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THE ASSOCIATION BETWEEN ORGANIZED SPORT PARTICIPATION AND PHYSICAL FITNESS IN CHILDREN AGED 9 TO 11 YEARS

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(Original scientific paper)

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Abstract

Regular physical activity is recognized as a key determinant of optimal growth and development in children, with organized sport playing a particularly critical role in enhancing physical fitness. The aim of this study was to examine the relationship between the average daily time spent in organized sport activities and various components of physical fitness in children aged 9 to 11. The study involved 415 students (205 boys and 210 girls) from the second educational stage. Seventeen variables were assessed: four anthropometric measures, two body composition indicators, nine motor fitness tests, and two indicators of sport participation. Average daily sport time was calculated by multiplying the number of weekly training sessions by their duration, divided by the number of days in a week. Partial Pearson correlation analysis, controlling for age, revealed significant positive associations between greater daily sport involvement and higher muscle mass ($r = 0.169$, $p = 0.001$), handgrip strength ($r = 0.148$, $p = 0.003$), explosive strength ($r = 0.174$, $p < 0.001$), abdominal endurance ($r = 0.278$, $p < 0.001$), VO_2max ($r = 0.319$, $p < 0.001$), and agility ($r = -0.221$, $p < 0.001$), as well as bip-test performance. These associations were more pronounced in boys but also significant among girls. No significant correlation was found with body mass index (BMI), although a clear relationship emerged with muscle mass percentage. These findings underscore the crucial role of organized sport in supporting children's physical development and highlight the importance of promoting sport participation, particularly among less active children and girls, as a strategy for improving health outcomes in childhood.

Keywords: *child physical activity, sport participation, physical fitness*

Introduction

Insufficient physical activity represents a global public health concern with profound implications for both the physical and mental well-being of the younger population (Trost et al., 2014; Pedersen & Saltin, 2015). According to the World Health Organization, a substantial proportion of children and adolescents fail to meet the recommended 60 minutes of moderate to vigorous physical activity per day (WHO, 2020). This lack of activity, often established in childhood, tends to persist into adulthood, contributing to cumulative long-term health risks (Malina, 1996).

Contemporary studies indicate that a significant number of children already exhibit cardiometabolic risk factors at an early age, including elevated BMI, dyslipidemia, and insulin resistance conditions that form the basis for the development of chronic diseases such as type 2 diabetes and hypertension (Thomas & Williams, 2008; Berenson et al., 2005).

Urbanization, increased screen time, and limited access to safe recreational spaces further promote sedentary lifestyles in children (Dollman et al., 2005; Hills et al., 2007). In parallel, parental attitudes and their own levels of physical activity play a crucial role in shaping behavioral patterns that children often mirror (Biddle et al., 2009; Kaiser-Jovy et al., 2017). The consequences of diminished physical fitness manifest not only in impaired physical health but also in the cognitive and psychosocial development of children, affecting academic performance, memory, and mental health (Tomkinson & Olds, 2007; Ortega et al., 2008; Mintjens et al., 2018).

Physical fitness is a multidimensional construct encompassing aerobic endurance, muscular strength, flexibility, and body composition all essential for disease prevention and overall health improvement (Malina & Katzmarzyk, 2006). High levels of physical fitness during childhood are widely recognized as predictors of long-term health status. In this context, organized sport emerges as a particularly effective protective factor. Participation in sports clubs not only enhances fitness but also promotes discipline, self-confidence, and social skills (Wickel & Eisenmann, 2007; Tremblay et al., 2016). In Europe, it is estimated that 40% to 59% of children are engaged in organized sport, which often constitutes their primary source of daily physical activity (Hardy et al., 2014).

Early engagement in sport is associated with a greater likelihood of maintaining an active lifestyle into adulthood, thereby reducing chronic disease risk and fostering lifelong health-promoting behaviors (Hallal et al., 2006; Azevedo et al., 2007).

The present study aims to investigate the relationship between organized sport participation and levels of physical fitness among children aged 9 to 11a critical developmental window for establishing health-related habits and motor competence.

Methods

Sample of Participants

This study was conducted on a representative sample of 415 participants, randomly selected from several primary schools located in the Skopje region, Republic of North Macedonia. The children were aged between 9 and 11 years, corresponding to the second cycle of primary education. The sample was divided into two subgroups based on sex: 205 boys and 210 girls.

Participation was granted only to students whose parents or guardians provided written informed consent. Additional inclusion criteria included satisfactory psychophysical health and regular attendance in physical and health education classes. Participants who were unable to complete all planned measurements or were hindered by objective factors were excluded from the analysis.

All students were fully informed about the voluntary and anonymous nature of their participation, ensuring strict adherence to ethical standards. The study was conducted in accordance with the principles of the Declaration of Helsinki (1961), revised in Edinburgh in 2013, with particular attention paid to the protection of participants' rights and dignity.

Measurement Methodology

The study involved a total of 17 variables, grouped into four categories: anthropometric measures (4), body composition indicators (2), motor fitness tests (9), and indicators of participation in organized sport (2).

Body height and weight were measured using standardized instruments (a stadiometer and electronic scale) according to the methodology of the International Biological Program (Lohman et al., 1988). Body Mass Index (BMI) was calculated as the ratio of body weight to height squared (kg/m^2), while waist circumference was measured using a non-elastic tape, and the waist-to-height ratio (WHtR) was used as a relative measure of central adiposity.

Body fat percentage and muscle mass were assessed using bioelectrical impedance analysis (BIA) with an OMRON BF511 monitor. This method has been validated in child populations through comparison with DXA, the gold standard for body composition assessment (Pietrobelli et al., 2004). All measurements followed standardized procedures recommended by ACSM (2005) and Heyward (2006) to minimize external influences and ensure accuracy.

Fitness was evaluated through nine standardized tests: flexibility (sit-and-reach), explosive strength (standing long jump), abdominal endurance (sit-ups in 30 seconds), speed and agility (4×10 m shuttle run), static strength (handgrip dynamometry), and cardiorespiratory capacity (20 m progressive shuttle run test), including the estimation of VO_2max. These tests were implemented following EUROFIT battery standards, along with modified protocols from the AVENA, HELENA, ALPHA, IDEFICS, and MAKFIT studies (Ruiz et al., 2006; Gontarev et al., 2018).

Children's participation in organized sport was assessed through a standardized parental questionnaire. Parents were asked whether their child actively participated in organized sport, how many training sessions were attended per week, and the typical duration of each session. Based on this information, the average daily time spent in organized sport was calculated by multiplying weekly frequency by session duration and dividing by the number of days in a week.

All measurements were conducted in controlled school settings by trained kinesiology professionals. Motor and anthropometric tests were performed between 07:30 and 14:30 under suitable microclimatic conditions (17–22°C), and all instruments were calibrated prior to each measurement session.

Statistical Analysis

Data distribution was tested for normality using the Kolmogorov-Smirnov test. To examine the association between average daily time spent in organized sport and anthropometric measures, body composition, and motor fitness outcomes, partial Pearson correlation analysis was conducted, controlling for age as a confounding variable. Analyses were performed separately for boys, girls, and the entire sample. All statistical analyses were carried out using SPSS software (version 26.0, IBM) for Windows. The level of statistical significance was set at $p < 0.05$, with p-values below this threshold considered statistically significant.

Results

To investigate the association between average daily time spent in organized sport and selected morphological, body composition, and motor fitness indicators among children in the second educational cycle, a partial Pearson correlation analysis was conducted, with age controlled as a covariate. Analyses were performed separately for boys, girls, and the entire sample, allowing for precise differentiation of trends and identification of potential sex-based differences in correlation strength.

As presented in Table 1, the results demonstrated multiple statistically significant and practically meaningful correlations. For the total sample, greater daily engagement in organized sport showed a small but significant positive correlation with muscle mass percentage ($r = 0.169$, $p = 0.001$), absolute handgrip strength ($r = 0.148$, $p = 0.003$), and explosive strength ($r = 0.174$, $p < 0.001$); a moderate effect for abdominal muscular endurance (sit-ups, $r = 0.278$, $p < 0.001$); and a moderate to large effect for cardiorespiratory endurance, including estimated VO_2max ($r = 0.319$, $p < 0.001$), bip-test levels ($r = 0.306$, $p < 0.001$), and distance covered ($r = 0.325$, $p < 0.001$). Additionally, a moderate negative correlation with agility and coordination performance time (4×10 m shuttle run, $r = -0.221$, $p < 0.001$) indicates better agility with more frequent sport participation.

Table 1. Cross-correlation between average daily time spent in organized sport and anthropometric measures, body composition, and motor (fitness) test results among boys, girls, and the total sample.

	Boys		Girls		Total sample	
	r	sig	r	sig	r	sig
Height	,040	,575	,114	,110	,082	,104
Body Weight	-,049	,493	,073	,306	,023	,649
Waist Circumference	-,081	,256	,010	,893	-,001	,977
Body Mass Index (BMI)	-,069	,333	,021	,774	-,008	,875
Body Fat Percentage	-,125	,079	,012	,861	-,048	,343
Muscle Mass Percentage	,151	**,033**	,110	,123	,169	**,001**
Sit-and-Reach Test	,142	**,046**	,100	,162	,070	,162
Handgrip Strength (Absolute)	,113	,112	,144	**,043**	,148	**,003**
Handgrip Strength (Relative)	,134	,059	,047	,512	,094	**,060**
Standing Long Jump	,218	**,002**	,062	,382	,174	**,000**
Sit-Ups (30 seconds)	,297	**,000**	,226	**,001**	,278	**,000**
4 × 10 m Shuttle Run	-,219	**,002**	-,163	**,022**	-,221	**,000**
20 m Shuttle Run Test (Levels)	,340	**,000**	,152	**,032**	,306	**,000**
20 m Shuttle Run Test (Distance)	,353	**,000**	,176	**,013**	,325	**,000**
20 m Shuttle Run Test (VO_2max Estimation)	,350	**,000**	,177	**,013**	,319	**,000**

Among boys, the associations were even more pronounced, especially for VO_2max ($r = 0.350$, $p < 0.001$), bip-test distance ($r = 0.353$, $p < 0.001$), sit-ups ($r = 0.297$, $p < 0.001$), and explosive strength (standing long jump, $r = 0.218$, $p = 0.002$). Effect sizes in this subgroup ranged from moderate to large, particularly for aerobic capacity.

For girls, moderate but statistically significant associations were noted with VO_2max ($r = 0.177$, $p = 0.013$), bip-test distance ($r = 0.176$, $p = 0.013$), handgrip strength ($r = 0.144$, $p = 0.043$), and abdominal endurance ($r = 0.226$, $p = 0.001$). Although the strength of associations in girls was generally lower, these findings confirm that organized sport contributes meaningfully to the development of functional physical capacity in both sexes, albeit with sex-specific nuances possibly linked to biological and sociocultural factors.

Overall, these results emphasize that sustained and structured sport participation is positively and systematically associated with key indicators of physical fitness and functional health in children. The observed effect sizes, especially in the domains of muscular endurance and aerobic capacity, support the development of intervention programs and public health strategies aimed at increasing regular sport engagement during childhood.

Discussion

The aim of this study was to explore the associations between organized sport participation and physical fitness in children aged 9 to 11, to identify mediating factors, and to propose directions for future research and practical interventions. Partial Pearson correlation analysis, controlling for age, revealed a clear and statistically significant relationship between average daily time spent in organized sport and various indicators of physical fitness, particularly among boys. In the overall sample, increased sport engagement was associated with a higher percentage of muscle mass, greater absolute handgrip strength, better performance in the standing long jump, sit-up test, VO_2max, bip-test stages and distance, as well as improved coordination, speed, and agility. These results support the hypothesis that regular participation in organized sport positively influences key components of physical fitness in children.

Among boys, the associations were especially strong for cardiorespiratory endurance and muscular strength, aligning with previous studies indicating that prepubescent boys typically have a higher percentage of lean body mass and are more socially encouraged to engage in physical activities (Hands et al., 2009; López García et al., 2011). Among girls, although the correlations were more moderate, significant associations were observed with VO_2max, the sit-up test, absolute handgrip strength, and the coordination, speed, and agility test. This suggests that sport participation also benefits this subgroup, albeit with potentially subtler physiological adaptations.

No statistically significant relationship was found between body mass index (BMI) and sport participation, a result consistent with previous findings by Zahner et al. (2009), Graf et al. (2004), and Vella et al. (2018). However, a significant association with muscle mass was observed, indicating that BMI, as a general indicator, may not accurately reflect differences in body composition among physically active children. This highlights the importance of using direct body composition measures, such as bioimpedance, to evaluate the impact of physical activity.

It is worth noting that the strongest correlations were found with VO_2max, a key indicator of cardiorespiratory capacity and a predictor of general health. These findings are in line with those of Ortega et al. (2008) and Haapala et al. (2014), who emphasize VO_2max as one of the most sensitive markers for detecting physical activity effects in children.

Sex-based differences in sport participation and fitness outcomes were consistent with the data reported by Cooper et al. (2015) and Spruijtenburg et al. (2022), who found that girls, particularly in preadolescence and early adolescence, generally engage in lower levels of physical activity partly due to sociocultural factors, self-perception, and motivation. Our findings confirm this trend while also showing that regularly active girls outperform their inactive peers across several fitness dimensions.

A major strength of this study is its multidimensional approach, which integrated anthropometric, body composition, and motor fitness indicators alongside sport participation data. However, limitations include its cross-sectional design (which prevents causal inference), the reliance on self-reported sport activity data, and the relatively limited sample size. Future studies are recommended to adopt longitudinal designs, employ objective measures (e.g., pedometers, accelerometers), and use more broadly representative samples. Additionally, future research should aim to include indicators of biological maturation (e.g., peak height velocity or Tanner stages), account for the type and intensity of sport activity, and control for potential confounders such as socioeconomic status and parental support, which may influence children's physical activity levels and fitness outcomes.

The study's findings carry important implications for educational and health policies. Promoting regular sport participation among childrene specially among girls and those with lower baseline fitnessshould be a strategic goal for schools, families, and the broader community. Only through coordinated efforts can an environment be created that supports physical activity, reduces gender and social disparities, and enhances holistic development in children.

In conclusion, the results of this study add to the growing body of evidence affirming the importance of organized sport as a key factor in children's health and functional capacity. Encouraging regular physical activity during childhood should be a priority for health and education systems, as part of a comprehensive strategy for chronic disease prevention and the advancement of public health outcomes.

Conclusion

The findings of this study clearly demonstrate that regular participation in organized sport has a significant positive impact on physical fitness among children aged 9 to 11. A higher average daily duration of sport participation was associated with improved outcomes in muscle mass, strength, endurance, agility, and cardiorespiratory capacity. These associations were more pronounced in boys but were also evident among girls, underscoring the universal importance of sport in supporting child development.

Although no significant association was observed between BMI and sport participation, body composition analysis revealed a favorable effect of sport on muscle mass. The presence of sex-based differences and the influence of sociodemographic factors further highlight the need for individualized and inclusive strategies to promote physical activity.

This study provides a valuable foundation for developing educational and public health programs aimed at increasing sport engagement, particularly among girls and children with lower levels of physical fitness. Future research should include longitudinal and intervention-based designs with broader population representation to better understand causal relationships and inform the development of more effective policies and practices.

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