METHODOLOGY

Effects of Varying Team Sizes on Physical Activity Levels of College Students

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Abstract

The purpose of this exploratory study was to examine physical activity levels among various team sizes for basketball and soccer in a C/UIPAP setting. Twenty-eight university physical education majors participated in the study. Participants engaged in three-on-three and five-on-five basketball and five-on-five and 11-on-11 soccer games. All games were 20 min in duration, with one game per class period. Objective measures of physical activity were gathered using ActiGraph GT1M accelerometers, and intensity levels were measured via carotid pulse counts and Borg scale. Results indicated that five-on-five matchups in each sport elicited the highest levels of physical activity. Three-on-three basketball and 11-on-11 soccer games provided the least benefit to participants. Findings indicated that team size is an important component for C/UIPAP instructors to consider when designing course activities to promote physical activity.

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For well over 100 years college and university instructional physical activity programs (C/UIPAPs)—also known as basic instruction, general physical education, or service programs—have been a significant component of the general curriculum at higher education institutions (Hensley, 2000). Annually, thousands of students enroll in C/UIPAP course offerings for many reasons. One of these is for the opportunity to engage in structured and meaningful physical activity (PA) and wellness-enhancing activities. Moreover, C/UIPAP courses are recognized as important venues to promote PA and prevent the potential health problems associated with a sedentary lifestyle (World Health Organization, 2004). Through a diversity of courses including baseball, tennis, weight training, stress reduction, swimming, and hiking, students might develop sport-related skills, improved fitness, conceptual knowledge relevant to recreational sport engagement, and an appreciation for lifelong healthy lifestyle behaviors. For these outcomes to occur, maximal practice time is needed. Given this, more attention should be paid to how C/UIPAP courses are structured and what pedagogical strategies instructors are using to maximize class time with the goal of engaging in appropriate PA levels. Therefore, the primary purpose of this exploratory study was to examine PA levels among various team sizes for basketball and soccer in a C/UIPAP course.

Why is maintaining appropriate levels of fitness-enhancing PA crucial to the instructional mission of C/UIPAP courses? Despite the popularity of C/UIPAP courses on campuses across the United States, a real and growing concern exists for the overall PA habits of college-aged students (National Association for Sport and Phsycial Education [NASPE], 2007). The existing literature has demonstrated that regular engagement in PA is positively linked to physiological and psychological health benefits. Unfortunately, many young adults do not obtain sufficient PA to promote enhanced health (Leslie & Owen, 2001; Leslie et al., 1999). Furthermore, college-aged students are at particular risk of low PA levels (NASPE, 2007) with only roughly 37% engaging in regular PA (Centers for Disease Control and Prevention, 2006). Additionally, research demonstrates that PA patterns established during college-age years are likely to continue for the 6 years following graduation and through adulthood (Sparling & Snow, 2002).

Historically, the college and university setting has provided an environment in which PA and wellness-enhancing activities can be convenient and enjoyable for students (Leslie & Owen, 2001).

What is important to note from a pedagogical perspective is that C/UIPAP course instructors interact with a considerable number of students who come into class with diverse fitness and PA needs. Instructors must be able to diversify pedagogical practices to best meet the students' needs that are presented to them. Also, C/UIPAP courses often serve as the last opportunity for students to engage in formal PA instruction prior to adulthood. Consequently, engaging in appropriate PA in C/UIPAP courses can benefit not only the respective program but also entities on campus (campus recreation, housing, student health services, etc.) that share a common interest in students' lifelong PA, health, and wellness (Leslie & Owen, 2001).

Although no data have been reported for college-aged students in sport-based PA courses, activity levels ranging from 3% to 9% of total class time have been reported for adolescents in soccer, basketball, and hockey games with as little as 3 min reported in classes lead by physical education specialists (Simons-Morton, Taylor, Snider, & Huang, 1993; Simons-Morton, Taylor, Snider, Huang, & Fulton, 1994). In addition, competitive sport units in physical education have been associated with excessive repetition, waiting, downtime, and a general lack of involvement (Arnett, 2004; Sallis et al., 1997; Siedentop & Tannehill, 2000). Thus, instructors and students might have difficulty successfully achieving PA levels appropriate for healthful benefits. In light of this lack of research available, this work examined the PA levels of college-aged students in two popular C/UIPAP course offerings, basketball and soccer, based on team sizes in an effort to shed light on how instructors can best facilitate higher levels of PA during class.

Method

Participants

Information about the participants is presented in Table 1. A sample of 33 upper division physical education teaching majors provided informed consent at the beginning of the study. Twenty-eight participants completed all testing and were used in the analyses. All 28 participants were Caucasian (male = 19, female = 9) ranging in age from 19 to 24 years. Prior to initiation of the study, institutional review board approval was obtained and each participant provided informed consent. All participants were recruited from an upper division physical education class for majors at a Midwestern metropolitan university. The course in which they were enrolled

was "teaching methods of team activities." Throughout the course, participants received theoretical information regarding instructional strategies (i.e., teaching games for understanding, sport education) and then engaged in team activities using the specific tactics and strategies. Skill levels of the participants in both sports ranged from those who were beginners to those who had engaged at the high school varsity level. Participants were deemed healthy as determined by a PA readiness questionnaire (PAR-Q; Thomas, Reading, & Shephard, 1992).

Table 1

Baseline Characteristics of Participants

N	28	Weight (lb)	175.3 ± 40.3
Male/Female	19/9	BMI (kg/m^2)	25.2 ± 4.7
Age (years)	23.6	Waist (in.)	33.4 ± 5.1

Note. $M \pm SD$.

Setting and Conditions

This study used a repeated measures design in which all participants completed six sport activities and acted as their own controls. The six sport activities included one-on-one basketball, three-on-three basketball, five-on-five basketball, one-on-one soccer, five-on-five soccer, and 11-on-11 soccer. We determined that engaging in a one-on-one bout for greater than 10 min would be too physically taxing on the participants and that they would not be able to sustain high levels of PA for a longer period. Therefore, one-on-one basketball and one-on-one soccer were performed for 10 min, and the remaining activities were performed for 20 min. The decision to observe play in 10-min increments was based upon recommendations from the American College of Sports Medicine (Haskell et al., 2007). All basketball bouts were conducted in an intercollegiate athletics facility. Five-on-five full-court games were played on a standard basketball court. Three courts were used simultaneously and two volunteers were added to make 30 players. The volunteers were not included in data collection. The three-on-three bouts were played simultaneously on the same courts using five goals, with the addition of two volunteers to make 30 players. One-on-one bouts were conducted on the same courts using six goals simultaneously until rounds were completed.

All soccer bouts were played on an intramural practice field adjacent to the student fitness center. Two 11-on-11 bouts were played on a full field (110 yd x 60 yd) with a regulation goal. Participants engaged in two bouts of full-field soccer so that data could be collected on everybody. However, data were only collected once per participant. Five-on-five games were played on three side-by-side areas that went across the field. Fields were 60 yd x 50 yd with a 5-ft cone goal at each end. Two volunteers were added to make 30 players. The volunteers were not included in data collection. The one-on-one bouts were played in unrestricted space with each pair provided a cone. The participants scored points by knocking down the cone placed with the soccer ball. All activities were performed during student class time.

Procedures

Data were collected during three consecutive class periods for basketball and four consecutive class periods for soccer. All basketball games were played in an intercollegiate athletics basketball facility. Soccer games were played on a dry grass practice field under similar and optimal weather conditions.

Basketball. On the first day of basketball play, participants engaged in one one-on-one, 10-min modified game, with the 3-point arc serving as a boundary to take the ball back following change of possession with all standard basketball rules in place. No other modifications were made to increase PA. On the second day, participants played one three-on-three, 20-min basketball game also with the 3-point arc as the boundary to take the ball back following change of possession with all standard basketball rules in place. No other modifications were made to increase PA. On the third and final day, participants played one five-on-five full-court basketball game for 20 min with all standard basketball rules in place. No other modifications were made to increase PA. During each basketball activity, participants were given approximately 10 min to warm up and then were provided an accelerometer that was used to quantify the amount of PA each participant completed. Participants were then instructed to obtain preexercise heart rate (HR) and to record it on a personal data sheet. They also completed a short survey assessing subjective intensity ratings of perceived exertion (RPE) scale (Borg, 1998). Subsequently, participants were signaled by the instructor to begin their sport activity to coincide with a predetermined time on the accelerometers. After each 5-min interval (5, 10, 15, and

20 min), participants were signaled to stop play and immediately take their heart rate at the carotid artery. Participants then recorded their HR and RPE on a personal data collection sheet and resumed playing. Each 5-min interval of data recording required 30 to 45 s of stop time.

Soccer. On the first day of soccer play, participants engaged in one one-on-one modified game for 10 min, with unrestricted space and with one cone per pair serving as a shared goal. On the second day, participants played a five-on-five soccer game for 20 min. The five-on-five games were played cross-field with dimensions of 60 yd x 50 yd. As only one full-length soccer field was available, soccer 11-on-11 required 2 days to complete. Therefore, on the third and fourth days of soccer play, participants played one 11-on-11 full-field game for 20 min. The field dimensions for the full-sided game were 110 yd x 60 yd with a regulation goal and goalkeeper that was rotated every 5 min. Warm-up and data collection procedures for the soccer activities were consistent with those previously described for basketball.

Measures

Heart rate and rating of perceived exertion. We determined perceived intensity of each sport activity using both objective (HR) and subjective (RPE) measures. Prior to the beginning of the study, all participants had received training in effective protocol for taking their HR measurements at the carotid artery. HR was calculated at the carotid artery at preexercise and after every 5 min of the sport activity our command. Next, we signaled participants to begin counting their heart beats for 10 s. We then asked participants to multiply that number by 6 to obtain beats per minute (BPM). Participants immediately recorded their BPM on a data sheet. In addition, we used the RPE Scale (Borg, 1998) to assess subjective intensity preexercise, after every 5 min of play, and postexercise. At each interval, participants responded to the stem "How light or hard were you working?" by circling a number on the scale ranging from 6 (*extremely light*) to 20 (*extremely hard*). Responses to this scale, when multiplied by 10, have been shown to roughly approximate the participant's HR at that moment. This was the case in the current study. Along with HR, participants recorded their RPE number and immediately resumed activity.

Total and light-, moderate-, and vigorous-intensity physical activity. Total and light-, moderate-, and vigorous-intensity PA were

captured objectively during participation in each sport activity using an ActiGraph GT1M accelerometer (ActiGraph LLC, Pensacola, FL, USA). Accelerometers are small computerized devices that objectively track and record all physical movement and have been shown to be valid and reliable instruments to assess PA in adults and children (Brage, Brage, & Franks, 2005; Brage, Wedderkopp, & Franks, 2003; Esliger, Probert, & Gorber, 2007; Welk, Schaben, & Morrow, 2004). Each accelerometer was set at an epoch of 60 s (i.e., accelerometer counts were averaged for every 60-s interval). Thus, the more movement that occurred during any 60-s epoch, the higher the number of activity counts that would register and be recorded. For each participant, the accelerometer was attached at the hip (using a belt strap or clip) prior to the sport activity and worn for the duration of the activity. After each activity session, we immediately downloaded accelerometer data to an Excel spreadsheet for storage and subsequent analysis. We used the following epoch categories to characterize light-, moderate-, and vigorous-intensity PA: light-intensity PA = 250–2019 counts per minute (epoch); moderate-intensity PA = 2020–5998 counts per minute (epoch); and vigorous-intensity PA ≥ 5999 counts per minute (Troiano et al., 2008).

Data Analysis

We used the statistical software package PC-SAS, version 9.3 (SAS Institute, Inc., Cary, NC) for all statistical analyses. The significance level was set at $p < 0.05$, and descriptive statistics were reported for all outcomes. For 10-min activities, we computed means for HR, RPE, and PA counts at 5 min and 10 min for each participant. For 20-min activities, we computed means for HR, RPE, and PA counts at 5, 10, 15, and 20 min for each person. We used the general linear model in SAS to determine the overall differences within basketball activities and within soccer activities. We used the least squares means statement to make specific comparisons within each sport. In two cases involving basketball activity, we removed HR data, as the number recorded by the participant was (HR = 208, 248 BPM) grossly inconsistent with their remaining data.

Results

The purpose of this study was to examine PA levels among various team sizes for basketball and soccer in a C/UIPAP setting. We hypothesized that modified games (less than five players in

basketball, less than 11 in soccer) would result in higher levels of PA and intensity than traditional full-sided games.

Participants

Thirty-three participants provided informed consent and initiated the study. Twenty-eight participants (21.6 ± 2.1 years) completed all testing and were used in the analyses. Of the 28 participants, all were Caucasian and 68% were male. Participants' BMI ranged from 19.5 to 38.5 kg/m^2 (M = 25.2 ± 4.7 kg/m^2) with 50% considered normal weight, 36% overweight, and 14% obese. Participants were in the normal range for waist circumference (Table 1).

Heart Rate and RPE

Means and standard deviations for HR and RPE are reported in Table 2 for each sport activity. When comparing basketball activities, we found no difference in preexercise HR (F = 0.26, p = 0.769). During the first 10 min, we found no difference in HR (F = 0.57, p = 0.567), though it tended to be high for each activity (156–161 BPM). However, comparison of HR during the basketball activity from 11 to 20 min revealed that five-on-five basketball was significantly higher than three-on-three (F = 13.29, p < 0.001) and was higher over the entire 20 min (F = 6.09, p = 0.017). For RPE, three-on-three basketball yielded a significantly lower RPE over the first 10 min than one-on-one but was not different than five-on-five (F = 3.12, p < 0.0496). Furthermore, RPE was lower for three-on-three basketball compared to five-on-five during minutes 11 to 20 (F = 4.72, p = 0.034) and lower over the entire 20 min (F = 4.09, p = 0.048).

When comparing soccer activities (Table 2), we found no difference in preexercise HR (F = 0.82, p = 0.442). During the first 10 min, 11-on-11 produced a significantly lower HR than five-on-five or one-on-one (F = 8.48, p < 0.001). However, HR was not different between five-on-five and 11-on-11 soccer during minutes 11 to 20 (F = 3.38, p = 0.072) but was lower in 11-on-11 over the entire 20 min (F = 4.82, p = 0.033). Likewise, 11-on-11 soccer yielded a significantly lower RPE over the first 10 min than one-on-one or five-on-five soccer (F = 8.46, p < 0.001). Similarly, RPE remained lower for 11-on-11 soccer compared to five-on-five soccer during minutes 11 to 20 (F = 11.68, p = 0.001) and over the entire duration of the 20 min (F = 12.13, p = 0.001).

Table 2

Mean HR and RPE Values by Sport and Team Size

	Basketball (n = 28)					Soccer (n = 28)				
	1-on-1	**3-on-3**	**5-on-5**	***F***	***p***	**1-on-1**	**5-on-5**	**11-on-11**	***F***	***p***
Heart Rate (BPM)										
Preexercise	84 ± 19	88 ± 24	86 ± 18	0.26	0.7690	82 ± 16	80 ± 16	77 ± 12	0.82	0.4420
0–10 min	161 ± 20	156 ± 17	159 ± 18	0.57	0.5670	162 ± 20[a]	149 ± 28[a]	134 ± 25[b]	8.48	0.0005
11–20 min	ND	148 ± 19[a]	167 ± 21[b]	13.29	0.0006	ND	155 ± 26	142 ± 26	3.38	0.0716
1–20 min	ND	152 ± 17[a]	163 ± 18[b]	6.09	0.0170	ND	152 ± 26[a]	138 ± 24[b]	4.82	0.0325
RPE (6–20)										
Preexercise	6 ± 0	6 ± 0	6 ± 0	NA	NA	6 ± 0	6 ± 0	6 ± 0	NA	NA
0–10 min	13 ± 2[a]	12 ± 3[b]	13 ± 3[c]	3.12	0.0496	13 ± 2[a]	12 ± 2[a]	10 ± 2[b]	8.46	0.0005
11–20 min	ND	12 ± 2[a]	14 ± 3[b]	4.72	0.0340	ND	14 ± 3[a]	12 ± 2[b]	11.68	0.0012
1–20 min	ND	12 ± 2[a]	13 ± 3[b]	4.09	0.0480	ND	13 ± 2[a]	11 ± 2[b]	12.13	0.0010

Note. $M \pm SD$. HR = heart rate; RPE = ratings of perceived exertion; ND = no data.
[a]difference compared to [b]. [c]no difference compared to either condition.

Total and Light-, Moderate-, and Vigorous-Intensity Activity

Means and standard deviations for total and light-, moderate-, and vigorous-intensity PA for basketball activities are presented in Table 3. Over the initial 10 min, three-on-three was significantly lower for total activity than one-on-one or five-on-five ($F = 8.57$, $p < 0.001$). This trend continued over 11 to 20 min ($F = 7.96$, $p = 0.007$) and over the entire 20 min ($F = 13.38$, $p < 0.001$). Light-intensity activity was not different during the initial 10 min ($F = 1.92$, $p = 0.153$) but was greater during three-on-three compared to five-on-five during minutes 11 to 20 ($F = 5.32$, $p \leq 0.025$) and over the entire 20 min ($F = 5.44$, $p = 0.024$). Moderate-intensity PA was lowest during one-on-one over the initial 10 min ($F = 6.38$, $p = 0.003$). We found no difference between three-on-three and five-on-five during minutes 11 to 20 ($F = 0.21$, $p = 0.646$); however, moderate-intensity activity was significantly lower during five-on-five compared to three-on-three over the entire 20 min ($F = 6.35$, $p = 0.015$). Vigorous-intensity activity was lowest during three-on-three basketball during the initial 10 min ($F = 7.11$, $p = 0.001$) and remained lowest during minutes 11 to 20 ($F = 7.26$, $p = 0.009$) and over the entire 20 min ($F = 12.84$, $p < 0.001$).

Means and standard deviations for total and light-, moderate-, and vigorous-intensity PA for soccer activities are presented in Table 3. Over the initial 10 min, total activity was highest in five-on-five soccer ($F = 5.70$, $p < 0.05$). We found no difference in total activity between five-on-five and 11-on-11 during minutes 11 to 20 ($F = 1.94$, $p = 0.170$); however, 11-on-11 was significantly lower than five-on-five over the entire 20 min ($F = 7.54$, $p = 0.008$). Light-intensity activity was not different during the initial 10 min ($F = 2.14$, $p = 0.124$) or during minutes 11 to 20 between five-on-five and 11-on-11 ($F = 3.4$, $p = 0.071$). Over the entire 20 min, 11-on-11 produced more light-intensity activity than five-on-five ($F = 6.41$, $p = 0.014$). Moderate-intensity PA was not different among soccer activities during any period ($p > 0.05$). Vigorous-intensity activity was lowest during 11-on-11 soccer during the initial 10 min ($F = 3.32$, $p = 0.041$). No statistical difference was found in vigorous-intensity activity during minutes 11 to 20 between five-on-five and 11-on-11 ($F = 1.41$, $p = 0.240$) but was significantly higher during five-on-five compared to 11-on-11 over the entire 20 min ($F = 5.19$, $p = 0.027$).

Table 3

Activity and Intensity Values by Sport Relative to Team Size

	Basketball (n = 28)					Soccer (n = 28)				
	1-on-1	**3-on-3**	**5-on-5**	***F***	***p***	**1-on-1**	**5-on-5**	**11-on-11**	***F***	***p***
Total Activity										
0–10 min	48,494[a] ± 10,850	40,627b ± 8,720	50,802[a] ± 8,898	8.57	0.0004	39,520[a] ± 9,561	44,857[b] ± 8,810	36,334[a] ± 10,216	5.70	0.0048
11–20 min	ND	33,932[a] ± 7,938	40,101[b] ± 8,421	7.96	0.0067	ND	32,915 ± 8,832	29,971 ± 6,882	1.94	0.1698
1–20 min	ND	74,559[a] ± 33,932	90,903[b] ± 16,711	13.38	0.0005	ND	77,773[a] ± 15,904	66,306[b] ± 15,348	7.54	0.0082
Light Intensity										
0–10 min	1.0 ± 0.6	0.9 ± 0.9	0.7 ± 0.5	1.92	0.1534	1.2 ± 1.0	0.6 ± 0.7	1.2 ± 1.8	2.14	0.1240
11–20 min	ND	2.0 ± 1.2[a]	1.4 ± 1.0[b]	5.32	0.0249	ND	1.6 ± 1.1	2.3 ± 1.9	3.40	0.0710
1–20 min	ND	3.0 ± 1.8[a]	2.0 ± 1.1[b]	5.44	0.0235	ND	2.2 ± 1.4[a]	3.5 ± 2.4[b]	6.41	0.0143
Moderate Intensity										
0–10 min	5.9 ± 2.9[a]	8.2 ± 1.7[b]	6.3 ± 2.7[a]	6.38	0.0027	7.7±1.7	7.6 ± 2.1	8.0 ± 2.1	0.32	0.7288
11–20 min	ND	7.5 ± 1.1	7.3 ± 1.7	0.21	0.6462	ND	7.6 ± 1.9	7.3 ± 1.9	0.39	0.5350
1–20 min)	ND	15.7 ± 2.3[a]	13.6 ± 3.7[b]	6.35	0.0147	ND	15.2 ± 3.0	15.3 ± 2.8	0.01	0.9274
Vigorous Intensity										
0–10 min	3.0 ± 2.8[a]	0.9 ± 1.6[b]	3.0 ± 2.7[a]	7.11	0.0014	1.1 ± 1.6[c]	1.8 ± 2.1[a]	0.6 ± 1.3[b]	3.32	0.0412
11–20 min	ND	0.4 ± 0.7[a]	1.3 ± 1.6[b]	7.26	0.0094	ND	0.5 ± 1.2	0.2 ± 0.5	1.41	0.2400
1–20 min	ND	1.3 ± 2.2[a]	4.4 ± 3.9[b]	12.84	0.0007	ND	2.3 ± 3.0[a]	0.9 ± 1.5[b]	5.19	0.0267

Note. $M \pm SD$. ND = no data.

[a]difference compared to [b]. [c]no difference compared to either condition.

Discussion

The purpose of this exploratory study was to examine PA levels among various team sizes for basketball and soccer in a C/UIPAP setting. We hypothesized that modified games (less than five players in basketball, less than 11 in soccer) would result in higher levels of PA and intensity than traditional full-sided games. The findings for activity levels during soccer supported the hypothesis, and those in basketball did not. These findings support existing literature in that team size is an important consideration in promoting PA within physical education classes.

Basketball

Results indicate that although the five-on-five playing condition elicited the highest average HR values, the three-on-three condition resulted in the highest levels of overall intensity throughout the duration of a 20-min playing period. This is consistent with Arnett's (2004) finding that smaller team sizes provide higher levels of moderate to vigorous PA. Based on this, it seems that both three-on-three and five-on-five playing conditions are desirable for eliciting PA within a university-based physical education context. Furthermore, findings indicate that both of these conditions are superior to one-on-one play with regard to achieving health-enhancing levels of PA.

Participants who engaged in five-on-five basketball demonstrated the highest levels of PA. The most plausible explanation for this outcome is that participants increased levels of PA were primarily in response to the larger court dimensions. Specifically, the one-on-one and three-on-three games were restricted to the 3-point line and the five-on-five game was played on a full court. PA counts were not significantly different between five-on-five and one-on-one games even though participants were "covering" much less playing area. This is likely because the one-on-one game presents the maximum opportunity to be fully involved in a game. For example, in a five-on-five game, a low-skill participant may travel the length of the floor and then stand and wait while teammates work to score. In a one-on-one matchup, the player has no opportunity to be a bystander because he or she has no teammates and the participant is solely responsible for "team" performance. HR was not significantly different between one-on-one and five-on-five games. This indicates that participants were engaged at similar levels of intensity, again, despite a smaller playing area. One-on-one and five-on-five matchups in basketball

appear to generate similar levels of activity and intensity and may be equally functional in promoting health benefits and that three-on-three matchups are less effective. Of course, the problems of limited space and equipment, as well as concerns regarding how long students can actually sustain high levels of PA in 1-on-1 play, seem to indicate that five-on-five full-court basketball is the most efficient means of promoting PA. However, it would be interesting to investigate whether three-on-three basketball on a half court with a hoop at each end would promote higher levels of PA and intensity as participants would need to travel from one end of the floor to the other.

Soccer

Results seem to indicate that for soccer traditional 11-on-11 full-sided play is the least desirable for achieving health-enhancing levels of physical fitness. Furthermore, small-sided five-on-five play is most desirable to foster elevated HR, RPE, and total PA over a 20-min playing period within a university-based physical education course. This finding causes us to consider Arnett's (2004) results that team sizes of five or more players (in soccer) demonstrate a dramatic decline in mean percentages of class time in moderate to vigorous PA. This may be because the current study involved 20-min bouts of play, whereas Arnett (2004) examined an entire physical education class period. In addition, the participants in Arnett's (2004) study were significantly younger than the participants in the current study and likely had significantly lower skill levels that would have impacted game play and engagement.

Participants who engaged in five-on-five soccer demonstrated the highest levels of PA. The most likely explanations for this outcome are number of players and field dimensions. Although one-on-one games elicited the highest RPE and HR among participants, the playing area was limited, so the actual activity was restricted. During 11-on-11 full-field soccer matchups, participants could easily "hide" and not fully engage in team play. For example, a participant positioned defensively can stand and watch while team members attack the opponent's goal without being active. Similarly, a forward could stand and watch while his or her team is defending its goal. Clearly 11-on-11 is not an appropriate team arrangement for generating beneficial levels of PA. During five-on-five cross-field play, less opportunity exists for a participant to engage in bystander behavior. The ball travels quickly from end to end and side to side,

and team success is enhanced if all participants are engaged. A five-on-five cross-field matchup in soccer appears to have the strongest potential for high levels of PA. One-on-on matchups led to higher HR and RPE, but they appear to be limited in participants' ability to sustain high levels of PA. As in basketball, the problems of limited space, equipment, and sustainability seem to indicate that five-on-five cross-field soccer is the most efficient means of promoting PA for the conditions studied.

Implications

The results of this study examining participant PA levels during traditional and modified soccer and basketball games indicate that the highest levels of PA are attained in five-on-five full-court basketball and five-on-five cross-field soccer. Simons-Morton et al. (1993) offered that exceptional teachers who organize students in small groups for game play were able to achieve 40% to 50% of class time engaged in moderate to vigorous PA. Based on findings presented here, and consistent with Simons-Morton et al.'s (1993) recommendation, if instructors in C/UIPAPs wish to design competitive team sport experiences for the widest variety of student needs and offer the most opportunity for higher levels of PA, they should consider modifying team sizes such as those used in the present study. If time is limited, they might also employ one-on-one activities to derive the most PA benefits in a short amount of time. Conversely, 11-on-11 full-field soccer appears to be limited in promoting PA comparatively. As college is students' last opportunity for formal PA instruction before adulthood, it is imperative that instructors be able to diversify pedagogical practices to best meet the students' needs that are presented to them. Because students choose to enroll in C/UIPAP courses for many reasons (skill development, social interaction, or stress relief), addressing these motivations and needs is important. For those seeking health-related benefits, modifying team sizes to facilitate increased engagement and PA is one way to maximize gains in this area for students.

Limitations

We should note three limitations concerning the interpretation of this research. First, participants in this study were a convenience sample of a group of upper level university physical education teaching majors who tended to involve themselves at a high level in competitive activities and demonstrated confidence in their sport

skill abilities. It may be that possessing higher levels of skill, interest, and motivation resulted in elevated levels of PA and engagement in game play. This is not likely to be the case in all physical education courses, and greater differences in ability, fitness, and motivation are likely among non–physical education majors involved in a PA course. Further research is needed with the general population of college students to determine the extent to which the outcomes for physical education teaching majors approximate those students.

Second, the collection of HR data by the participants themselves is a recognized limitation of this study. The participants had received instruction in the proper protocol for accurate self-measurement of HR, but we concede that this might not be as accurate as the use of a heart rate monitor. In an effort to increase the likelihood of accurate measure, we provided stop and start signals for the participants and facilitated an immediate recording of the HR at all designated time increments throughout game play. However, the chance for human error in counting and reporting HR data could not be completely eliminated.

A third recognized limitation exists in the focus on PA levels, without attention to the number of quality "touches" during game play or levels of appropriate involvement in the competitive matches. Although participants engaged in more PA during five-on-five soccer and basketball, we do not know to what extent their activity was the result of deliberate tactical and skill execution (i.e., strategic movements) and how much of the activity was simply running up and down the court or field. Furthermore, no controls existed for skill level, fitness level, or tactical knowledge of the participants, as we used a convenience sample. Future research should investigate the amount of PA in which participants engage (both within and outside of C/UIPAPs) and the quality of game play and involvement. For example, although three-on-three basketball did not garner the PA levels of five-on-five, participants may have had more opportunity to learn skills and successfully touch the ball and engage in game play, which could result in greater tactical play. Also, space considerations may make three-on-three a more viable offering than five-on-five basketball. University instructors who are teaching competitive team sport units must keep in mind that in some sports (e.g., soccer) the "full game" may not be an optimal means of promoting PA. However, in other competitive sports (e.g., basketball), the full-sided, full-court game can be used to help students engage in higher levels of PA.

Furthermore, the current study focused specifically on PA only. We did not collect data regarding the skill level of the participants in soccer or basketball. Because of this, we did not gather data from which to make assertions regarding the influence of skill level on engagement in game play as it relates to PA levels in varying team sizes. As skill level is an influencing factor in PA engagement, future research is needed to provide clarity regarding the impact of skill level on PA levels of college students in these contexts.

Recommendations

Based on findings from this study, we recommend that physical educators in school-based secondary physical education or in C/UIPAPs use three-on-three team sizes for basketball and five-on-five team sizes for both basketball and soccer to maximize PA in these two contexts. Simons-Morton et al. (1993) and Siedentop and Tannehill (2000) noted low activity levels for competitive sport units for adolescents in soccer, basketball, and hockey. Our findings seem to provide modifications to team size as an appropriate solution to these issues within physical education classes. In fact, it seems that three-on-three (basketball) and five-on-five (soccer) increased the amount of PA when used in the physical education lesson.

Furthermore, consistent with Leslie and Owen (2001), increasing PA engagement in these modified game contexts has implications for campus recreation departments and intramural programs. For instance, we recommend that campus recreation and intramural tournaments in soccer and basketball structure competitions using three-on-three (basketball) and five-on-five (soccer) team sizes. Doing so would increase PA levels of college students participating in these activities. Arnett (2001) offered that smaller teams sizes could provide individuals with greater opportunities for skill development and enjoyment. Our findings imply that this is also the case for college and university-based PA contexts.

In conclusion, the findings of the current study indicate that team size is an important component for PA instruction program teachers to consider when designing learning activities to promote PA. Hensley (2000) argued that the future of C/UIPAPs is likely bright for teachers who adapt to the changing needs and interests of students. Our findings offer one such adaptation by identifying specific competitive team sport activity organization structures that will promote PA and enhance the physical education experience for college students in C/UIPAPs.

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