

## PHYSICAL ACTIVITY

# Physical Activity Levels in Coed and Same-Sex Physical Education Using the Tactical Games Model

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## Abstract

*This study compared physical activity levels of junior high school physical education students participating in coeducational and same-sex PE classes that followed the Tactical Games Model. A total of 446 students, aged 11 to 16 years old, enrolled in the seventh to ninth grades from one junior high school participated. Each student participated in four team sport units while wearing an accelerometer. All lessons followed the Tactical Games instructional model. Four three-way between-subjects analyses of variance were conducted as a method of evaluating the effect of gender, class setting, and grade on PE students' PA levels for each sport unit. There was not a significant difference in PA for males by setting or sport unit. During the volleyball, flag football, and soccer unit, there was a nonsignificant difference between female students in the same-sex setting and between female and male students in the coeducational setting for percentage of time spent in MVPA. Results suggest setting does not affect MVPA time of males but does affect that of females depending on sport. Results also suggest that males spend more time in MVPA than females regardless of setting and sport unit.*

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Regular participation in physical activity (PA) can provide adolescents immediate and long-term physical and psychological health benefits (Office of the Surgeon General 2010; U.S. Department of Health and Human Services [USDHHS], 2008a, 2008b). Despite this knowledge, adolescents are becoming increasingly sedentary (Gordon-Larsen, Nelson, & Popkin, 2004; Kahn et al., 2008; Kelder, Perry, & Klepp, 1993; Owen, Sparling, Healy, Dunstan, & Matthews, 2010; Sallis, 2000; Trost et al., 2002). Approximately 47.8% of American youth lack regular PA (Song, Carroll, & Fulton, 2013). Research suggests that PA participation declines rapidly during the childhood and adolescent years (Centers for Disease Control and Prevention [CDC], 2013; Ekelund, Tomkinson, & Armstrong, 2011; Nader, Bradley, Houts, McRitchie, & O'Brien, 2008; Trost et al., 2002). As a result, the prevalence of adolescent obesity is increasing in the United States. Approximately 17% of children and adolescents in the United States between ages 2 and 19 years old are obese (Ogden et al., 2016). Children and adolescents between ages 6 and 19 are recommended to participate in 1 hr of moderate to vigorous physical activity (MVPA) on most days of the week, preferably daily (USDHHS, 2008b, 2010). Currently, more than 80% of adolescents do not get enough aerobic PA to meet the recommended guidelines (USDHHS, 2010). Because of the increase of obesity and the decrease in PA among adolescents, health initiatives such as Healthy People 2020 and national organizations such as the Society of Health and Physical Educators (SHAPE America) recognize that physical education (PE) classes can influence PA among children and adolescents (National Association of Sport and Physical Education, 2009). In a review study of PA research within PE, results indicated that students on average engage in MVPA for about 27% of the class time (Fairclough & Stratton, 2005). Many factors (environmental, psychological, and physiological) may help ensure that PE students are receiving appropriate amounts of PA, and these need to be accounted for and further researched. This research study examined the environmental factors of setting (same-sex vs. coeducational classes) and instructional model (Tactical Games) on PE students' PA.

An implication of Title IX (gender equity) was that PE classes would integrate same-sex classes into coeducational classes (Hannon & Williams, 2008). This occurred because it was thought that males

were receiving more or better opportunities to learn than females. Through the formation of coeducational PE classes, females would be receiving the same opportunities as males, thus the Title IX requirements of gender equity would be met. However, teachers were given limited opportunity to provide their input on the situation or be active participants in the legislation process mandating coeducational PE (Treanor, Graber, Housner, & Wiegand, 1998). Additionally, research has indicated that inequitable teaching behaviors still occur and thus limit the learning potential of all students (Dunbar & O'Sullivan, 1986; Griffin, 1984; Treanor et al., 1998). Since the mandate of coeducational PE, research regarding this topic has been somewhat contradictory and has focused mainly on teacher and student perceptions, teacher–student interactions, and student participation.

Few studies have measured and compared PE students' PA levels in same-sex and coeducational classes. McKenzie, Prochaska, Sallis, and LaMaster (2004) examined the PA levels of middle school boys and girls in coeducational and same-sex PE settings using the System for Observing Fitness Instruction Time (SOFIT). Their results indicated that the boys had similar amounts of MVPA in both settings, whereas girls accumulated more MVPA in a coeducational setting than a female-only setting. Hannon and Ratliffe (2005) examined PA levels of male and female high school PE students in soccer, flag football, and Ultimate Frisbee gameplay using pedometers. Their results indicated that males and females accumulated the same or higher steps per minute in the coeducational setting than the same-sex setting. Most recently in a study conducted in Europe, Van Acker, da Costa, Bourdeaudhuij, Cardon, and Haerens (2010) examined middle school students' MVPA levels in same-sex and coeducational PE classes using heart rate monitors. Results indicated females had higher levels of MVPA than males in both settings, and MVPA for males and females was higher in coeducational classes than same-sex classes. These studies suggest that coeducational classes are more appropriate than same-sex settings for providing higher levels of MVPA, which is in accordance with the Title IX philosophy. However, because few studies have examined PA in coeducational and same-sex settings and all have used a different method to measure PA, it cannot be concluded that coeducational

classes are appropriate in providing higher levels of MVPA. Further, studies need to be conducted with multiple grade levels with multiple individual and team sport activities before definitive conclusions can be made. Research exploring grade-level PA differences have indicated that PA level declines as grade level increases (Gao, Hannon, & Carson, 2009; Hodges-Kulinna, Martin, Lai, Kilber, & Reed, 2003; Parish & Treasure, 2003). Hannon and Williams (2008) suggested that additional studies need to be conducted on student PA levels in coeducational and same-sex settings among various grade levels and with the use of various instructional models.

PE instructional models provide a framework of what students are going to learn, how students are going to acquire that learning, and how they will be assessed. Within the various instructional models used in PE such as Sport Education, cooperative learning, direct instruction, peer teaching, inquiry teaching, and Tactical Games, little research has measured PA levels of students (Metzler, 2005). Specifically, the Tactical Games Model (TGM) has received little attention relative to PA. The small-sided games associated with the TGM may aid PE students in engaging in adequate amounts of PA (Harvey, Smith, Fairclough, Savory, & Kerr, 2015; McCormick et al., 2012). Because of the physical and psychological health benefits of regular PA participation, it is important for educators to understand how various curricular models, specifically the TGM, may influence PA in PE.

The TGM is a simplified three-step model derived from the original Teaching Games for Understanding six-step model (Mitchell, Oslin, & Griffin, 2006). The TGM is based on a sequence of developmentally appropriate games called game forms. The first step of the TGM is the game form. Students participate in a game form (modified/small-sided game) that focuses on a tactical problem. Typically, these games are usually three versus three or four versus four. Students solve the tactical problem through playing the game form and using the appropriate skill that corresponds with the tactical problem. For example, a tactical problem in basketball involves the player moving without the ball to get open to receive a pass to score. A game form for this tactical problem would be a half-court basketball game in which the rules of the original basketball game are modified so that each team is required to make four passes before

shooting and students are not allowed to dribble the ball. Playing this modified version of basketball forces the students to move without the ball and to create ways to elude the defenders so they may receive a pass. The second step is tactical awareness. During this step, the teacher helps students recognize the tactical problem through questioning. These questions pertain to what certain skills or movements are required to be successful. Once the students understand the skills or movements needed to be successful, the teacher can ask the students what they need to practice. This leads to the third and final step of the TGM: skill execution. During this step, the teacher can demonstrate and describe how to perform the skills and movements with the appropriate learning cues. After practicing the appropriate skills, the students go back to playing the modified game.

The TGM is not a widely adopted curricular model in PE in the United States. Past research on the TGM has focused primarily on improving student knowledge and student motivation or interest. To date, only one other study has examined PA levels using the TGM (Harvey et al., 2015).

A rationale for using the TGM is it provides an interesting and exciting way for PE students to learn games and is a positive motivator for participating (Mitchell et al., 2006). Previous research indicates that students find the tactical games approach to be motivational (Berkowitz, 1996; Burrows, 1986; Mitchell, Griffin, & Oslin, 1994). One teacher has indicated that students come to class excited, motivated, and ready to participate because they know they are going to play a game right away (Berkowitz, 1996). This is also supported by research conducted on five PE teachers and 392 secondary PE students (Cruz, 2004). Results indicated that teachers perceived that their students were more engaged, excited, and happier in the tactical approach than a skill-based approach. Students supported the teachers' perceptions by verifying that the tactical approach was more exciting and interesting and that they preferred to learn in this type of environment. It was suggested that the TGM provided the students with a positive emotional experience in playing games. Of the student participants, 76% indicated they would like their teacher to adopt the TGM for all games taught in PE (Cruz, 2004).

A second rationale for using the TGM in PE is that the knowledge gained through this approach will empower students to become

knowledgeable game players (Mitchell et al., 2006). The knowledge students obtain through the use of the TGM is decision making in game situations. Research has shown that the TGM may significantly improve student knowledge and decision making during game play (Turner, 1996; Turner & Martinek, 1992, 1999).

Because research demonstrates that the TGM influences student motivation and knowledge through decision making during game-play, one may assume this model would in fact affect PA levels in PE. To date, limited research has been conducted on students' PA levels during instruction using the TGM. This study compared PA levels of junior high school PE students participating in coeducational and same-sex PE classes that follow the TGM in basketball, soccer, flag football, and volleyball units. The study is significant because it examines three factors (grade, setting, and instructional model) regarding their influence on junior high PE students' PA levels during 32 PE lessons.

## Method

### Participants

The participants in this study were 446 (240 males, 206 females) junior high school students between ages 11 and 16 who were enrolled in a required seventh, eighth, and ninth grade PE class. The study was conducted at a junior high school located in the Southwestern United States. Racial distribution of the participants of this study was 74.4% Caucasian, 10.8% Hispanic, 7.6% Multicultural, 3.6% Asian American, 1.6% African American, 0.9% Pacific Islander and 0.4% Native American. Racial background was not reported by 0.7% of participants.

Two experienced certified PE teachers, one male and one female, taught all PE classes. Each teacher had approximately 20 years of teaching experience. Both teachers graduated from an accredited PE program from a university in the Southwestern United States and earned a PE teaching K–12 certification.

Prior to the collection of data, permission was obtained from the university institutional review board, school district, the school administration, and the teachers. Students and parents provided written informed consent prior to participation in this study.

## Instrumentation

ActiGraph GT1M (Pensacola, FL) accelerometers monitored PA levels of the participants participating in four tactical game units during their PE class. Several studies have reported favorable validity of ActiGraph accelerometers by comparing the ActiGraph outputs with direct observation of the participants during activity and/or with direct measures of energy expenditure (Corder et al., 2007; Kelly et al., 2004; Puyau, Adolph, Vohra, & Butte, 2002). In this study, the Puyau et al. (2002) 30-s epoch cut-point equations were applied to the data as a method of determining the intensity classification of percentage of class time spent in MVPA. The cut-point for the MVPA classification is moderate + vigorous =  $\geq 1600$  (Puyau et al., 2002). Thirty-second epochs were used and controlled for underestimation of activity levels (Welk, Blair, Wood, Jones, & Thompson, 2000; Welk, Corbin, & Dale, 2000). The percentage of class time spent in MVPA was derived for each student from each lesson.

Tactical game lesson plans for the basketball, soccer, and volleyball units for this study were selected from the textbook *Teaching Sport Concepts and Skills: A Tactical Approach* (Mitchell et al., 2006). The flag football unit and the Ultimate Frisbee mini unit (practice unit) lesson plans were designed by the primary investigator and checked by the primary author of *Teaching Sport Concepts and Skills: A Tactical Approach*. A progression of tactical levels from 1 to 3 was used in the eight lesson plans for each unit. A progression of levels was used based on the fact that PE students in this region of the United States where the study occurred may not have had a required PE class in elementary school and may have been limited in certain foundational skills required for game execution.

## Research Design

A quasi-experimental design was used as a method for examining the effect of coed and same-sex settings using the tactical games approach on the percentage of class time spent in MVPA of junior high school PE students.

## Procedures

Prior to the beginning of data collection, the two PE teachers went through two sessions (approximately 6 hr) of tactical games

training conducted by the primary investigator. Training consisted of lectures, readings, and watching video clips of other teachers using the TGM. The teachers were provided with all of the lesson plans for each unit being taught during this training. The same lesson plans were used by each teacher, which ensured similarity among all classes. To ensure fidelity of all lessons between the two PE teachers, the primary researcher reviewed the lessons the day prior to the lesson being taught and was present for all lessons. Based on observation, the PE teachers did not deviate from the written lessons. After completing the training, the PE teachers taught one mini unit (four lessons) of Ultimate Frisbee at the beginning of the semester. During this time, the primary investigator evaluated each teacher on performance of teaching tactically and ability to follow the lesson plans.

Before data collection began, the primary investigator assigned a number and an accelerometer with the same number to the PE students and taught the PE students how to wear their assigned accelerometer. All accelerometers were worn around the waist on the right hip. Each accelerometer was labeled with a number, and the students wore that same accelerometer for all four units. Prior to data collection, the students practiced picking up, wearing, and returning their accelerometer during the Ultimate Frisbee mini unit. At the beginning of each class, the primary investigator and teachers observed students putting on the accelerometer to ensure they were wearing the accelerometer properly. Once data collection began, at the completion of each week the primary investigator downloaded the accelerometer data and checked that each accelerometer was working properly. All accelerometers were recharged at the end of each week.

The data collection period spanned 32 days. Data collection occurred during all regularly scheduled PE classes. Each PE student participated in two sport units in a coeducational setting and two sport units in the same-sex setting. There was a total of six class periods, with one male and one female PE class per period (12 PE classes). There were four seventh grade, four eighth grade, and four ninth grade PE classes. Classes were randomly determined as coeducational or same-sex. For example, first period was selected as same-sex. The male teacher taught the all-male class, and the female teacher taught the all-female class. Second period was determined

as coeducational. The all-male and all-female classes were integrated and divided in half, and the male teacher taught half the class and the female teacher the other half. After two of the sport units were taught, the coeducational classes were separated back into same-sex classes and the other same-sex classes were integrated and split into coeducational classes. This allowed all participants to participate in either type of setting. However, not every participant participated in each sport unit in each setting. Each teacher taught six classes a day (three coeducational and three same-sex).

### **Data Analysis**

Data from the accelerometers were downloaded according to the manufacturer's instructions using ActiLife Lifestyle Monitoring software (Version 1.0.54, Actigraph, LLC, Pensacola, FL) and exported into an Excel file at the end of each week. After completing this for all students, the primary and secondary researchers entered formulas in the Excel program to calculate the percentage of time spent in MVPA and then calculated the average for all eight lessons of each sport unit. Once that was completed, all of the information of each student was put into one Excel file and imported into the SPSS statistics program.

Preliminary analyses included descriptives, frequencies, reliabilities, and correlations. Alpha coefficients were computed as a method of determining the internal consistency between lessons for MVPA for each sport unit. Alpha coefficients ranged from .80 to .95, showing a high reliability between the lessons for each sport unit and PA categories. This justified use of all data regardless of days attended by each student during each unit, and the average MVPA of each unit was used rather than the MVPA from each lesson.

Because type of sport and setting were not completely crossed, four three-way between-subjects analyses of variance evaluated the effect of gender, class setting (coeducational or same-sex), and grade on PE students' PA levels for each sport unit. The dependent variable was the percentage of time spent in MVPA. The between-subjects factors were setting (with two levels: coeducational and same-sex), gender (with two levels: male and female), and grade (with three levels: seventh, eighth, and ninth grade). An alpha level of .05 was used for all statistical tests.

## Results

Results of the ANOVA indicated significant differences among gender, grade, and setting in MVPA within basketball, volleyball, and soccer sport units. However, results for flag football indicated no significant differences among gender, grade, and setting in MVPA. Tables 1 and 2 show percentage of time spent in MVPA, means, and standard deviations for each sport unit. Statistically significant data were organized and presented according to sport unit.

### Basketball Unit

Results of the ANOVA for basketball indicated a significant main effect of Setting, Wilks's lambda,  $F(2, 405) = 15.48, p < .01, \eta^2 = .07$ , as well as Gender, Wilks's lambda,  $F(2, 405) = 51.09, p < .01, \eta^2 = .07$ , and Grade, Wilks's lambda,  $F(4, 810) = 2.63, p < .033, \eta^2 = .01$ . The Setting  $\times$  Gender interaction effect was significant, Wilks's lambda,  $F(2, 405) = 20.42, p < .01, \eta^2 = .09$ . An independent-samples  $t$  test determined the specific difference between settings for each gender. Results indicated a significant difference between settings for female students for percentage of time spent in MVPA,  $t(193) = 4.18, p = .01$ . A Tukey's post hoc analysis for Grade indicated a significant difference in MVPA between the seventh ( $M = 20.70, SD = 12.98$ ) and ninth ( $M = 17.64, SD = 12.59$ ) grades.

### Volleyball Unit

Results of the ANOVA for volleyball indicated a significant main effect of Setting, Wilks's lambda,  $F(2, 406) = 4.21, p < .02, \eta^2 = .02$ . The Setting  $\times$  Grade interaction effect was significant, Wilks's lambda,  $F(4, 812) = 2.58, p = .04, \eta^2 = .01$ . An independent-samples  $t$  test determined the specific difference between settings for each grade level. Results indicated a significant difference between settings for MVPA for seventh graders,  $t(135) = 1.62, p = .03$ . The seventh graders in a same-sex setting spent more time in MVPA than the seventh graders in a coeducational setting.

**Table 1**  
*Percentage of Class Time Spent in MVPA in Each Sport Unit by Grade and Gender for Each Setting*

Sport unit	Grade level	Coed class						Same-sex class		
		Males <i>M (SD)</i>	Females <i>M (SD)</i>	Both <i>M (SD)</i>	Males <i>M (SD)</i>	Females <i>M (SD)</i>	Both <i>M (SD)</i>			
Basketball	7th	28.20 ± 11.32	12.69 ± 6.60	19.46 ± 11.80	27.22 ± 13.27	15.67 ± 12.70	22.09 ± 14.15			
	8th	21.71 ± 11.77	8.96 ± 4.86	15.08 ± 10.89	23.19 ± 11.86	19.11 ± 10.46	21.78 ± 11.48			
	9th	23.69 ± 13.04	10.15 ± 7.94	17.20 ± 12.79	21.04 ± 13.87	14.07 ± 9.06	18.05 ± 12.47			
	All	24.37 ± 12.29	*10.65 ± 6.68	17.23 ± 11.93	23.58 ± 13.18	*15.91 ± 10.83	20.45 ± 12.82			
Volleyball	7th	11.62 ± 7.97	5.97 ± 3.28	*8.49 ± 6.46	13.76 ± 9.34	6.50 ± 4.20	*10.53 ± 8.29			
	8th	11.40 ± 7.82	5.54 ± 1.72	8.39 ± 6.28	10.05 ± 6.58	6.70 ± 2.83	8.92 ± 5.79			
	9th	10.32 ± 8.39	5.89 ± 4.38	8.17 ± 7.06	9.29 ± 7.70	5.35 ± 2.54	7.53 ± 6.26			
	All	11.10 ± 8.01	5.80 ± 3.24	8.35 ± 6.57	10.88 ± 8.04	6.08 ± 3.28	8.90 ± 6.91			
Football	7th	27.26 ± 11.62	13.95 ± 7.00	21.53 ± 11.87	28.78 ± 9.92	12.27 ± 6.03	19.65 ± 11.47			
	8th	24.76 ± 10.23	11.65 ± 6.65	20.32 ± 11.06	27.34 ± 9.92	12.54 ± 5.89	19.64 ± 10.94			
	9th	25.19 ± 13.09	9.11 ± 5.42	18.27 ± 13.16	30.63 ± 11.18	12.51 ± 7.39	22.05 ± 13.17			
	All	25.67 ± 11.71	11.38 ± 6.57	19.91 ± 12.17	29.00 ± 10.40	12.43 ± 6.39	20.46 ± 11.91			
Soccer	7th	27.35 ± 9.28	16.81 ± 7.20	22.47 ± 9.87	26.56 ± 7.93	16.02 ± 5.69	20.64 ± 8.53			
	8th	26.35 ± 10.69	14.35 ± 6.89	22.22 ± 11.09	26.20 ± 12.22	16.80 ± 7.27	21.30 ± 10.95			
	9th	23.95 ± 11.88	12.29 ± 5.76	*18.42 ± 11.10	30.36 ± 10.00	17.89 ± 8.88	*24.45 ± 11.32			
	All	25.82 ± 10.73	14.35 ± 6.78	20.86 ± 10.83	27.88 ± 10.34	16.87 ± 7.32	22.18 ± 10.45			

\**p* < .05.

**Table 2**

*Percentage of Class Time Spent in MVPA in Each Sport Unit by Grade and Gender With Both Settings Combined*

Sport unit	Grade level	Coed and same-sex settings combined		
		Males <i>M (SD)</i>	Females <i>M (SD)</i>	Both <i>M (SD)</i>
Basketball	7th	27.68 ± 12.31	13.92 ± 9.62	*20.70 ± 12.98
	8th	22.50 ± 11.76	12.57 ± 8.76	18.13 ± 11.61
	9th	22.27 ± 13.47	12.05 ± 8.67	*17.64 ± 12.59
	All	23.95 ± 12.75	12.86 ± 9.03	18.78 ± 12.46
Volleyball	7th	12.72 ± 8.71	6.18 ± 3.66	9.43 ± 7.40
	8th	10.68 ± 7.17	5.95 ± 2.23	8.63 ± 6.05
	9th	9.76 ± 7.99	5.61 ± 3.56	7.83 ± 6.64
	All	10.98 ± 8.01	5.92 ± 3.25	8.61 ± 6.74
Football	7th	27.99 ± 10.79	12.94 ± 6.44	20.52 ± 11.65
	8th	25.94 ± 10.11	12.22 ± 6.13	19.95 ± 10.96
	9th	27.75 ± 12.46	10.86 ± 6.68	20.12 ± 13.26
	All	27.23 ± 11.21	12.00 ± 6.47	20.20 ± 12.03
Soccer	7th	26.98 ± 8.62	16.36 ± 6.35	21.52 ± 9.21
	8th	26.28 ± 11.35	15.93 ± 7.17	21.72 ± 10.99
	9th	27.15 ± 11.38	15.09 ± 7.95	21.43 ± 11.57
	All	*26.81 ± 10.57	*15.78 ± 7.18	21.55 ± 10.64

\* $p < .05$ .

### Soccer Unit

Results of the ANOVA for soccer indicated a significant main effect for Setting, Wilks's lambda,  $F(2, 417) = 6.37, p < .01, \eta^2 = .03$ , as well as Gender, Wilks's lambda,  $F(2, 417) = 86.32, p < .01, \eta^2 = .3$ , and Grade, Wilks's lambda,  $F(4, 834) = 3.19, p < .01, \eta^2 = .02$ . The Setting  $\times$  Grade interaction effect was significant, Wilks's lambda,  $F(4, 834) = 6.22, p < .01, \eta^2 = .03$ . An independent-samples  $t$  test determined the specific difference between settings for each grade. There was a significant difference between ninth grade students for percentage of time spent in MVPA,  $t(154) = 3.36, p = .001$ . These results suggest that ninth grade students in the same-sex setting spent more time in MVPA than ninth grade students in the coeducational

setting. In regard to gender, males ( $M = 26.81$ ,  $SD = 10.57$ ) spent significantly more time in MVPA than females ( $M = 15.78$ ,  $SD = 7.18$ ,  $p = .01$ ). These results indicated that during the soccer unit males spent more time in MVPA than females.

## Discussion

The primary aim of this study was to determine MVPA, as measured by accelerometers, of junior high school PE students participating in coeducational and same-sex PE classes that follow the TGM in basketball, soccer, flag football, and volleyball units. However, the effect of environmental factors, such as the sex of the participant, the setting (same-sex or coeducational), grade level, and instructor's choice of activity on the level of MVPA was so variable that the discussion will be broken down by activity.

### Activity Levels in Coeducational Versus Same-Sex Settings

Results from this study indicated that male junior high PE students accumulated similar amounts of MVPA in coeducational and same-sex PE settings for all sport units. Results of this study are comparable to those reported by McKenzie et al. (2004), who examined 26 males only, 32 females only, and 240 coeducational lessons in 24 middle schools over a 2.5-year investigation. Their findings revealed that males accumulated similar amounts of MVPA in male-only and coeducational class settings. Similarly, Hannon and Ratliffe (2005) examined male high school PE students' PA in same-sex and coeducational settings during gameplay of several invasion games (flag football, Ultimate Frisbee, and soccer). Their findings revealed that male students had similar amounts of PA in same-sex and coeducational settings. McKenzie et al.'s (2004) and Hannon and Ratliffe's (2005) studies were different than this study in that they used different methods to measure PA (pedometers, direct observation) and did not follow a particular instructional model. Although basketball and volleyball were not investigated or reported by either study, one could assume that basketball would be similar to soccer, flag football, and Ultimate Frisbee because all four are team sports and are classified as invasion games. Fromel, Formankova, and Sallis (2002) reported that male students preferred team sports, and when these team sports were played in a coeducational setting, males would

dominate gameplay. Thus, one would assume the males would receive the same amount of activity in either setting because females would not hinder them in a gameplay situation. The current study was the first to examine PA levels of males participating in volleyball in coeducational and same-sex settings. Results were somewhat surprising since volleyball is not a preferred sport by middle school male PE students (Hill & Hannon, 2008); it was expected that females might have dominated the gameplay opportunities in the coeducational setting. However, as reported by Griffin (1981) and Solomons (1980), in team games males tend to have more opportunities to touch the ball and females tend to give their opportunities to touch the ball and to score to males, thus potentially affecting their PA levels.

In this study, female students had higher levels of MVPA in a same-sex setting than in a coeducational setting during the basketball unit. There were no differences in time spent in MVPA among females in the volleyball, football, or soccer unit in the coeducational and same-sex setting. Contradictory to the findings of this study, McKenzie et al.'s (2004) results showed that females had higher levels of PA in a coeducational setting. However, the lesson context was unknown. Similar to the football and soccer results of this study, Hannon and Ratliffe's (2005) results showed that high school females had no difference in levels of PA in either setting during invasion games. No coeducational and same-sex setting studies have examined PA in basketball and volleyball units. The MVPA levels during the volleyball unit among females in both settings were not surprising. Volleyball is more of a female-specific sport (Hannon, Soohoo, Reel, & Ratliffe, 2009), and it was assumed that no matter the setting the female students would have an equal percentage of time spent in MVPA.

Results of this study showed several differences in time spent in MVPA regarding grade and setting across volleyball and soccer. Results indicate that seventh graders spent more time in MVPA in the same-sex setting than the coeducational setting during the volleyball unit, and ninth graders had a higher percentage of time spent in MVPA in the same-sex setting than the coeducational setting for the soccer unit. Although there was no significance in the percentage of time spent in MVPA specifically between males and females, PE

teachers should be mindful of these result when selecting coeducational and same-sex settings for these sport units.

### Activity Levels by Grade

Results indicate that during the basketball unit, seventh graders spent more time in MVPA than ninth graders. The U.S. Department of Health and Human Services (1996) indicates that student PA levels decline with increasing age and grade level during adolescence. Gao et al. (2009) examined 146 middle school PE students' average heart rate and percentage of time spent above their target heart zone. Results indicated that students' average heart rate and percentage of time spent above their target heart zone declined from sixth grade to eighth grade. Similarly, Parish and Treasure (2003) examined middle school PE students and also found that PA levels declined from sixth grade to eighth grade. Hodges-Kulinna et al. (2003) examined mean heart rates of PE students from Grades 3 to 12. They did not analyze mean heart rates of PE students in seventh and ninth grade specifically. However, the overall results indicated that PE students in elementary and high school spent more time in the target heart rate zone than middle school students. Results of this study during the basketball unit support previous research findings indicating that PA levels decline with age and grade level. However, The U.S. National Youth Risk Behavior Survey (CDC, 2014) indicated that more adolescents met the recommended levels of PA participation in the ninth grade than in the school years following ninth grade. This possibly indicates that younger students value or like activity more. This could be the same reasoning for seventh graders having spent a higher percentage of time in MVPA than ninth graders during a basketball unit. Further research needs to explore activity levels of PE students in specific grades, specifically seventh to ninth grades.

### Conclusions

Even though there was statistically significant Gender  $\times$  Setting interactions and statistically significant Setting  $\times$  Grade interactions, none of the patterns of interaction were similar in terms of optimizing PA levels. The variability of the results is not totally unexpected given the developmental changes occurring among junior high students. The issue of whether a coeducational or same-sex setting is most effective for student outcomes in PE continues to be debated at

school district, state, and national levels. However, more studies need to be conducted and added to the limited body of research before any evidence-based decision is made. This study has added to the limited amount of research that has examined student PA levels in coeducational and same-sex settings. This study was unique in that it is the only study that has measured PA levels (via accelerometers) of students for the entire class period for four sport units in coeducational and same-sex settings. The accelerometer data were valuable to this study, providing information in regard to MVPA in a PE setting. Regardless of setting, gender, grade level, or sport, the national recommendation of 50% MVPA in PE was not met. Thus, many other factors must be considered in terms of PA levels in PE settings. Factors not measured in this study but worth examining and considering in the future include student motivation and attitudes toward PE and PA, skill competency in the sport being played, tactical and game knowledge, teacher–student interactions, self-efficacy, and possibly cardiovascular fitness levels of students engaging in invasion games. All of these factors are magnified given the age group (middle school), many of whom are going through many physical, emotional, and social change issues.

Additionally, this study was also unique from the perspective that the lessons were based on the TGM. No other studies examining PA in coeducational and same-sex settings have controlled for the type of instruction. Further research needs to examine the PA of students in coeducational and same-sex settings using other instructional models and activities.

## References

- Berkowitz, R. J. (1996). A practitioner's journey from skill to tactics. *Journal of Physical Education, Recreation, and Dance*, 67, 44–45.
- Burrows, L. (1986). A teacher's reactions. In R. Thorpe, D. Bunker, & L. Almond (Eds.), *Rethinking games teaching* (pp. 45–52). Loughborough, England: University of Technology.
- Centers for Disease Control and Prevention. (2013). Youth risk behavior surveillance—United States. *MMWR Surveillance Summaries*, 63(SS-4), 1–168.

- Centers for Disease Control and Prevention. (2014). Youth risk behavior surveillance. *Morbidity and Mortality Weekly Report*, 63(4), 1–168.
- Corder, K., Brage, S., Ramachandran, A., Snehalatha, C., Wareham, N., & Ekelund, U. (2007). Comparison of two actigraph models for assessing free-living physical activity in Indian adolescents. *Journal of Sports Sciences*, 25, 1607–1611. <https://doi.org/10.1080/02640410701283841>
- Cruz, A. (2004). Teachers and students perceptions of Teaching Games for Understanding approach in physical education lessons. *Journal of Physical Education and Recreation*, 10, 57–66.
- Dunbar, R. R., & O’Sullivan, M. M. (1986). Effects of intervention on differential treatment of boys and girls in elementary physical education lessons. *Journal of Teaching in Physical Education*, 5, 166–175. <https://doi.org/10.1123/jtpe.5.3.166>
- Ekelund, U., Tomkinson, G. R., & Armstrong, N. (2011). What proportion of youth are physically active? Measurement issues, levels, and recent time trends. *British Journal of Sports Medicine*, 45, 859–865. <https://doi.org/10.1136/bjsports-2011-090190>
- Fairclough, S., & Stratton, G. (2005). Physical activity levels in middle and high school physical education: A review. *Pediatric Exercise Science*, 17, 217–236. <https://doi.org/10.1123/pes.17.3.217>
- Fromel, K., Formankova, S., & Sallis, J. (2002). Physical activity and sport preferences of 10- to 14-year-old children: A 5-year prospective study. *Gymnica*, 32(1), 11–16.
- Gao, Z., Hannon, J. C., & Carson, R. L. (2009). Middle school students’ heart rates during different curricular activities in physical education. *ICHPER-SD Journal of Research in Health, Physical Education, Recreation, Sport, and Dance*, 4, 21–24.
- Gordon-Larsen, P., Nelson, M. C., & Popkin, B. M. (2004). Longitudinal physical activity and sedentary behavior trends: Adolescence to adulthood. *American Journal of Preventive Medicine*, 27, 277–283. <https://doi.org/10.1016/j.amepre.2004.07.006>
- Griffin, P. (1981). One small step for personkind: Observations and suggestions for sex equity in coeducational physical education classes. *Journal of Teaching in Physical Education*, A, 12–17. <https://doi.org/10.1123/JTPE.A.1.12>

- Griffin, P. (1984). Girls' participation patterns in a middle school team sports unit. *Journal of Teaching in Physical Education*, 4, 30–38. <https://doi.org/10.1123/jtpe.4.1.30>
- Hannon, J. C., & Ratliffe, T. (2005). Physical activity levels in coeducational and single-gender high school physical education settings. *Journal of Teaching in Physical Education*, 24, 149–164. <https://doi.org/10.1123/jtpe.24.2.149>
- Hannon, J. C., Soohoo, S., Reel, J., & Ratliffe, T. (2009). Gender stereotyping and the influence of race in sport among adolescents. *Research Quarterly for Exercise and Sport*, 80, 676–684. <https://doi.org/10.1080/02701367.2009.10599608>
- Hannon, J. C., & Williams, S. M. (2008). Should secondary physical education be coeducational or single-sex? *Journal of Physical Education, Recreation, and Dance*, 79, 6–8. <https://doi.org/10.1080/07303084.2008.10598126>
- Harvey, S., Smith, L., Fairclough, S., Savory, L., & Kerr, C. (2015). Investigation of pupils' levels of MVPA and VPA during physical education units focused on direct instruction and tactical games model. *Physical Educator*, 72, 40–58. <https://doi.org/10.18666/TPE-2015-V72-I5-6998>
- Hill, G., & Hannon, J. C. (2008). An analysis of middle school students physical education physical activity preferences. *Physical Educator*, 65, 180–194.
- Hodges-Kulinna, P., Martin, J., Lai, Q., Kliber, A., & Reed, B. (2003). Student physical activity patterns: Grade, gender, and activity influences. *Journal of Teaching in Physical Education*, 22, 298–310. <https://doi.org/10.1123/jtpe.22.3.298>
- Kahn, J. A., Huang, B., Gillman, M. W., Field, A. E., Austin, S. B., Colditz, G. A., & Frazier, A. L. (2008). Patterns and determinants of physical activity in U.S. adolescents. *Journal of Adolescent Health*, 42, 369–377. <https://doi.org/10.1016/j.jadohealth.2007.11.143>
- Kelder, S. H., Perry, C. L., & Klepp, K. I. (1993). Community-wide youth exercise promotion: Long-term outcomes of the Minnesota Heart Health Program and the Class of 1989 Study. *Journal of Scholastic Health*, 63, 218–223. <https://doi.org/10.1111/j.1746-1561.1993.tb06125.x>

- Kelly, L. A., Reilly, J. J., Fairweather, S. C., Barrie, S., Grant, S., & Paton, J. Y. (2004). Comparison of two accelerometers for assessment of physical activity in preschool children. *Pediatric Exercise Science, 16*, 324–333. <https://doi.org/10.1123/pes.16.4.324>
- McCormick, B. T., Hannon, J. C., Newton, M., Shultz, B., Miller, N., & Young, W. (2012). Comparison of physical activity in small-sided basketball games versus full-sided games. *International Journal of Sports Science and Coaching, 7*, 689–697. <https://doi.org/10.1260/1747-9541.7.4.689>
- McKenzie, T., Prochaska, J., Sallis, J., & LaMaster, K. (2004). Coeducational and single-sex physical education in middle schools: Impact on physical activity. *Research Quarterly for Exercise and Sport, 75*, 446–449. <https://doi.org/10.1080/02701367.2004.10609179>
- Metzler, M. W. (2005). *Instructional models for physical education*. Boston, MA: Allyn and Bacon.
- Mitchell, S. A., Griffin, L. L., & Oslin, J. L. (1994). Tactical awareness as a developmentally appropriate focus for the teaching of games in elementary and secondary physical education. *Physical Educator, 51*, 21–28.
- Mitchell, S. A., Oslin, J. L., & Griffin, L. L. (2006). *Teaching sport concepts and skills: A tactical approach* (2nd ed.). Champaign, IL: Human Kinetics.
- Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA, 300*, 295–305. <https://doi.org/10.1001/jama.300.3.295>
- National Association of Sport and Physical Education. (2009). *Appropriate instructional practice guidelines for middle school physical education*. Reston, VA: Author.
- Office of the Surgeon General. (2010, January). *The Surgeon General's vision for a healthy and fit nation*. Rockville, MD: Author.
- Ogden, C. L., Carroll, M. D., Lawman, H. G., Fryar, C. D., Kruszon-Moran, D., Kit, B. K., & Flegal, K. M. (2016). Trends in obesity prevalence among children and adolescents in the United States, 1988–1994 through 2013–2014. *JAMA, 315*, 2292–2299. <https://doi.org/10.1001/jama.2016.6361>

- Owen, N., Sparling, P. B., Healy, G. N., Dunstan, D. W., & Matthews, C. E. (2010). Sedentary behavior: Emerging evidence for a new health risk. *Mayo Clinic Proceedings*, 85, 1138–1141. <https://doi.org/10.4065/mcp.2010.0444>
- Parish, L. E., & Treasure, D. C. (2003). Physical activity and situational motivation in physical education: Influence of the motivational climate and perceived ability. *Research Quarterly for Exercise and Sport*, 74, 173–182. <https://doi.org/10.1080/02701367.2003.10609079>
- Puyau, M. R., Adolph, A. L., Vohra, F. A., & Butte, N. F. (2002). Validation and calibration of physical activity monitors in children. *Obesity Research*, 10, 150–157. <https://doi.org/10.1038/oby.2002.24>
- Sallis, J. (2000). Age-related decline in physical activity: A synthesis of human and animal studies. *Medicine and Science in Sports and Exercise*, 32, 1598–1600. <https://doi.org/10.1097/00005768-200009000-00012>
- Solomons, H. (1980). Sex role mediation of achievement behaviors and interpersonal interactions in sex-integrated team games. In E. Pepitone (Ed.), *Children in cooperation and completion*. Lexington, MA: D.C. Heath.
- Song, M., Carroll, D. D., & Fulton, J. E. (2013). Meeting the 2008 Physical Activity Guidelines for Americans among US youth. *American Journal of Preventive Medicine*, 44, 216–222. <https://doi.org/10.1016/j.amepre.2012.11.016>
- Treanor, L., Graber, K., Housner, L., & Wiegand, R. (1998). Middle school students' perceptions of coeducational and same-sex physical education classes. *Journal of Teaching in Physical Education*, 18, 43–56. <https://doi.org/10.1123/jtpe.18.1.43>
- 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 and Science in Sports and Exercise*, 34, 350–355. <https://doi.org/10.1097/00005768-200202000-00025>
- Turner, A. P. (1996). Teaching for understanding: Myth or reality? *Journal of Physical Education, Recreation, and Dance*, 67(4), 46–48, 55. <https://doi.org/10.1080/07303084.1996.10607374>

- Turner, A., & Martinek, T. (1992). A comparative analysis of two models for teaching games (technique approach and game-centred [tactical focus] approach). *International Journal of Physical Education*, 29, 131–152.
- Turner, A., & Martinek, T. (1999). An investigation into Teaching Games for Understanding: Effects on skill, knowledge, and game play. *Research Quarterly for Exercise and Sport*, 70, 286–296. <https://doi.org/10.1080/02701367.1999.10608047>
- U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention.
- U.S. Department of Health and Human Services. (2008a). *2008 Physical Activity Guidelines for Americans*. Washington, DC: Author.
- U.S. Department of Health and Human Services. (2008b). *Physical Activity Guidelines Advisory Committee report*. Washington, DC: Author.
- U.S. Department of Health and Human Services. (2010). *Healthy People 2020*. Washington, DC: Government Printing Office.
- Van Acker, R., da Costa, F. C., Bourdeaudhuij, I. D., Cardon, G., & Haerens, L. (2010). Sex equity and physical activity levels in coeducational physical education: Exploring the potential of modified game forms. *Physical Education and Sport Pedagogy*, 15, 159–173. <https://doi.org/10.1080/17408980902877609>
- Welk, G. J., Blair, S. N., Wood, K., Jones, S., & Thompson, K. W. (2000). A comparative evaluation of three accelerometry-based physical activity monitors. *Medicine and Science in Sports and Exercise*, 32, S489–S497. <https://doi.org/10.1097/00005768-200009001-00008>
- Welk, G. J., Corbin, C. B., & Dale, D. (2000). Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport*, 71, 59–73. <https://doi.org/10.1080/02701367.2000.11082788>