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ASSOCIATION BETWEEN CLUB SPORTS PARTICIPATION AND PHYSICAL FITNESS OF 6–10-YEAR-OLD MACEDONIAN CHILDREN

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Abstract

Background. Physical inactivity is associated with poor physical fitness and weight gain. Organized sports activities can be a significant component in providing adequate fitness which, on its part, is an important aspect of general health and well-being. The purpose of the study was to establish the relationship between participation in organized sports activity and obesity as well as physical fitness of 6–10-year-old children from the region of the city of Skopje in the Republic of North Macedonia.

Materials and methods. The height, weight, body mass composition, and various components of physical fitness were measured in 940 children (aged 8.98 ± 3.39). The sports participation and confounding variables, such as parents' education and body weight as well as parents' sports activities, were estimated through a questionnaire completed by parents. In order to achieve the study purpose, the study used the multinomial logistic regression analysis and the multivariate analysis of covariance (MANCOVA).

Results. Less-than-once-a-week sports participation was established in 41.1% of the children, once or twice a week – in 48.4%, and more often – in 10.5%. Obesity was established in 38.1% of the children. Children that had organized sports activity 1-2 times a week or more often showed a higher physical fitness level.

Conclusions. Even though causality cannot be established, facilitation of organized sports activities may be a crucial aspect in public health efforts addressing the growing problems associated with overweight and obesity.

Keywords: cardiorespiratory endurance, strength, power, agility, body weight, children, adolescents, physical activity.

Introduction

Not engaging in physical activity (PA) is one of the main causes affecting public health, due to its negative impact on physical and mental health (Trost et al., 2014; Pedersen & Saltin, 2015). Young people to have good health, should participate in physical activities at least 60 minutes during the day (WHO, 2016), the largest possible participation in physical activities during the early childhood can become a habit during adult age (Malina, 1996). Many children and adolescents are at risk for cardiovascular disease through inactivity (Thomas & Williams, 2008), although the clinical symptoms of cardiovascular disease may not become apparent before adulthood (Berenson, et al., 2005). Bad habits such as sitting, watching TV, playing computer games are what children and adolescents during in their free time (Kaiser-Jovy et al., 2017; Biddle et al., 2009). Low stage of physical activities in childhood and adolescence also have their share in the physical fitness decrease (Tomkinson & Olds, 2007; Fraser et al., 2019; Runhaar et al., 2010), which, on its part, have negative implications with various health destructions and affects the cognitive development and academic performances (Ortega et al., 2008; Mintjens et al., 2018; Marques et al., 2018). Physical fitness is defined as a person's ability to carry out daily activities without undue fatigue (Malina & Katzmarzyk, 2006). Children and adolescents have adopted the habit of spending most of their time in sedentary activities, which results in having less activity of physical recreation. So, children's participation in sports activities, such as sports clubs, influences the growth of PA in youth (Wickel & Eisenmann, 2007; Malina, 2009;

Marques et al., 2016). In addition, organized physical activity promotes health promotion in children and adolescents (Tremblay et al., 2016). Recent studies have shown that 40-59% of European children participate in various sports clubs (Tremblay et al., 2016). Therefore, participation in organized physical activities increases the physical activity of children by fulfilling the recommendations of participation in physical activities (Hebert et al., 2015; Marques et al., 2016; Kokko et al., 2018; Lee et al., 2018). Particularly, recommendations for vigorous PA have been more definitively achieved in club sports participants (Kokko et al., 2018; Riso et al., 2019), and it is assumed that there is a positive connection of the organized physical activity in childhood and adolescence with the level of physical activity in adulthood (Tammelin et al., 2003; Hallal et al., 2006; Azevedo et al., 2007). It has also been established that there is a stronger relation of the organized sports activity with the physical fitness compared to the unorganized leisure-time physical activity (Tammelin et al., 2003). The high level of physical abilities stimulates the willingness of children to participate in physical activities. So, physical fitness is an important factor in the health and well-being of children (Lang et al., 2019). The present research was organized in order to provide better understanding of the relation between the organized sports activity participation and physical fitness, which could make serious input into developing the strategy and intervention in promoting physical activity. The purpose of the study, therefore, was to examine the association between participation in organized sports and physical fitness as well as overweight in 6-10 year-old children while considering various environmental constraints.

Materials and methods

Study participants

Baseline data from 940 (49.6% male, 50.4% female) first-grade children (8.98 ± 3.39 years) were of random selection from several primary schools in the region of Skopiein the Republic of Macedonia. The sample covers all participants whose parents agreed for their children to take part in the project, and who were mentally and physically healthy and regularly attended the classes of Physical Health and Education. Along with that, the final analysis data collection did not include some of the participants who had not undergone all of the measurements and tests or of some other reasons dropped from the project. The respondents were treated in accordance with the Helsinki Declaration (revision of Edinburgh, 2013). Protocols were approved by the Ethics Committee at the Ss. Cyril and Methodius University of Skopje. The measurements were realized in March, April and May 2019.

Anthropometric measures

The anthropometric measurements were taken according to the standard methodology of the International Biological Program (IBP) and recommendations the World Health Organization (WHO) and Weiner and Lourie (1981). Weight was measured in underwear and without shoes with a medical decimal weight scales, to the nearest 0.1 kg, and height was measured barefoot in the Frankfurt horizontal plane with a telescopic height measuring instrument (Martin's anthropometry) to the nearest 0.1 cm. Body mass index (BMI kg/m^2) was calculated as weight in kilograms divided by the square of height in meters. Components of the body composition were determined by the method of bioelectrical impedance (measuring of the electric conductivity – Bioelectrical Impedance Analysis – BIA). The measuring was completed by a Body Composition Monitor, model "OMRON – BF511", by means of which we have measured the body weight, fat tissue percent and muscular mass percent. Prior to commencing the measurement, we had entered the parameters of gender, years and body height of the respondent in the Body Composition Monitor. In order to provide better precision of the results obtained from the estimation of the body composition, prior to each measuring, we ensured that the preconditions recommended by ACSM (2005) and Heyward (2006) had been fulfilled.

Evaluation of Physical Fitness

Prior to starting the study, the researchers involved in the project undertook training sessions in order to guarantee the standardization, validation, and reliability of the measurements. Seven tests, forming part of the EUROFIT battery, validated and standardized by the European Council, were applied in the following order:

- Sit and Reach Test.
- Hand Grip Test.
- Standing Broad Jump Test.
- Sit-ups 30 sec.
- Shuttle Run: 4×10 meters.
- CRF was measured using the 20-m shuttle-run test.

Sports Participation

To determine participation in organized sports outside the school setting was used a parental questionnaire. Children's sports participation was classified as less than once a week, once or twice a week, and more than twice a week.

Confounding Variables

In addition, the questionnaire assessed confounding variables such as parental education, parental overweight and parental participation in organized sports. Confounding variables were dichotomized. Level of parents' education was differentiated by 12 years of schooling of either father or mother. A BMI cutpoint of 25 was used to determine between overweight and nonoverweight, and parental sports participation was separated by participation in organized sports or visiting a fitness centre more than one hour per week.

Statistical Analysis

Descriptive statistics for the three sports participation groups were calculated and checked for normal distribution. The relationship between overweight and obesity, sports participation in children and predictor variables (parental education, maternal education, paternal overweight, maternal overweight and paternal organized sport) were determined by multinominal logistic regression analysis. Differences in individual fitness parameters by sports participation were calculated via multivariate analysis of covariance (MANCOVA), again adjusting for the previously mentioned confounding

variables. Bonferroni adjustment was used for post hoc analyses in case of significant group differences. Missing values were excluded per case, and level of significance was defined as $p < 0.05$. All statistics were calculated in SPSS (24.0.0).

Results

Table 1 represents the age, anthropometric measures and measures of assessing body composition regarding the whole sample and each group in particular that is formed in accordance with its sports participation. The inspection of Table 1 shows that the body height of those children who had done an organized sports activity for more than two times a week is statistically significantly greater and they have a greater muscle mass percentage in comparison with the children who had done organized sports activity 1-2 times a week or less than once a week. Also, the children who had done organized sports activity more than twice a week are statisti-

Table 1. Subjects characteristics of the total sample (all) stratified by participation in organized sports per week. Values are mean and SD

Variables	Children's participation in organized sports per week							
	All		Less than once		1-2 times		More often	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	8.98	3.39	8.92	4.73	8.82	1.44	9.31	1.40
Weight (kg)	34.67	10.55	33.60	10.42	34.73	9.99	36.71	11.14
Height (cm)	134.84	10.41	133.02	10.29	135.20	9.78	137.98	10.65
BMI (kg/m^2)	18.73	3.59	18.64	3.61	18.71	3.42	18.96	3.77
Body fat percentage	23.35	8.09	23.43	8.37	23.42	7.87	23.11	7.84
Muscle mass percentage	30.46	3.03	29.86	3.02	30.66	2.80	31.39	3.06

Table 2. Distribution of the occurrence of confounding variables of the total sample (all) stratified by participation in organized sports perweek. Indicated are N and %.

Variables	Children's participation in organized sports per week							
	All		Less than once		1-2 times		More often	
Overweight	357	38.1%	168	37.8%	106	38.0%	83	39.0%
Parental education ≤ 12 y	544	59.5%	295	67.5%	134	49.8%	115	55.3%
Maternal education ≤ 12 y	385	42.1%	230	53.0%	77	28.2%	78	37.5%
Paternal overweight	622	73.8%	289	71.7%	191	76.1%	142	75.1%
Maternal overweight	579	66.9%	264	64.2%	180	69.0%	135	69.6%
Paternal organized sport	335	35.6%	106	23.8%	129	46.1%	100	46.7%

Table 3. Prevalence of overweight and obesity by multiple logistic regression analysis

Explanatory variables	Unstandardized coefficient (B)	Wald statistics	p	OR (95% CI)
Children sports participation				
Less than once	-0.02	0.01	0.92	0.98 (0.66-1.45)
1-2 times	-0.03	0.03	0.87	0.97 (0.64-1.46)
More often (Ref)				
Sports participation parents				
Nonparticipation	-0.05	0.09	0.77	0.95 (0.69-1.31)
Participation (Ref)				
Weight status father				
Normal weight	0.65	12.96	0.00	1.92 (1.35-2.73)
Overweight (Ref)				
Weight status mother				
Normal weight	0.36	5.24	0.02	1.44 (1.05-1.97)
Overweight (Ref)				
Education father				
Education ≤ 12 y	-0.03	0.02	0.88	0.97 (0.70-1.35)
Education > 12 y (Ref)				
Education mother				
Education ≤ 12 y	-0.12	0.45	0.50	0.89 (0.64-1.25)
Education > 12 y (Ref)				

*Dependent variable: overweight and obesity-BMI (Cole et al., 2000, 2007)

Table 4. Odds ratio (OR) for overweight by participation in organized

Explanatory variables	Unstandardized coefficient (B)	Wald statistics	p	OR (95% CI)
Weight status				
Normal weight	0.07	0.21	0.65	1.08 (0.79-1.47)
Overweight				
Sports participation parents				
Nonparticipation	0.89	28.96	0.00	2.43 (1.76-3.35)
Participation (Ref)				
Weight status father				
Normal weight	0.05	0.07	0.79	1.05 (0.74-1.48)
Overweight (Ref)				
Weight status mother				
Normal weight	0.01	0.00	0.98	1.01 (0.73-1.39)
Overweight (Ref)				
Education father				
Education ≤ 12 y	0.41	5.76	0.02	1.51 (1.08-2.11)
Education > 12 y (Ref)				
Education mother				
Education ≤ 12 y	0.66	14.83	0.00	1.93 (1.38-2.70)
Education > 12 y(Ref)				

Table 5. Mean values and SD for individual fitness tests by participation in organized sports. F and p-values are from MANCOVA

Dependent Variable	Children's participation in organized sports per week						MANCOVA		
	Less than once		1-2 times		More often		F	p	eta
	Mean	SD	Mean	SD	Mean	SD			
Sit and reach test (cm)	15.44	6.68	15.84	15.98	16.61	6.66	1.78	0.170	0.01
Handgrip strength (kg)	12.76	3.70	13.70	13.68	14.20	5.21	10.08	0.000	0.03
Standing longjump (cm)	106.67	21.91	112.36	112.44	115.76	25.49	11.74	0.000	0.03
30 sec sit ups (n)	11.69	5.10	13.22	13.17	14.51	5.00	21.18	0.000	0.05
4×10m shuttle run test (sec)	15.36	2.02	15.00	14.97	14.53	2.05	11.37	0.000	0.03
CRF (VO_{2max})	47.57	3.29	48.03	47.99	49.60	3.81	28.63	0.000	0.07

*Difference between less than once a week and weekly sports participation.

cally significantly heavier than those having sports activity less than once a week. The children with 1-2 times-a-week organized sports activity are higher and possess a greater percentage of muscle mass than those having less than once a week an organized sports activity. Within the rest of the variables (age, BMI, body fat percentage), statistically significant differences between the groups are not established.

Table 2 displays the prevalence of potential confounding variables on child's sports participation. The relation between overweight and fatness that are classified due to BMI in children and the predictor variables (sports participation, parental education, maternal education, paternal overweight, maternal overweight and paternal organized sport) are determined through the multinominal logistic regression analysis, and the obtained results are presented in Table 3. The inspection of Table 3 shows that those of the children whose parents' body weight is normal (OR: 1.92, CI: 0.69-1.31, p ≤ 0.00; OR: 1.44; CI: 1.05-1.97, p ≤ 0.05), run less possibility of being classified as OV/OB than the children whose parents' body weight is excessive. It is not established to be present a statistically significant relation between the criterion and the rest of the predictor variables.

The relation between the sports participation and predictor variables (weight status, parental education, maternal education, paternal overweight, maternal overweight and paternal organized sport) is established through the multinominal logistic regressive analysis, whereas the obtained results are presented in Table 4. The inspection of Table 4 shows that there is less possibility to undertake organized sports 1-2 or more often per week for those children whose fathers are not doing sports (OR: 2.43, CI: 1.76-3.35, p ≤ 0.00), mothers' education is less than ≤ 12 y (OR: 1.51, CI: 1.08-2.11, p ≤ 0.05) and fathers' education is less than ≤ 12 y (OR: 1.93, CI: 1.38-2.70, p ≤ 0.00).

Using MANCOVA, controlling for age, sex, BMI, parental education, maternal education, paternal overweight, maternal overweight and paternal organized sport, a significant main effect of participation in organized sports on most physical fitness parameters was shown (Table 5). Post hoc analysis using Bonferroni adjustment shows that the children who had done organized sports more than twice per week demonstrate statistically significantly better results in the fitness tests 30 sec sit ups, 4×10 m shuttle run test and CRF (VO_{2max}) as compared to the children who had done or-

ganized sports 1-2 or less times per week. The children with organized sports activity for more than twice a week show statistically significantly better results in the fitness tests of handgrip strength and standing long jump than those who had done organized sports less than once a week. Those of the children who hadorganized sports activity 1-2 times per week show statistically significantly better results in the fitness tests of handgrip strength, standing long jump and 30 sec sit ups than the children who participated less than once a week in organized sports.Statistical differences between the groups are not found in sit and reach test.

Discussion

Participation in organized sports activity for less than once a week was marked in 41,1% of the children; for once or twice a week – in 48,4%; and more often – in 10.5%. The prevalence and obesity in the present research is 38.1% for the whole sample of respondents. Although the sample does not represent the entire population of the country, the prevalence of overweight and obesity is similar to values established in other studies conducted on samples of Macedonian children and adolescents (Gontarev & Ruzdija, 2014; Gontarev & Ruzdija, 2015; Gontarev et al., 2018). Yet, the present study provides an additional indication that the mentioned relation further persists even after the control of different confusing variables related to the family was performed. The results suggest that participation in sports activities is important when considering overweight and physical fitness, even when it comes to young ages. The present study does not establish a correlation between the overweight/obesity, estimated through BMI, and sports participation of the children. Similar results have been obtained in some other studies conducted on samples of similar age (Graf et al., 2004; Zahner et al., 2009; Vella et al. 2018), but several of these studies - conducted on adolescents (Ara et al., 2004; Quinto Romani et al., 2011), children aged 10 to 11 (Saar & Jürimäe, 2007) and children of preschool age (Nagel et al., 2009) – a correlation between regular sports activity participation and overweight/obesity is established. Some explanation for these results can be found in the assumption that BMI does not necessarily make difference between body fats and the fat-free component, but in this research the fatty/adipose tissue percentage was measured, too, which confirms previous results. The lower amount of body fat in children with greater participation in sport can be disguised by higher percentage of the fat-free component, which would result in statistically insignificant differences of BMI. In a certain way, this is confirmed in the present study, namely the children having 1-2 times organized sports activity weekly possess a greater percentage of muscle mass than the children who do sports activity less than once a week.

Zahner et al. (2009), however, relied on skinfold measurements rather than BMI but could not show any connection between BMI and participation in physical sports activities. This gives us limited information about the effect of different sports on body composition. Along with this, participation in sports is only a component of young children's physical activity, so through free games they increase participation in physical activities. Thus, long-term participation in physical activities is related to engaging in organized sports activities (Kjønniksen, Anderssen & Wold, 2009). This study shows that parents's body weight as well as their education should be taken into account when examining the correlation between organized sports engagement and children's body weight. The results show that parents' overweight correlates with the overweight/obesity of their children (Treuth et al., 2003; Keane et al., 2012), and parents' education and sports engagement correlate with the organized sports activities of their children. In addition, Van der Horst et al. (2007) The support of children by parents, by sending children to training and sports competitions, is an important factor that affects the participation of children in sports activities. Furthermore, the research results suggest about the correlation between sports participation and various components of physical fitness, regardless the age, sex, BMI, paternal education, maternal education, paternal overweight, maternal overweight and paternal organized sport. Particular importance should be given to regular physical activity, because it affects the improvement of aerobic skills, because the association between aerobic fitness and the risk of cardiovascular disease has been reported in children (Andersen et al., 2006). Drenowatz et al. (2019) established better performances with the 6-minute test in children aged 6-14 years who were engaged in organized sports activity. Carlisle et al. (2019) established that those children who participated in organized sports activity had better results in the 12-minute Cuper's test of running/walking than those who did not participate in organized sports activity. The regular doing of sports also improves: strength, explosive power, repetitive power, coordination, agility, speed (Graf et al., 2004; Zahner et al., 2009). To be active in participating in various sports activities, motor skills have an important role, thus, having better motor skills and performance of students is better and increases their motivation to participate in sports activities.

Interestingly, Saar and Jürimäe (2007) they show that there is a connection between participating in sports and fitness activities only in adolescents, but not in young children. According to (Zahner et al., 2009) young children are not very active in organized sports, so their interest is more to do exercises through unorganized sports (Salmon et al., 2006). Bürgi et al. (2011) claim that it is the participation in energetic activity in particular boosts the physical fitness, and that kind of activities can appear in non-structured playing as well as in general physical activity. It should also be considered that the directionality of the relationship between regular sports participation and physical fitness cannot be determined via a cross-sectional study. It is possible for children of higher level of physical fitness to have more frequent participation in organized sports activities due to their better abilities. It should also be established if the greater weight/obesity is a result of insufficient sports participation or it is the bias and partiality selection that is the reason for a smaller number of children with overweight/obesity to participate in organized sports activity. The present research has not confirmed this thesis, namely it has not established differences in the weight/obesity between the children doing organized sports activity more or less. It is very likely for the correlation between the sports participation and physical fitness as well as the body composition to be twofold, which will make it harder to establish the cause-and-effect relation even in longitudinal research works. Nevertheless, the participation in sports is one of the ways to increase the physical fitness and

decrease the body fats (Michaud et al., 1999; Van Mechelen et al., 2000), although it should be taken into consideration the role of the biological and genetic factors.

In addition to the cross-sectional design other limitations of the present study should be addressed. Collecting data on children's participation in sports activities through questionnaires that are answered by parents may have had some unobjective partiality, particularly as parents were informed about the intention of the study due to the following intervention. In addition, there is no information about the intensity of the training as well as its duration. In general, however, training in organized sports at this age lasts between 60 and 90 minutes per day. Also, it was taken into account only the participation in sports activities and not the whole physical activity, which can occur as a shortage, especially when young children are into consideration. Ebenegger et al. (2012), shows the correlation between participation in sports activities and daily physical activities of preschool children from 1st grade to 5th grade. The large sample size, on the other hand, is a strength of the present study, and an analysis of missing value did not show any systematic bias. In addition, the anthropometric measures and measures of physical fitness were conducted by trained professionals and the standard procedures were followed, which increases the research credibility.

Conclusions

In spite the fact that the direction of the mentioned correlation can not be determined, the study results emphasize the necessity of early foundation of active lifestyle, including an organized sports activity, in order to provide development of different components related to the physical fitness, since it can give impetus to long-term engaging in sports and physical activity. Considering the low levels of physical education at school, and the running risk of further decrease, the promotion and facilitation of engagement in organized sports would be an important aspect concerning public health. What is more, participation in organized sports is positively related to the development of psycho-social components such as better self-confidence, stress tolerance, and lower stage of social isolation (Coatsworth & Conroy, 2007). Therefore, the facilitation of access to various sports that allow children with different abilities to engage in a variety of activities is a crucial aspect in today's efforts concerning public health.

Conflict of interest

The author declares that there is no conflict of interest.

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ЗВ'ЯЗОК МІЖ УЧАСТЮ В ЗАНЯТТЯХ У СПОРТИВНИХ СЕКЦІЯХ І ФІЗИЧНОЮ ПІДГОТОВЛЕНІСТЮ 6–10-РІЧНИХ ДІТЕЙ У ПІВНІЧНІЙ МАКЕДОНІЇ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 9 с., 5 табл., 54 джерела.

Передумови. Брак фізичної активності асоціюється зі слабкою фізичною підготовкою та збільшенням ваги. Організовані заняття спортом можуть бути вагомою складовою забезпечення належної фізичної підготовленості, яка, зі свого боку, є важливим аспектом загального стану здоров'я та гарного самопочуття. Метою цього дослідження було

встановлення зв'язку між участю в організованих заняттях спортом та ожирінням, а також фізичною підготовкою дітей віком від 6 до 10 років із регіону міста Скоп'є в Республіці Північна Македонія.

Матеріали та методи. У 940 дітей (віком 8,98 ± 3,39 року) вимірювали зріст, вагу, склад маси тіла та різні компоненти фізичної підготовки. Участь у заняттях спортом і фактори, які здатні спотворювати результати дослідження, наприклад, освіта та маса тіла батьків, а також заняття батьків спортом, оцінювали за допомогою анкети, яку заповнювали батьки. Для досягнення мети дослідження в дослідженні застосовували поліноміальний логістичний регресійний аналіз і багатоваріантний коваріаційний аналіз (MANCOVA).

Результати. Було встановлено, що 41,1% дітей брали участь у заняттях спортом рідше одного разу на тиждень, 48,4% – раз або двічі на тиждень, а 10,5% – частіше. У 38,1% дітей було встановлено наявність ожиріння. Діти, які брали участь в організованих заняттях спортом 1-2 рази на тиждень або частіше, показували вищий рівень фізичної підготовленості.

Висновки. Навіть якщо встановити причинний зв'язок неможливо, сприяння організованим заняттям спортом може бути ключовим аспектом заходів органів охорони здоров'я, спрямованих на вирішення зростаючих проблем, пов'язаних із надлишковою масою тіла та ожирінням.

Ключові слова: кардіореспіраторна витривалість, міць, сила, спритність, маса тіла, діти, підлітки, фізична активність.

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