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PHYSICAL FITNESS

Examining the Relationship Between High School Physical Education and Fitness Outcomes in College Students

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Abstract

The decline in physical activity (PA) from youth to young adulthood is evident, though limited research has addressed whether specific factors of K–12 physical education (PE) have any influence on outcomes during college years. This study examined the relationship between college students' physical fitness and PA behavior and their high school PE experiences. College student volunteers (n = 537) completed a fitness assessment examining aerobic endurance, muscular endurance, body composition, and blood glucose and lipids. A survey examined current PA and PE experience in high school (number of semesters, enjoyment, requirements). Analyses were conducted separately for males and females. Pearson correlations examined relationships between fitness, behavioral, and PE outcomes. Differences in behavioral and fitness outcomes were compared with t tests. The final sample was 56.6% male (n = 298) and 43.4% female (n = 227). For males, analyses revealed that PE enjoyment was significantly related to VO_2 max , curl-ups, and vigorous physical activity. Number of semesters of PE in high school was negatively associated with triglycerides and

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total cholesterol and positively associated with moderate physical activity. Those who took PE when it was not required were more vigorously active than those who did not. Males who had a waiver for PE had a lower body fat percentage, performed more curl-ups, and were more vigorously and moderately active compared with those who had no waiver. Number of semesters of PE in high school was negatively associated with triglycerides and total cholesterol. PE enjoyment was positively associated with VO_2 max and push-ups. For females, those who took PE when it wasn't required had a higher VO_2 max and vigorous physical activity compared with those who did not. Females with a waiver for PE class had higher triglycerides and total cholesterol compared with those who did not. Females in a coed PE class had a higher BMI and VO_2 max compared with those in a combination class. Effective PE programs that encourage participation and educate students on the benefits of physical activity have the capability to establish lifelong healthy and active habits that translate to the college years, and likely beyond. The main findings of this study have the potential to influence the policies regarding PE requirements for school-aged students in all states, such as possibly increasing PE requirements for all grades and discovering certain aspects of PE that could make it more enjoyable for a larger number of students.

Physical education (PE) in schools is a cornerstone in the development of early physical activity (PA) habits, gross motor and movement skills, and personal and social character development in children and teenagers (Roslow Research Group, 2009). In the past 15 years, PE programs in K–12 schools have placed a greater emphasis on introducing students to activities that encourage lifelong fitness habits by providing children with a wide array of exercise methods and educational techniques that focus on the importance of PA and how they can continue to take the skills and activities learned in K–12 PE and pursue them for a lifetime (Kohl & Cook, 2013). Although PE can positively impact fitness and health outcomes, research suggests that the decline in regular moderate to vigorous and vigorous physical activity participation for males and females begins as early as high school and translates into the college years (Trost, Pate, et al., 2002). Specifically, research suggests that physical activity declines in college at a steady rate from the first semester to

the seventh semester (Small, Bailey-Davis, Morgan, & Maggs, 2013), and sedentary behavior is becoming increasingly more common.

While the clear decline in PA from the youth years to young adulthood, and the resulting negative physical impact, is evident, limited research has addressed whether specific factors of K–12 PE, such as length of participation or level of PE enjoyment, have any influence on frequency, type, and intensity of PA or on physical fitness outcomes during the college years. It is also unclear whether gender differences exist for these outcomes. This study examined the relationship between college students' physical fitness and PA behavior and their high school PE experiences. The results of this study could influence future programming and policies for K–12 PE programs.

Method

Participants and Recruitment

Participants were college student volunteers (n = 537) enrolled in for-credit physical activity and nutrition classes that required a fitness assessment as a part of their course requirements at a university with an approximate enrollment of 44,000 between September 2015 and April 2016. These classes were a part of a student general education requirement. Upon completing the fitness assessment, students were invited to complete a survey and provided written consent to use their data. This study was approved by the institutional review board at ***Pennsylvania State University***.

Fitness Outcomes

Aerobic fitness. All subjects completed the YMCA cycle ergometer protocol, which included of four 3-min stages of submaximal exercise (American College of Sports Medicine, 2013). Heart rate was recorded each minute with an ePulse2 Heart Rate Monitor Armband (Impact Sports Technologies, San Diego, CA). An estimate of maximal oxygen consumption (VO_2max) was calculated via direct heart rate plotting.

Muscular endurance. Assessments included two tests: a 1-min maximum repetition push-up test and a modified curl-up test. Women performed modified push-ups, as per established protocols. Modified curl-ups are performed under a 40-bpm cadence (max

number possible to perform is 75 repetitions; American College of Sports Medicine, 2013).

Body composition. Height, weight, waist girth, body mass index (BMI), and body fat percentage via bioelectrical impedance (Omron BF306, Omron Global, Lake Forest, IL) were used for assessing body composition and weight.

Blood lipids. Participants were asked to fast overnight. Total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), and triglycerides (measured or calculated) were measured with a commercially available analyzer (Cholestech LDX, Alere, Waltham, MA). Forty microliters of blood were collected via finger stick and injected into a Cholestech LDX lipid profile cassette.

Self-Report Measures

Following the objective fitness measurements, subjects were asked to complete a brief survey. An identifying code number linked the participant's fitness outcomes with their survey responses.

Demographics. Students self-reported their age, sex, and race/ethnicity.

Behavioral outcomes. The Global Physical Activity Questionnaire (GPAQ) assessed moderate and vigorous leisure, occupational, and transportation-related physical activity (Armstrong & Bull, 2006). Minutes a week of moderate and vigorous physical activity were used in analyses.

Physical education variables. Several variables were used for examining PE experience in high school.

Number of semesters of PE in high school. Participants were asked to report the number of times they took PE in each year from ninth through 12th grade. The total number of times they took PE was summed.

PE requirement. Participants were asked to report (yes/no) if they ever took PE when it was not required.

PE class. Participants were asked to report if their PE classes were always coed, always single sex, or a combination of both.

PE waiver. Respondents were asked to indicate (yes/no) if they ever had a waiver or exemption from PE so they did not have to take a PE course.

PE enjoyment. Participants were asked to indicate on a 5-point Likert scale how much they agreed (1 = *strongly disagree* to 5 = *strongly*

agree) with the statement "Overall I enjoyed my physical education experience in 9-12th grade."

High school physical activities. Participants were asked to indicate (yes/no) if they took part in any physical activities in high school (high school varsity team, high school junior varsity team, school-sponsored sports/activity, sports/activity team outside of high school, or a sport/activity not a part of a team). The number of activities was summed (range 0–5) and was dichotomized into no participation in physical activities/participation in one or more activities.

Statistical Analysis

Basic descriptive statistics described the sample. All analyses were conducted separately for males and females. Pearson correlations examined the relationships between the fitness, behavioral, and PE outcomes. Independent *t* tests compared the differences between participation in any high school physical activities, taking PE when it was not required, and having a waiver for PE. A one-way analysis of variance (ANOVA) examined differences in fitness and behavioral outcomes by PE class type with a Tukey post hoc test. Significance levels were set at $p < .05$, and all analyses were run using SPSS 22.0 (IBM, Armonk, NY).

Results

The final sample was 56.6% male ($n = 298$) and 43.4% female ($n = 227$). Table 1 shows the demographic characteristics of the sample. Males were significantly older (21.52 ± 2.04 vs. 21.07 ± 1.04 years), were more vigorously active (192.21 ± 161.39 vs. 142.25 ± 135.12 min), had a higher fitness level (35.74 ± 6.53 vs. 34.25 ± 6.44 ml/kg/min), had a lower body fat percentage (15.20 ± 5.03 vs. 26.13 ± 4.64%), had a higher BMI (24.85 ± 3.61 vs. 23.94 ± 4.64 kg/m^2), could perform more push-ups (33.56 ± 14.77 vs. 26.36 ± 10.21), and had lower total cholesterol (152.36 ± 32.13 vs. 166.42 ± 31.88 mg/dL) and HDL (49.03 ± 14.98 vs. 64.79 ± 15.79 mg/dL) than females ($p < .05$).

Table 1
Demographic Characteristics of the Sample and Comparisons Between Males and Females

	Males (n = 298)		Females (n = 227)		
Demographic variable	***n*** **(%)**	***M* (*SD*)**	***n*** **(%)**	***M* (*SD*)**	***t* or χ^2**
Age (years)		21.52 (2.04)		21.07 (1.04)	3.03**
Race/Ethnicity					5.32
Non-Hispanic White	216 (72.7)		177 (78.3)		
Non-Hispanic Black	7 (2.3)		7 (3.1)		
Hispanic	18 (6.0)		14 (6.2)		
Asian American/Pacific Islander	47 (15.8)		26 (11.5)		
Other	9 (3.0)		2 (0.8)		
Behavioral outcomes					
Moderate physical activity minutes/week		154.78 (142.97)		158.84 (129.69)	0.33
Vigorous physical activity minutes/week		192.21 (161.39)		142.25 (135.12)	3.74***
Fitness Outcomes					
VO_2 max (ml/kg/min)		35.74 (6.53)		34.25 (6.44)	2.53*
% Body Fat		15.20 (5.03)		26.13 (5.53)	23.06***
Body Mass Index (kg/m2)		24.85 (3.61)		23.94 (4.64)	2.49*
Curl-ups (per minute)		28.59 (20.79)		31.22 (23.06)	1.34
Push-ups (per minute)		33.56 (14.77)		26.36 (10.21)	6.14***
Total cholesterol (mg/dL)		152.36 (32.13)		166.42 (31.88)	4.15***
HDL (mg/dL)		49.03 (14.98)		64.79 (15.79)	9.69***
LDL (mg/dL)		80.86 (32.09)		79.52 (28.17)	0.41
Triglycerides (mg/dL)		94.15 (63.52)		106.44 (62.79)	1.84
Physical education outcomes					
Total semesters of PE in high school		6.52 (3.52)		6.95 (4.20)	1.23
Participation in one or more high school PA	131 (43.9)			117 (51.7)	1.05
PE enjoyment		4.12 (0.96)		3.85 (1.00)	2.98**
% taking PE when it wasn't required	97 (39.2)		60 (33.5)		1.5
Type of PE class					3.99
Single sex only	20 (6.4)		30 (13.6)		
Coed only	240 (77.0)		154 (70.0)		
Combination	50 (16.1)		36 (16.3)		

*$p < .05$. **$p < .01$. ***$p < .001$.

Outcomes for Males

Correlational analyses (Table 2) revealed that PE enjoyment was significantly related to VO_2 max ($r = 0.19$, $p = .04$), curl-ups ($r = 0.17$, $p = .03$), and vigorous physical activity ($r = 0.16$, $p = .02$). Number of semesters of PE in high school was negatively associated with triglycerides ($r = -0.23$, $p = .01$) and total cholesterol ($r = -0.18$, $p = .02$) and positively associated with moderate physical activity ($r = .014$, $p = .02$).

Table 3 shows a comparison of fitness and behavioral outcomes by PE variables. Among males, those who participated in any high school physical activities had a lower body fat percentage ($t = 2.58$, $p = .01$), higher VO_2 max ($t = 3.60$, $p < .001$), lower triglycerides ($t = 2.29$, $p = .04$), and greater moderate physical activity ($t = 1.93$, $p = .05$) compared with those who did not participate in any high school physical activities. Those who took PE when it was not required were more vigorously active ($t = 2.38$, $p = .02$) than those who did not. Males who had a waiver for PE had a lower body fat percentage ($t = 2.33$, $p = .02$), performed more curl-ups ($t = 3.12$, $p = .001$), and were more vigorously ($t = 2.08$, $p = .04$) and moderately ($t = 2.41$, $p = .02$) active compared with those who had no waiver. Males in combination-type classes performed more curl-ups ($F = 5.93$, $p = .003$) than those who were in single sex ($p = .01$) or coed classes ($p = .002$). Also, males in combination-type classes were more vigorously active ($F = 5.16$, $p = .003$) than those in coed classes ($p = .006$).

Outcomes for Females

Table 4 shows Pearson correlation analyses for females. Number of semesters of PE in high school was negatively associated with triglycerides ($r = -0.23$, $p = .004$) and total cholesterol ($r = -0.18$, $p = .02$). PE enjoyment was positively associated with VO_2 max ($r = 0.15$, $p = .04$) and push-ups ($r = 0.13$, $p = .03$).

Table 2

Pearson Correlations Between Fitness, Behavioral, and PE Outcomes for Males (n = 297)

Academic outcomes	Body fat	BMI	VO_2 max	Curl-ups	Push-ups	Triglycerides	Total cholesterol	LDL	HDL	VPA min/week	MPA min/week
Number of semesters of PE in high school	0.01	0.11	0.01	0.04	0.04	-0.23**	-0.18*	-0.07	-0.12	0.06	0.14*
PE Enjoyment	-0.04	-0.02	0.19*	0.17*	0.14*	-0.09	-0.02	0.03	0.06	0.16*	0.02

Note. BMI = body mass index; VPA = vigorous physical activity; MPA = moderate physical activity.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Comparison of Fitness and Behavioral Outcomes by Physical Education Variables for Males (n = 297)

		Physical education variables												
Fitness outcomes		**Participated in any HS PA (*n* = 166)**	**No participation in HS PA (*n* = 131)**	***t***	**Took PE when it was not required (*n* = 97)**	**Did not take PE when it wasn't required (*n* = 149)**	***t***	**Had a waiver for PE (*n* = 36)**	**No waiver for PE (*n* = 261)**	***t***	**Class type: Single sex (*n* = 20)**	**Class type: Coed (*n* = 240)**	**Class type: Combination (*n* = 50)**	***F***
Body Fat	*M*	14.34	15.87	2.58**	14.74	15.13	0.59	13.02	16.35	2.33*	18.4	16.06	15.31	1.27
	SD	5.1	4.9		4.67	5.14		3.78	5.01		5.64	5.12	3.92	
BMI	*M*	24.72	24.96	0.54	24.99	24.56	0.87	23.82	25.24	1.41	27.43	24.83	25.44	2.52
	SD	3.83	3.43		3.58	3.72		2.82	3.54		4.55	3.52	2.706	
$V0_2$ max	*M*	37.29	34.54	3.60***	36.41	35.65	0.87	32.85	34.58	0.98	33.88	34.63	34.07	0.13
	SD	6.72	6.14		6.8	6.34		7.74	5.94		3.35	6.41	5.73	
Curl-Ups	*M*	29.27	28.06	0.49	28.51	28.14	0.26	45.08	26.62	3.12**	$17.78_{a,b}$	28.55_{a}	34.96_{b}	5.93**
	SD	20.64	20.95		20.47	20.87		22.72	20.08		7.68	19.57	26.04	
Push-Ups	*M*	33.69	33.45	0.14	35.27	32.75	1.28	40.15	33.75	1.58	25.67_{a}	33.37	39.84_{a}	3.93*
	SD	15.36	14.4		16.19	13.79		15.36	13.72		19.21	12.81	16.64	
Triglycerides	*M*	82.79	103.74	2.29*	89.48	87.24	0.65	104.38	105.24	0.03	74.86	99.89	139.08	2.03
	SD	45.43	74.38		53.72	58.92		48.27	79.25		49.84	71.23	105.32	
Total Cholesterol	*M*	148.33	155.73	1.59	151.92	153.49	0.28	166	154.87	0.85	148	156.99	159.57	0.25
	SD	28.44	34.69		31.63	28.42		33.79	35.53		29.68	37.66	24.94	
LDL	*M*	78.48	82.86	0.91	80.47	81.86	0.56	95.75	82.21	1.06	79.14	84.03	85.31	0.08
	SD	31.47	34.09		32.15	34.09		28.34	34.81		43.84	34.32	28.33	
HDL	*M*	47.95	49.92	0.9	49.32	48.57	0.25	51.88	48.69	0.59	42.57	50.45	50	0.86
	SD	14.39	15.46		17.12	13.27		12.94	14.58		8.94	15.64	14.68	
VPA min/week	*M*	192.11	163.54	0.01	225.44	175.07	2.38*	286.61	189.6	2.08*	166.1	180.04_{a}	287.8_{a}	5.16**
	SD	192.28	160.22		181.57	148.33		221.69	153.51		191.66	134.87	222.18	
MPA min/week	*M*	172.78	140.65	1.93*	154.78	156.45	0.11	219	186.94	2.41*	186.8	143.59	115.32	1.12
	SD	153.39	133.01		141.33	152.49		132.11	116.56		223.27	123.78	114.47	

Note. Subscript letters indicate a difference between categories. BMI = body mass index; VPA = vigorous physical activity; MPA = moderate physical activity; HS PA = high school physical activities; PE = physical education.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4
Pearson Correlations Between Fitness, Behavioral, and PE Outcomes for Females (n=227)

Academic outcomes	Body fat	BMI	VO_2 max	Curl-ups	Push-ups	Triglycerides	Total cholesterol	LDL	HDL	VPA min/ week	MPA min/ week
Number of semesters of PE in high school	0.14	0.11	0.01	0.04	0.04	−0.23**	−0.18*	−0.07	−0.15	0.06	−0.11
PE Enjoyment	−0.04	−0.02	0.15*	0.11	0.13*	−0.10	−0.02	0.03	−0.06	0.06	−0.02

Note. BMI = body mass index; VPA = vigorous physical activity; MPA = moderate physical activity.
*$p < .05$. **$p < .01$. ***$p < .001$.

For females, Table 5 shows a comparison of fitness and behavioral outcomes by PE variables. Those who participated in any high school physical activities had higher triglycerides ($t = 2.65$, $p = .009$) and lower HDL ($t = 2.30$, $p = .02$) than those who did not participate in any activities. Females who took PE when it was not required had a higher VO_2 max ($t = 1.99$, $p = .04$) and vigorous physical activity ($t = 2.00$, $p = .03$) compared with those who did not. Those with a waiver for PE class had higher triglycerides (t = 1.98, p = .02) and total cholesterol ($t = 1.93$, $p = .04$) compared with those who did not. Females in a coed PE class had a higher BMI ($F = 3.27$, $p = .02$) and VO_2 max ($F = 3.45$, $p = .01$) compared with those in a combination class ($p = .02$, $p = .01$, respectively).

Discussion

The findings of this study indicate that an individual's PE experience in high school relates to a number of factors during the college years, such as aerobic fitness, muscular endurance, body composition, and blood lipid composition outcomes. The most significant findings from this study relate to the total length of PE participation throughout high school, students who chose to take PE when it was not required, and level of PE enjoyment in high school. Physical activity patterns, as well as overall physical health and fitness outcomes, were found to significantly relate to PE outcomes, suggesting a potential for long-term health impacts. While many outcomes apply to males and females, a few significant differences between genders were also present in the findings.

One of the most important findings of this study dealt with the relationship between number of semesters of PE taken in high school and health-related fitness for this population. A strong negative association was noted between the total number of semesters of PE that were taken in high school and triglyceride levels and total cholesterol for males and females. These data indicate a possible relationship between prior PE participation with physical health components, whereas the relationship with PA patterns was inconsistent. These findings were consistent with previous research in this area, which included the amount of PE participation in high school with young adult weight. Menschik, Ahmed, Alexander, and Blum (2008) concluded not only that increased participation in physical activities as an adolescent was strongly related to a decrease in the

Table 5

Comparison of Fitness and Behavioral Outcomes by Physical Education Variables for Females (n = 227)

		Physical education variables												
Fitness outcomes		**Participated in any HS PA (*n* = 110)**	**No participation in HS PA (*n* = 117)**	***t***	**Took PE when it was not required (*n* = 60)**	**Did not take PE when it wasn't required (*n* = 119)**	***t***	**Had a waiver for PE (*n* = 30)**	**No waiver for PE (*n* = 197)**	***t***	**Class type: Single sex (*n* = 30)**	**Class type: Coed (*n* = 154)**	**Class type: Combination (*n* = 36)**	***F***
Body Fat	*M*	25.8	26.45	0.85	26.2	26.1	0.11	25.28	26.55	0.99	25.15	27.09	24.64	1.64
	SD	5.41	5.65		6.24	5.36		4.2	5.88		3.12	5.91	6.15	
BMI	*M*	24.24	23.64	0.95	23.94	24.05	0.14	22.64	23.9	0.66	22.74	24.30_a	21.94_a	3.27*
	SD	5.38	3.67		3.87	5.35		2.88	3.86		2.43	3.99	3.39	
$V0_2$ max	*M*	34.45	34.05	0.45	33.73	34.79	0.99	34.33	33.79	0.23	33.2	33.02_a	37.70_a	3.45*
	SD	6.15	6.75		5.9	6.92		5.93	6.93		4.61	6.56	8.14	
Curl-Ups	*M*	30.84	31.59	0.29	28.96	32.21	0.86	35.2	30.09	0.66	19.71	33.83	29.41	2.28
	SD	22.41	23.76		23.94	22.91		22.06	23.19		12.55	25.26	18.01	
Push-Ups	*M*	26.14	26.58	0.93	25.93	26.29	0.23	25.5	26.94	0.43	24.14	27.86	25.71	1
	SD	10.41	10.06		10.77	9.25		10.12	9.99		9.59	9.62	11.04	
Triglycerides	*M*	113.62	92.51	2.65**	104.23	107.7	0.34	122.14	90.71	1.99*	97.6	88.85	106.73	0.88
	SD	58.64	41.97		39.06	61.08		92.01	33.53		46.08	31.51	76.57	
Total Cholesterol	*M*	167.56	165.23	0.47	165.89	168.92	0.5	184.57	164.19	1.93*	159.4	169.51	157.36	1.23
	SD	34.94	28.49		29.71	33.83		39.08	26.66		27.17	26.95	33.48	
LDL	*M*	82.14	79.75	0.58	83.25	79.49	0.79	90.14	79.58	1.2	75.5	82.89	73.91	1.08
	SD	29.96	21.91		26.33	25.19		23.47	21.9		20.96	22.11	21.09	
HDL	*M*	62.08	67.62	2.30*	61.91	66.51	1.52	70	67.18	0.46	64.6	69.69	62.27	1.31
	SD	15.65	15.53		16.31	16.3		15.63	15.41		9.01	16.38	15.51	
VPA min/week	*M*	146.08	138.72	0.4	153.1	106.07	2.00*	143.17	139.74	0.09	134.07	146.98	113.89	0.51
	SD	144.67	126.19		106.37	123.71		101.66	131.23		138.07	121.07	141.3	
MPA min/week	*M*	157.87	159.76	0.18	154.37	168.5	0.72	127.17	169.27	1.13	197.33	158.72	149.72	0.77
	SD	142.23	117.3		124.2	122.92		119.04	121.18		190.33	107.24	92.85	

Note. Subscript letters indicate a difference between categories. BMI = body mass index; VPA = vigorous physical activity; MPA = moderate physical activity; HS PA = high school physical activities; PE = physical education.

*$p < .05$. **$p < .01$. ***$p < .001$.

prevalence of overweight young adults, but also that increasing the number of days that adolescents participated in PE decreased their chances of being overweight as an adult by up to 28%. This finding was not surprising given that the amount of PE was also significantly related to blood lipid levels; a dose–response relationship was present in which increased participation in PE could lead to overall better health as a young adult, which could include both healthy cholesterol levels and weight.

It is interesting that students who took PE in high school when it was not required by their school district or state policy (as an elective) performed more PA at a vigorous level in college compared to those who chose not participate in PE unless it was a requirement. A number of possible factors could explain these outcomes, one being a greater sense of enjoyment of PE. Children who enjoy PE classes likely possess greater perceptions of self-efficacy in a physically active environment, causing them to actively choose to take PE classes. A related study found a positive relationship with PE and the resulting amount of MVPA on days that PE was taken by the school-aged children (Chen, Kim, & Gao, 2014). Regardless of whether the source of increased PA in college was due to high perceptions of enjoyment or self-efficacy, only six states currently require their high school students to perform a specific number of minutes of PE per week and only 46% of students nationally attend PE class at least once per week on average while in high school (Society of Health and Physical Educators, 2016). As outlined in the National Physical Activity Plan, a comprehensive school physical activity plan addresses PE policy in terms of frequency and quality, and this study suggests that there is an impact beyond K–12 (National Physical Activity Plan Alliance, 2016). In addition to these findings, it is also important to note that sedentary lifestyles and obesity continue to rise among adolescents and young adults, with 32% of all adolescents currently being considered overweight or obese (Society of Health and Physical Educators, 2016). PE programs during the adolescent years have the opportunity to instill lifelong activity patterns in individuals, as well as provide knowledge about the benefits of PA overall. If PE was made a requirement in more schools, and if PE programs were made more enjoyable and increased enthusiasm for PE classes, this situation

could cultivate more active lifestyles in the future and encourage more vigorous levels of PA.

While partaking in PE when it was not a requirement proved to be a relevant outcome in this study, this finding can be related to students' levels of perceived enjoyment of their PE experiences in high school. It is noteworthy that level of PE enjoyment related significantly to different physical fitness components in males and females. Perceived level of PE enjoyment in high school positively related to VO_2 max in males and females. It also positively related to different strength assessments, including number of push-ups for females and number of sit-ups for males. Overall, these results suggest that students who report greater PE enjoyment in high school typically tend to perform at a higher level of physical fitness than those students who do not enjoy PE, and are also more likely to partake in additional PE, even when it is not required. This could lead to increased vigorous PA in the future, in addition to achievement of higher levels of physical fitness in general. These results are not surprising, given that PA enjoyment is a strong correlate of participation in nearly every population (Trost, Owen, Bauman, Sallis, & Brown, 2002). This study suggests that creating enjoyable PE experiences can result in positive long-term outcomes; therein further study on the aspects that make PE enjoyable are warranted.

Although this study had a number of significant findings about how PE experiences relate to PA patterns and fitness levels at the college level, it has some limitations. To obtain information related to PE experiences in high school, the researchers used retrospective self-report surveys. While this was the most feasible method for this study, the accuracy of responses could not be ensured with recall or social desirability bias. Additionally, the sample that volunteered for the study, though representative of the current study body, was not diverse in terms of race/ethnicity, with greater than 70% of the sample reporting they were non-Hispanic White. The strength of the correlations was also moderately weak, limiting the researchers' ability to interpret the real-world implications of the findings. Last, the sample was drawn from volunteers, which could create additional bias. Further studies in this area may opt to use longitudinal study designs or objective forms of measurement (e.g., pedometers or accelerometers) to address some of these methodological limitations.

Despite these limitations, this study offered insight into how physical activity and different physical fitness components in college relate to students' PE experiences in high school. Effective PE programs that encourage participation and educate students on the benefits of PA have the capability to establish lifelong healthy and active habits that translate to the college years, and likely beyond. The main findings of this study could influence the policies regarding PE requirements for school-aged students in all states, such as possibly increasing PE requirements for all grades and discovering certain aspects of PE that could make it more enjoyable for a larger number of students. Strategies to improve enjoyment could include the inclusion of lifestyle-based activities to promote lifelong participation, opportunities for discovery of lesser known sports or activities, or allowing students to have greater choice and input on activities included in the curriculum. Based on the results of this study, further investigation of the potential of PE to impact population health and alter the incidence rates of inactivity-related chronic disease is warranted.

References

American College of Sports Medicine. (2013). *ACSM's guidelines for exercise testing and prescription* (9th ed.). New York, NY: Lippincott, Williams, & Wilkins.

Armstrong, T., & Bull, F. (2006). Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *Journal of Public Health, 14*(2), 66–70. https://doi.org/10.1007/s10389-006-0024-x

Chen, S., Kim, Y., & Gao, Z. (2014). The contributing role of physical education in youth's daily physical activity and sedentary behavior. *BMC Public Health, 14*. https://doi.org/10.1186/1471-2458-14-110

Kohl, H. W., & Cook, H. D. (Eds.). (2013). *Educating the student body: Taking physical activity and physical education to school*. Washington, DC: National Academies Press.

Menschik, D., Ahmed, S., Alexander, M. H., & Blum, R. W. (2008). Adolescent physical activities as predictors of young adult weight. *Archives of Pediatrics & Adolescent Medicine, 162*(1), 29–33. https://doi.org/10.1001/archpediatrics.2007.14

National Physical Activity Plan Alliance. (2016). *The 2016 United States report card on physical activity for children and youth*. Washington, DC: Author.

Roslow Research Group. (2009). *Physical education trends in our nation's schools: A survey of practicing K–12 physical education teachers*. Port Washington, NY: National Association for Sport and Physical Education.

Society of Health and Physical Educators. (2016). *Shape of the nation: Status of physical education in the USA*. Reston VA: Author.

Small, M., Bailey-Davis, L., Morgan, N., & Maggs, J. (2013). Changes in eating and physical activity behaviors across seven semesters of college: Living on or off campus matters. *Health Education and Behavior, 40*, 435–441. https://doi.org/10.1177/1090198112467801

Trost, S. G., Owen, N., Bauman, A. B., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Medicine & Science in Sports & Exercise, 34*, 1996–2001. https://doi.org/10.1097/00005768-200212000-00020

Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., & Sirard, J. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine & Science in Sports & Exercise, 34*, 350–355. https://doi.org/10.1097/00005768-200202000-00025