et al. [16] and Etnier et al. [22]. However, Gates [17] and Heyn [21] used quite another data in their meta- analysis.

Effect of physical activity on lowering cognitive impairment and dementia risk

Some researchers [23-24] analyzed impact of physical activity on risk of cognitive decline and dementia. Laurin et al. [23] concentrated on association between regular physical activity and following occurrence of cognitive impairment and dementia from elderly Canadian population. They used data from community sample of 9008 randomly selected men and women 65 years or older in Canadian Study of Health and Aging. First, participants were selected based on Modified Mini-Mental State Examination, nurse's examination, neurological examination and neuropsychological testes. The 4615

participants have holistic 5-years observation. The level of physical activity was estimated by combining two questions regarding frequency and intensity of exercise for subjects who declared regular exercise. Patients who reported no regular physical activity were categorized as control group. Laurin et al. [23] suggested that physical activity is essential tool to make inhibition cognitive decline. This relationship was noted chiefly in women and show decreasing risk with increasing level of physical activity. Sofi et al. [24] analysis contained 15 manuscripts, (including Laurin et al. [23]) 30 331 non-demented subjects had been examining in the range of 1 to 12 years, during the researches cognitive decline occurred in 3003 subjects. Except one, all of the manuscripts were examining elders over 65 years old. Authors [24] admit that meta-analysis has its limitations. One of them is a variety of methods used to investigate cognitive decline and levels of physical activity in analyzed studies. Majority of analyzed manuscripts contained MMSE, however this method of cognitive decline examination have not appeared in every manuscript. As a result, variety of methods can lead to confusion in definitions of cognitive decline. Additionally, data concerning the physical activity were received from questionnaires; therefore, bias could be introduced by misunderstanding of the questions and the subjective self-perception. Moreover, researches varies in the level of activity categorization. Some studies used method of distinguish between active and not active, others researches ranged between three to four levels of intensity. Nonetheless, authors [24] demonstrated a 38% reduced risk of cognitive decline in subjects with high levels of physical exercise, compared to control participants. Additionally, low-to-moderate levels of physical activity resulted in a significantly decreased risk of cognitive performance decline (35%). Sofi et al. [24] Suggest that analyzed researches are dose– response effect independent. Noteworthy [25-51], reports significant, positive effect for high and low-to-moderate intensity of exercise on decreased risk of cognitive decline in elderly people.

Results

Review shows beneficial results of physical activity on cognitive functioning, and lowering risk of cognitive impairment and dementia occurring.
However, more researches with standardized cognitive test examination of impaired should be included. Moreover, physical activity methodology should be describe more precisely; indicating type, frequency and intensity.

Conclusions

Previous review shows that physical training influence on central nervous system [25]. Moreover, analyzed manuscripts show that cortical plasticity refers to people in every age. Additionally, changes in elderly people brains structures and functioning do not have to cause poorer results. Contra-wise, physical activity can results in better cognitive functioning, regardless of participants age.

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