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PEDAGOGY

An Examination of In-Class Physical Activity Across Games Classifications

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Abstract

The purpose of this study was to examine the in-class physical activity opportunities across game classifications. A total of 221 (male, 100; female, 121) Year 9/10 physical education students were used within this study. Each student was engaged in four sport-based units (target, net/wall, striking/fielding, and invasion). Physical activity data were collected during each lesson using an accelerometer. For analysis of data, descriptive statistics were used to examine whether students met physical activity thresholds, and repeated measures ANOVAs were used to examine unit differences. Results indicated (a) none of the lessons met the percentage of time standard for quality physical activity and (b) significant differences between games classifications in regard to moderate to vigorous physical activity were identified. These results indicate that unit of study (i.e., different games classifications) should be considered when focusing on in-class physical activity.

The public health agenda has focused teachers and policy makers toward meeting physical activity (PA) benchmarks within physical education (PE) classes (U.S. Department of Health and Human Services [USDHHS], 2010). Currently, a commonly adopted thresh-

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old is that students should engage in a minimum 50% class time in moderate to vigorous physical activity (MVPA; USDHHS, 2010). The 50% MVPA criterion is deemed critical toward a student's exercise-related health, but there is the potential issue associated with the achievability when teaching diverse units of study in PE, in particular, when examining the breadth of units taught and the inherent PA opportunities under the concept of school-based sport. Therefore, the aim of this project was to provide initial data focused on students' in-class PA levels (i.e., total and moderate to vigorous) across sport units.

Physical Activity Opportunities and Physical Education

The concept of in-class PA levels has become a popular area of inquiry (USDHHS, 2010). Policy makers have indicated that in a quality PE program, students should be engaged in a minimum of 50% class time in health-enhancing levels of PA (USDHHS, 2010). Currently, much of the research focused within PE and the ability to meet current benchmarks or significantly change in-class PA patterns has dealt with interventions involving prescriptive units of instruction outside sport (Kahn et al., 2002). For instance, units of instruction focused within areas such as fitness/aerobics (Gortmaker et al., 1999; Harrell et al., 1996; Neumark-Sztainer, Story, Hannan, & Rex, 2003), gymnastics (Fairclough & Stratton, 2005), and whole school programs (McKenzie et al., 2004; Pangrazi, Beighle, Vehige, & Vack, 2003; Pate et al., 2005) have been used in interventions. The aforementioned studies have indicated initial results that students can meet PA benchmarks during PE lessons, but there seems to be a lack of research related to the area of sport. Although some researchers in their studies have used sport within their PA interventions, the examination of how diverse games and sports influence in-class PA was not a primary focus.

Teaching Sport and Games Within Physical Education

As teachers design, develop, and implement curricular options, the concept of games and sport continues to be a prevalent choice in school programs. For instance, in secondary PE programs, some form of one or a range of sports within the secondary curriculum is commonly implemented (United Nations Educational, Scientific, and Cultural Organization, 2010). Although games and sports are a

critical aspect of PE, it seems inconceivable that students can engage or experience each and every sport in their school career. As a result of the mismatch between limited class time and the number of sports available to study, one key trend within games and sport–based PE is the classification of games into four categories or classifications: target, net/court, striking and fielding, and invasion (Mitchell, Oslin, & Griffin, 2006). These classifications are based on common underlying game play principles as well as strategy and tactics that are common to the sports in each category (Bunker & Thorpe, 1983) and have been further expanded by authors such as Oslin and Mitchell (2006), Hopper (2003), and Memmert and Harvey (2010).

The classification of games and sports into categories (target, striking/fielding, net/court, and invasion) and the features of each game category have the capacity to provide a conceptualization of students' opportunities to engage in PA. Characteristics of the games and sports in each category provide plausible reasons for the conceptual differences associated with PA opportunities and could be attributed to (a) the intent of games and sports in each category and (b) the governing or primary rules that define the sports within each category (Gréhaigne, Richard, & Griffin, 2005). A description of information on (a) sports, (b) play principles, and (c) conceptualization of PA per games classification is provided in Table 1.

Table 1
Game Categories, Sample Sports, and Conceptualization of MVPA

Game category	Sample sports	Play principles	Conceptualization of MVPA
Target	Lawn Bowls Bocce	Place an implement closest to a target or goal	Low: High level of focus on cognitive aspects
Net/Wall	Tennis Squash	Place the implement in a spot that cannot be returned	Moderate: Quick bouts of movement with potential for slow restarts
Striking/ Fielding	Softball Cricket	Hit or strike a ball into a place that eludes opponents	Moderate: High potential for wait time

Table 1 (cont.)

Game category	Sample sports	Play principles	Conceptualization of MVPA
Invasion	Soccer Basketball	Move into opponents territory to score	High: Most players can be involved in game play

PA research focused within the area of games and sport has been broad. Researchers who have used sport as a mode of instruction to influence in-class PA have grouped sports together for convenience (e.g., target and invasion games housed under the same concept of sport). To date, a more micro-analysis of school sport whereby students engaged in a single unit of a sports category (i.e., invasion) has been used in two studies (Hastie & Trost, 2002; Perlman, 2013). The majority of these researchers have purposely used invasion sports due to the relatively low level of down time (e.g., quick restarts) and opportunities for all students to move. Although these researchers have provided empirical evidence toward meeting PA goals using the 50% MVPA threshold, the quality of PE programs relies on teaching a range of sports, including those under the target, net/wall, and striking/fielding categories. Therefore, the purpose of this study was to examine the in-class PA opportunities for secondary students across the spectrum of game categories. Specifically, this study was guided by the following research questions:

- How many games and sports lessons meet the 50% MVPA threshold?
- What is the influence of unit of study (i.e., games classifications) on in-class physical activity (i.e., total PA and MVPA)?

Method

Participants and Settings

A total of 221 (males, 100; females, 121) Year 9/10 PE students were used within this study. Students were from one public secondary school in the United States. Each student was engaged in four sport-based units (target, net/wall, striking/fielding, and invasion). Each unit of study was conducted over 10 lessons and adopted the skill–drill–game approach. Use of the skill–drill–game approach was due to the school curriculum and staff familiarity.

Contextualization of each unit was defined as follows: target – bocce, net/wall – badminton, striking/fielding – softball, and invasion – soccer. A sample unit plan for volleyball is provided is Table 2. During each unit, students were required to switch positions to allow for a more equal opportunity to engage in PA.

Table 2
Sample Block Plan of Volleyball

Day	Lesson content
1	Introduction to Volleyball Game Play (Needs Assessment)
2	Forearm Pass Skill Practice Game Play (6v6) "Forearm Pass Only"
3	Overhead Pass Skill Practice Game Play (6v6) "Forearm and Overhead"
4	Serve (Underhand) Skill Practice Game Play (6v6) "No Attacking"
5	Serve (Overhand) Skill Practice Game Play (6v6) "No Attacking"
6	Spike and Dink Skill Practice Game Play (6v6)
7–9	Tournament
10	Championship Games Awards

Measuring Physical Activity

At the beginning of each PE lesson, students were asked to wear an ActiGraph GT1M Accelerometer. The ActiGraph GT1M was placed on the waist at the right hip and supported by an elastic band. As students engaged in activity, the GT1M were used to collect data as a measure of activity intensity and duration measured in 10-s counts. Data were downloaded into ActiWeb Software and cal-

culated into metabolic equivalents (METS). METs were a measure of activity and categorized into time spent in total physical activity (TPA; ≥ 1 METS) and MVPA (≥ 3 METS; Trost, Loprinzi, Moore, & Pfeiffer, 2011). Trost et al. (2011) indicated that accelerometers may be used to get an objective and valid assessment of physical activity. Students wore the same accelerometer throughout the study to alleviate the issue with interaccelerometer variability.

Data Collection

Before the study began, approval from university ethics committee was granted, as well as appropriate consent from each participant/guardian. During the first week of school, students were taught about the accelerometers and how to wear them. When the study began, students were asked to wear the accelerometer for the length of each PE class. PA data were collected on a daily basis and downloaded into the mobile physical activity kit. The mobile physical activity kit housed all the accelerometers, accessories, and laptop.

Data Analysis

Data from each accelerometer were downloaded into the ActiWeb software to determine the amount of time spent in TPA and MVPA per lesson. TPA and MVPA cut points were based on the recommendations of Trost et al. (2011). As a result, each student was provided an overall amount of time spent within each dependent variable per day (i.e., TPA and MVPA). Further analysis of data was conducted in four stages. First, lesson (e.g., time spent in TPA during Lesson 1) and unit (e.g., average time spent in MVPA throughout the 10 lessons) descriptive statistics (mean and standard deviation) were calculated. Second, to examine the number of days that met the MVPA threshold, a percentage of lessons per unit was calculated using the following: [Number of Days = (Number of Days Above 50% MVPA / Number of Days in Unit) × 100]. Third, intraclass correlation coefficients (ICCs) were calculated to identify the appropriate unit of analysis (individual or class). Fourth, to examine differences between units, two repeated measures ANOVAs were calculated for TPA and MVPA. A Bonferroni adjustment was used due to multiple ANOVAs ($p \leq .025$). Pairwise comparisons were calculated for all significant ANOVAs to examine where significant differences were located between units of study.

Results

Descriptive statistics (mean and standard deviations) by lesson and unit for dependent variables are displayed in Tables 3 to 5. A total of 0 days were identified as meeting or exceeding the 50% threshold for students engaging in MVPA. ICCs for all dependent variables were negative, and per the recommendation of Kenny and LaVoie (1985), the individual was used as the level of analysis. With the repeated measures ANOVAs, an insignificant effects was revealed for TPA, $F(3, 218) = 3.53$, $p = .016$, $\eta^2 = .046$, and significant differences were found for MVPA between games classifications, $F(3, 218) = 2067.98$, $p = .000$, $\eta^2 = .966$. Follow-up pairwise comparisons are illustrated in Table 6 and show that significant differences occurred between all compared units of study.

Table 3
Descriptive Statistics (Mean and Standard Deviation) of TPA per Lesson

	Target		Net/Wall		Striking		Invasion	
Day	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
1	31.7	6.60	32.3	5.48	30.7	6.45	32.7	5.76
2	31.7	6.75	31.9	5.78	30.4	6.77	32.5	6.12
3	31.6	6.29	32.0	4.65	30.6	5.81	32.6	5.11
4	32.1	6.47	32.7	5.15	31.6	6.39	33.2	5.60
5	31.5	6.36	31.9	5.38	30.6	6.43	32.6	5.76
6	31.8	6.51	32.1	5.00	30.6	6.11	32.6	5.48
7	31.2	6.89	31.5	5.97	30.2	6.79	32.2	6.35
8	31.5	6.69	32.0	5.46	30.6	6.48	32.6	5.84
9	31.8	6.63	32.2	5.36	30.6	6.51	32.7	5.79
10	31.9	6.42	32.7	5.32	30.8	6.54	32.8	5.81

Note. Each class lasted 50 min.

Table 4
Descriptive Statistics (Mean and Standard Deviation) of MVPA per Lesson

	Target		Net/Wall		Striking		Invasion	
Day	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
1	1.33	1.36	5.71	2.84	2.97	2.46	9.84	5.02
2	1.30	1.31	5.69	3.48	2.71	2.96	10.94	4.31

Table 4 (cont.)

	Target		Net/Wall		Striking		Invasion	
Day	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
3	1.19	1.29	6.65	2.87	3.20	2.54	12.24	3.41
4	1.31	1.31	6.58	3.44	3.74	3.89	13.30	4.95
5	1.28	1.19	6.18	3.29	3.37	3.58	12.51	3.11
6	1.32	1.36	6.23	3.07	3.88	2.93	14.21	4.97
7	1.32	1.36	5.18	2.59	3.76	2.82	12.93	5.57
8	1.32	1.36	6.23	3.07	3.44	2.51	12.24	3.84
9	1.31	1.37	5.48	2.82	5.24	4.18	11.76	5.81
10	1.32	1.37	6.28	1.92	4.53	3.32	10.66	4.38

Note. Each class lasted 50 min.

Table 5
Descriptive Statistics (Mean and Standard Deviation) of TPA and MVPA per Unit

	TPA		MVPA	
Unit	*M*	*SD*	*M*	*SD*
Target	31.67	6.24	1.30	1.31
Net/Wall	32.06	5.02	6.02	0.92
Striking	30.67	6.20	3.69	1.83
Invasion	32.68	5.54	12.06	1.67

Table 6
Pairwise Comparison of MVPA Between Games Classifications

I	J	Mean difference (I-J)	*SE*	Sig.	Lower bound	Upper bound
Target	Net/Wall	−4.722	.113	.000*	−5.022	−4.421
Target	Striking	−2.386	.156	.000*	−2.801	−1.972
Target	Invasion	−10.765	.139	.000*	−11.136	−10.394
Net/Wall	Striking	2.336	.136	.000*	1.974	2.697
Net/Wall	Invasion	−6.043	.127	.000*	−6.381	−5.706
Striking	Invasion	−8.379	.167	.000*	−8.823	−7.935

*$p \leq .025$.

Discussion

The emphasis of this study was to examine in-class PA opportunities of secondary students across multiple sport-based PE units. Specifically, the following were examined in this study: (a) the degree by which students met the 50% threshold for engaging in MVPA in each lesson and (b) whether there were significant differences across games classifications (e.g., target, invasion) of students engaging in both physical movement (i.e., TPA) and MVPA. Results indicated that in all lessons, no matter the type of sport, students did not meet the 50% MVPA threshold. In addition, a significant difference was found among games classifications in terms of MVPA.

Findings from this study support that through sport-based PE, students tend to participate in a severely low level of health-enhancing in-class PA. This supports the position statement of the USDHHS (2010) whereby students are not engaging in high levels of in-class PA. In previous studies whereby in-class PA has been the focus, the lack of TPA and MVPA has been attributed to the design and development and implementation of activities that do not allow for adequate PA (Hattie, 2009; Rink & Hall, 2008). To this resolve, the authors share the aforementioned rationales for limited in-class MVPA, yet also suggest that inherent opportunities within each sport influence the degree by which students can engage in MVPA.

The result that students were below the 50% MVPA threshold in all lessons was interesting. This result supports the notion that students are not engaged in MVPA at or above 50%. A plausible reason for the alarmingly low amount of time spent in MVPA could be the unit of instruction (e.g., net/court) or the instructional approach (skill–drill–game). Models-based instruction, such as sport education, have been shown to influence students' level of in-class PA positively (Hastie & Trost, 2002; Perlman, 2012, 2013), although invasion sports were used as the mode of investigation in these studies.

The second significant finding is associated with differences between games classifications. Within this study, results indicated that students were most likely to be involved in higher levels of MVPA during invasion games. This result supports the notion identified by Hastie and Trost (2002) whereby they used the invasion sport of basketball due to the perception of allowing for more engagement in PA. Similar to Hastie and Trost, it is believed that invasion-type sports inherently allow more opportunities to engage in health-enhancing PA due to aspects such as quicker restarts of play.

The results of this study indicate that more research is needed to understand the PA and educational paradigm within school-based PE. The implementation of a 50% MVPA threshold as part of a quality PE program may need more research support. It seems that (a) some sports do not inherently allow students to engage in high levels of MVPA, and (b) the need for students to engage in learning activities (e.g., cognitive) that may take away from activity time, yet lead to increased PA outside the class setting may need to be considered. Secondary sport-based PE encompasses a wide scope of activities and units of study. As such, teachers may need to be provided PA benchmarks to consider these variables. For example, target-type sports may be viewed as effective if they can be used to meet the 10% MVPA criteria. Based on these findings, a reexamination of (a) PA guidelines and (b) instructional practices is needed. Engagement in school sport within PE is common and popular due to the increased level of sporting cultures and popularity of elite and youth sporting opportunities. This study is not without limitations, as TPA and MVPA could be different under the diverse sports under each games classification. Future studies could be focused on different instructional models or approaches that could be viewed as pedagogically appropriate that may be used to elicit a higher degree of PA and maintain a relatively high level of educational richness.

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