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Contribution of Organized Sport Participation to Health-Related Fitness in Adolescents

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Abstract

The purpose of this study was to investigate the relationship between organized sport (OS) participation and health-related fitness (HRF) in adolescents. A total of 320 adolescents (176 boys) aged between 10 and 16 years reported their engagement in OS and were assessed on 5 components of HRF (cardiovascular endurance, push-ups, curl-ups, flexibility, and body mass index). Data on OS participation frequency and duration were collected through a self-reported questionnaire. Adolescents were stratified by OS participation (engaged, n = 113; nonengaged, n = 220; 55% boys). Nonparametric quantile regression models were used to estimate the differences in HRF by participation group. Less than 30% of the participants reported they were regularly engaged in OS. Frequency of participation ranged from 2 to 5 days per week (median = 2; SD = 3), and duration of participation ranged from 45 to 180 minutes per week (median = 81.7; SD = 32.4). Adolescents who participated in OS displayed better cardiovascular endurance (+4.1 laps completed), with no statistically significant difference detected on any other HRF component. Our results highlight engagement in OS as a promising strategy for achieving cardiovascular endurance. Engagement in OS alone does not seem to be sufficient to enhance fitness components other than cardiovascular endurance.

Keywords

organized physical activity, physical fitness, youth

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Introduction

The Global Advocacy for Physical Activity report,[1] among many other government reports,[2-4] has acknowledged that organized sport (OS) participation (eg, sports, dance, and martial arts) can play a key role in youth's accumulation of physical activity (PA). OS includes structured games and regular training sessions that are supervised by a coach, instructor, or teacher,[5-7] and have been considered one of the most important environments for children and youth to accumulate health enhancing levels of PA.[7-9]

Previous studies show that individuals engaged in OS are more likely to achieve PA guidelines,[10] have greater levels of PA,[11] and spend more time in moderate, vigorous,[10] and moderate vigorous physical activity,[10,12] when compared with nonparticipants. Furthermore, OS programs allow youth to participate in weekly training sessions that contribute to increased energy expenditure,[13] which may increase physical fitness.[14-16] For example, Basterfield et al[17] reported an inverse relationship between fat weight (estimated from bioelectric impedance) and sport club participation in 12-year-old adolescents. Fransen et al[15] investigated differences in physical fitness (flexibility, speed and agility, and cardiovascular endurance) between 12-year-old adolescents participating in one versus multiple OS's. Findings suggested that adolescents in more than one sport performed better on knee pushups, the standing broad jump, cardiovascular endurance, and the shuttle run tests. However, the study did not include children who were nonengaged in OS, not allowing the study's authors to draw conclusions about the differences in health-related fitness (HRF) between children who are not engaged in OS and those who are.

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While some studies have shown a relationship between OS participation and fitness, it is still unclear whether OS participation can improve all components of HRF.[18,19] Cross-sectional[10,19,20] and longitudinal[18] studies have shown that engaging in OS is not associated with body mass index (BMI) in youth. Furthermore, Phillip and Young[19] reported that adolescents who participated in OS did not differ in cardiovascular endurance, when compared with adolescents who were nonengaged in OS.

Engagement in OS does not guarantee that all individuals will achieve health-related benefits such as muscular strength and flexibility, since some OS programs might not provide PA at the frequency and duration necessary to enhance HRF in youth.[20-22] Frequency and duration of OS should be considered when examining the health-related benefits of OS.[22-24] Previous studies[25,26] have reported some OS programs offer practice only once per week, with a duration of less than 1 hour per session.[22,24] These infrequent and short OS programs might not provide enough active time, which means that the adolescent might not be sufficiently active to expend energy on a consistent basis to enhance participant's HRF.[22] Frequency, duration, and intensity of OS participation are all important factors that can influence HRF of OS participants. Thus, the purpose of this study was to investigate the relationship between OS participation and HRF of adolescents.

Methods

Participants

Participants in this cross-sectional study were healthy adolescents aged between 10 and 16 years from a public school located in the urban northwestern part of Brazil. This school was purposefully selected because it offers free OS for students. The study included only those adolescents who met the follows inclusion criteria: (1) volunteers; (2) aged between 10 and 16 years; (3) no report of learning difficulties or physical, neurological, or orthopedic problems; and (4) completed all study's procedures. Literature suggests that in order to provide benefits, individuals should participate in OS programs more than once a week.[27] Thus, for the purpose of this study only adolescents who reported practicing for at least 2 days or more per week (ie, frequency) for a minimum of 45 minutes (duration) per practice were included in the final sample. Those adolescents who reported current engagement in OS but not for the requisite frequency and/or duration were excluded from the sample ($n = 8$). All participants were Brazilian and had similar social demographic status characteristics (see Table 1 for descriptive characteristics).

Procedure

Prior to the completion of HRF tests, participants completed a questionnaire to collect OS participation data. Height and weight were also collected from all participants. Height was assessed with a portable stadiometer (GIMI, Inc) to the nearest 0.01 m, and weight (kg) was measured using a portable digital scale (Glicomed, Inc) to the nearest 0.1 g.

Organized Sport

The questionnaire to collect OS participation was completed by all participants under the supervision of a trained researcher. OS was defined as activities that (1) involved regular classes, training, or competition; (2) were formally structured; and (3) were led by a coach, instructor, or teacher.[28] Examples include attending dance or martial arts; swimming or athletics clubs; playing soccer or basketball; or any other team or individual sports. Collecting OS participation via a questionnaire is consistent with past research.[15,29-34] A self-report measurement is often the most feasible methodology to collect information on OS participation because it is cost-effective, efficient, and easy to administer on a large scale. Additionally, the questionnaire used was originally developed for this study,[35] and it reported excellent content validity (based on experts' ratings of item relevance, clarity, and pertinence; content validity index = 85%) and test-retest reliability ($\geq .75$) using Cohen's κ coefficient.[36]

The present study questionnaire[35] was developed to analyze adolescents' organized PA, including OS participation (excluding physical education). Students reported the type of the organized activity (eg, swimming, soccer, and ballet), frequency of participation (ie, times attended per week), and the duration (ie, hours per practice) of the activities in which they were engaged in the last 6 months. Adolescents were stratified into 2 groups: (1) "engaged in OS" and (2) "nonengaged" (for descriptive characteristics see Table 1).

Health-Related Fitness

Five physical fitness components (upper-body strength/endurance [number of push-ups in a minute]), abdominal muscle strength/endurance (number of curl-ups in a minute), BMI (weight [kg]/height [m^2]), lower back flexibility (sit and reach), and cardiovascular endurance (Cooper 12-minute walk/run test) were used to assess students' HRF. Previous research has demonstrated acceptable validity and reliability of these tests and protocols.[37] Tests were conducted as part of regular

Table 1. Mean (M) and Standard Deviation (SD) of Age, Mass, Height, Frequency, and Duration of Organized Sport Participation and Distribution of Type of Organized Sport Participation.

	Organized Sport Participants (n = 113)		Nonparticipants (n = 207)		
Descriptive Characteristics	Mean	SD	Mean	SD	*P*
Age (years)	12.4	1.1	12.3	1.0	.814
Mass (kg)	45.2	6.0	44.9	5.4	.967
Height (cm)	152.9	7.5	153.4	6.4	.275
	Mean	SD			
Frequency of organized sport (events per week)	2	3			
Duration of organized sport (minutes)	78.2	34.4			
	n	%			
Type of organized sport practiced					
Soccer	48	42.5			
Indoor soccer	18	15.9			
Volleyball	6	5.3			
Basketball	3	2.7			
Athletics	2	1.8			
Swimming	19	16.8			
Dance	14	12.4			
Other	3	2.7			
Total	113	100			

physical education classes. Prior to testing students were familiarized with the testing procedures. Students were required to wear proper clothing (shorts, running shoes, T-shirts) to participate in physical fitness testing. A 10-minute warmup period of stretching and jogging was performed prior to measurements. All tests were completed at an indoor soccer facility at the school. Trained research assistants administered all fitness tests.

Data Analysis

Initially, analysis of descriptive data (frequency, duration, and type of sport practiced) and the normality (Kolmogorov-Smirnov) of the sample was assessed. Because the data were not normally distributed, nonparametric analyses were used. Mann-Whitney *U* tests assessed anthropometric differences between the engaged and nonengaged groups and differences in median HRF scores between engaged and nonengaged OS participants were estimated using quantile regression models. Principles of quantile regression are considered to have better power when compared with other methods, making the analyses quite robust.[38-40] Median scores on HRF components (ie, push-ups in a minute, number of curl-up in a minute, BMI, sit and reach, and Cooper 12-minute walk/run test) were used as dependents variables and OS participation as the independent variable. Age and gender were included as covariates in all analyses. Data were analyzed using Stata release 14.1, with the statistical significance set at $P \leq .05$.

Ethical Approval and Informed Consent

Prior to data collection, study procedures were approved by the institutional review board (UPE IRB: CAAE: 05712212.9.0000.5207), and written informed consent was collected from all participants and their parents/guardians.

Results

The summary of participants' anthropometric characteristics and descriptive statistics of OS are provided in Table 1. A total of 320 adolescents participated in this study (boys = 176; 55%). Of those 113 (33.9%) reported they were currently engaged in OS, with 72 (63.7%) of OS participants being boys. Soccer (n = 48; 42.2%) and indoor soccer (n = 18; 15.9%) were the most common OS reported. Frequency of OS participation of the engaged group varied from 2 to 5 days per week (median = 2 days per week; SD = 3). The duration reported ranged from 45 to 180 minutes per practice (median = 78.2; SD = 34.4 minutes per day). Mann-Whitney *U* tests did not find differences among age, weight, and height between OS engaged and non-engaged groups.

Table 2. Differences in Health-Related Fitness Between Organized Sport Participants and Nonparticipants Estimated by Quantile Regression.

	Organized Sport Participants (n = 113)		Nonparticipants (n = 207)			
	Median	IQR	Median	IQR	Difference	95% CI
BMI, kg/m^2	20.0	2.3	20.5	2.1	−0.5	0.0 to 1.0
Number of laps[a]	**36.2**	**15.5**	**31.6**	**13.6**	**4.6**	**1.6 to 7.7**
Flexibility (cm)	25.7	4.0	26.2	4.6	−0.5	−0.4 to 1.4
Curl up (n)	34.9	10	35.7	10	−0.8	−3.4 to 1.8
Push up (n)	11.7	4	11.7	4	0.0	−0.6 to 0.6

Abbreviations: IQR, interquartile range; CI, confidence interval; BMI, body mass index.
[a]Boldface indicates $P \leq .05$.

Table 2 presents descriptive performance of HRF tests. Median and interquartile range for cardiovascular endurance, number of push-ups and curls-ups performed, distance (cm) reached in the sit and reach, BMI, and frequency and duration are reported for all participants.

Differences in HRF by OS are also reported in Table 2. Primary analyses indicated a significant difference, for number of completed laps (95% confidence interval [CI] = 1.6 to 7.7) between the engaged and nonengaged groups on the Cooper 12-minute walk/run test, with the engaged group performing 4.1 more laps relative to those that were nonengaged in OS. Age was a significant covariate for number of laps performed (95% CI = −6.12027 to −1.750699). There were no significant differences between engaged and nonengaged groups observed for the number of push-ups, distance reached on the sit and reach test, number of curl-ups completed, or BMI.

Discussion

The purpose of this study was to investigate the relationship between OS participation and HRF in a sample of adolescents aged between 10 and 16 years.

The results of this study indicate that, overall, there was an association between cardiovascular endurance and current engagement in OS. In this sample, adolescents who reported engagement in OS ran more laps than those who were not currently engaged. These results are consistent with the literature linking cardiovascular endurance and OS.[15,19,20]

Individuals exposed to a greater amount of PA, generally are more active, which contributes to increased cardiovascular endurance.[15,41] Thus, since the majority of participants in this study were involved in soccer or indoor soccer, which requires large amounts of running, it is not surprising that participants engaged in OS in this sample displayed greater cardiovascular endurance when compared with those participants who were not engaged in OS.

However, our results reported that there was no other significant difference between OS and HRF aside from cardiovascular endurance, with adolescents presenting similar performance for the number of push-ups completed in a minute, the sit and reach test, the number of curl-ups completed in a minute, and BMI. These findings were also consistent with previous literature, with previous studies reporting no association between OS and other components of HRF.[19,20]

The nonsignificant results for fitness tests other than cardiovascular endurance can be explained for 2 reasons. First, the students in our sample reported a wide range of frequency (2-5 days) and duration (45-180 minutes) in OS, which might not be the ideal format to consistently improve certain aspects of fitness that are not specifically focused on OS.[27] The second reason for the similarity between groups is once again due to the majority of participants were engaged in sports that involves large amounts of running,[42] but may neglect strength or flexibility training, such as soccer or indoor soccer.[43] Bergeron[22] highlights that in order to acquire and to optimally promote the HRF benefits, supplemental training of multiple fitness components (ie, endurance, strength, and flexibility training) is needed in OS programs. Thus, it is not a surprise that due to the wide range of frequency and duration of the practice and the lack of emphasis on training all of HRF's components, there was no difference between engaged and nonengaged groups regarding the other HRF components. Taken together duration and frequency and specific training of multiple fitness components should be considered in order to promote substantial improvements in all aspects of HRF.

Some limitations should be considered when interpreting the findings of this study. The sample was not randomly selected and included only one high school limiting generalizability. Furthermore, the cross-sectional nature

of the data limits the ability determine a causal relationship between OS and HRF.

Conclusion

The findings of this study suggest that participation in OS is a regular activity for only a small portion of the adolescents. Findings also suggest that OS is related to cardiovascular endurance of participants. However, future studies examining reasons for drop out from OS are needed.

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Author Contributions

CCC, RWG, DFS, and MTC contributed to the conception of the study, CCC and MTC contributed to study's design. CCC and RWG contributed to study analysis, and DFS and MTC contributed to results interpretation. CCC drafted the paper and RWG, DFS, and MTC critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of work.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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