In comparison with the number of studies which have examined the physical activity influence on the cognitive capabilities with the adults (above 60 years of age), researches for children, adolescents and young adult population are rarely done. The examination of the potential connection, role or influence between Physical Activity and cognition during early age (the first third of the human life) is very complex and subtle due to a large number of external factors which are present in the period during which the cognitive capabilities are still being developed. Regular physical activity improves the physiological and psychological aspect of human health. Due to the well known advantages and benefits from the physical activity, one would expect it to be more present in the life of contemporary man. But it is a fact that the level of physical activity with people decreases in the course of lifetime, especially in the period when young people move from secondary school to university. The decrease of the physical activity additionally increases the pressure over the young academic persons. There is not enough literature which examines the connection of the neuropsychological indicators and physical activity with young adults. It is obvious the need for further researches in this field which will create a solid base for the connection of the physical activity and cognition, the same one that is found for the adult population. Within the frame of the positive role the physical activity has over the cognitive health, it is suggested as a means of reducing the risk of developing cognitive decrease connected with getting old. Future vast randomized researches and interventions would have to test the quantity and the type of physical activity which would be recommended in order to prevent or postpone the cognitive decrease.

Key words: physical activity, cognitive functions.

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1. INTRODUCTION

The role of the regular physical activity as a modulator of the physical and mental health has been well studied and well documented. Unlike the role of the physical activity on the somatic health which is well known to both scientific and non-scientific public, the role of activity upon the mental health (psychological and cognitive), although it has been present with the scientific public for a long time, it is not so much known to the public due to the delicacy and complexity of the physiological mechanisms.

The physical activity is considered to be simple and widely accepted behaviour which activates the molecular and cellular signal cascades included in numerous processes in the central nervous system.

Besides impressive results obtained from animal studies, researches on people in most cases also proved the pleasant influence of the physical activity on the cognitive health.

2. EFFECT OF THE PHYSICAL ACTIVITY OVER COGNITION DURING CHILDHOOD AND ADOLESCENCE

Recent epidemiological data show that children in the developed countries grow up and develop in sedentary conditions and that kind of lifestyle causes early chronic illnesses (such as diabetes 2 and obesity). As a result of this tendency caused by comfortable and technological progress, scientists estimate that this generation of young people in their developing period will grow up in the first generation in the USA who would be able to lead less healthy life than their parents (1). The economic expense of the sedentary lifestyle is enormous in the developed countries and the developing ones. In the year 2000 in the USA health expenses connected...
with the physical inactivity were 2.4% of the total expenses in the health sector: $76bn; in Canada 2.5% or around $2.1bn. Besides these scary findings for the epidemic of inactivity among young population, the researches for the influence of the physical activity on the cognitive processes during the developing period of a young person encourages little interest with researchers (2). In the meta analysis of the influence of PA over the cognition with the young population (4–18 years old) a positive connection is found out between the physical activity and cognitive performance of eight measures: perceptive skills, IQ, success (achievement), verbal tests, Math tests, remembering, developing level i.e. academic readiness. Sibley and Etner, in their research for the effect on PA over the cognition with the young population, observed the effect size (ES) from 0.32 which is similar to the average effect size of the physical activity over the cognition during their life (6–90 years of age) ES=0.25 (SD=0.69, n=1260, p<0.050)(43). Some studies suggest that participation into physical activities either has positive influence on the overall success in school, or has not influence at all, which again has been considered a positive influence. The starting point for this consideration is that although the time spent on physical activities shortened the study time it did not affect negatively the student's success. Regardless of the type of cognitive parameters measured in the course of research, the researchers had a common attitude that the time devoted to physical activities (health-based) is not followed by decrease of the academic success (3-6).

Thorough researches are being carried out in the United States of America for the needs of having physical education classes. Very similar to the situation in our country, the physical education classes are not carried out regularly and according to the school time-table. It decreases the young population's opportunity to participate into the physical activity, in this case organized one, carried out and observed by a professional person. The schools are the place where students have to be provided regularly with daily physical activity, to become aware of the importance of physical activity for one's health and develop skills for healthy way of life. In order to support the fact that the physical education is useful for the students' health and it is not harmful for the process of education, some researches have to be carried out in connection with activity-cognition with children, adolescents and young population included in the process of education.

In the period from 1967 to 2006 fourteen studies were published analyzing the data of about 58,000 students, whose connection between the total physical activities and achievement in school had been tested. Eleven of these studies showed that the students who regularly participated in physical activities had better academic performance. Five huge controlled experimental studies have been organized so far in the USA, Canada and Australia, which evaluate the effect of the physical activity on the academic success of the students. All five studies clearly showed that the physical activity does not have to be sacrificed for the sake of the academic success (7-9). A study carried out in 2006 on 214 students from the sixth grade in Michigan showed that the students who had participated in physical education classes had similar grades on the standardized tests with their classmates who had not participated in Physical Education classes, although they had had 55 minutes less daily classes. In the same research it is concluded that the students who had participated in energetic physical activities (rhythmic repetitive activities which included large muscle groups and achieved 70% of the maximum heart frequency: running, bicycle, aerobic, skating, rope jumping, football and others) after 20 minutes daily, at least three times a week, had much higher grades than the students who had not had intensive physical activity in the course of two semesters (4). In 1999 researchers had analyzed 759 students from California and found out that the success of the students in the regular tests was not negatively affected by their participation in Physical education. In several tests the students with high level Physical Education had better results than the students in the control group (10).

National study carried out in 2006 on the base of data collected from 11,957 adolescents from the whole of the USA reviewed the connection between the physical activity and academic performance. The adolescents who said that they had regularly participated in the school activities such as Physical Education, team sports or Participated in sports activities with their parents, had 20% bigger chances to get A (the highest grade) in Math and English (11-13). Two studies did not prove that there was connection between the physical activity and school success (17, 18), and one study carried out in Canada in 2000 showed negative connection between the physical activity and success in standardized tests (19). Two large national studies which had included elementary and secondary school children from Australia, Korea and the USA showed that high grade in physical fitness was positively connected with the school achievement. The aerobic capacity was positively connected with the total school achievement, whereas BMI was opposite, i.e. negatively connected (12, 20-22). The evaluation of the effect on aerobic training over the executive functions with children with increased weight showed that the children with high level of activity (40 minutes per day, 5 days a week, 15 weeks) had significant improvement in the executive functions compared with the control group (without physical activity). Children in a group with lower level of activity (20 minutes per day, 5 days a week, 15 weeks) showed twice as much lower improvement. The researches scanned the patients' brains and found out that with children who had exercised there appeared increased neuronal activity in the frontal areas of the brain which were crucial for the executive functions (1). Grisom used to evaluate the connection of the physical fitness with the academic achievements. For that purpose, the results of FITNESSGRAM were compared to the success of the standardized tests and it was concluded that the higher total fitness score resulted in the better average academic success. This connection appeared to be stronger with the females and the subjects with higher socioeconomic status (23). Hillman and his colleagues (24) presented a discovery that
the brain function of the young clearly showed that exercising in the early period in one’s life might be extremely important for improvement of cognitive health during childhood. It might also have prolonged effect in the later period of that person’s life. These authors think that the classes in physical culture and other physical activities connected with the education are cancelled in order to improve the students’ success at school. That goal has not been achieved. In fact, the researches showed that the secondary school students (25–27) who had exercised and participated more in the sports activities (7 or more hours a week) had higher grades, rarely took drugs and had better relationships with their parents than their friends with low level of PA (<2x per week). Van Praag suggests that the aerobic PA in childhood can increase the capability of brain recuperating further in life, which may result in so-called cognitive reserve (brain resistance to neurological disorders) (28).

These discoveries suggest that the physical activity may be pleasant i.e. useful in all phases of life, its role in the childhood and adolescence can be very important for improvement and preservation of cognitive health during adulthood.

3. EFFECT OF THE PHYSICAL ACTIVITY OVER COGNITION DURING EARLY ADULTHOOD

According to some psychologists, the developing period in life when a young person (child) enters the phase of maturity, i.e. in the period of young adulthood lasts from 16 to 28 years of age; according to others 18 – 30 years of age, and some even extend the upper limit of young adulthood from 34 to 35 years of age. When young people develop physically and socially, they also develop their cognitive capabilities such as thinking and learning. Although it might seem unnoticeable, the progress in adolescence and early adulthood and later on in adulthood, is followed by significant changes in the way of thinking and observing the world. According to the well-known expert in developing psychology, K. Warner Schaie, the adults make progress in regard with the adolescents only in the way using their intelligence. The adults transfer themselves from the mode of acquiring knowledge to the mode of applying the acquired knowledge in everyday routine (29). This period of intensive physical and even more expressed mental development is divided into two phases. The first phase is one of leaving parents’ home (16–22 or 16 – 24 years of age). The second phase is one of beginning an independent living, entering the adults’ world (30).

Unfortunately, the researches for the connection of the physical activity and cognition with young people are very rare. One of the several studies appeared with its report on the Conference of Neuro-Sciences Association in 2001. The report talks about a discovery where young adults carrying out a routine of 12 weeks’ running up to 30 minutes twice or three times a week show significant improvement on the cognitive tests. The second discovery is that the result gets worse if the running stops (31). Regular, moderate to intensive physical activity may reduce the health expense, prevent development of many diseases and improve the quality of life. The health benefit from physical activity depends on the degree of physical activity during the whole person’s life, but with more people the physical activity decreases with their getting older, i.e. reaching certain age. The highest decrease of the PA degree appears during adolescence and in the young adult period. In the USA about 65% of the secondary school population practise physical activity regularly, with regard to 32% students 18-24 years old, and 23% of population 25-30 years old (32). Hillman and his colleagues emphasized that there were many researches for cognitive functions and exercising with the young people (34). In his research Van Praag proved that exercising improved cognition with both young and elderly people (33).

In the course of early adulthood, when the central nervous system shows significant plasticity and when important cognitive characteristics are formed, the effect on exercising over cognition remains vaguely clear. A large study was carried out in Sweden on men born in the period between 1950 and 1976, from the list of military obligation, 18 years old (N=1,221,727). Among them there were pairs of brothers (28% from the subjects), 3,147 twin pairs and 1,432 pairs of identical twins. In this cohort study, data on physical fitness and intelligence were collected and connected with the information on school success, socioeconomic status and relative relations. The cardiovascular fitness was positively connected with the intelligence once the relevant factors had been given (those which could not have any influence) (regression coefficient b=0.172; 95% CI, 0.168–0.176). It was discovered that the cardiovascular changes in the period between 15 and 18 years of age predict the cognitive performance at the age of 18. According to this study, the cardiovascular fitness at the age of 18 also predicts the education process further in life. The investigations of psychomotor speed and working memory capacity in young adults with different level of PA show significantly better results in physically more active subjects (34, 35) These data essentially prove that the physical activity could be a very significant instrument in the public health for optimizing achievements in education, cognitive performance and preventing diseases (36).

4. EFFECT OF THE PHYSICAL ACTIVITY OVER COGNITION DURING LATE ADULTHOOD

In the report of June 1998 the American College of Sports Medicine (ACSM) says that in the USA in 2030 the number of people older than 65 will be 70 millions, and the people older than 85 will be the fastest growing population segment. The more prolonged is the contemporary person’s life, the greater is the determination of importance and mechanisms with which the exercising and physical activity improve health, functional capacity and quality of life. Participation in regular programmes for exercising is a very effective way to decrease, i.e. prevent numerous functional decreases connected with the old age. Besides significant improvement of cardiovascular system function (VO2, heart output, arteriovein oxygen difference), decrease of the
Influence of the Physical Activity on the Cognitive Functions with People Depending on their Age

risk factors for heart diseases, diabetes, osteoporosis, improvement of postural stability, flexibility, locomotion, decrease of the risk of fractures, numerous benefits in psychological health are noticed. Involvement in regular physical activity is connected with preservation of cognitive functions, decrease of depression symptoms and improvement of the personal control and self-efficiency (37). It is well known that the functions of the central nervous system decrease by getting older, and the changes are considered unrecurrent and irreparable (38). There is a large number of popular papers which document the connection of physical activity and cognitive functions with the elderly population (39-44). The primary goal of these researches was to document the effect of the aerobic fitness upon different indicators of cognitive functions (e.g. remembering, attention, reaction time, intelligence). The physiological base of neurological decrease with elderly persons is decrease of the cardiovascular function that leads towards reduced supply of blood to the brain. Exercising with its effects over the circulation may slow down or stop these changes which lead towards cognitive decrease. Early cross sectional studies in which active and inactive elderly persons are being compared, firmly show the superior performance of the active subjects in regard with the reaction time, remembering, visual and space skills (45-47). Prospective and longitudinal findings suggest that the physical inactivity is a predictor of successively cognitive decrease and that the change of habits connected with the physical activity (PA patterns) over the course of time become connected with change of cognitive functions (48).

Experimental studies with application of exercising and training program with the elderly persons have generally shown improvement of the cognitive functions especially with measure of speed when processing information and executive functions. Some experimental studies were less conclusive (49, 50) which most probably is caused (this discrepancy) by methodological differences: duration, intensity, exercising frequency, excluding and inclusive criteria and measurable cognitive parameters. Meta analysis by Colcombe and Kramer discovered that, in total, interventions with exercising have potential to improve the cognitive functioning with the elderly people, especially with the process of executive functions. I was emphasized in this meta analysis that the biggest positive part had those exercising and strength training components, and they targeted the group of people from 65 to 70 years old (49). It was an interesting research which lasted 16 weeks. Besides the control group it included two experimental groups, one with increase of the physical activity with three trainings out of 60 minutes per week, and the other with two aerobic trainings with 60 minutes and one 60 minute long cognitive training. The two experimental groups showed significant improvement in the parameters of the cognitive and physical functions in regard with the control group (50). In the research whether the exercising can improve the cognitive function of the problem concerning remembering with the adults, it is discovered that there was "modest" but long-lasting improvement after 6 month long treatment with physical activity. The benefit of the physical activity (142 minutes per week or 20 minutes per day) had appeared after 6 months but it persisted 12 months after the termination of the intervention (52). In a study for large population with persons with normal cognition (N=1126) and persons with mild cognitive disorder, MCI, (N=198), at the age of 50 – 65, it is concluded that exercising practice with medium intensity is connected with decreased risk of the phenomenon MCI (Mild Cognitive Impairment) (53). Renowned experts who have studied the connection between exercising and cognition, Kramer, Ericsson and Colcombe conclude that most of the researches suggest important and frequently significant connection between physical activity and increased level of cognitive functions in the old age. These authors think that the physical activity can influence neuroprotective of the brain, improving the brain health and cognitive function (54, 55).

5. CONCLUSIONS
In comparison with the number of studies which have examined the physical activity influence on the cognitive capabilities with the adults (above 60 years of age), researches for children, adolescents and young adult population are rarely done. The examination of the potential connection, role or influence between Physical Activity and cognition during early age (the first third of the human life) is very complex and subtle due to a large number of external factors which are present in the period during which the cognitive capabilities are still being developed.

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Within the frame of positive role the physical activity has over the cognitive health, it is suggested as a means of reducing the risk of developing cognitive decrease connected with getting old. Future vast randomized researches and interventions would have to test the quantity and the type of physical activity which would be recommended in order to prevent or postpone the cognitive decrease.

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