The Relationship between Sports Participation and Health-Related Physical Fitness in Middle School and High School Students

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Abstract

The purpose of this case study was to examine the relationship between sports participation and health-related physical fitness in middle school and high school students. Health-related physical fitness was measured using the Fitnessgram test battery to assess healthy fitness zone (HFZ) achievement in five areas: body composition, muscular strength, muscular endurance, muscular flexibility, and cardiovascular fitness. Students also indicated the number of organized sports in which they participated during the past 12 months. Chi-square analysis was run on sports participation and number of HFZs achieved layered by sex. There was a significant difference between the expected number and the observed number of HFZs achieved by sports participation for males ($p = .035$), but not females ($p = .255$). Males who played more sports achieved significantly more HFZs than males who played fewer sports, possibly due to the prolonged and intense nature of the sports they played most. It is recommended that physical educators encourage sports participation for all students to increase physical activity levels and improve health-related physical fitness in their students.

Physical activity (PA) is important in maintaining and improving health, especially in children and adolescents. In spite of overwhelming evidence of the physical and the psychological benefits of adequate PA, PA levels are declining in youth (Allison, Adlaf, Dwyer, Lysy, & Irving, 2007). Not surprising, subsequent rises in obesity have been evident in the past decade (Li, Ford, Mokdad, & Cook, 2007). To combat obesity in youth, methods of increasing PA are needed.

One way in which youth perform PA is through organized sport. Sport participation has even been shown to contribute to vigorous PA in the later high school years of females, a time when PA for this group tends to decline (Pfeiffer et al., 2006). Yet, according to the results of the 2007 Risk Behavior Survey, only half of high school students participate in some form of sport (Eaton et al., 2008). Similar results were found in a group of adolescent females (Phillips & Young, 2009). Consequently, girls who participated in sports had higher estimated energy expenditure and were more likely to complete a three-stage step test than their counterparts who did not play sports. Past sports participation was also positively associated with current PA levels. High school males also benefit from sports participation with more favorable blood pressures, lipid profiles, and percent body fat levels than those who do not participate in sports (Kawabe et al., 2000). However, the impact of sports participation on health-related physical fitness is not well documented.

The Fitnessgram test battery was developed in the late 1980s as a means to measure health-related physical fitness in children (Meredith & Welk, 2005). In the past 20 years, Fitnessgram testing has grown in popularity and is used to test children of different physical capacities, fitness levels, and races (Fahlman, Hall, & Lock, 2006; Mota, Flores, Flores, Ribeiro, & Santos, 2006; Painter, Krasnoff, & Mathias, 2007). The aim of the Fitnessgram test battery is not the testing of sport-specific fitness such as speed and power, but physical fitness as it pertains to health. A healthy fitness zone (HFZ) is defined by a score on a given test that indicates a healthy level for that component of physical fitness. For example, the HFZ for the Progressive Aerobic Cardiovascular Endurance Run (PACER) test for a 13-year-old boy begins at 41 completed laps.

While sports participation increases PA levels, it is unclear if it is directly related to health-related physical fitness levels in youth. Therefore, the purpose of this case study was to examine the relationship between sports participation and health-related physical fitness levels in middle school students and high school students as determined by the HFZs set forth by Fitnessgram.

Methodology

Participants

Students from a single private school (N = 246) in grades 7 through 12 participated in the study. The school was selected at the request of the school principle. Student ages ranged from 11 years to 18 years. Parental consent and student assent were obtained prior to testing. Descriptive statistics appear in Table 1.

Table 1

Descriptive Statistics for the Sample (N = 246)

Variables	M	SD
Age (years)		
Entire sample	14.5	1.7
Males (n = 144)	14.6	1.7
Females (n = 102)	14.4	1.7
BMI (kg/m^2)		
Entire sample	23.0	4.1
Males	23.3	4.0
Females	22.6	4.2

Note. BMI = body mass index.

Instrumentation

The Fitnessgram battery of tests was used to measure health-related physical fitness. Each component of fitness (body composition, muscular fitness, flexibility, cardiovascular fitness) has specific, validated cut-points at or above which children must achieve to be in the HFZ. The Fitnessgram Test Administration Manual (Meredith & Welk, 2005) details all HFZs which vary by age and sex.

Percent body fat. Percent body fat (BF) was assessed by triceps and calf skinfold measurements using Lange calipers (Beta Technology, Inc., Cambridge, MD) according to the instructions in the Fitnessgram Test Administration Manual (Meredith & Welk, 2005). Each site was measured twice. If the two measurements were not within 2 millimeters, a third measure was taken and the two closest measures were averaged and used to compute BF. The average of the two measurements was entered into the Fitnessgram software to compute BF.

Muscular fitness. Muscular strength and endurance were measured using the modified pull-up test and the abdominal curl-up test. To perform the modified pull-up test, students laid supine on the floor and grasped a bar on a modified pull-up stand. They pulled their bodies off the ground until their chest touched an elastic band 7 inches to 8 inches below the pull-up bar, while keeping their bodies rigid and heels of their feet in contact with the ground. After one warning, students were stopped the second time they could no longer maintain correct form (e.g., their posterior touched the floor).

In the abdominal curl-up test, students laid supine on the floor with knees flexed, heels flat on a mat, and arms straight to their sides with fingers touching a strip of carpet cut 4.5 inches wide. The students then curled their trunks upward until their fingers reached the other side of the carpet strip. Students were given a warning when they broke form the first time and were stopped after they broke form a second time. The maximum number of curl-ups recorded for each student was 75, as described by the Fitnessgram testing manual (Meredith & Welk, 2005).

Muscular flexibility. Muscular flexibility was measured using the Acuflex I sit-and-reach box (Novel Products, In., Rockton, IL). Prior to measurement, the students were asked to remove their shoes. The back saver sit-and-reach test was performed by extending one leg with the foot flat against the box. The other knee was bent with the sole of that foot flat on the floor. The arms were extended forward over the box with hands placed one atop the other. Students completed three attempts with each leg and the best attempt for each leg was recorded. Students who reached the distance for the HFZ for either leg were counted as achieving the flexibility HFZ.

Cardiovascular fitness. Cardiovascular fitness was measured using the PACER test. This test requires students to run back and forth over a 20-meter interval at an increasingly faster pace. Students were cued to the time intervals by a recording provided in the Fitnessgram test battery. The compact disc played music and beeps that signaled students to run to the other end of the 20-meter interval. Students were warned once if they did not make it to the other side before the beep and encouraged to increase their pace. The second time students did not make it to the other side before the beep, they were stopped and the laps completed were recorded.

Sports participation. Students identified the number of sports they played in the past 12 months via questionnaire. The multiple-choice format question was taken from the 2007 Youth Risk Behavior Survey. The question "During the past 12 months, on how many sports teams did you play? (Include any teams run by your school or community group.)" had four possible responses: 0 teams, 1 team, 2 teams, 3 or more teams.

Procedures

University Institutional Review Board approval was gained before the study was conducted. Trained and experienced Exercise Science graduate students and faculty administered the five Fitnessgram tests. First, students filled out the questionnaire and had their skinfolds measured. This was followed by height and weight measures. Students then moved in groups through different stations to perform the modified pull-up, curl-up, and back saver sit-and-reach tests. These tests were all conducted in the school library. The PACER test was conducted in the gymnasium the following day.

Data Analyses

Data were entered into the Teacher's Edition of the Fitnessgram software (Fitnessgram Version 8.0, Human Kinetics, Inc.) to calculate the number of HFZs achieved by each student, with HFZs defined as the score on a given test by age and sex that indicated a healthy level of fitness. Sports participation numbers and HFZs achieved were then entered into the Statistical Package for the Social Sciences (Version 17.0) for analysis. Chi-square analyses were used to examine the relationship between sports participation and HFZs achieved for each sex. Statistical significance was set at an alpha of .05.

Results

Descriptive statistics for the sample appear in Table 1. The distribution of males and females by grade appear in Table 2. A significant difference between the expected number and the observed number of HFZs achieved by sports participation was found for males, $\chi^2(15) = 26.26$, $p = .035$. Males who participated in more sports achieved more HFZs than males who participated in fewer sports. No significant difference was found for females, $\chi^2(12) = 14.75$, $p = .255$. Females who participated in more sports did not achieve more HFZs than females who participated in fewer sports. The number of HFZs students achieved by the number of sports in which students participated by sex appear in Tables 3 and 4.

Table 2

Sex and Grade Distribution of Participants (N = 246)

	Grade					
Sex	**7th**	**8th**	**9th**	**10th**	**11th**	**12th**
Males	19	33	27	21	18	26
Females	20	19	19	17	14	13

Discussion

The purpose of this case study was to examine the relationship between sports participation and healthy physical fitness levels in middle school students and high school students as determined by the HFZs set forth by Fitnessgram. Although numerous benefits of PA exist (Rodearmel et al., 2007) and sports participation has been shown to increase vigorous PA (Pfeiffer et al., 2006) as well as improve other health-related variables in youth (Kawabe et al., 2000; Phillips & Young, 2009), the extent to which sports participation is related to health-related physical fitness levels as assessed by the Fitnessgram is undocumented. The current study revealed a significant difference between the expected

Table 3

Sports Participation by Number of Healthy Fitness Zones (HFZs) Achieved in Males (n = 144)

Sports	**HFZs**					
Participation	**0**	**1**	**2**	**3**	**4**	**5**
0	0	3	6	9	4	1
1	1	3	9	9	9	6
2	1	2	9	5	11	15
> 2	0	2	2	7	14	16

Note. Sports participation represents the number of sports in which students participated.

Table 4

Sports Participation by Number of Healthy Fitness Zones (HFZs) Achieved in Females (n = 102)

Sports	**HFZs**					
Participation	**0**	**1**	**2**	**3**	**4**	**5**
0	0	3	1	7	3	8
1	0	2	3	9	5	12
2	0	2	2	4	5	8
> 2	0	0	0	4	12	12

Note. Sports participation represents the number of sports in which students participated.

number and the observed number of HFZs achieved by sports participation for male students. Males who participated in more sports achieved more HFZs than those who played fewer sports. Conversely, females who participated in more sports did not achieve more HFZs than those who played fewer sports.

The finding that males who participated in more sports achieve more HFZs than males who participated in fewer sports is in agreement with the findings of Kawabe and colleagues (2000). According to Kawabe et al., the increased PA that boys acquire from sports is probably responsible for lower body fat and blood pressure as well as superior lipid profiles. Unlike the study by Kawabe et al., the current study also included measures of muscular fitness (i.e., strength and endurance) and muscular flexibility. The strength and conditioning component of high school athletics, such as weight lifting and stretching sessions before and after practices, is likely to have caused these types of fitness improvements.

Females in the present study, unlike those in the study by Phillips and Young (2009), who participated in more sports did not achieve more HFZs than those who participated in fewer sports. The difference in the samples between the present study and the study by Phillips and Young may account for the difference in statistical significance. Phillips and Young had a sample of 221 predominantly African-American ninth grade girls from an urban school whereas the current study had only 102, predominantly Caucasian girls from grades 7 through 12 that attended a private school. Due to this difference in samples, a difference in sport choice may exist. If girls in urban schools play sports that require PA at a higher intensity (e.g., basketball) whereas the girls in a small private school enjoy sports (e.g., cheerleading, golf) that are of a lower intensity with, perhaps, less time at practice, girls in urban schools playing more sports may gain more fitness benefits. Kawabe et al. (2000) also mentioned the superiority of higher intensity aerobic sports to lower intensity sports in improving fitness. However, the present study and the Phillips and Young study included the general question from the Youth Risk Behavior Survey and therefore no data regarding type of sport were collected. Future studies would benefit from data on sport choice and the analysis thereof.

The results of this study are pertinent to the physical educator because they lend support to a method of enhancing students' physical fitness levels. Although physical educators assist children in developing motor and sport skills in a gymnasium setting while promoting PA, this may not be enough to increase PA to recommended levels. By encouraging students to participate in some form of organized sport, teachers can aid students in achieving healthy physical fitness levels and give them a foundation and appreciation for life-long physical fitness. School systems also share a role in student health by the support they give to sports programs. Offering various intramural and extramural sports to students can optimize sports participation and thereby increase opportunities for PA.

Which particular sport produces the highest level of health-related physical fitness for each component of physical fitness (muscular endurance, muscular strength, muscular flexibility, cardiorespiratory fitness, and body composition) merits further research. Indeed, certain sports require different intensities and amounts of PA (Bergeron, 2007). Although football and baseball have more "down time," football players and baseball players tend to excel more in muscular fitness. More aerobic-natured sports (e.g., soccer, tennis) probably increase cardiovascular health more than anaerobic-natured sports like football and baseball. Especially in light of the findings of the current study in which girls did not obtain the same the benefits as boys regarding increased sports participation, future research on sport choice and health-related physical fitness is needed.

Conclusion

Currently, children are becoming less active and more overweight. To curb childhood inactivity and obesity, sports participation may be an effective tool. The present study revealed that increased sports participation is related to increased health-related physical fitness as measured by Fitnessgram in middle school and high school males, but not females. This sex difference may be attributed to the difference of sport choice between boys and girls, especially in a private school setting. Future research is needed to distinguish which sports provide the greatest health-related physical fitness benefits to students. With budgetary and time constraints looming for physical educators, promoting increased sports participation can have a positive effect on their students' physical fitness while requiring no additional resources of the physical educator.

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