

Research Article

The Contribution of Soccer Games and Practices to Achieving Recommended Physical Activity in Boys and Girls

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Abstract

Soccer is a popular sport with children and is a potential vehicle for increasing physical activity. The current study aims to investigate the contributions of children's soccer practices and games to recommended physical activity (PA) levels. Further, we will examine gender differences and whether team size affects PA accumulation. Sixty-two (33 boys, 29 girls; 8.5 ± 0.6 years) soccer players from 7 six-a-side soccer teams wore Actigraph GT1M accelerometers during one practice and one game. Freedson-child accelerometer cut points were used to identify time spent in motionless, sedentary, light, moderate (3 to < 6 METs) and vigorous (≥ 6 METs) intensities. We used paired t-tests to compare practices and games and one-way ANOVA for the effect of both gender and team size on PA. More time was spent in MVPA during practices than games (74.1% versus 67.7%) and less time in motionless (4.1% versus 9.4%) or sedentary (12.9% versus 19.6%) activity. During practices boys spent less time in motionless, sedentary and light categories but more in vigorous and MVPA than girls. During games boys and girls spent similar time in each PA category. During games, players on teams with one or no spare players had fewer minutes of motionless time but otherwise had similar PA profiles. Parents should be informed about the importance of participating in both practices and games to attain the recommended physical activity guidelines.

Keywords: Child; Sports; Exercise; Sedentary Lifestyle

Introduction

Physical activity (PA) is important for the health of children and youth [1,2]. PA decreases the risk of cardiovascular disease, diabetes mellitus and other chronic diseases [1-3]. Physically active children are not only physically healthier but have greater self-image, confidence and cognitive abilities [1-4]. Decreases in PA may lead to increases in sedentary behavior which has a direct effect on metabolism, bone mineral content and vascular health [4]. Sedentary behaviour is emerging as a distinct risk factor for cardio metabolic diseases in children

and youth, independently of other factors such as physical activity and abdominal obesity [4]. To maintain health among children and youth, the Canadian Physical Activity Guidelines recommend 60 minutes per day of moderate to vigorous physical activity (MVPA), with vigorous activity at least 3 times per week [5].

However, PA levels are decreasing among Canadian children and youth with only 7% accumulating 60 minutes of MVPA daily and only 4% accumulating 20 minutes of vigorous activ-

ity 3 times per week [6]. Organized sport is a potential avenue for increasing children's PA levels. However, according to Statistics Canada the number of children participating in sports is decreasing. From 1992 to 2005, the number of boys regularly participating in sport dropped from 66% to 56% and the number of girls dropped from 49% to 45% [7]. According to Statistics Canada, soccer is the number one played sport in Canada with 20% of 5-14 year old Canadian youth playing soccer on a regular basis [7], making it a potential aid for increasing physical activity. With little equipment required, soccer is a cost-effective form of exercise available to families. Intermittent exercise performance, maximum oxygen uptake and coordination of youth can all be enhanced with soccer training [8]. Furthermore, there is evidence that for obese children regular participation in soccer training is at least as efficient in improving exercise capacity, health-related fitness and self-esteem as a standard sports program [9].

There is however limited data on the amount and type of PA acquired in organized soccer games and practices for children and youth. Some studies have examined MVPA contributions during soccer practices [10,11] or indoor soccer games [12] but only a single study compared practices and games with the same participants [13], and this was in girls only. The purpose of this study was to extend the literature on the contribution of soccer practices and games to recommended PA levels. Gender differences in the accumulation of various intensities of PA and whether team size affected the quality of PA accrued were also examined.

Methods

The protocol for this study was approved by the University of Victoria Human Research Ethics Board. The participating teams were recruited first by a note sent to the technical director of the Lower Island Soccer Association who contacted three club technical directors. Each club provided the names of three coaches of six-a-side teams (players aged 7-10 years) to contact. Of the nine teams contacted, seven were willing to participate. Informed parental consent and child assent were obtained prior to participation in the study. Players were asked to wear an accelerometer for one game and one practice over a one-week timeframe. Within the seven teams, 62 of the 69 players (89.9%; 33 boys and 29 girls) consented to participate.

Actigraph GT1M accelerometers (Actigraph, Pensacola, FL) were used to assess activity intensity during one practice and one game. The Actigraph accelerometer has been shown to

be a reliable and valid instrument [14,15]. Upon arrival at the practice or game, consented children were fitted with an accelerometer, which was worn on the right hip for the duration of the activity. Soccer games were scheduled for weekend days and practices took place on weekday evenings. Researchers recorded the time the device was put on and taken off each child as well as the start time and end time of the practice or game. Accelerometers were programmed to record 15-s epochs. The accelerometer files were downloaded to excel using ActiLife 6 data analysis software (Actigraph, Pensacola, FL). Age specific cut points [16] were used to determine the time spent in sedentary, light, moderate, vigorous and MVPA (motionless = zero counts; sedentary = zero counts to < 1.5 METs; light = 1.5 to < 3 METs; moderate = 3 to < 6 METs; vigorous = 6 or more METs) activity categories. The Freedson-child cut points [14] were time-adjusted to the 15-s epoch, a validated approach [17]. The time spent in each activity category was then converted to a percentage of the total practice or game time.

The data was analyzed using Statistical Package for Social Sciences (v 22.0, Chicago, IL) with statistical significance set to $p < 0.05$. A paired t-test was used to compare physical activity levels between practices and games. One way ANOVA followed by Bonferoni post-hoc analysis was used to compare female and male physical activity levels and to investigate the effect of team size on activity levels.

Results

Of the 62 participants that consented to participate (33 boys, age $8.5 \pm .57$ y and 29 girls, age $8.4 \pm .63$ y), we generated accelerometry data for more children on game day ($n = 55$; 30 boys and 25 girls; six absent and one accelerometer malfunctioned) than on practice day ($n = 49$; 27 boys and 22 girls; ten absent and three accelerometer malfunctions). Overall 48 children participated in both the practice and game but due to accelerometer malfunction we had game and practice data on 45 children (26 boys, 19 girls). Practices were between 53 and 71 minutes long while accelerometer wear time ranged from 37 to 71 minutes (mean wear time = 56.7 ± 7.8 minutes) due to children arriving late or leaving early. Game times ranged from 39 to 59 minutes (mean wear time = 50.1 ± 7.2 minutes). All children stayed the entire length of their game but game time varied due to the amount of pre-game warm-up. Only data recorded during the practice or actual game time was used in the analysis. Due to the range of practice and game times across teams, results are presented as a percentage of total time.

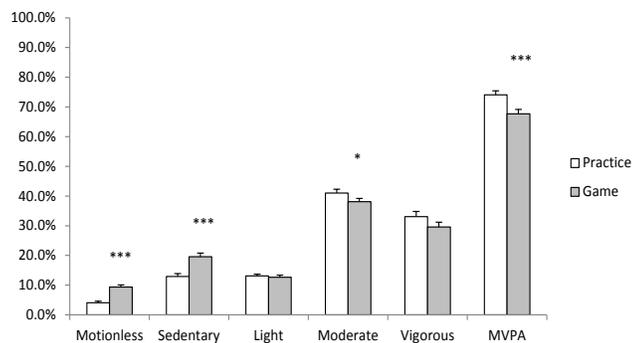
The mean percentage of time spent at each intensity during practices and games is shown in Table 1 and Figure 1. During practices compared to games, less time was spent in motionless (4.1% versus 9.4%; $p < 0.001$) and sedentary activity (12.9% versus 19.6%; $p < 0.001$), and more time was spent in moderate (41.0% versus 38.1%; $p < 0.05$) and MVPA (74.1% versus 67.7%; $p < 0.01$) activity categories.

Table 1. Comparison of percentage of time spent in activity categories during soccer games and practices

Intensity	Practice	Game	t	p
	(56.7 ± 7.8 min)	(50.1 ± 7.2 min)		
Motionless	4.1%	9.4%	- 6.425	0.000
Sedentary	12.9%	19.6%	- 4.673	0.000
Light	13.1%	12.7%	0.444	0.659
Moderate	41.0%	38.1%	2.028	0.049
Vigorous	33.1%	29.6%	1.967	0.055
MVPA	74.1%	67.7%	3.604	0.001

MVPA = moderate-to-vigorous physical activity.

Figure 1. Comparison of percentage of time spent in activity categories during soccer games and practices



Values are means ± SE. Significant differences: * $p < .05$; ** $p < .01$; *** $p < .001$

Differences in physical activity levels between genders during practice and games are shown in Table 2 and Figures 2 and 3. During practice, the percentage of time spent in motionless, sedentary and light activity was significantly higher for females ($p < 0.05$) compared to males. Vigorous activity and MVPA were, however significantly higher in males than females ($p < 0.01$). There were no significant gender differences in any PA categories during games.

Team size during games did not affect the proportion of time spent in sedentary, light, moderate, vigorous or MVPA activity ($p > 0.05$; Table 3). However, there was a significant difference

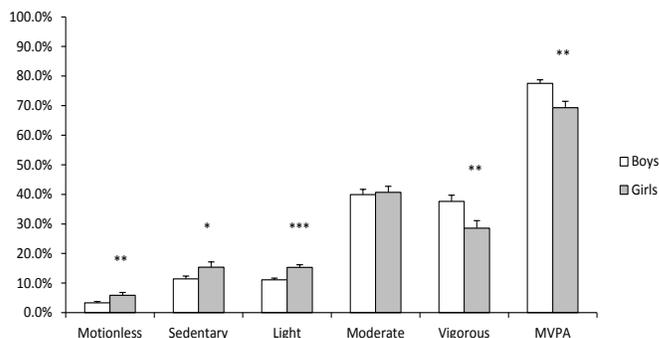
in motionless time during games with varying team size. Post-hoc analysis showed that teams with 6-7 players had less motionless time than teams with 8-9 or 10 players.

Table 2. Comparison of the percentage of time spent by boys versus girls in different activity categories during soccer games and practices

Intensity	Practice (56.7 ± 7.8 min)				Game (50.1 ± 7.2 min)			
	boys	girls	F	p	boys	girls	F	p
	(n=27)	(n=22)			(n=30)	(n=25)		
Motionless	3.3%	5.9%	7.695	0.008	9.6%	10.2%	0.191	0.664
Sedentary	11.4%	15.4%	4.368	0.042	19.9%	22.0%	0.842	0.363
Light	11.1%	15.3%	15.828	0.000	12.1%	14.5%	3.574	0.064
Moderate	39.9%	40.7%	0.091	0.764	37.1%	37.4%	0.022	0.882
Vigorous	37.6%	28.6%	7.617	0.008	31.0%	26.0%	2.470	0.122
MVPA	77.5%	69.3%	12.006	0.001	68.1%	63.4%	2.459	0.123

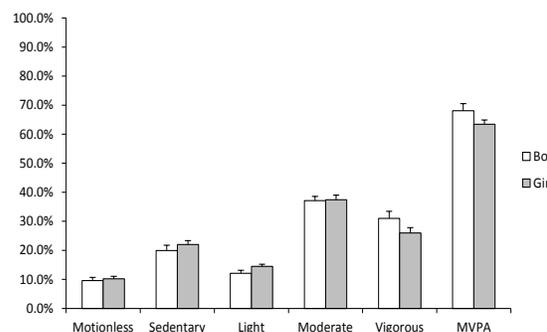
MVPA = moderate-to-vigorous physical activity.

Figure 2. Comparison of the percentage of time spent by boys versus girls in different activity categories during soccer practices



Values are means ± SE. Significant differences: * $p < .05$; ** $p < .01$; *** $p < .001$

Figure 3. Comparison of the percentage of time spent by boys versus girls in different activity categories during soccer games



Values are means ± SE. Significant differences: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Comparison of percentage of time spent in different activity categories during a six-a-side game when team size varied

Intensity	10 players/ team	8-9 players/ team	6-7 players/ team	p
Motionless	11.8 ^a	10.8 ^b	5.7	.004
Sedentary	22.9	21.5	17.5	.294
Light	14.0	12.4	14.6	.358
Moderate	38.2	35.8	40.1	.271
Vigorous	24.9	30.3	27.7	.438
MVPA	63.1	66.1	67.8	.611

^a differs from 6-7 players/team ($p < .05$)

^b differs from 6-7 players/team ($p < .01$)

MVPA = moderate-to-vigorous physical activity.

Discussion

We extend the literature by exploring the physical activity profile of young Canadian soccer players. Unique to our study, we investigated the time spent in different activity intensities by both boys and girls, and in both game and practice environments. Our findings indicate that in children's soccer practices and games the majority of the time is spent by both boys and girls in MVPA. With 74.1% of practice time spent in MVPA and practice wear time averaging 56.7 minutes, this represents 42 minutes of MVPA. In the average game, children are moderately to vigorously active for 67.7% of the time which equates to about 34 minutes of the average 50 minute game. According to our results, practices are providing children with 70% of the recommended 60 minutes of MVPA and games are supplying 57% of the recommended 60 minutes of MVPA on the day of participation.

Our finding that 74% of time was spent in MVPA during practices is somewhat higher than reported by others. Wickel and Eisenmann [11] found that 6-12 year old boys spent approximately half (55%) of their soccer practice in MVPA. Similarly, Leek [10] showed that 53% of soccer practice was spent at or above moderate physical activity levels in 7-14 year old boys and girls. Guagliano et al. [13] reported that during soccer practice, MVPA levels were maintained for only about one-third of the time in 11-17 year old Australian females. We would expect that lower levels of MVPA would be reported for the soccer players from the Wickel and Eisenmann [11] or Guagliano et al. [13] studies as these researchers used a more stringent 4-MET MVPA cut point than the 3-MET one used in the current

investigation and by Leek et al [10]. As well, since Leek et al [10] found that 7-10 year olds spent an average of 5.8% more time in MVPA than 11-14 year olds and boys spent an average of 7.8% more time in MVPA than girls in soccer and baseball/softball practices, we would expect our younger, mixed gender population to have higher levels of MVPA. Like our investigation, the study by Leek et al. [10] included both boys and girls and utilized the same Freedson [16] 3-MET MVPA cut point but they may have had a higher proportion of girls in the 7-10 year old group (but this was not reported). Not surprisingly, with a 4-MET accelerometer cut point and female participants between 11 and 17 years, youth in the Guagliano study [13] had the lowest percentage of time in MVPA at soccer practice.

Our results suggest that boys and girls spent a similar amount of time in moderate activity during practice but boys spent less practice time motionless or at sedentary and light intensities and more time in vigorous and MVPA activity categories than girls. This aligns with other studies comparing the physical activity levels of boys and girls in sport [10] and non-sports contexts [18-20]. It has been suggested that this may be a reflection of how boys and girls view opportunities for play. Boys see it as a time for rough and tumble play while girls are more likely to see it as an opportunity for verbal socialization [20]. It may also be due to the fact that girls prefer lower intensity activity over more vigorous intensity or that girls often have lower self-competency in physical activity and sports [18]. Finally, it may also reflect differences in coaching styles or expectations between boys and girls teams. Girls may view practice differently than boys or coaches of girls may put different emphasis on practice activities than coaches of boys. Regardless, coaches of girls' teams should be encouraged to find ways to increase PA during practices.

Similar to a report comparing activity levels in organized sport (basketball, netball and soccer) practices and games [13], our boys and girls also accumulated less MVPA and more sedentary time in games than practices. Of note, when Guagliano et al. [13] further examined their results for soccer specifically, they found less sedentary time in practice versus games but no significant difference in MVPA. Their sample size of only 19 soccer players may have been inadequate to show MVPA differences. Our soccer players spent 57% of game time in MVPA but Scheck et al. [12] and Guagliano et al. [13] reported MVPA intensity during only one third of game time. However, both of these studies, employed a more stringent MVPA cut point and the Guagliano participants were older females.

Interestingly, in our investigation team size did not significantly affect the proportion of sedentary, light, moderate or vigorous PA levels during soccer games, however there was a difference in motionless time. Teams with one or no spare players had less motionless time in games than teams with 2 or more spare players. Perhaps the extra time on the sideline with more players at the game increases motionless time but does not impact MVPA because the rested children are more energetic when they get their chance to play. Our limited sample size of only 7 teams may have been too few to draw meaningful conclusions. This topic warrants further examination with a larger sample size.

Unlike in the practice environment, there were no significant differences in PA intensity categories between males and females during the game. In their study on 7-10 year old boys and girls, Sacheck et al [12] showed that boys spent a similar proportion of time at sedentary light, vigorous and MVPA intensities but less time in moderate physical activity than girls. Differences could be the result of dissimilarity between the type of soccer game (indoor versus outdoor), the relative size of the playing field per player or the number of children on the field at once.

A strength of this study was the objective measurement of physical activity using accelerometers that have been validated with children and youth [14,15]. Unfortunately, due to the lack of consensus on accelerometer cut points [21], it was sometimes difficult to compare our results to other soccer studies.

A weakness of this study was the potential selection bias in our sample as the coaches who were willing to participate may have either consciously or unconsciously adjusted their coaching style to enhance PA participation. Also, since sprints in soccer generally last 2-4 seconds [22], the 15-s epoch that we used may not have been short enough to detect short bursts of vigorous activity and a shorter epoch of 5-s may have been more effective. As well, we only measured PA during games and practices so could not assess how participation in soccer games or practices might have added to total PA or otherwise affected PA levels on that day.

Conclusion

Soccer practices and games provide a substantial portion of a child's recommended MVPA on the day they participated in soccer practice or games, with practices providing more MVPA and fewer sedentary minutes than games. We should be en-

couraging attendance at games but even more so at practice. Even after participating in both their practice and game, children accumulated only 82 minutes of MVPA, which falls short of the total weekly PA needed to promote health.

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