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Young school children engaged with regular after-school soccer practice present improved physical fitness and cardiovascular risk

Luís Fernandes[1], Tânia Oliveira[2], José Oliveira[2], António Rebelo[1], JC Ribeiro[2], João Brito[3]

[1] Centre of Research, Education, Innovation and Intervention in Sport, Faculty of Sport, University of Porto, Portugal
[2] Research Centre in Physical Activity, Health and Leisure, Faculty of Sport, University of Porto, Portugal
[3] Federação Portuguesa de Futebol, Lisbon, Portugal

Abstract

Objective: The present study aimed to investigate the impact of after-school soccer practice in physical activity, physical fitness and cardiovascular risk of young school children.

Methods: 71 male children (8-11 years) from the same geographical area were followed. Children were divided in a soccer group (SG; *n*=33) and control group (CG; *n*=38). SG was engaged with regular after-school soccer practice, whereas CG was not engaged with any oriented physical activity other than school-based physical education classes. Physical activity, physical fitness, anthropometry and blood pressure were assessed.

Results: The anthropometric and body composition characteristics were similar in both groups (P>0.05), except for percentage of body fat (SG vs. CG, 20.4±5.8 vs. 23.8±8.2%; P=0.005). The groups were also similar for daily sedentary time (391.4±73.1 vs. 404.4±67.8 min; P>0.05). However, SG presented higher moderate-to-vigorous physical activity (73.6±26.1 vs. 56.0±22.5 min; P>0.05, d=0.7) and physical fitness composite score (0.34±0.7 vs. 0.36±0.8 AU; p<0.001, d=0.4). Similarly, SG presented lower values for systolic blood pressure (108.4±10.6 vs. 114.4±12.5 mmHg; p=0.012, d=0.3) and summation of cardiovascular risk factors (6.8±2.8 vs. 8.3±2.9 AU; p=0.034, d=0.3).

Conclusions: Young school children might benefit from regular after-school sport activities as a strategy to enhance physical fitness and thwart cardiovascular risk factors.

Keywords: Football; Team Sports; Youth; Health; Cardiovascular; Cardiorespiratory

Corresponding Author:
Luís Fernandes, MSc
Centre of Research, Education, Innovation and Intervention in Sport, Faculty of Sport, University of Porto, Portugal
Rua Dr. Plácido Costa, 91 - 4200.450 Porto, Portugal
Phone: +351 225 074 700
E-mail: luisantoniocfernandes@gmail.com

Resumo:

Objectivo: O presente estudo pretendeu investigar o impacto de prática de futebol extraescolar na atividade física, aptidão física e risco cardiovascular de crianças em idade escolar.

Métodos: Foram seguidas 71 crianças do sexo masculino (8-11 anos) da mesma área geográfica. As crianças foram divididas num grupo de futebol (GF; *n*=33) e grupo de controlo (GC; *n*=38). Os membros do GF estavam envolvidos em prática regular de futebol em contexto de clube e os membros do CG não praticavam nenhum tipo de atividade física orientada exceto as aulas de educação física. Foram avaliados os níveis de atividade física, aptidão física, antropometria e pressão arterial.

Resultados: As características antropométricas e de composição corporal apresentarem semelhanças nos dois grupos (*P*>0.05), exceto na percentagem de massa gorda (GF vs. GC, 20.4±5.8 vs. 23.8±8.2%; *P*=0.005). Os grupos apresentaram também semelhanças no tempo sedentário diário (391.4±73.1 vs. 404.4±67.8 min; *P*>0.05). No entanto, o SG apresentou maiores níveis diários de atividade física moderada e vigorosa (73.6±26.1 vs. 56.0±22.5 min; *P*>0.05, d=0.7) e de compósito de aptidão física (0.34±0.7 vs. 0.36±0.8 unidades arbitrárias; p<0.001, d=0.4). De igual modo, o SG apresentou menores valores de pressão arterial sistólica (108.4±10.6 vs. 114.4±12.5 mmHg; p=0.012, d=0.3) e soma de fatores de risco cardiovascular (6.8±2.8 vs. 8.3±2.9 unidades arbitrárias; p=0.034, d=0.3).

Conclusões: Crianças em idade escolar podem beneficiar da prática regular de futebol extraescolar como uma estratégia para melhorar os níveis de aptidão física e diminuir o risco cardiovascular.

Palavras-chave: Futebol; Desportos coletivos; Juventude; Saúde; Cardiovascular; Cardiorrespiratório

Introduction

Over the past few years, several studies have been conducted in order to investigate the impact of regular soccer practice on a considerable number of health parameters of distinct populations (1). Regular soccer practice has proven to induce significant benefits in physical fitness and cardiovascular health parameters of adults and children (2-7). Soccer is a very popular and pleasant sport to many children, but to date, most of the studies have been conducted in adults, and little is known regarding the impact of regular soccer practice in early ages.

Exercise-induced health benefits depend on adherence rates to exercise, and the latest is influenced by motivation and self-determination (8). Given the popularity of the sport, the adherence to soccer programs are high among the youth, and this might promote significant and relevant health benefits (9). In this line, physical education classes have proven to be a privileged context for the application of soccer intervention programs, resulting on improved physical fitness and contributing to health benefits (10).

Unfavourable cardiovascular risk profiles have been described in younger populations, particularly in children with low levels of cardiorespiratory fitness and high percentages of body fat (11), and it has been observed a trend to track through adulthood (12). A strong relationship between clustered risk and physical fitness, specially cardiorespiratory fitness, has also been identified (12). Previous studies have shown that physical education classes are the most privileged context for the promotion of public health through physical activity in children (13). However, the activities promoted do not always meet the intensity levels required to induce health gains, namely reducing cardiovascular risk (14, 15). Thus, extra-school sports participation often plays an important role, allowing the children to meet the desired levels of physical activity and exercise intensity in order to reduce cardiovascular risk (16, 17). In the present study, we aimed to further investigate differences in physical fitness and cardiovascular risk factors of male children aged 8–11 years engaging, or not, in after-school soccer practice.

Methods

Participants

The sample was composed by 71 male children aged 9.6 ± 0.7 (range 8–11) years. Height, weight and body mass index were: 136.4 ± 6.8 cm, 36.5 ± 8.3 kg and 19.5 ± 3.5 kg/m^2, respectively. The children were recruited in six elementary schools of the same community in Braga, Portugal, and two groups were formed: soccer group (SG; n = 33) and control group (CG; n = 38). The inclusion criteria for the SG was that the child had been engaged with regular and oriented after-school soccer practice in the 5 months prior to the study, with two weekly 60-min practice sessions and sporadic weekend matches. The soccer training sessions consisted of a general warm-up, followed by technical exercises and several small-sided soccer games. On the other hand, children from CG were not engaged with any regular and oriented physical activity other than elementary physical education classes, consisting of three sessions per week. Generally, school-based physical education classes consisted of a general warm-up, technical exercises of several sports, small-sided games and recreational activities lasting a total of 45 minutes. The emphasis of the physical education classes was made on several different sports, according to the timing of the year and the National programme for physical education. The soccer season and the school season were coincident, and had the duration of 10 months. Information about physical activity engagement was collected via individual interviews with each child 5 months prior and at the start of the study.

Procedures

In each school, the cross-sectional measurements took place in two sessions, with an interval of two days apart. The first session was dedicated to anthropometry and blood pressure analysis; the second session was devoted to physical fitness assessment.

The study design and the procedures used are in accordance with ethical standards and the Declaration of Helsinki. The University of Porto Ethics Committee approved the study. All children and their parents were fully informed about the risks associated with study participation, and provided written informed consent.

Instruments

Anthropometry

Height was measured with a stadiometer (model 708, Seca, Hamburg, Germany); weight and percentage of body fat were assessed with a Tanita Inner Scan (BC-532, Tanita, Hoofddorp, Netherlands). Waist circumference was measured to the nearest millimeter with flexible tape, midway between the lowest rib and the iliac crest and hip circumference at the level of the great trochanters (18). Duplicate measures were taken for each individual. Children wore light clothing and shoes were removed.

Physical fitness

With the exception of anthropometry and physical activity, all tests were administered indoors on a multi-sports ground. Prior to testing of physical capacities, the children performed a 12-min warm-up consisting of light jogging and stretching exercises, as well as familiarization trials of each test.

Speed was evaluated with a 15-m sprint test. Elapsed times were measured using 3 pairs of photoelectric cells (Speed Trap II, Brower Timing Systems, USA), positioned at the starting line, and at 5 m (5-m sprint) and 15 m (15-m sprint). Subjects were instructed to run as fast as possible from a standing position 30 cm behind the starting line. The better (fastest) of 2 trials was retained for analysis.

Jumping height was evaluated with a countermovement jump (CMJ) on a special mat (Digitime 1000, Digitest, Finland). For the CMJ, the child was standing erect; after flexing the knees to the squat position, he jumped vertically as high as possible maintaining hands on hips. Two trials were given for each jump and the better of the two trials was retained for analysis.

The Yo-Yo intermittent endurance test – level 1 (Yo-Yo IE1) was used to evaluate aerobic capacity (19). Research has proven that this test can be used as an indicator of aerobic fitness for children of this age (20). The test required repeated 2 x 20-m shuttle runs between a start and finish line, at progressively increased speeds controlled by audio bleeps from a CD player; there was a 5-s period of rest between runs. The aim of the test was to perform as many shuttles as possible. When the individual failed twice to reach the finish line in time, the distance covered was recorded and used as the test result. Only one trial was given.

A composite score ($PF_{composite}$) was determined to provide a more complex operational indicator of physical fitness. Z scores were then calculated for all physical fitness tests; performance in 5- and 15-m sprint tests was reversed since lower times reflect better performance.

Physical activity

Physical activity was measured using Actigraph accelerometers (model GT1M, Pensacola, FL, USA), which are small (5.1×3.8×1.5 cm), lightweight (45 g), uniaxial accelerometers that record the occurrence and intensity of movement. Participants were instructed to use the accelerometer attached to an elastic belt placed above the right iliac crest for 7 consecutive days. Instructions were given to wear the monitor all the time, including training sessions, except when sleeping or participating in water activities. Data was analysed with Actlife 6.81 (Pensacola, FL, USA) software. Inclusion criteria for valid data consisted of a minimum recording of 8 h, during a minimum of 4 consecutive days with at least one weekend day (Trost et al., 2005). Sixty min of consecutive zeros were considered invalid data, and therefore excluded from the analysis. Raw data were collected and then analysed with 15-sec epochs in accordance with the procedures suggested elsewhere (21).

Acceleration counts were translated into minutes of light, moderate and vigorous physical activity using accepted cut points of 101, 1952, and 5725, respectively (21). Moderate-to-vigorous physical activity (MVPA), and daily sedentary time (DST) were used in the analysis. Daily sedentary time was estimated by summing the minutes with acceleration counts between 0 and 100 for valid hours of monitoring.

Blood pressure

Systolic and diastolic blood pressure measurements were performed with Colin model BP 8800 (Critikron, Inc., Tampa, FL, USA) on the right arm after a 5-min rest. Participants were in a comfortably seated position with their back supported and legs not crossed. The arm was bared without constrictive clothes, supported at the heart level and resting in a table. At least two readings were performed at 5-min intervals; if there was a > 5 mmHg difference between the first and second readings additional readings were done. The average of two readings with < 5 mmHg difference was used for analysis (22).

Cardiovascular risk

In order to evaluate cardiovascular risk, the following parameters were divided in quartiles: waist circumference, fat mass percentage and systolic blood pressure. The quartiles of each individual in these parameters were summed in order to reflect individual cardiovascular risk.

Data analysis

Data was tested positively for normality using the Kolmogorov-Smirnov test. Descriptive statistics (mean ± standard deviation) were calculated. Differences between groups were obtained using independent-samples *t*-test. Standardized differences in means (effect sizes, *d*) were computed for comparisons. Effect sizes were classified according to Hopkins (23) as trivial ($d < 0.2$), small ($0.2 < d < 0.6$) moderate ($0.6 < d < 1.2$), large ($1.2 < d < 2.0$), very large ($2.0 < d < 4.0$), nearly perfect ($d > 4.0$), and perfect (d = infinite). Predictive values of $PF_{composite}$ and DST were obtained using linear regression analysis. Significance was set to $p < 0.05$.

Results

Table 1 presents age, anthropometry, physical activity, physical fitness, and cardiovascular risk. No significant differences were found between SG and CG for any anthropometric variables (weight: p = 0.26; height: p = 0.89; BMI = 0.11; lean mass: p = 0.78), except for fat percentage (p=0.005; d = 0.23) with higher values for the CG. No significant differences were found for daily sedentary time (p = 0.49). Significant differences were detected between groups for physical fitness and MVPA. SG presented higher values for Yo-Yo IE1 (p < 0.001; d = 0.55), 5-m sprint test (p = 0.002; d = 0.30), 15-m sprint test (p = 0.001; d = 0.33), $PF_{composite}$ (p < 0.001; d = 0.42) and MVPA (*p* > 0.05; d = 0.72) than CG. Additionally, compared to CG, the SG presented lower values for systolic blood pressure (p = 0.012; d = 0.25) and cardiovascular risk (p=0.034; d = 0.20). No differences were detected for diastolic blood pressure (p = 0.272) and waist circumference (p = 0.212).

Table 1. Comparisons between the football group (FG) and control group (CG) in age, anthropometry, physical activity, physical fitness and cardiovascular risk factors.

	FG	CG	p	Effect size
Age (years)	9.6±0.7	9.6±0.7	0.610	0
Weight (kg)	35.3±7.5	37.6±8.9	0.264	0.14
Height (cm)	136.5±6.7	136.3±6.9	0.885	0.01
BMI [kg/(m)^2]	18.8±2.5	20.1±3.5	0.108	0.21
Lean Mass (kg)	27.8±4.4	28.1±4.9	0.776	0.03
Fat (%)	20.4±5.8	23.8±8.2	0.054	0.23
Physical activity				
MVPA (min/day)	73.6±26.1	56.0±22.5	0.008	0.72
DST (min/day)	391.4±73.1	404.4±67.8	0.490	0.18
Physical fitness				
Yo-Yo IE1 (m)	1391±566.6	774.6±349.3	<0.001	0.55
5-m sprint (s)	1.27±0.07	1.32±0.09	0.019	0.30
15-m sprint (s)	3.08±0.14	3.20±0.20	0.007	0.33
CMJ (cm)	23.6±5	21.6±4	0.085	0.22
$PF_{composite}$ (arbitrary units)	0.34±0.7	-0.36±0.8	<0.001	0.42
Cardiovascular Risk				
Systolic blood pressure (mmHg)	108.4±10.6	114.4±12.5	0.035	0.25
Waist circumference (cm)	63±7.2	66.4±9.7	0.104	0.20
Cardiovascular risk (arbitrary units)	6.8±2.8	8.3±2.9	0.041	0.25

MVPA, Moderate-to-vigorous physical activity; DST, Daily sedentary time; CMJ, Countermovement jump; $PF_{composite}$, composite score of physical fitness tests

$PF_{composite}$ and MVPA presented significant predictive value on cardiovascular risk. A stepwise regression model including both $PF_{composite}$ and MVPA presented a significant predictive value on the cardiovascular risk factors ($r^2 = 0.41$; $p < 0.001$).

Discussion

The present study aimed to investigate the differences in physical fitness and cardiovascular risk of two groups of male school children, one with regular engagement with after-school soccer practice and one with no extra-school sports participation. The results indicate that children engaged with regular after-school soccer practice presented higher fitness levels and lower cardiovascular risk comparing with children not engaged with any oriented extra-school sports participation. The positive association between regular sports participation and enhanced physical fitness is well documented (24-26); thus, the results support the assumption that regular participation in organised sports is more effective on improving cardiovascular health than non-organised sports practice (17).

We observed that MVPA levels of children engaged with regular after-school soccer practice were higher than that of children not engaged with any oriented extra-school sports participation. It is therefore plausible to state that the characteristics of soccer—a highly intermittent activity with multiple turns, jumps, sprints, accelerations and decelerations (27)—might induce a proper impact on children's health, by meeting the standard recommendations for daily MVPA levels (28, 29). In the present study, soccer practice might have been the cause for the higher fitness levels presented by the youths that practiced soccer regularly after school. Concomitantly, the soccer group also showed lower values for body fat percentage. In youths, body composition can be improved by increasing physical activity (25, 30). Since a selection process hardly exists in pre-pubertal soccer players, the explanation for the differences on body fat percentage might at less partially reside on the engagement with regular after-school soccer practice.

We observed that physical fitness and MVPA were significant predictors of cardiovascular risk; children with higher physical fitness and higher daily moderate-to-vigorous physical activity presented lower cardiovascular risk. Interestingly, cardiovascular risk was higher on the control group than in soccer group. This is in accordance with evidence that unfavourable cardiovascular risk profiles are usually reported in youths with low levels of physical fitness, high percentages of body fat and low physical activity (31-33).

Altogether, the results suggest that soccer programs, applied as after-school physical activity, might induce positive effects on the children's physical fitness levels. Indeed, recent research highlighted that physical education programs should incorporate exercise with high intensity profiles, such as soccer (10). Soccer is an activity associated with high motivational levels, therefore with the potential of implementing regular physical activity habits on children of early ages. Incorporating soccer-related activities on physical education programs might be an effective strategy to induce significant physical fitness improvements and to reduce cardiovascular risk in children.

Limitations

The lack of effective control of physical education classes and soccer training sessions, as well as maturational status stands as limitations of the present study.

Conclusion

After-school soccer practice stands as a valid strategy to improve physical fitness and thwart cardiovascular risk factors in pre-pubertal children. Since physical education classes are a privileged context for the promotion of physical activity in early ages, the inclusion of soccer practice on physical education programs should be strongly considered.

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