Optimising girls’ physical activity levels in organised youth sports

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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

..............................................................

Justin Michael Guagliano
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Abbreviations

BMI – body mass index
LPA – light physical activity
MD – mean difference
MET – metabolic equivalent
MPA – moderate physical activity
MVPA – moderate-to-vigorous physical activity
NCAS – National Coaching Accreditation Scheme
OYS – organised youth sport
RCT – randomised controlled trial
SDI – self-determination index
SD – standard deviation
SE – standard error
SOFIT – System for Observing Fitness Instruction Time
VPA – vigorous physical activity
Abstract

Participation in organised youth sport (OYS) is positively associated with an increased likelihood of complying with national physical activity and sedentary behaviour guidelines. Considering many youth are not meeting recommended daily physical activity guidelines, in particular girls, OYS participation may have substantial public health implications. The primary aim of this PhD thesis was to investigate mechanisms by which to improve the proportion of time players spent in MVPA during OYS. The secondary aims of this PhD thesis were to test methods to reduce the proportion of time players spent inactive during OYS and to understand coaches’ perceptions of themselves as being influential on players’ physical activity in OYS. Hypothesised variables that may have mediated the effect of a coach-based intervention on players’ MVPA and inactivity were also investigated. A series of four studies was conducted to achieve these aims.

The first study of this thesis aimed, primarily, to objectively examine players’ physical activity levels during OYS, and to compare physical activity levels between games and practices. The secondary aim of this study was to document lesson context and coach behaviour during practices and games. Participants were 94 girls recruited from 10 teams in three OYS. Each player wore an accelerometer throughout one practice and one game. A direct observation system was concurrently used to document lesson context and coach behaviour. Findings indicated that players spent a significantly higher percentage of time in MVPA during practice compared to games. Players spent roughly two-thirds of their time in OYS in light physical activity or sedentary. Findings also indicated that coaches spent a large proportion of practice time in management and
knowledge delivery. For this population, OYS appeared to make a substantial contribution to MVPA of participating girls; however, there is room for improvement. The second study of this thesis investigated whether coaches perceived themselves as being influential on physical activity of their players. Participants were 30 coaches who coached girls’ OYS teams. Participants individually took part in a semi-structured interview that lasted approximately 30 minutes. Many coaches considered themselves role models for physical activity due to their own involvement in organised sports. Coaches felt that they were conscious of and could accurately gauge their players’ physical activity levels during practice. Coaches perceived their practice sessions to provide sufficient physical activity and, thus, did not feel the need to try to increase physical activity during practice. Also, many coaches expressed concern that increasing high-intensity physical activity could result in decreased motivation and potentially player dropout. This study provided a unique insight from the perspective of coaches in OYS and found that most coaches thought they had the potential to influence physical activity for girls in OYS.

The third study was a randomised controlled trial designed to evaluate the efficacy of coach education on players’ physical activity intensity during practices. This study took place over the course of a five-day OYS basketball program. A convenience sample of 76 players and 8 coaches were recruited. Players were girls aged 9 to 12 years. Compared to the control group, players in the intervention group spent a significantly higher proportion of practice time in MVPA, vigorous physical activity, and moderate physical activity, and a significantly lower proportion of practice time inactive from baseline to follow-up. There were no significant changes in player motivation from
baseline to follow-up in either group. Brief coach education sessions, then, can increase
MVPA and decrease inactivity without deleterious effects on players’ motivation.
The fourth study investigated two models where it was hypothesised that coaches’
physical activity levels, lesson context, and coaches’ behaviours may mediate the effect
of the intervention on players’ MVPA/inactivity. The findings of the mediation analysis
indicated that only coaches’ MVPA and inactivity significantly mediated the effect of
the intervention on players’ MVPA and inactivity.
The four studies that formed this thesis have addressed gaps and provided a series of
firsts in an understudied area of OYS literature. Findings from this PhD research
provided the first:

- Comparison of players’ physical activity levels during practice and games, and
  provided insight on lesson context and coach behaviours during OYS (Study 1).
- Investigation into whether coaches perceived themselves as influential on
  physical activity for their players during OYS (Study 2).
- Randomised controlled trial designed to evaluate the efficacy of coach education
  on players’ physical activity intensity in OYS (Study 3).
- Insight on the causal mechanisms through which the intervention (i.e., coach
  education) achieved its effects (i.e., increased player MVPA, decreased player
  inactivity) (Study 4).

Further, all four studies in this series were conducted while targeting girls, a high
priority population group for physical activity promotion. These findings provide a
foundation for further research aiming to increase MVPA and reduce inactivity during
OYS.
Chapter 1

Introduction
1.1 Definition of terms

Variations in terminology exist in the literature for several of the terms used throughout this thesis. Thus, a definition of the terms specific to the context of this thesis are defined below to assist the readers of this thesis.

Club player. Throughout this thesis, a club player is a player who has registered with an OYS club and has been assigned to a team to participate in local leagues or competitions.

Counts. A count can be defined as a conversion of the magnitude of accelerations over a given time (epoch – defined below) that provide a quantitative measure of physical activity intensity (Chen & Bassett Jr., 2005; Yang & Hsu, 2010).

Epoch. An epoch is the duration over which accelerometer counts are averaged (Chen & Bassett Jr., 2005).

Organised youth sports. Organised youth sport (OYS) is formally arranged and governed by the rules of the sport being played (Janssen, 2014). In OYS, players attend practices and games under supervision of one or more adults, who most often assume the role of team coach (Janssen, 2014; Smoll & Smith, 2002). OYS players typically range from six to 18 years of age. In Australia, OYS coaches can obtain formal coach accreditation through the National Coaching Accreditation Scheme (Australian Sports Commission, n.d.). Coach accreditation, however, is not mandatory to coach in OYS. Coach accreditation was only required for inclusion in Study 3 (see Chapter 5).
**Physical activity.** This is defined as “any bodily movement produced by skeletal muscles that requires energy expenditure” (Caspersen, Powell, & Christenson, 1985, p. 126).

**Physical inactivity.** This term is used “to describe those who are performing insufficient amounts of MVPA [moderate-to-vigorous physical activity] (i.e., not meeting specified physical activity guidelines)” (Sedentary Behaviour Research Network, 2012, p. 540).

**Representative player.** A representative player has also been registered with an OYS club; however, these players were selected members of a team. Representative players represent their district and compete in a higher level of competition than club players. The representative level is not the highest level of competition in OYS; however, these players were the most accomplished players to be recruited in the four studies forming this PhD thesis (studies described briefly below. Detailed descriptions of the four studies for this PhD thesis can be found in Chapter 3-6).

**Sedentary.** The term sedentary refers to “any waking behaviour characterised by an energy expenditure ≤1.5 METs [metabolic equivalents] while in a sitting or reclining posture” (Sedentary Behaviour Research Network, 2012, p. 540).

**Sufficient physical activity.** Based on national guidelines Australian youth, aged 5-17, should accumulate at least 60 minutes of MVPA daily (Department of Health and Aging, 2014b, 2014c). In addition, physical activities that strengthen muscles and bones are recommended for at least three days of the week (Department of Health and Aging,
Engaging in more physical activity than required to meet national guidelines (up to several hours per day) has also been recommended for additional opportunities for health gain (Department of Health and Aging, 2014b, 2014c). These guidelines are consistent with the World Health Organization’s global physical activity recommendations (World Health Organization, 2010). Furthermore, the recommended 60 minutes of daily MVPA can be accrued cumulatively in multiple bouts throughout the day (Strong et al., 2005).

Youth. The terms children and youth have been previously defined as young people aged five to 17 years (Janssen & LeBlanc, 2010). Children and youth will be collectively referred to as “youth” throughout this thesis to keep terminology consistent with the OYS literature.

1.2 Background

This background section briefly highlights the literature that is important for setting the context for the work conducted as part of this thesis. A more detailed literature review is presented in Chapter 2, and also in the background sections of each of the studies in Chapters 3-6.

1.2.1 Youth physical activity

The benefits of regularly engaging in MVPA among youth are well established, and include contributions to physical, mental, and social health outcomes (Janssen & LeBlanc, 2010; Strong et al., 2005). Tremblay et al. (2014) compared the overall
physical activity levels of youth aged five to 17 from 15 countries representing all inhabited continents except Asia. These authors found that the majority of youth were not sufficiently physically active (as defined above). Tremblay et al.’s (2014) findings were consistent with those from several other earlier studies that found youth were not sufficiently physically active. Further, youth are less active on weekends compared to weekdays, and older youth are less active than younger youth (Currie, 2012; Hallal et al., 2012; Nader, Bradley, Houts, McRitchie, & O’Brien, 2008; Rowlands, Pilgrim, & Eston, 2008; Troiano et al., 2008; Trost et al., 2002). In Australia, a recent report found that less than one-fifth of Australian youth, aged 5-17, met recommended physical activity guidelines every day of the week (Active Healthy Kids Australia, 2014). This issue is even more concerning when examining youth physical activity levels separately, by sex. Girls accumulate less physical activity than that of boys throughout childhood (Hardy, Okely, Dobbins, & Booth, 2008; Troiano et al., 2008), and their participation in physical activity declines more precipitously than boys during the transition into adolescence (Kahn et al., 2008; Kimm et al., 2002; Nader et al., 2008). As such, girls have been identified as a high priority group for physical activity promotion (Camacho-Miñano, LaVoi, & Barr-Anderson, 2011) and constitute the population of focus for this PhD research. It is critical for youth to develop positive physical activity habits, as an active childhood can continue into adulthood (Debate, Pettee Gabriel, Zwald, Huberty, & Zhang, 2009; Van der Horst, Paw, Twisk, & Van Mechelen, 2007).

To address the “global physical inactivity crisis” (Tremblay et al., 2014, p. S114) among youth, research has focused on areas of physical activity promotion in and
around youth school time. For instance, a considerable amount of attention has been
given to active transport to and from school (Carver et al., 2011; Cooper, Page, Foster,
& Qahwaji, 2003; Faulkner, Buliung, Flora, & Fusco, 2009; Hohepa, Schofield, Kolt,
Scragg, & Garrett, 2008) activity at recess (Escalante, García-Hermoso, Backx, &
Saavedra, 2014; Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2009; Ridgers, Salmon,
Parrish, Stanley, & Okely, 2012; Sara, Van Dyck, De Bourdeaudhuij, & Cardon, 2013),
physical activity during physical education lessons (Lonsdale, Rosenkranz, Sanders, et
al., 2013; McKenzie et al., 2006; McKenzie et al., 2004), and activity generated through
after-school programs (Coleman, Geller, Rosenkranz, & Dzewaltowski, 2008;
Dzewaltowski et al., 2010; Trost, Rosenkranz, & Dzewaltowski, 2008). This is not a
comprehensive review of the research conducted attempting to increase youth physical
activity in the abovementioned settings; however, it is an indication of where extensive
research has been focused. Focusing in and around the school setting is understandable
due to near universal attendance rates and the large portion of youth waking hours that
are spent at school, which makes it an ideal place to target physical activity
interventions. OYS is potentially a critical contributor to youth daily MVPA, yet has
been frequently overlooked and understudied (Heart Foundation of Australia, 2014).

1.2.2 Organised youth sport – a brief historical context

In the United States, for example, the first opportunity for youth to participate in
structured, adult-led sporting programs was introduced in the 1890’s (Wiggins, 1987,
2013). OYS, however, was limited to the wealthy until the 1920’s, when new economic
prosperity allowed for an increase in OYS participation of youth from working class households (Frankl, 2007). In the 1960’s, race segregation ended in OYS, and in the 1970’s, it became more accepted for girls to participate in some OYS (e.g., baseball) (Wiggins, 2013). Coinciding with the abovementioned events was a growing fixation with professional and intercollegiate sports, likely contributing to the rapid growth of OYS (Sage & Eitzen, 2013). Since the 1970’s, participation in OYS has continued to rapidly gain momentum (Adler & Adler, 1998) and unstructured spontaneous play has partially been replaced by structured adult-led OYS programs (Smoll & Smith, 2002; Washington et al., 2001). In just over a century, OYS have become one of the most popular and time consuming leisure activities for youth (Hansen & Larson, 2007) and OYS clubs have become prominent institutions within communities (Frankl, 2007).

Similar to the United States context outlined above, in Australia, the prevalence of youth participating in OYS has steadily risen since the 1980’s (Active Healthy Kids Australia, 2014). The most recent prevalence data have indicated that 66% of Australian youth (67% of boys, 65% of girls) participated in at least one OYS (including dance) outside of school hours (Active Healthy Kids Australia, 2014; Australian Bureau of Statistics, 2009). Cross-sectional data indicated that as youth get older the amount of time spent in nonorganised physical activity has decreased (5-8 years: 91 minutes; 9-11 years: 53 minutes; 12-14 years: 33 minutes; 15-17 years: 20 minutes) (Australian Bureau of Statistics, 2013). Okely, Booth, Hardy, Dobbins, and Denney-Wilson (2008) suggested that less incidental physical activity, decreasing backyard space, and decreased parental perceptions of neighbourhood safety may be reasons for increased
participation in OYS. Lareau’s (2011) notion of ‘concerted cultivation’, where parents invest money, time, and energy to structure experiences in organised activities for youth, may also share responsibility for increased participation in OYS. One recent study lends support to this assumption, finding that sport appeared to be viewed as an appropriate investment activity by parents (Wheeler & Green, 2014).

Numerous studies have suggested the use of OYS clubs as a potential avenue for health promotion (Almond, Almond, & Saunders, 2013; Geidne, Quennerstedt, & Eriksson, 2013; Kelly et al., 2014; Kokko, Kannas, & Villberg, 2006, 2009). Furthermore, Almond et al. (2013) stated that health promotion, using a settings approach (e.g., workplaces, schools), has been widely and successfully implemented and “therefore there is no reason why a sports club as a setting cannot be an effective vehicle.” (p. 3). A common approach to health-promotion research within the sports club setting has been to use coaches to deliver the programs of interest (Hilland et al., 2014). Coaches have been used to deliver programs aimed at promoting health because they can carry considerable influence and are viewed as experts by their players (Conroy & Coatsworth, 2006). Also, Smith and Smoll (1997) have suggested that coaches can have a strong impact on youth within an OYS context due to the amount of direct involvement they have with their players on a weekly basis. Some health-promotion research conducted in OYS clubs and delivered by coaches include promoting healthy eating (Kelly et al., 2010), alcohol prevention (King, Dowdall, & Wagner, 2010), smoking prevention, (Hilland et al., 2014), mental health support (Mazzer, Rickwood, &
Vanags, 2012), and injury prevention (Glang, Koester, Beaver, Clay, & McLaughlin, 2010).

To date, no research has been conducted in OYS promoting physical activity, despite the fact that sport has been identified as a research priority in the area of youth physical activity and sedentary behaviour (Almond et al., 2013; Gillis et al., 2013). In summary, (1) the majority of Australian youth, particularly girls, are not meeting daily physical activity guidelines; (2) physical activity declines with age; (3) incidental physical activity decreases with age; (4) OYS currently reaches a high proportion of youth; and (5) coaches may be ideal candidates to promote healthy behaviour (e.g., physical activity). Therefore, OYS appears to be an attractive setting for physical activity promotion.

1.3 Research aims

The primary aim of this PhD thesis was to investigate mechanisms by which to improve the proportion of time players spent in MVPA during OYS. The secondary aims of this PhD thesis were to test methods to reduce the proportion of time players spent inactive during OYS and to understand coaches’ perceptions of themselves as being influential on players’ physical activity in OYS. Hypothesised variables that may have mediated the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity were also investigated. A series of four studies are included in this PhD thesis; each study will be briefly outlined in this chapter and discussed in detail in the ensuing chapters.
1.4 Research objectives

The following research objectives were developed to achieve the above research aims:

- Using an observational cross-sectional design, determine players’ levels of physical activity while participating in OYS (during practice and games) and generate contextual data on how time is spent and how coaches conduct themselves during practices and games in OYS.

- Through a series of in-depth semi-structured interviews, investigate whether coaches perceive themselves as influential on players’ physical activity in OYS. More specifically, participants’ perceived role as coaches, their perception of themselves as role models for physical activity, their views on their players’ current physical activity levels, their opinions on improving their players’ physical activity levels, and their perceived challenges during OYS were investigated.

- Conduct a randomised controlled trial (RCT) to assess the short-term efficacy of coach education (where education on increasing MVPA and decreasing inactivity during practice was delivered) on player MVPA. More specifically, the study’s primary aim is to assess whether coach education (relative to a standard-care control) can increase the proportion of time players spend in MVPA during practices over a five-day basketball program. The secondary aims of this study are to assess whether coach education can
lower the proportion of practice time players spent inactive, investigate
effects on players’ motivation and perceived autonomy support, and assess
how time was spent during practice (lesson context) and leader behaviour,
via the System for Observing Fitness Instruction Time (SOFIT; McKenzie,

- Conduct a mediation analysis to test whether hypothesised variables
  mediated the effect of a coach-based intervention (discussed in Chapter 5) on
players’ MVPA and inactivity.

### 1.5 Thesis outline

This thesis contains seven chapters. A brief description of each chapter has been
provided below:

- Chapter 1 (this chapter) presents a brief background to the overarching
  research questions, and outlines the aims, objectives, and significance of this
  PhD research. As well, an outline of the thesis is included.

- Chapter 2 presents a detailed review of the literature regarding physical
  activity and inactivity in OYS.

- Chapter 3 describes and discusses the findings of an observational study
  (Study 1) that objectively determined the physical activity levels of 94
  female netball, basketball, and soccer players (from 10 teams) during OYS,
  and compared their physical activity levels between games and practices.
  This study also provided clarity, through direct observation, on how time was
spent and how coaches conducted themselves during practices and games in OYS. Findings from this study have been published in *Medicine & Science in Sports & Exercise* (Guagliano, Rosenkranz, & Kolt, 2013, see Appendix A).

- Chapter 4 describes and presents the findings of a qualitative study (Study 2) that investigated whether coaches perceive themselves as influential on players’ physical activity in OYS. In total, 30 coaches (10 basketball, 10 netball and 10 soccer coaches) participated in an in-depth semi-structured interview. Coaches answered questions relating to their perceived role as coaches, their perception of themselves as role models for physical activity, their views on their players’ current physical activity levels, their opinions on improving their players’ physical activity levels, and their perceived challenges during OYS. Findings from this study have been accepted for publication in *PLoS ONE* (Guagliano, Lonsdale, Rosenkranz, Kolt, & George, 2014, see Appendix B).

- The findings from Chapters 3 and 4 informed the development of an intervention study (Study 3) that is presented in Chapter 5. More specifically, a fully-powered RCT was conducted to assess the short-term efficacy of coach education on player MVPA. This study’s trial protocol has been published in *BMC Public Health* (Guagliano, Lonsdale, Kolt, & Rosenkranz, 2014, see Appendix C) and a main outcomes manuscript is currently under review in the *Journal of Science and Medicine in Sport*. 
• In Chapter 6, two separate models were investigated where it was hypothesised that coaches’ physical activity levels, lesson context (i.e., management, knowledge delivery), and coaches’ behaviours (i.e., promoting physical activity, demonstrating physical activity, discouraging physical activity) mediated the effect of the intervention (Study 3) on players’ MVPA and inactivity. Findings from this study will be submitted for peer-review at Preventive Medicine.

• Lastly, Chapter 7 provides a synthesis of the work comprising this PhD thesis (i.e., Studies 1 to 4), and implications, limitations, and future research with regard to promoting youth physical activity in an OYS setting are discussed.

1.6 Significance of the thesis

The four studies that formed this PhD thesis have addressed gaps and provided a series of firsts in an under-studied area of the OYS literature. Findings from this research provided the first:

• Comparison of players’ physical activity levels during practice and games within the same study, and the first insight into coach behaviours and how time is allocated during OYS practices and games (Study 1),

• Investigation into whether coaches perceived themselves as influential on players’ physical activity during OYS (Study 2),
• RCT designed to evaluate the short-term efficacy of coach education on players’ physical activity intensity in OYS (Study 3),

• Insight on the causal mechanisms through which the intervention (i.e., coach education) achieved its effects (i.e., increased player MVPA, decreased player inactivity) (Study 4).

Further, all four studies in this series were conducted while targeting girls, who are a high priority population group for physical activity promotion (Camacho-Miñano et al., 2011). These findings provide a foundation for further research aiming to increase MVPA and reduce inactivity during OYS.

1.7 Synopsis

In this chapter, the literature important for setting the context for the work conducted as part of this thesis was briefly highlighted. Overall, the majority of Australian youth are not meeting physical activity guidelines. This inactivity is particularly problematic for girls, as they accumulate less physical activity than boys throughout childhood, and their participation in physical activity drops more steeply than that of boys during the transition into adolescence. As such, girls have been identified as a high priority group for physical activity promotion. Sport has been identified as a research priority in the area of youth physical activity and sedentary behaviour, and public health experts have called for evaluation of strategies for increasing MVPA in OYS. To date, however, no research has been conducted in OYS promoting physical activity. Considering: (1) the majority of Australian youth are not
meeting physical activity guidelines, (2) youth incidental physical activity is on the decline, and (3) OYS ability to reach a high proportion of youth, makes OYS an attractive opportunity for youth to accumulate substantial amounts of MVPA contributing to daily recommendations. A more extensive literature review relevant to this thesis is presented in the subsequent chapter (Chapter 2).
Chapter 2

Literature Review
2.1 Introduction

Chapter 1 provided an overview of the overarching research questions, aims, objectives, and significance of this PhD research. In Chapter 1, the literature important for setting the context for the work conducted as part of this thesis was also briefly highlighted. This chapter builds upon the information provided in Chapter 1 by presenting a detailed review of the literature pertaining to youth physical activity in OYS. An overview of the literature related more specifically to Studies 1 to 4 will be presented at the beginning of their respective chapters (Chapters 3 to 6).

2.2 Background

As discussed in Chapter 1, many youth are not sufficiently physically active (Tremblay et al., 2014), less physical activity is accumulated on weekends compared to weekdays, and older youth are less active than younger youth (Currie, 2012; Hallal et al., 2012; Nader et al., 2008; Rowlands et al., 2008; Troiano et al., 2008; Trost et al., 2002). Concurrently, sedentary behaviours (e.g., television viewing, computer usage) are highly prevalent among youth (Klitsie et al., 2013; Pearson, Braithwaite, Biddle, Sluijs, & Atkin, 2014; Ruiz et al., 2011), particularly after school and on weekends (Gorely, Marshall, Biddle, & Cameron, 2007; Sallis, Prochaska, & Taylor, 2000). A recent report found that less than one-fifth of Australian youth met recommended physical activity guidelines every day of the week (Active Healthy Kids Australia, 2014). Sex differences have also been found, with girls being less active than boys throughout childhood (Hardy et al., 2008; Troiano et al., 2008) and their participation in
physical activity declining more precipitously than boys during the transition into adolescence (Kahn et al., 2008; Kimm et al., 2002; Nader et al., 2008). Accordingly, girls have been identified as a high priority group for physical activity promotion (Camacho-Miñano et al., 2011) and constitute the population of focus for this PhD research.

While cross-sectional data have suggested that Australian youth spend less time in nonorganised physical activity as they get older (Australian Bureau of Statistics, 2013), the prevalence of youth participating in OYS has steadily risen over the past three decades (Active Healthy Kids Australia, 2014). Recent prevalence data have indicated that 66% of Australian youth (67% of boys, 65% of girls) participated in at least one OYS (including dance) outside of school hours (Active Healthy Kids Australia, 2014; Australian Bureau of Statistics, 2009). As outlined in Table 2.1, sport participation has been associated with a myriad of positive outcomes for youth.
<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic achievement</td>
<td>Fox, Barr-Anderson, Neumark-Sztainer, and Wall (2010)</td>
</tr>
<tr>
<td>Behavioural wellbeing</td>
<td>Donaldson and Ronan (2006)</td>
</tr>
<tr>
<td>Cardiorespiratory fitness</td>
<td>Silva et al. (2013)</td>
</tr>
<tr>
<td>Caring</td>
<td>Zarrett et al. (2009)</td>
</tr>
<tr>
<td>Character</td>
<td>Zarrett et al. (2009)</td>
</tr>
<tr>
<td>Cognitive performance</td>
<td>Esteban-Cornejo et al. (2014)</td>
</tr>
<tr>
<td>Commitment</td>
<td>Scanlan, Carpenter, Schmidt, Simons, and Keeler (1993)</td>
</tr>
<tr>
<td>Connectedness</td>
<td>Linver, Roth, and Brooks-Gunn (2009), Zarrett et al. (2009)</td>
</tr>
<tr>
<td>Cooperation</td>
<td>Findlay and Coplan (2008)</td>
</tr>
<tr>
<td>Coordination</td>
<td>Zahner et al. (2009)</td>
</tr>
<tr>
<td>Discipline</td>
<td>Scanlan et al. (1993)</td>
</tr>
<tr>
<td>Emotional control</td>
<td>Holt et al. (2011)</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>Donaldson and Ronan (2006), Steptoe and Butler (1996)</td>
</tr>
<tr>
<td>Empathy</td>
<td>Côté (2002)</td>
</tr>
<tr>
<td>Endurance</td>
<td>Zahner et al. (2009)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental motor skills</td>
<td>Seefeldt, Ewing, and Walk (1993)</td>
</tr>
<tr>
<td>General health perceptions</td>
<td>Snyder et al. (2010)</td>
</tr>
<tr>
<td>Increased likelihood of meeting physical activity and screen time guidelines</td>
<td>Vella, Cliff, Okely, Scully, and Morley (2013)</td>
</tr>
<tr>
<td>Less hopelessness</td>
<td>Taliaferro, Rienzo, Miller, Pigg, and Dodd (2008)</td>
</tr>
<tr>
<td>Lower parent-reported psychological difficulties</td>
<td>Vella, Cliff, Magee, and Okely (2014a)</td>
</tr>
<tr>
<td>Mental health</td>
<td>Pyle, Mc Quivey, Brassington, and Steiner (2003), Snyder et al. (2010)</td>
</tr>
<tr>
<td>Perceived health</td>
<td>Michaud et al. (2006)</td>
</tr>
<tr>
<td>Positive affect</td>
<td>Findlay and Coplan (2008)</td>
</tr>
<tr>
<td>Psychological resilience</td>
<td>Bartko and Eccles (2003)</td>
</tr>
<tr>
<td>Reduced social/performance anxiety</td>
<td>Findlay and Coplan (2008), Schumacher-Dimech and Seiler (2011), Smith, Smoll, and Barnett (1995)</td>
</tr>
<tr>
<td>Reduction in antisocial and improved prosocial behaviour</td>
<td>Rutten et al. (2007)</td>
</tr>
<tr>
<td>Relationships with coaches, friends</td>
<td>Holt et al. (2011)</td>
</tr>
<tr>
<td>Respectfulness</td>
<td>Howie, Lukacs, Pastor, Reuben, and Mendola (2010)</td>
</tr>
<tr>
<td>Health outcome</td>
<td>Study</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------------------------------------------------------</td>
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<tr>
<td>Responsibility</td>
<td>Côté (2002)</td>
</tr>
<tr>
<td>Self-concept</td>
<td>Dishman et al. (2006), Donaldson and Ronan (2006)</td>
</tr>
<tr>
<td>Self-knowledge</td>
<td>Hansen et al. (2003)</td>
</tr>
<tr>
<td>Social functioning</td>
<td>Snyder et al. (2010)</td>
</tr>
<tr>
<td>Social interaction/integration; social skills</td>
<td>Hansen et al. (2003)</td>
</tr>
<tr>
<td></td>
<td>Holt et al. (2011), Howie et al. (2010), Wiersma and Fifer (2008)</td>
</tr>
<tr>
<td>Social self-concept</td>
<td>Marsh (1993)</td>
</tr>
<tr>
<td>Social well-being</td>
<td>Linver et al. (2009)</td>
</tr>
<tr>
<td>Speed</td>
<td>Zahner et al. (2009)</td>
</tr>
<tr>
<td>Sportsmanship</td>
<td>Wiersma and Fifer (2008)</td>
</tr>
<tr>
<td>Strength</td>
<td>Zahner et al. (2009)</td>
</tr>
<tr>
<td>Team cohesion</td>
<td>Westre and Weiss (1991)</td>
</tr>
<tr>
<td>Teamwork</td>
<td>Wiersma and Fifer (2008)</td>
</tr>
<tr>
<td>Weight</td>
<td>Romani (2011)</td>
</tr>
<tr>
<td>Wellbeing</td>
<td>Ferron et al. (1999), Findlay and Coplan (2008)</td>
</tr>
<tr>
<td>Youth development</td>
<td>Linver et al. (2009)</td>
</tr>
</tbody>
</table>

*Note.* Table adapted from Eime, Young, Harvey, Charity, and Payne (2013).
While many youth experience positive outcomes through OYS (Fraser-Thomas, Côté, & Deakin, 2005), there is some research available that suggests that experiences are sometimes less positive. Table 2.2 outlines some of the negative outcomes associated with youth participation in OYS. Although, there are some negative outcomes associated with OYS participation, it is possible that the positives may outweigh the negatives (Fraser-Thomas et al., 2005).

Table 2.2 Summary of negative outcomes associated with participation in organised youth sport.

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body image</td>
<td>Steiner, McQuivey, Paveski, Pitts, and Kraemer (2000)</td>
</tr>
<tr>
<td>Eating disorders</td>
<td>Davison, Earnest, and Birch (2002)</td>
</tr>
<tr>
<td>Injuries</td>
<td>Roberts (2014), Steiner et al. (2000)</td>
</tr>
<tr>
<td>Negative coach experiences</td>
<td>Weiss and Williams (2004)</td>
</tr>
<tr>
<td>Poor sportsmanship</td>
<td>Lemyre, Roberts, and Ommundsen (2002)</td>
</tr>
<tr>
<td>Pressure to win</td>
<td>Wankel and Berger (1990)</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>Martens (1993)</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>Martens (1993)</td>
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</tbody>
</table>
Despite widespread reach and extensive evidence of numerous health-enhancing benefits, the role of the OYS setting as a critical contributor to daily youth MVPA has been frequently overlooked and understudied (Heart Foundation of Australia, 2014). Instead, extensive research aimed at increasing youth physical activity has been conducted in and around the school setting (i.e., active transport to and from school, recess/lunchtime, physical education classes, after school programs) (Carver et al., 2011; Coleman et al., 2008; Hohepa et al., 2009; Lonsdale, Rosenkranz, Sanders, et al., 2013). OYS may also contribute to a reduction in time youth spend participating in sedentary behaviour. Sallis et al. (2000) found that it is not total sedentary time that was associated with lower levels of physical activity, but rather sedentary behaviour after school and on weekends. Thus, participation in OYS may be an important setting for providing opportunities for youth to be physically active, given that participation in OYS occurs primarily after school and on weekends, where youth may otherwise partake in more sedentary pursuits.

To date, however, no research has been conducted in OYS with an explicit aim to test interventions designed to promote physical activity despite sport having been identified as a research priority in the area of youth physical activity and sedentary behaviour (Almond et al., 2013; Gillis et al., 2013). This literature review will focus primarily on literature related to youth physical activity in OYS (outside of school). There is some research that has investigated youth physical activity in sports within a school setting (e.g., Bocarro, Kanters, Edwards, Casper, & McKenzie, 2014; Weintraub et al., 2008); however, these findings were excluded as this PhD research focused on an
OYS setting outside of school. In the literature to date, there have been no randomised controlled trials conducted to evaluate the effect of interventions designed to increase physical activity in OYS (Camacho-Miñano et al., 2011; Priest, Armstrong, Doyle, & Waters, 2008). Given the limited evidence base of controlled studies, this literature review will rely primarily on longitudinal and cross-sectional studies. Although longitudinal and cross-sectional studies, compared to a RCT, may be lower in terms of quality of evidence (e.g., statistical precision, risk of bias) (Coleman et al., 2005), these studies are currently the best available evidence from which to draw from. Trends, energy expenditure, and time spent physically active/inactive in OYS, as well as the potential role of OYS clubs and coaches in promoting youth physical activity will be presented.

2.3 Physical activity levels in organised youth sport

Several peer-reviewed studies were found that provided insight into: (1) the role OYS may have in protecting youth physical activity levels, (2) physical activity levels of OYS participants compared to nonparticipants, (3) OYS participation and the likelihood of meeting recommended physical activity guidelines, and (4) OYS participation as a predictor of physical activity in adulthood. These studies were conducted in Australia, Canada, Finland, New Zealand, Norway, Portugal, and the USA. Of the identified studies, five were longitudinal and eight were cross-sectional studies. The majority of the studies included samples of both boys and girls. These identified articles and their findings are summarised in Table 2.3.
Table 2.3 Summary of the studies that have examined physical activity in organised youth sport.

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (N)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Measure</th>
<th>Sport(s)</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
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</thead>
<tbody>
<tr>
<td>Bélanger et al. (2009)</td>
<td>Canada</td>
<td>Longitudinal</td>
<td>1276</td>
<td>12-13</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Not reported</td>
<td>To determine if participation in OYS during early adolescence protects against declines in physical activity levels during adolescence.</td>
<td>Participation in OYS during early adolescence is associated with more physical activity throughout secondary school, but does not protect against declines in physical activity over time.</td>
</tr>
<tr>
<td>Eime, Harvey, Sawyer, et al. (2013)</td>
<td>Australia</td>
<td>Cross-sectional</td>
<td>732</td>
<td>11-20</td>
<td>Girls</td>
<td>Self-report</td>
<td>Netball, Australian Rules Football, volleyball, field hockey, softball, soccer, basketball, swimming, gymnastics, tennis, track and field, cycling</td>
<td>To investigate contexts of physical activity participation for female adolescents at two life transition points.</td>
<td>Adolescent girls shifted their participation away from organised, competitive modes and settings toward nonorganised and noncompetitive modes and settings and individual types of PA.</td>
</tr>
<tr>
<td>Authors (year)</td>
<td>Country</td>
<td>Study design</td>
<td>Sample size (N)</td>
<td>Age (years)</td>
<td>Sex</td>
<td>Measure</td>
<td>Sport(s)</td>
<td>Relevant study aim(s)</td>
<td>Relevant key finding(s)</td>
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<tr>
<td>Katzmarzyk and Malina (1998)</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>54</td>
<td>12-14</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Basketball, downhill skiing, soccer, wrestling, football, cheerleading, volleyball, swimming, tennis, dance</td>
<td>• To examine the contribution of participation in OYS to TDEE in youth.</td>
<td>Boys and girls expended 20.4% and 16.3% of TDEE and 55% and 64.6% of MVEE in OYS. • Youth who participated in OYS had greater TDEE and MVEE, and spent less time watching television than youth who did participate in OYS.</td>
</tr>
<tr>
<td>Kjønniksen, Anderssen, and Wold (2009)</td>
<td>Norway</td>
<td>Longitudinal</td>
<td>924</td>
<td>13a</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Not reported</td>
<td>• To examine whether early and sustained OYS during childhood and adolescence predicts the frequency of leisure-time physical activity at age 23 years.</td>
<td>• OYS during childhood and adolescence was positively related to frequency of leisure-time physical in young adulthood. • Joining OYS at an early age and continuing through</td>
</tr>
<tr>
<td>Authors (year)</td>
<td>Country</td>
<td>Study design</td>
<td>Sample size (N)</td>
<td>Age (years)</td>
<td>Sex</td>
<td>Measure</td>
<td>Sport(s)</td>
<td>Relevant study aim(s)</td>
<td>Relevant key finding(s)</td>
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<tr>
<td>Machado-Rodrigues et al. (2012)</td>
<td>Portugal</td>
<td>Cross-sectional</td>
<td>165</td>
<td>13-16</td>
<td>Boys</td>
<td>Self-report</td>
<td>Soccer, basketball, volleyball, track and field, handball, rugby, swimming, tennis, rowing, sailing, gymnastics, martial arts.</td>
<td>• To examine the contribution of participation in OYS to TDEE and MVEE in boys.</td>
<td>Boys expended 11-13% of TDEE and 35-42% of MVEE in OYS.</td>
</tr>
<tr>
<td>Mandic, Bengoechea, Stevens, de la Barra, and Skidmore (2012)</td>
<td>New Zealand</td>
<td>Cross-sectional</td>
<td>1837</td>
<td>13-15</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Not reported</td>
<td>• To examine individual- and sport-related factors that influence amount of time spent in sports among OYS participants.</td>
<td>Participation in OYS was associated with significantly higher levels of MVPA than nonparticipation.</td>
</tr>
<tr>
<td>Authors, Country, Study design, Sample size, Age (years), Sex, Measure, Sport(s), Relevant study aim(s), Relevant key finding(s)</td>
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<tr>
<td>Perkins, Jacobs, Barber, and Eccles (2004) USA Longitudinal 652 12 Boys and girls Self-report Not reported To examine whether OYS participation during childhood and adolescence was related to participation in OYS and physical fitness activities in young adulthood. OYS participation was a significant predictor of young adults’ participation in sports and physical fitness activities.</td>
<td></td>
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<tr>
<td>Pfeiffer et al. (2006) USA Longitudinal 429 13 Girls Self-report Not reported To determine the odds of engaging in future MVPA and vigorous physical activity among adolescent female OYS participants. For MVPA, 8th and 9th grade participants were more likely to be active in 12th grade than nonparticipants. For vigorous physical activity, OYS participants had higher odds of being active at</td>
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<tr>
<td>Authors (year)</td>
<td>Country</td>
<td>Study design</td>
<td>Sample size (N)</td>
<td>Age (years)</td>
<td>Sex</td>
<td>Measure</td>
<td>Sport(s)</td>
<td>Relevant study aim(s)</td>
<td>Relevant key finding(s)</td>
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<tr>
<td>Seabra, Mendonça, Thomis, Malina, and Maia (2007)</td>
<td>Portugal</td>
<td>Cross-sectional</td>
<td>12,568</td>
<td>10-18</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Swimming, soccer, gymnastics, cycling, handball, basketball</td>
<td>• To compare OYS participation preferences by sex. • The prevalence of OYS participation is greater in males than females. • Males participated in OYS &gt;4 hours per week compared to 1-2 hours per week in females.</td>
<td></td>
</tr>
<tr>
<td>Silva et al. (2010)</td>
<td>Portugal</td>
<td>Cross-sectional</td>
<td>208</td>
<td>14-16</td>
<td>Boys and girls</td>
<td>Objective</td>
<td>Not reported</td>
<td>• To determine the impact of OYS on boys’ and girls’ MVPA. • OYS increased the likelihood of achieving PA guidelines.</td>
<td></td>
</tr>
<tr>
<td>Authors, Country</td>
<td>Study design</td>
<td>Sample size (N)</td>
<td>Age (years)</td>
<td>Sex</td>
<td>Measure</td>
<td>Sport(s)</td>
<td>Relevant study aim(s)</td>
<td>Relevant key finding(s)</td>
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<tr>
<td>Tammelin, Näyhä, Hills, and Järvelin (2003)</td>
<td>Finland, Cross-sectional</td>
<td>7,794</td>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Hockey (ice), soccer, volleyball, other ball games&lt;sup&gt;b&lt;/sup&gt;, skiing (cross-country and downhill), running, swimming, cycling, skating, track and field, gymnastics, riding, dance, martial arts, strength training, other sports&lt;sup&gt;c&lt;/sup&gt;</td>
<td>To evaluate the association between OYS participation in various types of sports in adolescence and the level and types of physical activity in adulthood.</td>
<td>Frequent participation in sports after school hours in adolescence was associated with a high level of physical activity in adulthood.</td>
<td>OYS participation at least once a week among females and twice a week among males was associated with high level of physical activity in later life.</td>
</tr>
<tr>
<td>Telama, Yang, Hirvensalo, and Raitakari (2006)</td>
<td>Finland, Longitudinal</td>
<td>2,309</td>
<td>9-18</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Not reported</td>
<td>To investigate how participation in OYS predicts adult physical activity.</td>
<td>Participation in OYS, in particular, persistent participation in OYS significantly predicted adult physical activity.</td>
<td>Participation in (continued)</td>
</tr>
<tr>
<td>Authors (year)</td>
<td>Country</td>
<td>Study design</td>
<td>Sample size (N)</td>
<td>Age (years)</td>
<td>Sex</td>
<td>Measure</td>
<td>Sport(s)</td>
<td>Relevant study aim(s)</td>
<td>Relevant key finding(s)</td>
</tr>
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</tr>
<tr>
<td>Vella et al. (2013)</td>
<td>Australia</td>
<td>Cross-sectional</td>
<td>12,188</td>
<td>12-17</td>
<td>Boys and girls</td>
<td>Self-report</td>
<td>Not reported</td>
<td>• To examine the relationship between OYS participation, physical activity, and screen time, in a sample of Australian adolescents.</td>
<td>• OYS participation was associated with a greater likelihood of meeting physical activity guidelines and electronic screen time recommendation</td>
</tr>
</tbody>
</table>

*Note.* MVEE, moderate-to-vigorous energy expenditure; MVPA, moderate-to-vigorous physical activity; OYS, organised youth sport; TDEE, total daily energy expenditure. *a* age in years at study commencement; *b* squash, badminton, tennis, table tennis, bandy, Finnish baseball, baseball; *c* shooting, hiking, ski jumping.
The following four sections will discuss (1) the role OYS may have in protecting youth physical activity levels (section 2.3.1), (2) physical activity levels of OYS participants compared to nonparticipants (section 2.3.2), (3) OYS participation and the likelihood of meeting recommended physical activity and sedentary guidelines (section 2.3.3), and (4) OYS participation as a predictor of physical activity in adulthood (section 2.3.4) in greater detail below.

2.3.1 Physical activity levels of sports participants compared to nonparticipants

Several studies have found that youth who participate in OYS are more physically active (overall) than those who do not participate (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Mandic et al., 2012; Pfeiffer et al., 2006). One study reported that OYS participants were greater than three times more likely to be more physically active than nonparticipants (Pfeiffer et al., 2006). Further, Silva et al. (2010) found that those who participated in OYS are more physically active every day of the week and were also more likely to be active on weekends than youth who did not.

Studies by Mandic et al. (2012) and Pfeiffer et al. (2006) found that OYS participation was associated with significantly higher levels of MVPA and vigorous physical activity, respectively, than nonparticipation. Similarly, studies by Katzmarzyk and Malina (1998) and Machado-Rodrigues et al. (2012) found that sports participants had higher total daily energy expenditure and moderate-to-vigorous energy expenditure than nonparticipants. Both studies also found that OYS participants spent less time
sedentary than their counterparts. The Katzmarzyk and Malina (1998) and Machado-Rodrigues et al. (2012) studies will be discussed in detail in section 2.4.

In the study conducted by Pfeiffer et al. (2006), data were collected longitudinally (at three time points – eighth, ninth, and twelfth grades) over a four-year period, and commenced when the sample of girls recruited were in the eighth grade (approximately 13 years of age). Findings suggest that OYS participation may have a considerable impact on vigorous physical activity. In their study, OYS participants had higher odds of being vigorously physically active at every time point (eighth, ninth, and twelfth grades), whereas for MVPA, girls who played sports in all three years were not more likely be moderately-to-vigorously physically active in twelfth grade than nonparticipants. The authors also compared physical activity levels for three OYS participation groups (nonparticipants, dropouts, three-year participants) from eighth to twelfth grade. Pfeiffer et al. (2006) found that three-year participants were significantly more vigorously active than nonparticipants and dropouts at all three time points. These are important findings as they demonstrate that participation in OYS may contribute to overall physical activity, in particular vigorous physical activity, during late adolescence when physical activity is known to decline sharply (Kimm et al., 2002; Nader et al., 2008). These findings are also important because vigorous physical activity has been associated with health benefits, over and above benefits accrued from lower-intensity activity (Carson et al., 2014; Hay et al., 2012; Rosenkranz, Rosenkranz, Hastmann, & Harms, 2012).
2.3.2 The role of organised youth sport in predicting youth physical activity levels

Bélanger et al. (2009) investigated whether participation in OYS in early adolescence protected against declining physical activity levels later during adolescence. Every three months for five years, participants (who were initially aged 12-13 years) completed a seven-day physical activity recall. Participants provided data on the number and type of OYS they took part in. Bélanger et al. (2009) found that participation in OYS was associated with more frequent participation in MVPA throughout adolescence. The researchers found, however, the average frequency of physical activity participation among youth declined with age. Eime, Harvey, Sawyer, et al. (2013) found that adolescent girls shifted their participation away from organised, competitive physical activity settings towards nonorganised, noncompetitive physical activity settings and also individual types of physical activity.

Based on the findings presented, OYS does not appear to protect against declining physical activity levels during adolescence and youth may shift their participation away from OYS. Maintaining participation in OYS throughout adolescence is critical, however, as it has been shown that OYS significantly contributes to higher levels of MVPA (Bélanger et al., 2009).

2.3.3 Organised youth sport participation and the likelihood of meeting recommended physical activity guidelines
Several studies have found that OYS increased the likelihood of youth achieving recommended levels of physical activity as outlined in guidelines (Mandic et al., 2012; Silva et al., 2010; Vella et al., 2013). In Mandic et al.’s (2012) cross-sectional investigation, the authors reported that one-third of youth in their study were meeting minimal physical activity guidelines solely through participation in OYS. The percentage of youth meeting physical activity guidelines increased significantly from 29% of students who participated in OYS up to 2 hours per week to 75% of students who participated for 6 or more hours per week (Mandic et al., 2012). The authors concluded that although OYS presents an important opportunity for increasing physical activity in youth, OYS alone might be insufficient for meeting physical activity recommendations. Although this might be the case, other studies have suggested that there may be room for improvement with regard to increasing physical activity levels in OYS (Guagliano et al., 2013; Leek et al., 2011). Thus, the quality of time spent in OYS should be considered in order to optimise physical activity levels in OYS (Guagliano et al., 2013; Janssen, 2014). Literature related to how time is spent is included in section 2.5.

2.3.4 Organised youth sport participation as a predictor of physical activity in adulthood

As discussed above, OYS participation may not protect against decreased physical activity levels during adolescence, but it does appear to provide participants significantly more MVPA and a greater likelihood of meeting physical activity and
sedentary behaviour recommendations than nonparticipants. OYS is also one of the strongest predictors of physical activity in early adulthood (Telama et al., 2006).

Of the identified studies, all have found OYS participation in childhood and/or adolescence was a significant, albeit modest, predictor of physical activity in adulthood (Kjønniksen et al., 2009; Perkins et al., 2004; Tammelin et al., 2003; Telama et al., 2006). Telama et al. (2006), however, suggested that persistent OYS participation from a young age considerably improves the likelihood of physical activity in adulthood. The association between OYS participation and physical activity in adulthood was stronger in males compared to females in all studies. Furthermore, sports participation increased the probability of high-intensity activity in adulthood more among males than females (Telama et al., 2006). Interestingly, Tammelin et al. (2003) found that, compared with boys, a lower frequency of OYS participation was associated with a higher level of physical activity in later life in girls (once a week among girls and twice a week among boys). Seabra et al. (2007) reported that boys participated in OYS more than four hours per week compared to less than two hours per week in girls. Despite these sex differences, girls need to be encouraged to stay involved in OYS, as the literature suggests that this participation may influence their physical activity levels later in life (Perkins et al., 2004).

Kjønniksen et al. (2009) conducted a 10-year longitudinal study examining whether early and sustained OYS during the youth years predicted physical activity at age 23 years. The authors found that youth first became involved in OYS around six to 10 years of age, and that being a member of an OYS club increased the chances of being
a physically active young adult. Those who reported becoming members of a sports club even earlier were more physically active as young adults than those who reported starting at an older age (Kjønniksen et al., 2009). During adolescence, participation in OYS declined for both males and females, but these authors’ findings suggested that those who remain in OYS at age 16 years had a better chance of continuing to be physically active at age 23 years than those who dropped out by age 16 years (Kjønniksen et al., 2009).

Frequency of participation and level of competition in OYS may also be associated with physical activity/sports participation as adults. Perkins et al. (2004) reported youth who rated their involvement in OYS as high (i.e., more than four hours per week) were eight times more likely to participate in sports as young adults than youth who rated their involvement in OYS as low (i.e., spent no time in OYS). Furthermore, Telama et al. (2006) found that in both sexes, participation in high-level OYS (e.g., representative-level) increased the likelihood of activity in adulthood.

2.4 Energy expenditure in organised youth sport

Considering paediatric overweight and obesity is a major public health concern (Fulton et al., 2009; Kosti & Panagiotakos, 2006), understanding avenues that can promote energy expenditure are important (Katzmarzyk & Malina, 1998; Sacheck et al., 2011). Four peer-reviewed studies were found in the literature that focused on investigating energy expenditure within an OYS setting (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Olds, Dollman, & Maher, 2009; Sacheck et al., 2011). The studies identified were conducted in Australia, Portugal, and the USA. All were
cross-sectional studies and the majority included samples of boys and girls (one of the five sampled boys only; Machado-Rodrigues et al., 2012). The studies that have been conducted examining energy expenditure within an OYS setting have been summarised in Table 2.4 and discussed below.
Table 2.4 Summary of the studies that have examined players’ energy expenditure during organised youth sport.

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (n)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Sport(s)</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katzmarzyk and Malina (1998)</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>54</td>
<td>12-14</td>
<td>Boys and girls</td>
<td>Basketball, downhill skiing, soccer, wrestling, football, cheerleading, volleyball, swimming, tennis, dance</td>
<td>• To examine the contribution of participation in OYS to TDEE in youth.</td>
<td>• Boys and girls expended 55% and 64.6% of MVTEE in OYS.</td>
</tr>
<tr>
<td>Machado-Rodrigues et al. (2012)</td>
<td>Portugal</td>
<td>Cross-sectional</td>
<td>165</td>
<td>13-16</td>
<td>Boys</td>
<td>Soccer, basketball, volleyball, track and field, handball, rugby, swimming, tennis, rowing, sailing, gymnastics, martial arts.</td>
<td>• To examine the contribution of participation in OYS to TDEE and MVTEE in boys.</td>
<td>Boys expended 35-42% of MVTEE in OYS.</td>
</tr>
<tr>
<td>Olds et al. (2009)</td>
<td>Australia</td>
<td>Cross-sectional</td>
<td>2200</td>
<td>9-16</td>
<td>Boys and girls</td>
<td>Soccer, Australian Rules Football, dance,</td>
<td>• To describe sports participation among Australian adolescents</td>
<td>Sports participation contributed 58% of MVTEE.</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (n)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Sport(s)</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacheck et al. (2011)</td>
<td>USA</td>
<td>Cross-sectional</td>
<td>111</td>
<td>7-10</td>
<td>Boys and girls</td>
<td>Soccer (indoor)</td>
<td>• To investigate the amount of energy expended during soccer games and how this relates to TGEE and physical activity recommendations.</td>
<td>• Youth TGEE was 121.6 ± 25.0 kcals</td>
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<td></td>
<td>• TGEE was significantly higher for youth aged 9-10 compared to 7-8 year olds (125.3 ± 25.1 vs. 106.5 ± 18.7)</td>
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<td>• About 20% of total daily MVEE is achieved through soccer games.</td>
</tr>
</tbody>
</table>

Note. kcals, kilocalories; MVEE, moderate-to-vigorous energy expenditure; OYS, organised youth sport; TDEE, total daily energy expenditure; TGEE, total game energy expenditure.
The majority of the identified studies had a similar primary aim, which was to investigate the contribution of participation in OYS to total daily energy expenditure and moderate-to-vigorous energy expenditure (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Sacheck et al., 2011). Although the contribution of participation in OYS to total daily energy expenditure and moderate-to-vigorous energy expenditure was not a primary aim of their study, Olds et al. (2009) provided findings of youth energy expenditure in OYS. Further, Sacheck et al. (2011) also examined total game energy expenditure during 50-minute soccer games, in addition to total daily energy expenditure. Sample sizes and age range varied between the identified studies in Table 2.4, ranging from 54 to 2,200 participants and from nine to 16 years of age. All but one study recruited participants of both genders; the study by Machado-Rodrigues et al. (2012) only recruited boys. Among the four identified studies, a wide range of sports was examined. Individual and team sports were included in all but one study (Sacheck et al., 2011), and sports ranged from ball games, water sports, dance/cheerleading, and martial arts.

Among the four studies, there was little similarity with regard to the methodologies employed. Katzmarzyk and Malina (1998), and Machado-Rodrigues et al. (2012) used a protocol by Bouchard et al. (1983) to estimate youth energy expenditure during OYS. This protocol used a three-day activity diary (including one weekend day) with each day divided into 96, 15-minute periods. Using the diaries, activities were coded and converted into energy expenditure estimates based on Bouchard et al.’s (1983) protocol. Moderate-to-vigorous energy expenditure was also
calculated using the activity diaries, where activities that were coded greater than or equal to six indicated moderate-to-vigorous energy expenditure (Katzmarzyk & Malina, 1998). Further, Katzmarzyk and Malina (1998) and Machado-Rodrigues et al. (2012) estimated television viewing times via participants’ three-day diaries. Olds et al. (2009) used a 24-hour recall software system (Ridley, Ainsworth, & Olds, 2008) to estimate youth energy expenditure. The software allowed youth to choose from 250 activities and rate their perceived physical activity intensity, and then calculated estimated energy expenditure (Olds et al., 2009). Lastly, Sacheck et al. (2011) measured physical activity using accelerometry and used energy expenditure regression equations by Puyau, Adolph, Vohra, Zakeri, and Butte (2004) and Schofield (1985) to calculate activity energy expenditure (during soccer games) and basal metabolic rate, respectively. Total game energy expenditure was found by summing activity energy expenditure and basal metabolic rate (Sacheck et al., 2011).

Despite differences in methodology, the contribution of OYS to total daily energy expenditure was comparable across studies, ranging from approximately 11% to 20% (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Olds et al., 2009). Compared to the findings found for total daily energy expenditure, there was a wider range found across studies for total daily moderate-to-vigorous energy expenditure (approximately 20% to 65%) (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Olds et al., 2009; Sacheck et al., 2011). Youth total daily moderate-to-vigorous energy expenditure was noticeably lower in the study by Sacheck et al. (2011) (~20%), compared to the other studies (~39% to ~60%) (Katzmarzyk & Malina, 1998; Machado-
Rodrigues et al., 2012; Olds et al., 2009). It is possible that Sacheck et al.’s (2011) energy expenditure findings are substantially lower compared to those from the other studies for a two reasons. First, Sacheck et al. used accelerometry and thus obtained objective physical activity rather than self-report, which is susceptible to participant overestimation. Secondly, Sacheck et al. only examined one sport (soccer) compared to the multiple sports included in the other studies; therefore, it is possible that the sports included in the other studies had a greater influence on youth energy expenditure.

Katzmarzyk and Malina (1998) found that boys and girls expended approximately the same proportion of total daily energy expenditure in OYS, however, the absolute amount expended by boys was greater. Boys also expended more moderate-to-vigorous energy expenditure (absolutely) in OYS than girls. As such, these results suggest that males are more intensely physically active than girls. Conversely, Sacheck et al. (2011) found no difference between genders for total game energy expenditure. In addition, both Katzmarzyk and Malina (1998) and Machado-Rodrigues et al. (2012) found that those who participated in OYS had greater total daily energy expenditure and moderate-to-vigorous energy expenditure, and spent less time watching television than youth who did participate in OYS.

Based on the available evidence, OYS appears to be an important outlet for energy expenditure and may also play a role in reducing sedentary behaviour. In Australia, one report found that youth expended 43% of their total daily energy in OYS, despite OYS constituting only 34% of their time spent physically active (Department of Health and Ageing, 2008). Although notable, there may be room for additional
opportunities for youth to expend more energy in OYS. The ensuing section will address
time efficiency relative to physical activity in OYS practices and games.

2.5 Time spent physically active in organised youth sport

Only four peer-reviewed studies have been identified in the literature focusing
on how much physical activity participants accumulate during OYS (Katzmarzyk,
Walker, & Malina, 2001; Leek et al., 2011; Sacheck et al., 2011; Wickel & Eisenmann,
2007). All of these studies were cross-sectional, conducted in the USA, and all but one
study included a sample of boys and girls. The studies that have been conducted
examining participants’ physical activity levels in OYS are summarised in Table 2.5 and
discussed below.
Table 2.5 Summary of the studies that have documented players’ physical activity levels in an organised youth sport setting.

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (n)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Sport(s)</th>
<th>Physical activity measurement/cut-off/epoch</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katzmarzyk et al. (2001)</td>
<td>USA</td>
<td>Cross-Sectional</td>
<td>79</td>
<td>11-14</td>
<td>Boys and girls</td>
<td>Basketball, soccer (indoor and outdoor), hockey (ice and in-line)</td>
<td>• DO</td>
<td>• To document the amount of time spent sitting, standing, walking, jogging, and sprinting in OYS practices and games. • Players were inactive 43% of the time (sitting/standing). • Significant differences were found in physical activity among sports, but not sex.</td>
<td></td>
</tr>
<tr>
<td>Leek et al. (2011)</td>
<td>USA</td>
<td>Cross-Sectional</td>
<td>200</td>
<td>7-14</td>
<td>Boys and girls</td>
<td>Soccer (outdoor), baseball/softball</td>
<td>• ACC • Freedson² • 10-sec</td>
<td>• To document physical activity intensity during soccer and baseball/softball practices. • Overall, players spent 46.1% time in MVPA, on average. • Soccer players, boys, and players aged 7-10 had significantly more MVPA than their counterparts. • Less than 25% of players were sufficiently active through solely through OYS practices.</td>
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<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (n)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Sport(s)</th>
<th>Physical activity measurement/cut-off/epoch</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
</tr>
</thead>
</table>
| Sacheck et al. (2011)       | USA     | Cross-Sectional | 111             | 7-10        | Boys and girls | Soccer (indoor) | • ACC  
• Puyau<sup>b</sup>  
• 1-sec | To document physical activity intensity during soccer games.  
To compare physical activity intensity based on weight status (normal weight vs. overweight/obese). | Overall, players spent 33% of game time in MVPA and 49% of game time sedentary.  
Overweight/obese children spent significantly more time sedentary (+3.2 ± 1.2 minutes; *p* < 0.05) and less time in MVPA (-3.0 ± 1.0 minutes; *p* < 0.01) compared to normal weight children. |
| Wickel and Eisenmann (2007) | USA     | Cross-Sectional | 119             | 6-12        | Boys | Basketball, soccer (outdoor), flag football | • ACC  
• Freedson<sup>a</sup>  
• 30-sec | To determine the contribution of OYS on total daily physical activity | OYS contributed approximately 23% of youth total MVPA.  
Overall, youth spent 27% and 22% of the time spent in OYS practices in moderate and vigorous physical activity. |
<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Country</th>
<th>Study design</th>
<th>Sample size (n)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Sport(s)</th>
<th>Physical activity measurement/cut-off/epoch</th>
<th>Relevant study aim(s)</th>
<th>Relevant key finding(s)</th>
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</table>

- 52% of the time in OYS practices was spent sedentary.

A seminal study that examined youth physical activity levels during OYS was that of Katzmarzyk et al. (2001). This line of research likely spawned from their previous work (discussed above) where the authors found that OYS contributed nearly 60% of youth moderate-to-vigorous energy expenditure (Katzmarzyk & Malina, 1998). Katzmarzyk et al.’s study (2001) aimed to document, using a direct observation method, the amount of time youth spent sitting, standing, walking, jogging, and sprinting. A total of 79 boys and girls (58 and 21, respectively) between the ages of 11-14 years were recruited. The sports included in this study were basketball, soccer (indoor and outdoor), and hockey (ice and in-line). The results indicated that players spent 43% of the time in OYS inactive (i.e., sitting or standing). The authors reported finding differences in physical activity levels among sports, where outdoor soccer players spent the most time sprinting and hockey players (ice and in-line) spent the most time sitting. No significant sex differences were found in physical activity levels.

Wickel and Eisenmann (2007) conducted a study that used objective measures to determine the contribution of OYS to total daily physical activity. A total of 119 boys, aged 6-12 years, participated in the study. Participants, who were recruited from basketball, outdoor soccer, and flag football programs, wore accelerometers (mounted at the hip) during all waking hours. Accelerometers were initialised to record activity at 30-second epochs and the authors used cut-points by Freedson et al. (2005) to classify physical activity intensity. Wickel and Eisenmann (2007) found that youth were either inactive or in light physical activity for over half (~52%) of the time spent in sport practices, whereas they were in moderate and vigorous physical activity for
approximately 27% and 22% of the time, respectively. Wickel and Eisenmann’s (2007) findings indicated that OYS contributed approximately 23% of youth total MVPA, which is noticeably lower than findings in other studies (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Olds et al., 2009). Important differences between Wickel and Eisenmann’s (2007) study and the others should be noted, however, and make comparisons between them difficult due to different outcome measures (e.g., energy expenditure vs. physical activity and activity diary vs. accelerometry). Nevertheless, Wickel and Eisenmann’s (2007) findings were some of the first to show that OYS can contribute a substantial amount of MVPA to youth total daily MVPA. It can also be inferred from these findings that there is likely room to improve physical activity levels in OYS, as youth spent the majority of time in OYS inactive (~52%).

In a more recent study, Sacheck et al. (2011) investigated youth physical activity intensity during soccer games and compared physical activity intensity based on weight status (normal weight vs. overweight/obese). This study was the only identified study that solely examined game-time physical activity. In this study, participants were 111 boys and girls, aged 7-10 years, playing indoor soccer. Participants wore accelerometers, placed and worn at the hip for the duration of the soccer game. Accelerometers were initialised to record activity at 1-second epochs and the authors used cut-points by Puyau et al. (2002). On average, players spent 33% of game time in MVPA and 49% of game time as inactive. The authors found no age or sex effects with regard to physical activity intensity. Furthermore, overweight/obese youth spent significantly more time sedentary (+3.2 ± 1.2 minutes; *p* < 0.05) and less time in MVPA.
(-3.0 ± 1.0 minutes; \( p < 0.01 \)) compared to normal weight youth. The authors reported that youth participation in indoor soccer provided 28% (16.8 minutes) of the 60 minutes of MVPA recommended by physical activity guidelines. Sacheck et al. (2011) highlighted that participation in OYS may mislead parents into thinking that their child is accumulating sufficient MVPA through these organised activities, as 60 minutes is commonly the average time spent in OYS (Janssen, 2014). The authors stressed that OYS offers a great setting to be physically active, however, it is unlikely that simply participating in OYS will lead to youth accumulating the recommended 60 minutes of MVPA daily.

The aim of the study by Leek et al. (2011) was to document youth physical activity intensity during soccer and baseball/softball practices. A total of 200 males and females between the ages of 7-14 years were recruited (105 and 95, respectively). Physical activity was measured using accelerometry. Accelerometers were initialised to record activity counts using 10-second epochs and the authors employed cut-points derived by Freedson et al. (2005). Overall, players spent about 46% and 30% of OYS time in MVPA and inactivity, respectively. It was also found that soccer players, boys, and players aged 7-10 had achieved significantly more MVPA than their counterparts (i.e., baseball/softball players, girls, players aged 11-14, respectively). Leek et al. (2011) found that soccer players spent about 17% time more per practice in vigorous physical activity than baseball/softball players (~28% vs. ~11% time). This supports the earlier findings of Katzmarzyk et al. (2001) who reported that soccer players obtained more vigorous physical activity compared with the other sports they included in their study.
Contrary to the findings of Leek et al. (2011), studies by Katzmarzyk and Sacheck and colleagues (2001; 2011) found no sex differences with regard to physical activity intensity. It was reported that the sex differences were larger in baseball/softball compared to soccer. Leek et al. (2011) suggested that the sex differences in baseball/softball might be because girls’ softball coaches included less physical practice, game play, and more skill building, compared to boys’ baseball coaches during OYS practices.

With regard to the age differences found, Leek et al. (2011) offered possible reasons to explain why 7-10 year old players had significantly more MVPA than the 11-14 year olds. The authors suggested that there could be a greater emphasis on skill development during practice and greater movement efficiency as youth get older. It is also possible that they recruited an unusually active sample, compared to Sacheck et al.’s (2011) examination of soccer players (also aged 7-10); Leek et al.’s (2011) findings are substantially higher (~60% vs. 33% time in MVPA). There are two issues with this assertion that should be noted. First, in the study by Leek et al. (2011), physical activity levels were only investigated during practices compared to only game time physical activity in the study by Sacheck et al. (2011). Given that coaches are better able to dictate the intensity of a practice compared to games (because they are not bound by the competition rules of a given sport during practice time), it is possible that youth physical activity levels may be higher during practice. Of the identified studies in Table 2.4, only that of Katzmarzyk et al. (2001) observed players’ practice and game time physical activity levels. The authors, however, did not provide a comparison of physical activity
between practices and games. Thus, a complete picture of OYS is lacking, no study has provided comparisons of the physical activity levels accumulated in both practices and games using the same participants. The second explanation for the difference in MVPA in the two studies mentioned above is that two different cut-points (and epoch lengths) were used to classify physical activity intensity. Leek et al. (2011) used cut-points derived by Freedson et al. (2005), whereas Sacheck et al. (2011) used cut-points developed by Puyau et al. (2002). This makes comparisons difficult, as previous research has found that certain cut-points are more sensitive to certain physical activity intensities (Crouter, Horton, & Bassett Jr., 2013; Trost, Loprinzi, Moore, & Pfeiffer, 2011). For example, Freedson et al. cut-points are more likely to show higher levels of MVPA than Puyau et al. cut-points (Trost et al., 2011). Beyond the studies by Leek et al. (2011) and Sacheck et al., there is little consistency in the identified literature regarding physical activity measurement (e.g., direct observation vs. accelerometry and discrepancies between cut-points and epoch lengths). This lack of consistency makes comparisons between studies difficult and should be interpreted with caution.

Similar to the argument suggested by Sacheck et al. (2011), Leek et al. (2011) stated that although participation in OYS contributes to overall physical activity, few players in the study were sufficiently active solely through OYS (i.e., met the 60 minutes of MVPA standard). The authors offered several recommendations for physical activity improvement in OYS, such as increasing practice frequency, using pedometers or accelerometers to monitor physical activity periodically during OYS, and providing coaches with strategies to increase physical activity. The authors called for the
evaluation of the abovementioned strategies (or others) as potential approaches to increase MVPA during OYS.

2.6 The potential role of coaches in promoting physical activity in organised youth sports

As noted in Chapter 1, several studies have suggested OYS clubs could be a potential avenue for health promotion (Almond et al., 2013; Eime, Payne, & Harvey, 2008; Geidne et al., 2013; Kelly et al., 2014; Kokko et al., 2006, 2009). Within OYS clubs, coaches have been identified and used as key agents to deliver health promotion programs (Hilland et al., 2014). Coaches are commonly used to deliver health promotion programs due to the amount of direct involvement they have with their players on a weekly basis and because of their strong impact on youth within an OYS context (Smith & Smoll, 1997). In addition, Conroy and Coatsworth (2006) suggested that coaches are ideal agents of intervention for promoting health because they are viewed as experts, and that their role as coaches can carry considerable influence with their players. Some health-promotion research conducted in OYS clubs and delivered by coaches include promoting healthy eating (Kelly et al., 2010), alcohol prevention (King et al., 2010), smoking prevention, (Hilland et al., 2014), mental health support (Mazzer et al., 2012), and injury prevention (Glang et al., 2010).

In the current literature, no studies have been conducted in OYS aiming to improve physical activity (Camacho-Miñano et al., 2011; Priest et al., 2008). In a similar setting (school-based physical education), several large randomised controlled trials
have been conducted using physical education teachers to increase youth physical activity levels (Lonsdale, Rosenkranz, Sanders, et al., 2013; McKenzie et al., 1996; McKenzie et al., 2004; Pate et al., 2005; Sallis et al., 1997). Given that studies have used coaches to deliver a variety of health-promotion interventions in OYS, and that teachers have been used to increase youth physical activity in a similar setting, it is possible that coaches may be viable agents to increase youth physical activity in OYS.

2.7 Conclusion

This literature review focused primarily on literature related to youth physical activity in OYS (outside of school). Despite sport having been identified as a research priority in the area of youth physical activity promotion and sedentary behaviour (Almond et al., 2013; Gillis et al., 2013), relatively little literature was found, compared to that in other settings (e.g., school-based physical education), and no controlled studies have been conducted in this area (Camacho-Miñano et al., 2011; Priest et al., 2008). Although the role of the OYS setting as a critical contributor to daily youth MVPA has been frequently overlooked and understudied, OYS has widespread reach and extensive evidence of numerous health-enhancing benefits exists.

Bélanger et al. (2009) reported that OYS does not appear to protect against the decline in physical activity levels during youth transition into adolescence. OYS, however, appears to significantly contribute to higher levels of MVPA among participants (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Mandic et al., 2012; Pfeiffer et al., 2006), and to increase the likelihood of participants achieving recommended levels of physical activity to meet guidelines (Mandic et al., 2012; Silva...
et al., 2010; Vella et al., 2013). OYS is also one of the best predictors of physical activity in early adulthood (Telama et al., 2006). Furthermore, OYS may contribute to a reduction in time spent in sedentary behaviour during youth (Katzmarzyk & Malina, 1998; Machado-Rodrigues et al., 2012; Sallis et al., 2000; Vella et al., 2013). As Sallis et al. (2000) suggested, sedentary behaviour after school and on weekends, and not total sedentary time, was associated with lower levels of physical activity. Given that youth participation in OYS occurs primarily after school and on weekends lends support to OYS as potentially an important setting for providing opportunities to be physically active.

There appears to be great opportunity to promote physical activity in OYS. Based on the available evidence, OYS appears to be an important outlet for energy expenditure and a significant contributor to time spent in MVPA. For example, one-third of participants in Mandic et al.’s (2012) study met minimal physical activity guidelines solely through participation in OYS. Within OYS, however, the literature suggests there may be room for additional opportunity for youth to accrue more MVPA, as participants spend the majority of their time in inactive or in light physical activity during OYS practices and games (Leek et al., 2011; Sacheck et al., 2011; Wickel & Eisenmann, 2007). Comparisons between studies have been difficult, however, due to different conditions (practice vs. game) and accelerometer cut-points used. A complete picture of OYS is currently lacking, where physical activity has been examined in both practices and games using the same participants to provide comparisons between conditions. In the published literature to date, no study has provided any contextual evidence regarding
how time is spent and how coaches conduct themselves during practices and games in OYS. This information will be vital for suggesting avenues for improvement and informing more rigorously designed studies.

Although coaches have commonly been enlisted to deliver health promotion programs in OYS, no studies have been conducted in OYS aiming to improve physical activity \textit{per se}. In a similar setting (physical education), though, several large-scale studies have been conducted using physical education teachers to increase youth physical activity levels (Lonsdale, Rosenkranz, Sanders, et al., 2013; McKenzie et al., 1996; McKenzie et al., 2004; Pate et al., 2005; Sallis et al., 1997). All of aforementioned studies were effective in increasing childrens’ moderate and/or vigorous physical activity in a physical education setting. Further, McKenzie et al. (2004) reported that their intervention components were well received by teachers. Thus, coaches may be viable agents to increase physical activity in OYS. Further research is warranted in order to optimise the opportunity youth have to be physically active and maximise health benefit through participation in OYS.

2.8 Synopsis

This chapter, Chapter 2, has presented a summary of the literature pertaining to physical activity time in OYS. Trends, energy expenditure, and time spent physically active in OYS, as well as the potential role of OYS clubs and coaches in promoting youth physical activity, were presented. Chapter 3 presents the findings of the first study conducted for this PhD thesis – an observational study that examined girls’ physical activity.
activity levels, how time was spent in OYS, and leader behaviour during OYS practices and games.
Chapter 3

Study 1 - Girls’ physical activity levels during organised youth sports in Australia

A peer-reviewed journal article based on the findings from the study presented in Chapter 3 has been published in *Medicine & Science in Sports & Exercise* (see Appendix A).


**Authorship details:**

Guagliano (90%), Rosenkranz (5%), Kolt (5%)
3.1 Introduction

This cross-sectional study is the first of a series of four studies that formed this PhD thesis, and it has been published in *Medicine & Science in Sports & Exercise* (see Appendix A). To be able to develop an intervention to increase players’ physical activity in organised youth sport (OYS), it was essential to first determine their levels of physical activity while participating in OYS (during practice and games). It was unclear with respect to opportunity for physical activity, how time is spent and how coaches conduct themselves during practices and games in OYS. This study provides a description of players’ experiences while participating in three of the most popular team sports for girls in Australia.

3.2 Background

The benefits of regularly engaging in MVPA among youth are well established and include contributions to physical, mental, and social health outcomes (Strong et al., 2005). National guidelines state that youth should engage in 60 minutes of MVPA daily, which can be achieved cumulatively throughout the day in bouts (Department of Health and Aging, 2014a, 2014c). A considerable proportion of youth, however, fail to meet recommended levels of physical activity (Hardy et al., 2008; Nader et al., 2008; Troiano et al., 2008; Trost et al., 2002). This is particularly evident for girls, as they are less physically active than boys (Hardy et al., 2008; Troiano et al., 2008), with the sharpest declines observed in adolescence (Kimm et al., 2002; Nader et al., 2008).
Participation in OYS has been recommended as an approach to increase physical activity (Washington et al., 2001). In Australia, yearly prevalence data indicate that approximately 66% of youth (67% of boys and 65% of girls) participate in at least one OYS (including dance) outside of school hours (Australian Bureau of Statistics, 2012). A recent systematic review found that youth who participated in OYS were more physically active than those who did not participate (Nelson et al., 2011). The amount of physical activity that girls achieve during OYS, however, is unclear.

Of the few studies that have examined physical activity in OYS, one study found that during soccer games, youth were in MVPA for 33% of the match (Sacheck et al., 2011) and another study found that about 46% of practice time was spent in MVPA (Leek et al., 2011). Youth, however, are spending high percentages of time during OYS inactive or in light physical activity (Katzmarzyk et al., 2001; Leek et al., 2011).

Despite these findings that youth may be less than optimally active during OYS practices and games, OYS contributed close to 25% of daily MVPA (Sacheck et al., 2011; Wickel & Eisenmann, 2007). These studies provide evidence to suggest that OYS can contribute substantially to MVPA levels; however, current literature has only examined physical activity in either OYS practices or games. To date, a complete picture of OYS is lacking, where physical activity has been examined in both practices and games for the same participants to provide comparisons between conditions. Furthermore, it remains unclear with respect to opportunity for physical activity how time is spent and how coaches conduct themselves during practices and games in OYS.

3.2.1 Study aims
The primary aim of this study was to objectively determine physical activity levels of players during OYS, and to compare the levels between games and practices for the same participants. Secondary aims of this study were to document lesson context and coach behaviour during practices and games.

3.3 Methods

3.3.1 Study design/protocol and setting

This study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines developed by Von Elm et al. (2007). The Human Research Ethics Committee of the University of Western Sydney approved this study (approval number H8930, See Appendix D).

Between May and August 2011, a team consisting of the author of this thesis and a female research assistant attended practices and games of all participating teams (which included teams playing netball, basketball, and outdoor soccer) in the Western suburbs of Sydney, Australia. The research team observed 1 practice and 1 game, with the exception of netball. The netball players practiced twice a week, with one of those practices dedicated solely to fitness. Therefore, an additional netball practice was observed (one fitness session and one skill session) for this sport.

All netball practices, games, and fitness sessions occurred outdoors, on asphalt netball courts. Netball practices and fitness sessions occurred on weekday evenings and games occurred on Saturday mornings or afternoons. All basketball practices and games occurred indoors, on hardwood basketball courts. Basketball practices occurred on
weekday evenings and games occurred on Sunday mornings or afternoons. Similarly, soccer practices also occurred on weekday evenings and games occurred on Sunday mornings or afternoons. All soccer practices and games were played outdoors on grass soccer fields.

There was an average of 13 and 15 days between observed practices and games for netball and soccer, respectively, and an average of 11 days between observed practices, games, and fitness sessions for netball. Before the practice, participating players were taken to a semi-private measurement area to be assessed on height, weight, and waist circumference. After anthropometric measurements, players were fitted with an accelerometer that was placed on the right hip (detailed description below), and worn for the duration of the practice. The female research assistant collected anthropometric data and fitted players with accelerometers. A declaration was signed by the research assistant and a witness (usually a coach or parent) confirming that the female research assistant collected the anthropometric data and fitted players with their accelerometers (see Appendix E).

The majority of players on each team wore accelerometers in all sports (netball: 38/39, basketball: 28/30, and soccer 28/43). In addition to accelerometry, SOFIT (McKenzie et al., 1991) direct observation system was used by the primary investigator (described in detail below). The protocol for games was the same as practice protocols, except that anthropometric measures were not taken.

### 3.3.2 Participants and sample size
A total of 94 players aged between 11 and 17 years (mean age = 13.4 ± 2.2 years) participated in this study. Participants were recruited from OYS clubs playing netball, basketball, and outdoor soccer in the Western suburbs of Sydney, Australia. These three OYS were chosen because of their popularity among girls in Australia (Australian Bureau of Statistics, 2009). A convenience sample of 10 teams from the 3 sports was recruited (4 netball, 3 basketball, and 3 soccer). Initially, a member of the executive committee of the OYS clubs was contacted by the author, to provide information about the study protocol (see Appendix F). Interested clubs then provided the primary investigator with contact details of interested coaches. Detailed study information was then sent to coaches and parents (see Appendices G and H). Participants were included based on their willingness to participate in the study. Prior to study commencement, informed consent and assent was obtained from coaches, parents, and players (see appendices I and J).

3.3.3 Outcome measures

3.3.3.1 Anthropometric measures

Prior to measurement, players were asked to remove shoes and heavy clothing. Standing height was measured to the nearest 0.1cm using a portable stadiometer (PE87 portable stadiometer; Mentone Educational, Victoria, Australia). Weight was measured using a digital scale (EF 538 HealthStream digital scale; Aussie Fitness, Queensland, Australia) to the nearest 0.1 kg. Body mass index (BMI) was calculated and converted into age- and sex-specific percentiles using the Centers for Disease Control and
Prevention growth charts (Kuczmarski et al., 2000). Waist circumference was measured on the right side of the body by finding the midpoint between the lowest rib and the iliac crest. A non-elastic tape measure (Myotape; Mentone Educational, Victoria, Australia) was wrapped snugly around the waist and measurement was taken at the end of exhalation to the nearest 0.1 cm. Measurements were conducted in duplicate for all assessments and an average was recorded. A third measurement was taken if the first two measures differed by more than 0.5 cm or 0.5 kg, and the average was recorded. All anthropometric measures were used for descriptive purposes.

### 3.3.3.2 Accelerometry

The ActiGraph GT3X accelerometer (ActiGraph; Pensacola, FL) was used to assess physical activity levels in this study. ActiGraph accelerometers are the most widely used accelerometers and have been shown to be valid and reliable devices for physical activity measurement in youth (Plasqui & Westerterp, 2007; Trost et al., 2011). Accelerometers were initialised to record counts and steps with 5-second epochs specified, to capture effectively the intermittent activity patterns of youth (Trost, McIver, & Pate, 2005).

Accelerometers were synchronised with an external clock and initialised to start recording a minimum of 30 minutes before and after the scheduled practice and/or game time. Start and finish times were recorded for every practice and game via direct observation to trim excess data outside the recorded start and finish time. Participating
coaches and players were instructed by the research team not to change activities or the way they practiced or played games during observation.

After each practice or game, raw accelerometer counts were uploaded to a computer using ActiGraph software, and saved to a Microsoft Excel file. Data outside the recorded start and finish time for given sessions were disregarded. Data were checked for spurious values that did not coincide with the direct observation records; all data between start and finish times for all practices and games were included in the analyses. Freedson’s MET prediction equation was used to determine physical activity intensity (Freedson et al., 2005). The age-specific counts per minute were divided by 12 to account for the 5-second epochs. Physical activity intensity was classified as the following: inactive ≤100 counts/min; light physical activity (LPA) ≥ 1.5 METs <4; moderate physical activity (MPA) ≥4 METs <7; and vigorous physical activity (VPA) ≥7 METs. Although a strong consensus does not exist regarding appropriate selection of MET-intensity thresholds for youth (Trost et al., 2011), those selected for this study have been used previously in an adolescent female population (Okely et al., 2011)

3.3.3.3 Direct observation

To complement accelerometry, SOFIT was used in this study to provide contextual data on physical activity in OYS. The SOFIT is a widely used direct observation system that uses momentary time sampling to generate data on participant physical activity, lesson context, and instructor (or for this research, coach) behaviour (McKenzie et al., 1991). The SOFIT has demonstrated acceptable reliability and validity
in a paediatric population (McKenzie et al., 1991; Rowe, Schuldheisz, & Van der Mars, 1997). Typically, SOFIT is used for structured physical activity sessions such as physical education classes, and OYS provides a similar environment, led by a coach instead of a teacher. Although SOFIT can be easily implemented in an OYS setting, only one report that the author is aware of had used the direct observation system in OYS (O'Connor & Cotton, 2009).

With SOFIT, 4 (plus one alternate) participants are quasi-randomly and furtively selected prior to session commencement by dividing the total number of participants attending a given session by 5 to inform selection order (e.g., 15/5 = 3, so every third participant is selected). On a rotational basis, the physical activity levels, lesson context, and coach behaviour were coded and recorded on paper every 20 seconds via a looped voice recording that prompted the observer to observe and record. Physical activity data from SOFIT were not used in this study, however, due to the availability of accelerometer data that render physical activity data at the individual level.

The OYS lesson context was coded into only 1 of 6 mutually exclusive categories: management, knowledge delivery, fitness, skill practice, game play, and free play at the end of each 10-second observe interval. Coach behaviour was coded using a hierarchical format and included (in hierarchal order) promotes physical activity (includes prompts of encouragement and praise) or discourages physical activity (includes prompts that are sarcastic and punitive in nature), demonstrates physical activity, and other. Therefore, promotes physical activity or discourages physical activity was recorded if it occurred at any time during the 10-second observe interval;
whereas other was only scored if the other categories were not observed during the 10-second observe interval. Multiple coding was only permitted if promotes physical activity or discourages physical activity and demonstrates physical activity were observed at any time during the 10-second observe interval. The SOFIT was used at each practice and game. The author was trained by a member of the PhD supervisory panel to use SOFIT and conducted all direct observations. The member of the PhD supervisory panel who trained the primary author has been trained to use SOFIT and has collected SOFIT data for other peer-reviewed work (Dzewaltowski et al., 2010).

The implementation of SOFIT is important to this study. The SOFIT has not been used in these particular sports, therefore important information regarding lesson context and coach behaviour is unknown. That is, how time is spent and how coaches conduct themselves with regard to physical activity during practices and games in OYS is unknown (Nelson et al., 2011). Generating data on lesson context and coach behaviour is best achieved through direct observation, as self-report data may be unreliable or otherwise biased (McKenzie et al., 1991).

### 3.3.4 Statistical analysis

All statistical analyses were performed with SPSS 18.0 (Chicago, IL, USA). Mean differences between practices and games for each physical activity intensity threshold (MVPA, VPA, MPA, LPA, and inactivity), steps per hour, lesson context variables, and coach behaviour variables were analysed using paired samples t-tests. Analysis of variance was used to examine the differences in means for the
anthropometric measures collected for players in each OYS. Descriptive statistics included means and standard deviations. Statistical significance was set at $p < 0.05$.

3.4 Results

3.4.1 Participant characteristics

Table 3.1 displays the physical characteristics of participants by sport. Physical characteristics were assessed for 98.9% of participants (93/94 participants), as one participant’s data were missing due to absence. The mean (± SD) age of the participants was $13.4 ± 2.2$ years. Based on age- and sex-specific growth charts, the average height ($164.1 ± 8.1$ cm), weight ($56.9 ± 10.9$ kg), and BMI ($21.0 ± 3.2$ kg m$^{-2}$) for all participating players corresponded approximately to the 75$^{th}$ percentile (Kuczmarski et al., 2000).
Table 3.1. Physical characteristics of the players by sport.

<table>
<thead>
<tr>
<th></th>
<th>All sports (N = 93)</th>
<th>Netball (n = 37)</th>
<th>Basketball (n = 28)</th>
<th>Soccer (n = 28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>13.4 ± 2.2</td>
<td>13.2 ± 1.1</td>
<td>12.8 ± 1.5</td>
<td>14.3 ± 3.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164.1 ± 8.1</td>
<td>165.8 ± 7.3</td>
<td>162.3 ± 10.3</td>
<td>163.5 ± 6.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>56.9 ± 10.9</td>
<td>56.8 ± 9.4</td>
<td>53.2 ± 12.3</td>
<td>60.9 ± 10.4</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>71.0 ± 7.2</td>
<td>71.1 ± 5.6</td>
<td>68.8 ± 7.9</td>
<td>72.9 ± 8.0</td>
</tr>
<tr>
<td>BMI (kg.m(^{-2}))</td>
<td>21.0 ± 3.2</td>
<td>20.6 ± 2.8</td>
<td>19.9 ± 2.7</td>
<td>22.8 ± 3.7</td>
</tr>
<tr>
<td>z-score</td>
<td>0.4 ± 0.8</td>
<td>0.4 ± 0.7</td>
<td>0.3 ± 0.8</td>
<td>0.5 ± 0.8</td>
</tr>
</tbody>
</table>

*Note.* Values are mean ± standard deviation. n = number of participants

### 3.4.2 Physical activity intensity during practices and games

Participants with intact data (i.e., attended both the observed practice and game) were 82 out of 94 participants (87.2%). Mean (± SD) duration, across OYS, for practice was 82.6 ± 22.6 min and 90.8 ± 13.7 min for games. Across OYS, the overall mean for percent time in MVPA during practices was significantly higher \((t = 2.94, p < 0.05)\) than during games.

Table 3.2 displays physical activity intensity (percent time) and step counts (per hour) at practice and games for each OYS. Significant mean differences for percent time were found for each physical activity intensity across OYS. During practices, the mean for percent time for VPA, MPA, and LPA were found to be significantly higher than during games \((VPA: t = 2.67, p < 0.05; MPA: t = 2.14, p < 0.05; LPA: t = 5.18, p < \)
0.001). The mean percent time for inactivity was significantly lower ($t = -5.20, p < 0.001$) during practice than during games.

Across the 3 OYS, the percentage of time spent in MVPA during games (netball, 31.4 ± 9.0; basketball, 30.5 ± 8.0; soccer, 29.2 ± 12.4) was slightly lower than during practice (netball, 33.7 ± 5.3; basketball, 35.5 ± 8.1; soccer, 31.5 ± 10.5). The only significant mean difference for percent time in MVPA between practice and games was found in basketball ($t = -2.34, p < 0.05$). With regard to LPA and inactivity, across all OYS, participants spent a greater percentage of time in LPA (netball, 34.7 ± 4.8 vs. 33.7 ± 4.7; basketball, 31.6 ± 6.7 vs. 20.6 ± 4.1; $t = 6.71, p < 0.001$; soccer, 45.0 ± 9.3 vs. 38.6 ± 10.8) and a lower percentage of time inactive (netball, 34.9 ± 9.9 vs. 31.6 ± 7.2; basketball, 48.9 ± 11.3 vs. 32.7 ± 11.6; $t = -4.82, p < 0.001$; soccer, 32.2 ± 18.3 vs. 23.5 ± 12.1; $t = -2.38, p < 0.05$) in practice compared to games.

Of the 3 OYS observed, netball was the only sport that dedicated 1 whole practice each week solely to fitness. During fitness practices, the mean percentage of time spent in MVPA was significantly greater than regular (skill-based) netball practices ($t = 10.10, p < 0.001$) and games ($t = 8.73, p < 0.001$). Also, LPA and inactivity were significantly lower at fitness practices compared to regular practices (LPA, $t = -7.68, p < 0.001$; inactivity, $t = -2.89, p < 0.05$) and games (LPA, $t = -7.38, p < 0.001$; inactivity, $t = -4.49; p < 0.001$).

### 3.4.3 Steps counts during practice and games
Across OYS, participants accumulated significantly more steps per hour during practice than during games (2,904 ± 728 vs. 2,709 ± 921; \( t = 2.15, p < 0.05 \)) (see Table 3.2). Among sports, only netball fitness practices provided significantly more steps per hour compared to regular netball practices (4,110 ± 746 vs. 2,716 ± 385; \( t = 10.10, p < 0.001 \)) and games (4,110 ± 746 vs. 2,577 ± 684; \( t = 9.50, p < 0.001 \)).
Table 3.2. Physical activity intensity (percent time) and step counts (per hour) at practice and games

<table>
<thead>
<tr>
<th>All sports (N = 82)</th>
<th>Netball (n = 36)</th>
<th>Basketball (n = 27)</th>
<th>Soccer (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Game</td>
<td>Practice</td>
<td>Fitness</td>
</tr>
<tr>
<td>MVPA</td>
<td>30.6 ± 9.5</td>
<td>33.8 ± 7.7*</td>
<td>31.4 ± 9.0</td>
</tr>
<tr>
<td>VPA</td>
<td>14.9 ± 6.5</td>
<td>16.7 ± 6.4*</td>
<td>15.5 ± 5.9</td>
</tr>
<tr>
<td>MPA</td>
<td>15.7 ± 5.7</td>
<td>17.1 ± 5.0*</td>
<td>15.9 ± 3.8</td>
</tr>
<tr>
<td>LPA</td>
<td>30.5 ± 9.7</td>
<td>36.0 ± 8.4*</td>
<td>33.7 ± 4.7</td>
</tr>
<tr>
<td>INA</td>
<td>38.9 ± 14.4</td>
<td>30.1 ± 10.6*</td>
<td>34.9 ± 9.9</td>
</tr>
<tr>
<td>Steps</td>
<td>2,709 ± 921</td>
<td>2,904 ± 728*</td>
<td>2,577 ± 684</td>
</tr>
</tbody>
</table>

Note. Values are mean ± standard deviation. Fitness means not included in All sports means ± standard deviations because they were exclusive to netball.

n = number of participants MVPA = moderate-to-vigorous physical activity; VPA = vigorous physical activity; MPA = moderate physical activity; LPA = light physical activity; INA = inactivity

* Significant difference between game and practice (p < 0.05)

• Significant difference between netball practice and fitness (p < 0.05)

• Significant difference between netball game and fitness (p < 0.05)
3.4.4 Organised youth sport contribution to recommended levels of physical activity

On average, OYS contributed 18.4 min per hour of MVPA during games (netball, 18.8 min per hour; basketball, 18.3 min per hour; soccer, 17.5 min per hour) and 20.3 min per hour during practice (netball, 20.2 min per hour; basketball, 21.3 min per hour; soccer, 18.9 min per hour). Large proportions of time, however, were spent inactive, on average 23.3 min per hour during games (netball, 20.9 min per hour; basketball, 29.3 min per hour; soccer, 19.3 min per hour) and 18.1 min per hour during practice (netball, 19.0 min per hour; basketball, 19.6 min per hour; soccer, 14.1 min per hour). Fitness practices provided approximately 27.0 min per hour of MVPA and 16.3 min per hour inactive.

Participants across sports accumulated 22.6% and 24.2% of the recommended 12,000 steps/day (Tudor-Locke et al., 2011) in 1 hour of game play (netball, 21.5% steps per hour; basketball, 20.0% steps per hour; soccer, 28.4% steps per hour) and practice time (netball, 22.6% steps per hour; basketball, 22.9% steps per hour; soccer, 29.0% steps per hour), respectively. During netball fitness practices, approximately 34.3% of the recommended 12,000 steps/day were accumulated every hour.

3.4.5 Lesson context

A total of 20 sessions were observed: 8 netball (4 games and 4 practices), 6 basketball (3 games and 3 practices), and 6 soccer sessions (3 games and 3 practices).
Four fitness practices were also observed, but were not included in the overall comparison across OYS because they were exclusive to netball. Table 3.3 displays lesson context as the percentage of a session that was spent in each category.
Table 3.3. Lesson context and coach behaviour during practice and games based on SOFIT

<table>
<thead>
<tr>
<th>Lesson context (% of time)</th>
<th>All sports (N = 20)</th>
<th>Netball (n = 12)</th>
<th>Basketball (n = 6)</th>
<th>Soccer (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Game</td>
<td>Practice</td>
<td>Game</td>
<td>Practice</td>
</tr>
<tr>
<td>Management</td>
<td>11.1 ± 3.9</td>
<td>15.0 ± 4.7</td>
<td>13.4 ± 3.8</td>
<td>14.3 ± 1.7</td>
</tr>
<tr>
<td>Knowledge</td>
<td>8.8 ± 4.4</td>
<td>18.5 ± 13.7</td>
<td>6.3 ± 2.2</td>
<td>25.0 ± 15.0</td>
</tr>
<tr>
<td>Fitness</td>
<td>2.3 ± 2.4</td>
<td>8.5 ± 5.8*</td>
<td>4.4 ± 2.1</td>
<td>9.5 ± 5.0*</td>
</tr>
<tr>
<td>Skill practice</td>
<td>6.9 ± 4.6</td>
<td>34.9 ± 18.2*</td>
<td>10.1 ± 3.2</td>
<td>37.4 ± 14.3*</td>
</tr>
<tr>
<td>Game play</td>
<td>69.4 ± 9.0</td>
<td>22.6 ± 24.9*</td>
<td>61.9 ± 3.2</td>
<td>13.3 ± 24.8*</td>
</tr>
<tr>
<td>Free play</td>
<td>1.6 ± 4.6</td>
<td>0.5 ± 0.6</td>
<td>3.9 ± 7.1</td>
<td>0.4 ± 0.9</td>
</tr>
</tbody>
</table>

Coach behaviour (occurrence per hour)

<table>
<thead>
<tr>
<th></th>
<th>All sports (N = 20)</th>
<th>Netball (n = 12)</th>
<th>Basketball (n = 6)</th>
<th>Soccer (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Game</td>
<td>Practice</td>
<td>Game</td>
<td>Practice</td>
</tr>
<tr>
<td>Promotes PA</td>
<td>15.8 ± 9.6</td>
<td>13.0 ± 11.5</td>
<td>23.2 ± 11.2</td>
<td>21.7 ± 8.2*</td>
</tr>
<tr>
<td>Discourages PA</td>
<td>1.9 ± 2.9</td>
<td>1.2 ± 1.5</td>
<td>2.3 ± 2.0</td>
<td>2.1 ± 1.8</td>
</tr>
<tr>
<td>Demonstrates PA</td>
<td>2.7 ± 4.4</td>
<td>7.6 ± 6.1*</td>
<td>1.9 ± 1.7</td>
<td>3.8 ± 1.0</td>
</tr>
</tbody>
</table>

Note. Values are mean ± standard deviation. Fitness means not included in All sports means ± standard deviations because they were exclusive to netball.

PA = physical activity, n = number of observations

* Significant difference between game and practice (p < 0.05)

• Significant difference between netball practice and fitness (p < 0.05)

• Significant difference between netball game and fitness (p < 0.05)
Across OYS, a greater percentage of practice time, compared to games, was spent in SOFIT categories of management (15.0 ± 4.7% vs. 11.1 ± 3.9%), knowledge delivery (18.5 ± 13.7% vs. 8.8 ± 4.4%), fitness (8.5 ± 5.8% vs. 2.3 ± 2.4%), and skill practice (34.9 ± 18.2% vs. 6.9 ± 4.6%); whereas, a greater percentage of game time was spent in game play (69.4 ± 9.0% vs. 22.6 ± 24.9%) and free play (1.6 ± 4.6% vs. 0.5 ± 0.6%). Mean percentages for fitness and skill practice were significantly higher during practice compared to games (fitness, $t = 2.92$, $p < 0.05$; skill practice, $t = 4.66$, $p < 0.05$); and mean percentages for game play were significantly higher during games compared to practice ($t = 6.99$, $p < 0.001$).

### 3.4.6 Coach behaviour

On average, there were more occurrences per hour of both promotion and discouragement of physical activity during games, compared to during practice among coaches (promoted physical activity: 15.8 ± 9.6 vs. 13.0 ± 11.5; discouraged physical activity: 1.9 ± 2.9 vs. 1.2 ± 1.5). There were, however, significantly fewer occurrences per hour of coaches demonstrating physical activity during games than during practice (2.7 ± 4.4 vs. 7.6 ± 6.1; $t = -2.95$, $p < 0.05$). These trends were consistent for each OYS.

### 3.5 Discussion

To the author’s knowledge, this is the first study to examine physical activity in Australian OYS and to compare mean proportions of physical activity levels of players during practice and games in OYS using the same participants. As far as the author is
aware, it is also the first to provide insight on lesson context and coach behaviours during OYS through the inclusion of SOFIT in the peer-reviewed literature.

Observations of the three sports showed that players achieved significantly higher levels of MVPA during practice compared to games, accumulating approximately 20 min per hour (~33% time) in MVPA during practice and about 18 min per hour (~30% time) in MVPA during games. The players also accumulated an average of 2,904 and 2,709 steps per hour during practice and games, respectively. Therefore, for every hour of game play or practice time, players accumulated approximately one-third of the recommended 60 minutes of MVPA (Strong et al., 2005) and about one-quarter of the 12,000 steps girls are recommended to accumulate daily (Tudor-Locke et al., 2011). For this population, OYS appears to make a substantial contribution to the recommended levels of physical activity of participating players.

The current study’s findings are comparable to findings of earlier studies. For example, Sacheck et al. (2011) found approximately 33% of soccer games were spent in MVPA, whereas Leek et al. (2011) examined physical activity levels during soccer and baseball/softball practices and found players spent 46% of the practice time in MVPA across sports. Consistent with the present findings, practices may provide more MVPA compared to games. A possible explanation for this difference may be because coaches are better able to dictate the intensity of a practice, compared to a game. Also, a larger proportion of the team can participate simultaneously, and in smaller groups, which can provide increased opportunities for players to participate at a higher physical activity intensity during practice compared to a game.
A study by Wickel and Eisenmann (2007) sought to determine the contribution of OYS (mean duration in OYS = 65 min) to daily physical activity. Similar to the present findings, OYS contributed substantially to the amount of recommended MVPA on days where players participated in OYS (approximately 23% or 26 mins) (Wickel & Eisenmann, 2007). The authors, however, indicated that this additional physical activity was not maintained on days without OYS. These findings indicate that even though OYS alone does not provide amounts of physical activity sufficient to meet daily recommendations, it does provide an important opportunity to be physically active and to contribute to daily MVPA of participating youth. Furthermore, evidence indicates that youth who participate in OYS are more active than those who do not, and are more likely to meet recommended physical activity guidelines (Nelson et al., 2011; Silva et al., 2010; Vella et al., 2013).

Although OYS provides a substantial proportion of the recommended amounts of MVPA, there may be potential for improvement in the contribution that OYS makes to daily MVPA. In the current study, a considerable proportion of practice and game time was spent insufficiently active (inactive or in LPA). Significantly higher proportions of time were spent inactive (~39% vs. ~30% time) during game time compared to practice and vice-versa for LPA (~31% vs. 36% time). On average, players were inactive or in LPA about 42 mins per hour (~70% time) during games and about 40 mins per hour (~67% time) during practice. This finding is consistent with other studies that have observed sizeable proportions of game or practice time spent inactive or in LPA (Katzmarzyk et al., 2001; Leek et al., 2011; Sacheck et al., 2011; Wickel &
Eisenmann, 2007). Thus, there are clearly opportunities to increase MVPA during games and particularly practices in OYS.

With the inclusion of SOFIT in this study, not only does it provide the first glimpse of how time is spent (lesson context) and coach behaviour during these OYS, but it may also assist in identifying opportunities to increase MVPA, particularly during practice. To the author’s knowledge, there are no peer-reviewed studies reporting use of SOFIT in OYS, and only one published report has used SOFIT in an OYS setting, where rugby league and rugby union practices were observed (O’Connor & Cotton, 2009). Rugby coaches spent similar percentages of practice time in fitness (9% vs. ~9%) and game play (~20% vs. ~23%) compared to present study findings across three OYS. However, coaches in the present study spent a considerably higher percentage of practice time in management (15% vs. 11%) and knowledge delivery (~19% vs. 12%) and considerably lower percentage of practice time in skill practice (~35% vs. 44%) compared to rugby coaches.

Rugby players in the earlier report (O’Connor & Cotton, 2009) spent a considerably higher percentage of time in skill practice, compared to the participants in this study. It is likely that physical activity levels are higher during skill practice than in management and knowledge delivery. Therefore, it is probable rugby players had more opportunities to be physically active during practice. It is also likely that players would be relatively inactive while in management and knowledge delivery. This finding has recently been exhibited in a physical education setting; the authors found a significant negative correlation between MVPA and time spent in management and knowledge
delivery (Dudley, Okely, Cotton, Pearson, & Caputi, 2012). Therefore, decreasing the percentage of time coaches spend in management and knowledge delivery may be a strategy to consider in helping create an environment that provides the most opportunity for physical activity.

Lastly, the findings indicated that coaches tend to promote physical activity (includes prompts of encouragement and praise) and discourage physical activity (includes prompts that are sarcastic and punitive in nature) more frequently during games than during practice. Coaches demonstrated physical activity more often during practice than during games. While one report (O'Connor & Cotton, 2009) had used SOFIT in OYS, direct comparisons of coach behaviour could not be made due to differences in coding made by the authors for this phase of SOFIT. Comparisons for promoting physical activity, however, can be made with physical education teachers. Compared to physical education teachers, higher rates of promoting physical activity were found with coaches in the present study, which may lead to increased physical activity (Fairclough & Stratton, 2005; McKenzie et al., 2006; Sallis et al., 1997).

A few potential limitations should be considered when interpreting the current findings. The present study was not designed for comparison between sports, but rather to describe physical activity levels of these three OYS and compare physical activity levels during games and practices within them. Secondly, a convenience sample was used, and as such, there is the potential for selection bias. Thirdly, physical activity findings were based on a single observation period for each team, that is, one game, one practice, and one fitness practice (for netball). Lastly, participants were recruited from
only one club for each sport, and thus the ability to generalise the current findings may be limited. Despite these limitations, the present study used high-resolution objective measures that allow for a rigorous description of the physical activity levels that players achieved during practice and games in OYS with some of the highest participation rates in Australia.

3.6 Conclusion

In conclusion, both games and practices in OYS appear to have made a substantial contribution to the accumulation of recommended proportions of MVPA of participating players. OYS alone, however, did not provide a sufficient amount of physical activity to meet daily recommendations for youth. Across OYS, large proportions of time were spent inactive or in LPA. Also, considerable percentages of time were spent in management and knowledge delivery. Therefore, there is room for improvement with regards to optimising physical activity levels in OYS, particularly during practice, without compromising fundamental lessons and skills taught by coaches.

This information on OYS can be used as a platform on which to inform policies, and to develop strategies to increase physical activity levels through OYS. Physical activity levels were not monitored on non-OYS days in the current study therefore; future research should examine the contribution OYS has on physical activity levels during days of OYS compared to non-OYS days for these sports. Furthermore, support should be provided to coaches in an effort to increase MVPA and decrease inactivity
time in OYS, without interfering with fundamental learning opportunities and skill
development that occurs in OYS.

3.7 Synopsis

This chapter has presented the findings of the first of four studies for this PhD
thesis. The study presented in this chapter was an observational cross-sectional study
that also represents an important contribution to the peer-reviewed literature and the
foundation of this thesis. Prior to this study, the amount of physical activity that girls
achieve during OYS was unclear, and this was the first study to compare mean
proportions of physical activity levels of players during practice and games in OYS
using the same participants. Furthermore, this study provided valuable insight on lesson
context and coach behaviours during OYS, which was previously unknown. Chapter 4
presents the results of a qualitative study, where a series of interviews were conducted
with coaches exploring whether they perceive themselves as influential on players’
physical activity in OYS.
Chapter 4

Study 2 - Do coaches perceive themselves as influential on physical activity for girls in organised youth sport?

A manuscript based on the findings from the study presented in Chapter 4 has been published in *PLoS ONE*.


**Authorship details:**

Guagliano (80%), Lonsdale (5%), Rosenkranz (5%), Kolt (5%), George (5%)
4.1 Introduction

This qualitative study is the second of four studies forming this thesis, and has been published in *PLoS ONE* (see Appendix B). The study presented in this Chapter provides unique insight into coaches’ perceptions of themselves as being influential on players’ physical activity levels. Findings from this study were used to inform the intervention study discussed in Chapter 5. This chapter presents the background, details the methods, then presents and discusses the findings of this study.

4.2 Background

Coaches in OYS are in an ideal position to impact the health and wellbeing of youth. Due to their role in OYS, coaches can carry considerable influence, as they are viewed as experts by their players (Conroy & Coatsworth, 2006). Similarly, Smith and Smoll (1997) have suggested that coaches can have a strong impact on youth within an OYS context due to the amount of regular direct involvement the coaches have with their players on a weekly basis. Coaches also have considerable reach, as high proportions of youth participate in OYS around the world (Tremblay et al., 2014). The most recent prevalence data indicate that approximately 66% of all Australian youth (67% of all boys and 65% of all girls) participate in at least one OYS (including dance) outside of school hours (Active Healthy Kids Australia, 2014; Australian Bureau of Statistics, 2012). Through their participation in OYS, youth have the potential to be exposed to an array of physical and psychosocial health and developmental benefits (Fraser-Thomas et al., 2005; Geidne et al., 2013; Kokko et al., 2009; Strong et al., 2005).
One of the most pertinent attributes of OYS is its potential to contribute significantly to MVPA levels of participating youth (Guagliano et al., 2013; Wickel & Eisenmann, 2007). Youth should engage in at least 60 minutes of MVPA daily; vigorous physical activity, including activity that strengthens muscle and bone, should be incorporated at least three times per week (Department of Health and Aging, 2014b, 2014c; World Health Organization, 2010). A sizeable proportion of youth around the world, however, do not meet the recommended levels of daily MVPA (Tremblay et al., 2014). In Australia, a recent report indicated that less than one-fifth of Australian youth, aged 5-17, met recommended physical activity guidelines every day of the week (Active Healthy Kids Australia, 2014). This issue is even more concerning when examining youth physical activity levels separately, by sex. Girls are less physically active than boys throughout childhood (Hardy et al., 2008; Troiano et al., 2008) and their participation in physical activity declines more sharply than in boys during the transition into adolescence (Kimm et al., 2002). As such, girls have been identified as a high priority group for physical activity promotion (Camacho-Miñano et al., 2011).

Although participation in OYS provides an ideal opportunity for youth to accumulate substantial amounts of MVPA, participation in OYS does not guarantee MVPA. Studies have found that youth spend large proportions of time during OYS inactive or in light physical activity (Guagliano et al., 2013; Leek et al., 2011; Sacheck et al., 2011). Furthermore, coaches spend a considerable proportion of practice time in management and knowledge delivery contexts (Guagliano et al., 2013), where it is likely that youth would be relatively inactive (Dudley et al., 2012).
Coaches, therefore, have the opportunity to influence their players’ physical activity levels, particularly during practice, where coaches are better able to dictate the intensity of physical activity, compared to during a game. The way coaches perceive themselves with regard to influencing girls’ physical activity, however, is not clear. Further exploration is warranted, due to the high proportion of youth who participate in OYS and the myriad of health and developmental benefits youth stand to gain through the setting. OYS presents a good opportunity to participate in physical activity, and has the potential to be a powerful health-promoting environment, where coaches are at the helm.

4.2.1 Study aims

To the author’s knowledge, no study has explored whether coaches perceive themselves as influential on physical activity for girls participating in OYS. Further, only a few cross-sectional studies that have examined physical activity levels in OYS (Guagliano et al., 2013; Leek et al., 2011; Sacheck et al., 2011), finding that youth spent large proportions of time during OYS inactive or in light physical activity. Coaches’ views on their players’ current physical activity levels and their opinions on improving their players’ physical activity levels, however, have not been investigated. Lastly, coaches’ perceived challenges in OYS have also not previously been considered. This information could provide valuable insight on aspects of the coaching experience that could inform future studies aiming to increase physical activity in OYS. Accordingly, this study aimed to explore OYS coaches’: (1) perceived role as a coach; (2) perception of themselves as role models for physical activity; (3) views on their players’ current
physical activity levels; (4) opinions on improving their players’ physical activity levels; and (5) their perceived challenges as coaches in OYS.

4.3 Methods

4.3.1 Study design and procedures

This study conforms to the Consolidated Criteria for Reporting Qualitative Research developed by Tong, Sainsbury, and Craig (2007). Between July and August 2012, each of the 30 coaches recruited took part in one in-depth semi-structured interview with the author of this thesis. Interviewing is one of the most commonly used methods in qualitative research (Bryman, 2012) and is a method capable of providing rich and comprehensive data (Creswell, 2012). Semi-structured interviews also provide the interviewer with the flexibility to further explore participants’ responses (Boeije, 2009).

The interview questions, prompts, and probes used in this study are outlined in Table 4.1. The development of the interview questions was guided by the aforementioned study aims. Most interview questions were open-ended to elicit a wide range of responses, and prompts and probes were used to encourage further discussion, when required. To ensure content validity, the interview guide was iteratively developed by the author of this thesis, his supervisors, and a research assistant (hereafter referred to as the “research team”). The research team reviewed the content, structure, wording and ordering of the questions, as well as the length of the interview. The questions were
pilot-tested on 3 adults who had coaching experience in a range of sports to ensure appropriate face validity.

Table 4.1 Interview questions, prompts, and probes.

- How do you describe your role as a coach?
- In terms of physical active, do you see yourself as a role model for your players?
  - In relation to having a healthy/active lifestyle?
- In what ways do you think you can influence the health behaviours of your players?
- How active do you think the players are during training?
- Can you tell me about the major demands or barriers you face as a coach?
  - Personal (e.g., lack of time, work or family commitments)
  - Players (e.g., lack of motivation, interest, or discipline)
  - Parents
  - Facilities/equipment
- If you were asked to make changes to your team with regard to promotion of greater physical activity levels during training time, what factors would influence your ability to do that?
- How important is it to you that your players are physically active during training?
- Can you identify ways you could increase youth’s physical activity levels during organised sport training?
- How do you plan what you’re going to do for a training session? Take me through your process.
- How important is it to you that your players are physically active outside of organised sport?
- To what degree do you think you are responsible for influencing the physical activity behaviours of your players outside of organised sport?

Each participant was informed that the current study would be disseminated as part of the author’s doctoral thesis and associated publications, and all participants provided verbal and written informed consent prior to participating in their interview (see Appendix K). All interviews were conducted face-to-face, and the majority of the interviews took place at a training ground prior to one of the participants’ regular scheduled practice sessions (23/30 interviews). Interviews were also conducted at
participants’ homes (5/30) or at a local café (2/30 interviews), as these locations were most convenient for the coaches. Each interview was conducted in a private or semi-private location, and only the participant and the author of this thesis were present during the interviews. The interviews lasted approximately 30 minutes, ranging from 28-40 minutes. At the conclusion of each interview, the participant received a $50 gift card as compensation for their time. Following each interview, field notes were made by the author reflecting any key moments or quotes that occurred.

All interviews were conducted by the author of this thesis, who has conducted prior research on the chosen organised sports (Chapter 3, Guagliano et al., 2013). He has four years of personal experience coaching OYS teams, and has played soccer for over 20 years. The author is also working towards a doctoral degree in the area of youth physical activity promotion in, and currently holds an honours bachelor’s degree in community health sciences. This knowledge and experience of sports and coaching was useful, because it helped build rapport with participants, and ensured jargon used by the coaches was understood. Most participants did not have any prior relationship with the research team; however, five coaches were involved in a previous study (Chapter 3, Guagliano et al., 2013).

4.3.2 Participants

A convenience sample of OYS coaches who coached representative- and club-level teams of girls aged 9 to 17 years participated in this study. Participants were recruited from OYS clubs playing netball, basketball, and outdoor soccer in the Greater
Sydney Metropolitan Area, Australia. These organised sports were chosen because of their popularity among girls (in terms of participation rates) in Australia (Australian Bureau of Statistics, 2009). Initially, a member of each of the organised sport club’s executive committee was contacted by the author, to provide information about the study (see Appendix L). Clubs then provided contact details (a phone number and/or an email address) of interested participants who were coaching girls’ teams in the appropriate age range. Detailed study information (see Appendix M) was then sent via email to each potential participant and coaches were included based on their willingness to participate in the study. The Human Research Ethics Committee of the University of Western Sydney approved this study (approval number: H9262, Appendix N).

Participant characteristics are detailed in Table 4.2. In total, 30 coaches (10 coaches from each of the 3 organised sports) participated. Coaches were aged 18-69 years (mean age = 42.2 ± 13.2 years) and had an average of 13.3 ± 11.8 years of coaching experience. The majority of the coaches were male (63%), married (57%), educated at a tertiary level (57%), held a form of coaching credential related to their sport (90%), and were overweight (43% with body mass index (BMI) = 25 to < 30 kg/m²) or obese (30% with BMI ≥ 30 kg/m²), based on participants’ self-reported height and weight.
Table 4.2. Characteristics of participating coaches.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Netball (n = 10)</th>
<th>Basketball (n = 10)</th>
<th>Soccer (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (±SD)</td>
<td>41.8 (18.8)</td>
<td>38.8 (12.3)</td>
<td>45.8 (5.4)</td>
</tr>
<tr>
<td>Sex, n</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>2</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mean height (cm) (±SD)</td>
<td>165.7 (9.4)</td>
<td>179.3 (11.4)</td>
<td>176.2 (10.8)</td>
</tr>
<tr>
<td>Mean weight (kg) (±SD)</td>
<td>74.6 (13.1)</td>
<td>83.3 (20.2)</td>
<td>94.4 (15.2)</td>
</tr>
<tr>
<td>Mean body mass index (±SD)</td>
<td>27.2 (4.2)</td>
<td>25.6 (4.3)</td>
<td>30.3 (5.3)</td>
</tr>
<tr>
<td>Marital Status, n</td>
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<td>Divorced</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Not married</td>
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<td>2</td>
</tr>
<tr>
<td>Level of education, n</td>
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<td></td>
</tr>
<tr>
<td>University or higher</td>
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<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Certificate/diploma</td>
<td>3</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Trade/apprenticeship</td>
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<td>0</td>
<td>1</td>
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<td>Less than secondary School</td>
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<tr>
<td>Annual income, n</td>
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</tr>
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<td>$100,000+</td>
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</tr>
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<td>$80,000- $99,999</td>
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<td>$60,000- $79,999</td>
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<td>$40,000- $59,999</td>
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<td>0</td>
<td>1</td>
</tr>
<tr>
<td>$20,000- $39,999</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>&lt;$20,000</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mean years coaching (±SD)</td>
<td>18.5 (16.3)</td>
<td>12.8 (8.7)</td>
<td>8.5 (7.2)</td>
</tr>
<tr>
<td>Mean number of sports coaching (±SD)</td>
<td>1 (0)</td>
<td>1.1 (0.3)</td>
<td>1.5 (0.9)</td>
</tr>
<tr>
<td>Mean number of age groups coaching (±SD)</td>
<td>1.8 (0.6)</td>
<td>2.8 (0.8)</td>
<td>1.7 (1.0)</td>
</tr>
<tr>
<td>Coaches with coaching credentials, n</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>
4.3.3 Data analysis

Interviews were audio-recorded and transcribed verbatim by the author of this thesis. During transcription, further notes were added to the original field notes made during post-interview reflection. After transcription, 20% of transcripts were returned to corresponding participants for verification. To ensure equal representation, two participants (a male and a female) were selected from each sport for verification (Appendix O). Participants made no changes to their transcripts, indicating that the transcript accurately reflected the interview they participated in.

Using a long table approach, content analysis was conducted using guidelines established by Côté, Salmela, Baria, and Russell (1993). Due to the exploratory nature of this study, an interpretational approach to analysis was used (Tesch, 1990). Côté et al. (1993) described two separate phases for interpretational qualitative analysis: (1) data organisation (or creating tags) and (2) data interpretation (or creating categories). The process used to analyse the data is illustrated in Figure 4.1. A decision-making heuristic for the analysis of unstructured qualitative data by Côté and Salmela (1994) was also used.
Figure 4.1. Data analysis process used to develop categories and themes.

Phase 1: Data organisation

- Raw data
  - Meaning units
    - Tags
      - Themes
        - Categories
          - Phase 2: Data interpretation

Phase 1: Data organisation
During the data organisation phase, text from each transcript (and corresponding field notes) were divided into segments called meaning units to produce a set of concepts that reflected meaningful pieces of information (Côté et al., 1993). Text was divided into meaning units directly on each transcript, where tags were assigned to each meaning unit. Tagging was performed by the author. A separate document was kept as an inventory of all the accumulated tags for the second phase of the analysis. For the data interpretation phase, the inventory of tags from all transcripts was examined by the author and the research assistant. For the purposes of this study, a deductive process was used to underpin the coding framework and help organise tags; where tags fell within five overarching categories (the aims of this study). An inductive process, however, was used to group tags with similar meaning together, which led to the emergence of themes and subthemes within each overarching category. Disagreements while categorising were discussed with 2 members of the research team (2 of 3 supervisors) until a consensus was reached.

Sample size was determined *a priori* to ensure equal representation of the 3 organised sports. Transcripts were analysed after all interviews were conducted, in the order in which the interviews were conducted to determine theoretical saturation. Côté et al. (1993) stated that theoretical saturation is reached when new data fits adequately into the existing framework. Theoretical saturation was determined to have occurred following the 23rd interview.

In order to assess classification consistency, a random sample of 25% of tags was selected for independent classification under mutually exclusive categories and
themes by a member of the research team familiar with the study aims but removed from data analysis until this point (the third supervisor).

Based on the exploratory nature of the current study, a conservative minimum level of agreement (70%) was set as the minimum acceptable level of agreement, which has been deemed appropriate for such studies (Neuendorf, 2002). Agreement was also assessed using Cohen’s kappa coefficient. The third supervisor’s independent classification of a random sample of tags showed a high level agreement with the rest of the research team (88.6% agreement, kappa coefficient = 0.88).

4.4 Results

A summary of the main themes, subthemes, and example quotes that emerged from the 30 in-depth semi-structured interviews with OYS coaches are presented by category in Tables 4.3 to 4.7. The 5 categories are presented in the following order: (1) participants’ perceived role as coaches (5 themes, 3 subthemes); (2) participants’ perception of themselves as role models for physical activity (2 themes, no subthemes); (3) participants’ views on their players’ current physical activity levels (5 themes, no subthemes); (4) participants’ opinions on improving their players’ physical activity levels (5 themes, 2 subthemes); and (5) participants’ perceived challenges as coaches in OYS (4 themes, 9 subthemes).

4.4.1 Perceived role as coaches
Coaches described roles in which they could be influential to their players, such as being a mentor or role model. The most common influential perceived role that coaches cited, though, was as a teacher:

“Mainly I’m like a teacher and that’s what I want to be seen as because that’s what I’m doing - teaching the girls about netball . . . skills, strategy and so on.” (Netball coach 13).

Within this theme, coaches described the need to foster sports-related development, promote the development of life skills, and to create a positive environment for their players. Sport-specific development was the focal point for many coaches, with a particular focus on teaching players skills, tactical/strategic awareness, and preparedness relevant to their sport. Another predominant topic discussed by coaches was their efforts to try to teach life skills through sport. The most frequently discussed life skills were accountability, confidence, respect, and social skills. Many considered generating a positive team environment to be an important aspect of their role as a coach. In particular, coaches identified the need to create an environment that was fun, friendly, and supportive.

Other coaches perceived their role to be that of a facilitator, which was described by coaches as someone who organises aspects of OYS (e.g., plan practice sessions, set line ups, ensure equal playing time), or as a disciplinarian, which was described as someone who is strict and resolves conflicts among players. Perceived roles as a facilitator or disciplinarian, however, were not as common as the previously mentioned perceived roles.
Table 4.3. Perceived role as coaches: summary of categories, themes, subthemes, and example quotes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived role as a coach</td>
<td>Teacher</td>
<td>To foster sports-related development</td>
<td>“My main role is to teach them how to be better soccer players. I focus on developing their soccer skills, preparing them for games and keeping them focused” (SC 6).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To foster the development of other life skills</td>
<td>“For the girls, I would hope I’m seen as kind of like a life coach. I try focus on teaching them things they can learn through sport that can be used later in life like I tell them if you lose a ball, you have to make sure you get back and try to win it back because you are not helping the team if you don’t – that’s being accountable” (SC 3).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To create positive environment</td>
<td>“... I’m a bit of a joker at times and I try to keep the atmosphere as light, fun, and friendly as possible and I think I have a pretty good rapport with the kids” (NC 15).</td>
</tr>
<tr>
<td>Role Model</td>
<td></td>
<td></td>
<td>“I see myself as a role model for the girls ... I’m only a little bit older than the girls on my team and I want them to know that I don’t care if other people judge me because I play sport and if they say things like ‘oh it’s not girly to be running around playing sport getting sweaty’. I want to show them that it’s just sports, I do it, and everyone should be doing it, really. (NC 17).”</td>
</tr>
<tr>
<td>Mentor</td>
<td></td>
<td></td>
<td>“I’m more of a mentor, someone who’s guiding them to achieve the goals that they want and helping them develop the skills that they need to achieve those goals” (SC 10).</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilitator</td>
<td>“I organise their training sessions once a week, prepare them for the</td>
<td>“... make sure they are ready to go, that they know what we’re doing, adjusting positions, making sure everyone has equal court time ... and I take care of all the paperwork.”(NC 16).</td>
</tr>
<tr>
<td>Disciplinarian</td>
<td>“A lot of people will tell you I’m a meanie (laughs). So, I suppose I’m a disciplinarian because I’m strict.” (BC 20).</td>
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</tbody>
</table>

*Note. SC = soccer coach; NC = netball coach; BC = basketball coach.*
4.4.2 Coaches’ perceptions of themselves as role models for physical activity

When asked, most coaches thought of themselves as a role model for physical activity, but many had not considered it before.

“I suppose I haven’t thought about it before now . . . But, I think it’s (being a role model) a given, you know, it’s just an understanding you have, that if you’re coaching and you’re still playing they’ll look up to you.” (Soccer coach 5).

Other coaches cited their participation at practice, their current involvement in the sport (as a player in a team), a physically active lifestyle, and their age and longevity in the sport as reasons for perceiving themselves as role models for physical activity for their players.

While most coaches considered themselves role models for physical activity, the view was not shared by all coaches. Poor fitness levels, old age, injury or health problems, and retirement from organised sports were the most common reasons for coaches not perceiving themselves as role models. Although some coaches did not perceive themselves as particularly good role models for the reasons listed above, some recognised the importance and the opportunity they had to be role models.

“I see the importance of people like me being a role model for our players . . . the truth is you don’t have to be a physically fit person to inspire others
to be fit. But, role modelling is always important and there is an opportunity as coaches to be a fantastic role model.” (Basketball coach 29).
Table 4.4. Coaches’ perceptions of themselves as role models for physical activity: summary of categories, themes, subthemes, and example quotes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches’ self-perceptions as role models for players</td>
<td>Positive self-perception as a role model for physical activity</td>
<td></td>
<td>“They see me play on Monday nights in the men’s comp and I train with them all the time, running around; so hopefully they see me as a role model both for basketball skills as well as the fitness aspect of it.” (BC 25).</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>“I’ve never really thought about it, but yeah, I haven’t not played sport (laughs) . . . and most of the kids that I coach know that I’ve played at a pretty high level too. So I’d consider myself a pretty good role model.” (BC 20).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“I do because this is my lifestyle. I find it odd that people aren’t physically active, you know (laughs). I’m a PE [physical education] teacher, I coach, play, umpire, I’m in an old ladies representative team as well, so you know, it’s just what I am about and hopefully some of that rubs off.” (NC 13).</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>“. . . not only in the teams that I’m coaching but also in my general life with people around the netball courts. I’m definitely a role model to people around the netball courts in terms of longevity, how long can you do this sport? And people just sort of respect that I think.” (NC 8).</td>
</tr>
<tr>
<td>Negative self-perception as a role model for physical activity</td>
<td></td>
<td></td>
<td>“. . . probably not in the physical activity sense – I’m a bit passed that . . . I’m not the fittest 50 year old I know.” (NC 15).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Probably not, you’re talking to an old bugger here.” (SC 6).</td>
</tr>
<tr>
<td>Category</td>
<td>Themes</td>
<td>Subthemes</td>
<td>Example quotes</td>
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<td></td>
<td></td>
<td>“Not since my knees have gone on me.” (BC 11).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Oh look, probably not. I don’t actually play netball anymore, I did for 15 years previously, but my physical activity has sort of taken a dip.” (NC 16).</td>
</tr>
</tbody>
</table>

*Note. SC = soccer coach; NC = netball coach; BC = basketball coach.*
4.4.3 Perceived levels and importance of physical activity

4.4.3.1 Coaches’ perceived importance related to players’ physical activity during practice

Coaches’ perceptions relating to the importance of player physical activity during practice were not universal. The majority of coaches, however, perceived physical activity to be important during practice, with some stating that being physically active is more important to them than winning.

“...keeping the girls active at training is very important, it’s one things I really try to do. I love seeing the girls improve their fitness, their skills... and hey, if we get some wins along the way, that’s great too (laughs).”

(Basketball coach 11).

Some coaches mentioned that a physically active practice session was needed to keep girls motivated and engaged. Other coaches stated that the players would benefit by being physically active during practice because their fitness levels will allow them to outperform their opposition late in games.

Also, a few coaches discussed how they front-loaded their practice sessions to include higher intensity physical activity at the beginning of the season, and purposefully dropped the physical activity intensity at practice as the season went on. The reason that coaches did this was because they felt girls’ fitness levels were not maintained over the offseason, so the focus of practice sessions at the beginning of the season was to regain girls’ fitness. Once coaches felt the girls’ fitness was regained, the
focus of their practice sessions shifted to skill development, where coaches perceived physical activity intensity to drop.

“Early in the year, fitness training was huge because the girls were pretty low in fitness, you know, they had the summer holidays and they hadn’t done much. But, as we move on during the season, ball skills and controlling the ball become paramount . . . then it’s lots of drills and getting their positions right. So the intensity at training drops a bit because we do more drills and focus less on the fitness aspect.” (Soccer coach 9).

Coaches who felt that their players’ physical activity level during practice was not important tended to believe that it was more important to focus on teaching sport-related skills and skill development. These coaches were willing to sacrifice physical activity intensity to achieve this.

4.4.3.2 Perceived levels of physical activity

Most coaches felt that they were conscious of their players’ physical activity levels and that they were able to gauge how active the girls were at practice. Furthermore, the majority of coaches considered high intensity physical activity to be inherent in OYS.

“I’m always on them about different things, trying to keep the intensity up . . . and as a coach you can gauge how the team is training . . . so, if the group is down then I can quickly gauge that the intensity is down and I’ll try to pick it up.” (Basketball coach 20).
“. . . I try to keep the girls moving and high intensity activity is natural in soccer.” (Soccer coach 1).

4.4.3.3 Training session preparation

Coaches’ practice preparation responses were highly variable, ranging from developing a meticulously written practice plan to no planning at all. In this sample of coaches, very few coaches actually wrote down their plan for practice, with many claiming that they just mentally prepare for their practice sessions.

“I usually just plan in my head on my way to training, so it’s mentally written down . . . so, there is the warm up that I want to do, there are certain drills I want to do and there is a cool down . . ..” (Netball coach 12).

Some coaches discussed having general or thematic (e.g., shooting drills, passing drills) practice session plans in mind rather than including specific drills, claiming that they are experienced enough to come up with specific drills on-the-spot. Some even claimed that they would just “wing it” during their practice sessions, relying on their coaching experience to develop a session as they go. Some coaches with multiple teams admitted that they spent less time preparing practice sessions for their less competitive teams. The majority of coaches said that their focus at practice was based on observed weaknesses from the previous game.

4.4.3.4 Coaches’ perceived importance related to players’ physical activity outside of organised youth sports
Players’ physical activity outside of OYS was perceived as being important by most coaches. This was due to the perceived positive effect it would have on performance in OYS. Also, being physically active outside of OYS was perceived as being more important for representative players compared to club players by coaches; especially if there was a desire to play at an elite level. It appeared that coaches were content if club players attended their weekly practice session and game, but for representative players, the expectation to be physically active went beyond weekly practice and games; these players were expected to be physically active in some way outside of OYS.

Some coaches reflected on changes in norms from their childhood where playing outside was regarded as a norm, compared to now, where coaches perceive youths to be doing very little outside of OYS.

“I remember when I was a kid, you get home from school, you go down to your mate’s place and play basketball, footy, soccer, whatever, or you’re on your push bike . . . now you don’t see any push bikes or anything like that. It’s a completely different lifestyle than when I was a kid. (Basketball coach 21).

“It’s not like it used to be back when I was a kid, we used to play outside until it got dark every night after school. Things have changed and I think that the kids have got to do something outside of your training session to get better, I think a lot of kids today come to training and that’s it for the week.” (Basketball coach 29).
Table 4.5. Coaches’ perceived levels and importance of physical activity: summary of categories, themes, subthemes, and example quotes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches’ perceived levels and importance of</td>
<td>Player physical activity</td>
<td>During practice is important</td>
<td>“Yeah because if they get too many drink breaks they shut off, they’re not motivated, they’re not active, and they talk. Then the training session just drags out and doesn’t become a good training session.” (SC 24).</td>
</tr>
<tr>
<td>physical activity</td>
<td></td>
<td></td>
<td>“The more you keep them active at training the easier it’ll be coping in game situations when they’re under pressure in the final quarter because they’ll have that fitness. So, you know, it’s really really important for them, far more than the club player who may only play a quarter or two.” (NC 23).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“...at the beginning of the season they’re a lot more active and we do a lot more running than they would later in the season later.” (SC 6).</td>
</tr>
<tr>
<td></td>
<td>Player physical activity</td>
<td>During practice is not important</td>
<td>“I’d rather they be focused and lazy than running around not listening at all. I think that’s more important... I’ve got to get across what we’re trying to do – the skills and how we’ll implement that in a game.” (NC 16).</td>
</tr>
<tr>
<td></td>
<td>Training planning</td>
<td></td>
<td>“I wing it. I’ve been coaching for so many years I just make it up as I go.” (NC 14).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“I write down what I want at the beginning of the year, but no, I don’t write a formalised plan for each session it’s more of a general idea.” (BC 11).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“... the less committed the team is the less time I put into making a training session.” (BC 27).</td>
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(continued)
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<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Player</td>
<td>physical activity outside of organised youth sport is important</td>
<td>“. . . anything they can do outside netball is only going to improve performance and make things easier during netball. So, that is important to me but I can’t demand it and I don’t initiate conversations about be active outside netball.” (NC 23).</td>
<td></td>
</tr>
<tr>
<td>Player</td>
<td>physical activity outside of organised youth sport is not important</td>
<td>“Nowadays what we do as coaches is not enough because the kids aren’t doing anything outside of the sports they play.” (BC 21). “For rep players it’s important.” (BC 22). “If you want to play at an elite level, one 2-hour training session a week is not going to get you there.” (BC 19).</td>
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</tr>
</tbody>
</table>

*Note. SC = soccer coach; NC = netball coach; BC = basketball coach.*
4.4.4 Coaches’ perceptions on improving player physical activity

4.4.4.1 Perceived need to increase player physical activity during practice

Few coaches perceived the need to increase physical activity because they were content with the level of physical activity during their practice sessions. Some coaches, however, reported having to reduce the intensity of their practice sessions because of the girls’ potential aversion to practice at a high intensity.

“. . . the girls were just not keen to put the effort into the training sessions that I was running . . . I’ve had to re-adjust my focus and my expectations for the girls and I’m happy where we sit now with the level of activity”

(Soccer coach 2).

A major concern raised by coaches was a fear of player dropout if the physical activity intensity during practice in OYS was too high.

“You can’t push some of these girls too much, because they’ll quit. You can try to be motivational to get them to be more active, but you can’t force them, you know.” (Basketball coach 22).

“. . . there’s a lack of fitness in probably two-thirds of the side and there’s a reluctance to put the effort in . . . So, if I were to step up the intensity, there would be more of a dropout rate. A lot of the girls fake injury to sit out as it is.” (Soccer coach 4).
“... they would revolt (if the coach tried to increase physical activity). They would just go ‘no, I’m not doing it’ or they wouldn’t come to training. So, you’ve really got to gauge how far you can push them. (Netball coach 15).

One coach, however, emphasised the need to take advantage of the time spent in OYS because she has noticed that the girls who she coaches are less active and has noticed changes in body shape and their physical ability.

“... compared to 10 years ago, the girls I coach are generally less active, and I’ve noticed that they don’t have the same gross motor skills as they would’ve had 10 years ago. I definitely see a change in body shape and physical ability. So, I think we need to take advantage of the time kids are at basketball because for some, this is all the activity they get in a week.”
(Basketball coach 21).

4.4.4.2 Methods to increase physical activity during practice

Although most coaches did not feel the need to increase physical activity during their practice sessions, they were, however, able to identify ways to increase practice session physical activity if they needed to. Coaches suggested improving their organisation, increasing preparation for practice, developing more specific practice plans, and reducing waiting (i.e., in lines during drills or during drill transition) and instruction time. They also suggested modifying drills to include smaller groups and having more equipment available.
4.4.4.3 Perceived responsibility to influence physical activity outside of organised youth sports

Although most coaches felt that their players should be physically active outside of OYS, very few felt it was their responsibility to influence physical activity outside of OYS. Coaches felt that they had very little influence over their players’ physical activity behaviours outside of OYS, most commonly citing parents as more influential in this respect. Peers were also considered by coaches to have a greater influence on physical activity levels outside of OYS than they did.

The comparison between representative players and club players emerged once again while discussing coaches’ perceived responsibility to influence physical activity outside of OYS. Some coaches thought it was more likely that they could encourage representative players to be physically active during their free time outside of OYS as opposed to club players; however, this was seldomly discussed.

Although not feeling a responsibility to influence physical activity outside of OYS, some acknowledged that coaches in OYS have a substantial opportunity to do so. See Table 4.6 for supporting quotes.

4.4.4.4 Coaches’ perceived ability to impact health behaviours

When coaches were asked if they felt they had the ability to impact girls’ health behaviours, they took a very pragmatic approach. Some coaches stated they have had coaches that have had a lasting impact on them, so it was plausible that they could have a lasting impact on their own players. There were no identifiable characteristics that were
apparent among coaches with differing opinions of their perceived ability to impact girls’ health behaviours (i.e., sport coached, coach’s sex, coaching experience).

Interestingly, physical activity was rarely discussed as a health behaviour when identifying whether coaches thought they could impact their players’ health behaviours or not. Often the conversation shifted from the designed focus on physical activity to coaches discussing their attempts to inform their players about healthy eating.

“I try to encourage healthier eating, like I had one girl that used to eat a meat pie before a game, so I tried to get her in the habit of eating the correct foods before games. That’s one area where I think I can leave an impression . . . what they eat and how they prepare is important and I think I can help with that.” (Netball coach 18).

Most coaches, though, perceived that their ability to impact girls’ health behaviours was limited. Insufficient exposure and influence were the main reasons that coaches could not impact girls’ health behaviours. Again, parents, teachers, and peers were considered to have a greater influence on girls’ health behaviours.
Table 4.6. Coaches’ perceptions on improving player physical activity: summary of categories, themes, subthemes, and example quotes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches’ perceptions on improving player</td>
<td>Perceives a need to increase player physical</td>
<td>“. . . there probably is a need to increase activity, but it might be hard to convince the girls.” (NC 17)</td>
<td></td>
</tr>
<tr>
<td>physical activity</td>
<td>activity during practice</td>
<td></td>
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<tr>
<td></td>
<td>Does not perceive a need to increase player</td>
<td>“No there’s no need, I’m fairly happy with where we’re at. I’ve been doing this for a while.” (BC 19).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>physical activity during practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methods to increase physical activity during</td>
<td>Coach-specific methods</td>
<td>“Make sure that you’re prepared and organised and that you set out a specific training schedule so that there isn’t any down time.” (BC 21).</td>
<td></td>
</tr>
<tr>
<td>practice</td>
<td>Drill modification</td>
<td>“focus more on constant running or movement and less standing time, less watching, less waiting, and less listening to instructions from myself . . .” (BC 30).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived responsibility to influence physical</td>
<td>“. . . using modified drills. So, smaller groups and lots of equipment so they’re really just keep chugging through.” (NC 13).</td>
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<tr>
<td></td>
<td>activity outside of organised youth sports</td>
<td></td>
<td></td>
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<tr>
<td>Perceived responsibility to influence physical</td>
<td></td>
<td>“No, I don’t think I’m responsible for the girls outside of the sport… I don’t have that much of an influence outside of soccer.” (SC 4).</td>
<td></td>
</tr>
<tr>
<td>activity outside of organised youth sports</td>
<td></td>
<td>“With the rep players we encourage them to do things outside of netball but not with the club players.” (NC 23).</td>
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<tr>
<td>Category</td>
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<tr>
<td></td>
<td></td>
<td>Coach has the ability to impact health behaviours</td>
<td>“I don’t feel a responsibility, but I’ll use the word opportunity again, I think there’s a huge opportunity as a coach.” (BC 29).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coach does not have the ability to impact health behaviours</td>
<td>“. . . I think I can because coaches I’ve had have had an impact on me and my sisters as well, I think I can . . .” (NC 7).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We (as coaches) only see the kids twice a week, once at training and once at the game, so I think parental influence is far outweighing anything I can do as a coach.” (NC 15).</td>
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<td></td>
<td></td>
<td></td>
<td>“. . . because I only see them for probably 2 hours a week I think other influences like parents, schools, and even friends would play a much larger role in influencing their physical activity.” (NC 16).</td>
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</table>

*Note.* SC = soccer coach; NC = netball coach; BC = basketball coach.
4.4.5 Coaches’ challenges in organised youth sport

4.4.5.1 Coaches’ perceived personal challenges relating to organised youth sport

Few coaches felt they had any personal challenges while coaching in OYS. The perceived time needed to commit to OYS was, however, the main issue identified by coaches who did report having personal challenges. The time needed for administrative tasks, as well as preparing for practice, were the two biggest time consumers, with the latter particularly affecting less experienced coaches. Some coaches discussed an over-commitment to their sport; this included coaching and refereeing multiple teams and games, respectively.

“Maybe an over-commitment to basketball . . . I can only be in one place at one time and sometimes it clashes with training. It takes a toll on you, some nights I’m coaching non-stop.” (Basketball coach 20).

“. . . Friday nights I’m here coaching three teams and reffing two, so it’s just bang-bang-bang five games in a row.” (Basketball coach 25).

Some coaches felt that they were weak in some aspects of coaching, which they perceived as a limitation in their coaching ability. Perceived coaching weaknesses included poor sport-specific technical skills, difficulty keeping players focused on the task at hand, and lack of formal practice. Work commitments also emerged as an issue faced by coaches occasionally, but were not commonly discussed.

4.4.5.2 Coaches’ perceived challenges relating to their players
A predominant challenge coaches discussed was the wide variation in players’ skill levels and experience within a team. Some coaches described the dilemma of trying to find the right balance at practice, where the skilled/experienced players feel engaged, without leaving the less skilled/experienced players to fall further behind.

Girls’ focus and interest levels posed problems for coaches as well, with the main reported obstacle being that girls talk too much during practice. Some coaches described practice as a “social gathering” and felt that girls’ motivation and commitment was lacking. As a negotiation with the girls, some coaches have implemented “talk time” where they are allowed to talk at certain points of the practice session, in an effort to minimise conversations that are not sports-related.

“I’ve had to implement, what I call, ‘talk time’ to keep the conversations to a minimum during training . . . see a lot of them went to primary school together and they’re at different high schools. So, it’s like a reunion every Wednesday night.” (Soccer coach 9).

Player management was another theme that emerged as a player-related challenge, which related to non-compliance with coach instructions, difficult players, and players with disabilities. See Table 4.7 for supporting quotes.

4.4.5.3 Coaches’ perceived challenges relating to their players’ parents

All coaches, at one point or another, experienced some sort of issue relating to their players’ parents during their years coaching OYS. Players’ playing time was one of the most common complaints from parents. Parental commitment to OYS was cited as a
major issue for coaches as well, with the main perceived issue being parents’ unreliability when it came to getting their daughters to practice. Also, one coach was frustrated with some parents’ lack of interest in the sport that their daughter was playing and felt that the lack of parental support could impact on further participation in OYS.

“It annoys me when the parents aren’t quite on the same wavelength as you because I love this stuff (netball), okay, and I think most of the girls do too. So, it bothers me when parents don’t take any interest in it and I’d bet there are probably kids who stop playing netball because they don’t have any support from their mum or dad.” (Netball coach 13).

Another coach noticed that, as the girls on his team got older, fewer parents were attending their daughters’ practice and game sessions.

“When I started coaching them at 12 . . . all the parents were there and now, no parents are there.” (Soccer coach 1).

4.4.5.4 Coaches’ perceived challenges relating to promoting physical activity

Frequency and duration of practice sessions were the most commonly cited challenges with regard to promoting physical activity. Coaches felt they had too little time at practice to discuss anything outside of the sport they were coaching.
Table 4.7. Coaches’ perceived challenges: summary of categories, themes, subthemes, and example quotes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches’ perceived challenges</td>
<td>Coaches’ perceived personal challenges</td>
<td>Time commitment to coaching</td>
<td>“There’s a high level of commitment required in coaching you have the campaign, training, match day, phone calls and emails to organise everyone, etcetera, etcetera. It can be pretty time consuming.” (SC 4).</td>
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<td></td>
<td></td>
<td></td>
<td>“After having a whole shift at work all day and then having to organise the drills and getting them down-pat that’s one barrier for me because this is my first year coaching.” (SC 9).</td>
</tr>
<tr>
<td>Weak in some coaching aspect</td>
<td></td>
<td></td>
<td>“I’m good at the coaching and the motivating and leadership skills; but the technical skills is not my expertise, you know, I haven’t really played a lot of soccer.” (SC 5).</td>
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<td></td>
<td></td>
<td></td>
<td>“One of my weaknesses is getting kids focused when they need to be focused. When I was a younger coach, kids were having fun but they weren’t actually getting better because there would be no focus at training.” (BC 27).</td>
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<tr>
<td>Work commitments</td>
<td></td>
<td></td>
<td>“I’m coaching the kids based on my own experiences, you know, I haven’t had any formal training so, that’s a big barrier for me.” (SC 28).</td>
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<td></td>
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<td>“I’m really really busy with work and I really try hard just to find the time to put the effort into being with the girls but often I have to get someone else to run training because I can’t make it.” (SC 10).</td>
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<tr>
<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
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<tbody>
<tr>
<td>Coaches’ perceived challenges relating to</td>
<td>Players’ variability in skill/experience</td>
<td>“I suppose one of the big barriers I have with the 11’s is that there is such a wide array of skill and experience. So, I have some girls that are really, really advanced and you have some that aren’t, like I’ve got two girls playing their first year of netball. So, it’s hard trying to catch them up as well as making the ones who want to advance not bored.” (NC 12).</td>
<td></td>
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<tr>
<td>their players</td>
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<tr>
<td>Players’ lack of interest/focus</td>
<td></td>
<td>“... they do chatter a lot and that can be a problem sometimes, to keep them interested and keep them focused on what they’re meant to doing.” (SC 10).</td>
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<tr>
<td>Players’ lack of motivation/commitment</td>
<td></td>
<td>“... lack of motivation is a barrier sometimes. Sometimes the girls probably don’t take it as seriously as they should and some girls just see training as a social thing: which it definitely can be. But, it’s important that they make an effort to train hard otherwise why bother coming?” (BC 30).</td>
<td></td>
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<tr>
<td>Player management</td>
<td></td>
<td>“Sometimes the girls don’t listen to what I tell them to do, like if I tell them to do warm up laps they’ll complain and it becomes a negotiation, which wastes time.” (NC 17).</td>
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<td></td>
<td></td>
<td>“There’s always one or two in most teams where you’ll find a personality where you’ve got to work really hard to work out where they’re coming from or what their problem is without having them blow up or getting upset or whatever. It’s definitely an obstacle – one that you don’t need.” (NC 23).</td>
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<th>Category</th>
<th>Themes</th>
<th>Subthemes</th>
<th>Example quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaches’ perceived challenges</td>
<td>Managing parental</td>
<td>expectations/perceptions</td>
<td>“I’ve got one girl who hasn’t spoken all year and one who is deaf so, she can’t get instructions from me. With those girls in particular, it’s been very difficult for me.” (SC 5).</td>
</tr>
<tr>
<td></td>
<td>Parental commitment</td>
<td></td>
<td>“... dealing with the parents is a big one ... playing time; expectations on the teams’ performance; their opinions on where I should be playing their daughter; parents who are yelling at refs, opposing parents, players, you name it.” (SC 3).</td>
</tr>
<tr>
<td></td>
<td>Coaches’ perceived</td>
<td>challenges relating to promoting physical</td>
<td>“The main barrier is getting the children to training. That’s the main barrier. All the children like to play and as a general rule you’ll get the children there on a Saturday to play, but the lack of commitment by the parents to get their kids to training is huge” (NC 8).</td>
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<td></td>
<td>challenges relating to</td>
<td>activity.</td>
<td>“There’s just not enough time to do anything besides basketball. We only have two sessions a week for two hours.” (BC 21).</td>
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</table>

*Note. SC = soccer coach; NC = netball coach; BC = basketball coach.*
4.5 Discussion

To the author’s knowledge, this is the first study to investigate whether coaches perceive themselves as influential on physical activity for girls participating in OYS. More specifically, the topics of coaches’ perceived role as coaches, their perception of themselves as role models for physical activity, their views on their players’ current physical activity levels, their opinions on improving their players’ physical activity levels, and their perceived challenges during OYS were explored. The analysis of 30 in-depth semi-structured interviews suggested that most coaches thought that they have the potential to influence physical activity for girls in OYS. It is possible, though, that coaches may underestimate, or not fully realise, the impact they can have on the girls they coach in OYS.

When asked about their perceived role as a coach, a range of influential roles were discussed. The perception of being a teacher, role model, or mentor resonated with many of the coaches in this study. The fact that several influential roles resonated with coaches is a positive finding from a physical activity promotion standpoint, as Smith and Smoll (1997) have suggested that coaches can have a strong impacts on youth due to consistent direct involvement with them. Not surprisingly, coaches primarily believed that it was their responsibility to provide sport-specific development (e.g., technical skills, tactical awareness, preparedness). Coaches also believed, however, that it was part of their role to create a positive environment (e.g., fun, friendly, supportive) and to foster the development of life skills, which was also found in recent study by Vella, Oades, and Crowe (2011). Vella et al. (2011) also noted that coaches felt responsible for
the development of players’ life skills was an important extension to existing literature, and the present study lends support to that finding.

While some coaches had never considered it before the interview, the majority perceived themselves to be role models for physical activity, particularly if they were still currently involved in organised sports in some capacity (i.e., active participants during practice or currently playing in a team). Although no direct comparisons are available, Drummond et al. (2002) examined student and health educators’ perceptions in relation to role modelling of exercise. The authors found that 90% (18 out of 20) of health educators perceived themselves as exercise role models for their students, citing their participation level as the main reason for this perception (Drummond et al., 2002). In contrast to the findings of this study, however, health educators in the study by Drummond et al. (2002) did not cite nonparticipation in sports as a reason for health educators not perceiving themselves as role models for exercise.

Most coaches stated that being physically active during OYS was important. Coaches reported that they were conscious of their players’ physical activity levels and had the ability to gauge their players’ physical activity levels. The presumption by many, however, was that high-intensity physical activity was inherent to OYS. So, it is not surprising that most coaches felt it was unnecessary for them to try to increase girls’ physical activity levels and reduce their inactivity during practice. Smith and Smoll’s (1997) research, however, indicates that coaches have limited awareness of their actions during OYS and state that increasing awareness is essential for change to occur. Therefore, low-cost methods, such as pedometers or direct observation systems (e.g., the
SOFIT; McKenzie et al., 1991), could be used to provide coaches with objectively measured feedback on girls’ physical activity levels, and self-monitoring could be introduced to coaches in an effort to assist in optimising time spent in practice during OYS.

An interesting theme that emerged was the concern held by coaches that girls might drop out of OYS if, for a prolonged period of practice, physical activity intensity was too high. Coaches’ recognition that they could be responsible for prompting players’ withdrawal is an important finding. OYS players in other studies have ranked their coach as the most influential person in making the decision to withdraw from OYS (Rottensteiner, Laakso, Pihlaja, & Konttinen, 2013), where one study found that nearly one-third of players withdrew from OYS due to their coach (Armentrout & Kamphoff, 2011). Of the extensive literature that exists relating to player dropout from OYS (Fraser-Thomas & Côté, 2006; Fraser-Thomas, Côté, & Deakin, 2008; Hedstrom & Gould, 2004), as far as the author is aware, high-intensity physical activity is not commonly reported as a reason for withdrawal from OYS among players. One study sampled nearly 400 players and reported over 30 reasons for player withdrawal from OYS and none of the player-reported reasons were related specifically to physical activity intensity. This is not to say that high-intensity physical activity cannot influence girls’ decision to withdraw from OYS. Though, as far as the author is aware, coaches’ perception that girls may withdraw from OYS due to high intensity physical activity does not appear to be in line with player-reported reasons for dropping out of OYS. Further exploration on this topic is warranted, and should be taken into consideration in any physical activity promotion interventions in OYS involving girls.
Generally, coaches in this study reported spending little time preparing for practice sessions. The majority of coaches said that they relied on their experience to create impromptu practice sessions. Mandic and colleagues (2012) have suggested that coaches should ensure that practice session drills are structured to maximise physical activity intensity. Further supporting a structured practice session, a recent study conducted in a physical education setting found a negative correlation between time spent in management (i.e., drill transition, instruction) and student MVPA (Dudley et al., 2012). Without prior preparation, there is a greater likelihood that time at practice is not being used as efficiently as it can be, and physical activity intensity could potentially drop.

Coaches reported that they were capable of altering their practice sessions to increase girls’ physical activity, if they felt they needed to do so. Coaches were able to identify numerous strategies that could be employed in their practice sessions to increase opportunities to be active, reduce inactivity, and improve their efficiency and management of practice. Many of the strategies that coaches identified have also been recommended within a physical education setting, and included using smaller groups, providing more equipment, reducing waiting, and reducing instruction time to increase girls’ opportunities to be physically active (Kelder et al., 2003; Rink, Hall, & Williams, 2010). Coaches’ awareness of these strategies, however, may not necessarily mean they will employ them, because knowledge can be a poor predictor of behaviour (Ajzen, Joyce, Sheikh, & Cote, 2011); especially if coaches’ perception of girls’ physical activity during practice is already considered adequate. Approaches are needed, then, to ensure that coaches are not only aware of strategies to increase opportunities to be active
(and reduce inactivity), but also have the belief that as a result of implementing these strategies it can lead to positive outcomes (e.g., health benefits) (Ajzen et al., 2011).

Most coaches stated that being physically active during OYS was important, but rarely discussed the health benefits associated with being physically active. Coaches in this study felt confident discussing the sport they coached, but may lack confidence discussing the more general health benefits associated with physical activity. Coaches’ perceived ability to impact girls’ health behaviours was also discussed, and few coaches felt that they could have an impact on the health behaviours of the girls they coached. This belief may represent a missed opportunity for coaches to make a meaningful impact on girls’ health behaviours as girls can learn behaviours from their coaches, particularly if the girls admire their coach (Blomquist, 1986). Most coaches, though, did not feel that they were able to impact their girls’ health behaviours, and two of the main reasons for this were a perceived lack of influence and limited exposure to their players. However, Smith and Smoll (1997) suggest the contrary; coaches can greatly impact their players. Interestingly, physical activity was rarely mentioned as a health behaviour that coaches felt they could impact, rather healthy eating was commonly discussed instead. This may be due to coaches’ perception that physical activity is inherent to OYS.

Outside of OYS, coaches discussed changes in norms from their childhood where unstructured leisure-time physical activity was regarded as a norm. They also perceived there to be a decline in physical activity among youth, however, very few coaches felt responsible for influencing girls to be physically active outside of OYS. Even though most coaches perceived their role to be one that could be influential to their
players in OYS, it appears many of them do not perceive their influence to extend outside of OYS. Coaches suggested that parents and peers had a greater influence on physical activity outside of OYS than coaches did. There is ample evidence to support coaches’ claims that parents and peers are influential in supporting youth to be physically active (Cox, Schofield, & Kolt, 2010; Fitzgerald, Fitzgerald, & Aherne, 2012; Trost et al., 2003). That said, one study found that physical education teachers were as influential as parents in supporting youth physical activity outside of school (McDavid, Cox, & Amorose, 2012). While this is not a direct comparison, it is possible that OYS coaches can also greatly influence girls’ physical activity outside of OYS, and coaches may be underestimating the impact they can have.

The most commonly perceived personal challenge experienced by coaches was the amount of time they felt they needed to commit to OYS. Administrative tasks and preparing for practice were considered the two biggest perceived consumers of coaches’ time. Many coaches, however, stated that they relied on their experience to plan practice sessions somewhat spontaneously. Coaches also identified a number of challenges relating to coaching their players. The predominant issue was the amount of variation in skill level and experience within their teams. Some coaches found it difficult to keep the skilled/experienced girls engaged during practice without having the less skilled/experienced girls falling further behind, likely increasing the amount of instruction needed. These findings could potentially result in practice sessions that do not maximise players’ opportunities to be physically active. These are important findings as previous literature has shown that the majority of time during OYS players are inactive or in light physical activity (Guagliano et al., 2013; Leek et al., 2011;
Sacheck et al., 2011; Wickel & Eisenmann, 2007); furthermore, Dudley et al. (2012) found negative correlations between instruction/management and MVPA. This valuable insight could inform future studies aiming to increase physical activity in OYS. Coaches also reported girls’ focus/interest levels, motivation/commitment, and player management as challenges. Although coaches identified these as challenges, they seemed confident in their ability to deal with them, often detailing how they overcome them.

When coaches discussed their perceived challenges in relation to parents, an interesting finding from a physical activity promotion perspective was that some coaches believed that they were able to identify girls on their teams who had low parental support. Coaches reported being frustrated with some parents’ lack of commitment and support for their daughters. One coach commented on how annoyed she was with parents who did not take any interest in the sport their daughter played, and suggested that girls with a lack of parental support are likely to stop playing OYS. Coaches’ perceived ability to identify players lacking parental support is an encouraging finding, as they may be able to play an important role maintaining parental support in OYS. There is strong evidence to suggest that parental support is linked with youth’s physical activity behaviours (Bauer, Nelson, Boutelle, & Neumark-Sztainer, 2008; Bélanger et al., 2011; Bradley, McRitchie, Houts, Nader, & O’Brien, 2011; Sallis et al., 2000) and youth’s participation in OYS (Eime, Harvey, Craike, Symons, & Payne, 2013; Timperio et al., 2013). Furthermore, Lubans, Sylva, and Morgan (2007) found that in older adolescents, parental support was significantly correlated with MVPA; however, one coach commented on his observation that parents’ presence during OYS
has decreased as the girls he coached got older. Given that girls’ physical activity levels tend to decrease precipitously in adolescence (Kimm et al., 2002), maintaining parental support may be an important factor to consider in efforts to increase and maintain physical activity levels in girls as they transition into adolescence and adulthood. Thus, the potential role of coaches in maintaining parental support of youth participation in OYS should be examined further.

Some potential limitations should be considered when interpreting the findings of this study. First, it is possible that coaches mainly offered socially desirable viewpoints during their interview. Second, a convenience sample was used, possibly introducing an element of selection bias. That said, a wide array of responses from a diverse sample of coaches was collected. Last, female-coaching perspectives may be underrepresented, as this sample contained more men than women; however, male coaches are more prevalent than female coaches in OYS (Leberman & LaVoï, 2011). Despite these limitations, the present study provides unique insight into coaches’ perceptions of themselves as being influential on physical activity for girls in OYS. Also, rigorous research methodology was employed to ensure the trustworthiness of the data. Several suggested strategies (Krefting, 1991) were used to strengthen the credibility of the data, for example, investigator triangulation during the interpretation phase, individual classification during data analysis, reflexivity, and member checking. Along with aiding in the credibility of the data, the abovementioned strategies also protected against individual perceptual biases (Patton, 2001). According to Lincoln and Guba (1985), demonstrating credibility may be considered sufficient to support the notion of dependability. As stated above, the issue of credibility has been adequately
addressed. Acceptable confirmability has also been established by using published guidelines to analyse the data (Côté & Salmela, 1994; Côté et al., 1993) and, as mentioned above, strategies were employed to reduce individual perceptual biases. Lastly, concerning transferability, Lincoln and Guba (1985) suggested that transferability is primarily the responsibility of the researcher interested in transferring the findings to another context or population than that of the original study. The authors argued that as long as the original study presents sufficient descriptive data to allow comparisons, the issues have been addressed the issue adequately. A thorough description of the research context has been provided as well as adequate descriptive data allowing other researchers to make judgement on how practical a transfer of the results are to a different context or population.

Considering the high proportion of youth who participate in OYS, and the myriad of health and developmental benefits associated with the setting, OYS has the potential to be a powerful health-promoting environment for participating youth. Recently, a number of studies have examined OYS clubs as a setting to promote health (Geidne et al., 2013; Kelly et al., 2014; Kokko et al., 2009). These studies illustrate a wide range of health-promoting capabilities that OYS can provide, and the importance of OYS clubs. Only one study’s authors, however, recognised that OYS clubs can play a role in promoting physical activity (Kelly et al., 2014). The present study provides a unique perspective on OYS coaches’ perceptions of themselves as being influential on physical activity for girls in OYS. Further, coaches in this study (whilst not the primary focus) indicated that they were confident discussing healthy eating with the girls on their team. They may, however, underestimate or not fully realise the impact they can have.
To further enhance the health-promoting capabilities of OYS, there should also be an emphasis placed on educating coaches to capitalise on the opportunity they have to promote physical activity to the girls they coach. This information on OYS can be used as a platform on which to inform policies, programs, and interventions to develop strategies to increase girls’ physical activity levels through OYS.

4.6 Synopsis

This chapter has presented the findings of the second of four studies of this PhD thesis. In the previous study (Chapter 3) it was established that although participation in OYS can provide players with substantial amounts of MVPA, a substantial proportion of time was spent insufficiently active (i.e., in LPA or inactive). Thus, coaches are in an ideal position to impact players’ physical activity levels in OYS (and perhaps outside of OYS as well). The way coaches perceived themselves with regard to influencing female players’ physical activity, however, was unknown and further investigation was warranted. The findings presented in this chapter suggested that most coaches felt that they had the potential to influence players’ physical activity in OYS. It is possible, though, that coaches may underestimate or not fully realise the impact they can have on the players they coach. These findings, along with those presented in Chapter 3, were used to inform the development and testing of an intervention (discussed in Chapter 5) primarily aimed at determining the efficacy of coach education on player MVPA.
Chapter 5

Study 3 - Increasing girls' physical activity during an organised youth sport basketball program: A randomised controlled trial

A peer-reviewed trial protocol has been published in *BMC Public Health* (see Appendix C).


Authorship details:

Guagliano (85%), Lonsdale (5%), Kolt (5%), Rosenkranz (5%)

Further, a manuscript based on the main findings presented in Chapter 5 is currently under peer-review with *Journal of Science and Medicine in Sport.*

Guagliano, J. M., Lonsdale, C., Rosenkranz, R. R., Kolt, G. S, & George, E. S. (*under review*). Increasing girls’ physical activity during an organised youth sport basketball camp: A randomised controlled trial. *Journal of Science and Medicine in Sport*

Authorship details:

Guagliano (80%), Lonsdale (5%), Rosenkranz (5%), Kolt (5%), George (5%)
5.1 Introduction

This chapter presents the third study in the series of studies forming this PhD thesis. This chapter presents the findings of the first (to the author’s knowledge) RCT conducted in an OYS context aimed at determining the short-term efficacy of coach education on player physical activity. This study has been registered with the Australian New Zealand Clinical Trials Registry (ACTRN12613001099718), and is reported in accordance with the Consolidated Standards of Reporting Trials guidelines (Schulz, Altman, & Moher, 2010). This study’s trial protocol has been published in *BMC Public Health* (Guagliano, Lonsdale, Kolt, et al., 2014), and a further manuscript based on this study’s main findings is currently under peer-review in the *Journal of Science and Medicine in Sport*.

5.2 Background

Sports are one of the most popular and time consuming leisure activities for youth (Hansen & Larson, 2007). In Australia, the prevalence of youth participating in OYS has steadily risen since the 1980’s (Active Healthy Kids Australia, 2014). Recent prevalence data indicate that 66% of Australian youth (67% and 65% of Australian boys and girls, respectively) participate in at least one OYS outside of school hours (Active Healthy Kids Australia, 2014; Australian Bureau of Statistics, 2012). Similarly, high proportions of participation in OYS can be found among youth in countries across the world (Tremblay et al., 2014).
Numerous studies have reported that participation in OYS by youth provides physical, psychological, and social health and developmental benefits (Eime, Young, et al., 2013; Fraser-Thomas et al., 2005; Geidne et al., 2013; Vella, Cliff, et al., 2014a). Participation in OYS has also been shown to protect the health-related quality of life of youth (Vella, Cliff, Magee, & Okely, 2014b) and improve cognitive performance (Esteban-Cornejo et al., 2014). Arguably one of the most pertinent attributes of OYS is its potential to contribute considerably to levels of MVPA in participants (Guagliano et al., 2013; Wickel & Eisenmann, 2007). OYS participation is positively associated with an increased likelihood of complying with national physical activity and sedentary behaviour guidelines (Nelson et al., 2011; Vella et al., 2013) which recommend accumulating at least one hour of MVPA and less than two hours of screen time daily (Department of Health and Aging, 2014b). Considering only one-fifth of Australian youth, aged 5-17 years, met recommended physical activity guidelines every day of the week (Active Healthy Kids Australia, 2014), OYS participation may have substantial public health implications. Several studies have found that girls accumulate less physical activity than boys throughout childhood (Hardy et al., 2008; Troiano et al., 2008), and their participation in physical activities drops more steeply than boys during the transition into adolescence (Kimm et al., 2002; Nader et al., 2008). As such, girls have been identified as a high priority group for physical activity promotion (Camacho-Miñano et al., 2011). Vella, Cliff, and Okely (2014) have also called for interventions that promote girls’ participation in OYS.

Many studies have identified OYS clubs as a potential avenue for health promotion (Almond et al., 2013; Geidne et al., 2013; Kelly et al., 2014; Kokko et al.,
Furthermore, Kelly et al. (2014) have stated that sports clubs could have a role in promoting physical activity. Although OYS may provide an ideal opportunity for youth to accumulate substantial amounts of MVPA, a large proportion of players’ time during OYS is spent inactive or in light-intensity physical activity (Guagliano et al., 2013; Leek et al., 2011; Sacheck et al., 2011). In OYS, coaches carry considerable influence over their players, as coaches are viewed as experts (Conroy & Coatsworth, 2006) and have consistent direct involvement with their players (Smith & Smoll, 1997). Coaches, then, may be able to increase their players’ physical activity levels, particularly during practice time, where coaches are likely to be more capable of influencing physical activity intensity, as compared to during games. Further, there has been a call to evaluate strategies for increasing MVPA in OYS (Leek et al., 2011). A recent study revealed that coaches were wary of increasing girls’ MVPA, due to a belief that it could result in reduced motivation and dropout from OYS (Chapter 4, Guagliano, Lonsdale, Rosenkranz, et al., 2014). Researchers aiming to increase MVPA during OYS, therefore, should consider simultaneously monitoring player motivation as a precaution.

5.2.1 Study aims

To date, no RCTs have been conducted in OYS aimed at evaluating interventions designed to increase physical activity, despite the fact that sport has been identified as a research priority in the area of youth physical activity and sedentary behaviour (Almond et al., 2013; Gillis et al., 2013). Primarily, this two-armed parallel-group RCT aimed to assess whether coach education, relative to a standard-care control,
could increase the proportion of time players spent in MVPA during practices over a five-day basketball program. Given that highly controlled studies are lacking, this study was conducted within a 5-day basketball program organised by the author, rather than in participants’ usual teams, because it was essential to first determine if this intervention was efficacious under optimal conditions before determining its effectiveness with intact community-based OYS teams. The secondary aims of this study were to assess whether coach education could lower the proportion of practice time players spent inactive, investigate effects on players’ motivation and perceived autonomy support, and assess how time was spent during practice (lesson context) and leader behaviour, via SOFIT (McKenzie et al., 1991).

5.2.2 Study hypotheses

Compared with a standard-care control, it was hypothesised that those players whose coaches attended coach education sessions would have: (1) spent a greater proportion of practice time in MVPA; (2) spent a lower proportion of practice time inactive; (3) exhibited no difference in motivation or perceived autonomy support scores; (4) spent a greater proportion of practice time in lesson contexts such as skill practice, game play, and fitness; and (5) spent a lower proportion of practice time in lesson contexts such as management and knowledge delivery.

5.3 Methods

5.3.1 Trial design
This study is a two-armed, parallel-group RCT, using a 1:1 allocation ratio, designed to investigate whether coaches who attended coach education sessions (where education on increasing MVPA and decreasing inactivity during practice was delivered) could increase their players' MVPA during practice sessions over a 5-day basketball program compared to coaches who did not receive coach education sessions. Outcomes were assessed at baseline (day 1 of the basketball program) and follow up (day 5 of the program). The Human Research Ethics Committee of the University of Western Sydney approved this study (approval number: H10215, Appendix P). This study has also been registered as a clinical trial with the Australian New Zealand Clinical Trials Registry (ACTRN12613001099718, see Appendix Q). This study adheres to the Consolidated Standards of Reporting Trials guidelines (Schulz et al., 2010).

5.3.2 Participants

It was planned to recruit a convenience sample of 80 female players and 8 coaches into the basketball program. Players were recruited through the distribution of flyers (Appendix R) to 5 intact community-based OYS basketball clubs, 6 primary schools (private and Catholic), 3 community centres, 2 after-school programs, and social media (Yammer and E-update, which are private social networks for University of Western Sydney staff, were used). Coaches were recruited via flyers (Appendix S) to 2 OYS basketball clubs and the UWS (undergraduate students). To be considered eligible for this study as a player, participants needed to be female, be aged 9-12 years, and intend to attend the program for its duration. For coaches to be eligible to coach in the program, basketball coaching credentials from the Australian Sports Commission’s
National Coaching Accreditation Scheme (NCAS) (Australian Sports Commission, n.d.) and previous experience coaching girls basketball teams were required. Coaches were also informed that participation might involve attending 2 coach education sessions, however, no information was divulged regarding what the coach education sessions entailed. Coaches also received payment for their time, at a rate of AUD$25/hour (intervention coaches were also paid to attend coach education sessions at the same rate). The rate of pay for coaches is comparable to other paid OYS coach positions.

5.3.3 Sample size and power calculation

On the basis of an \( \alpha \) of 0.05 and 80% power to detect a significant differential change in MVPA between groups, using an effect size of \( d = 0.6 \), a minimum sample size of 36 female players for each group was needed (\( N = 72 \)). The chosen effect size is consistent with the findings of a recent systematic review and meta-analysis of interventions designed to increase children and adolescents’ MVPA (measured using accelerometry) in a similar setting (physical education), \( d = 0.62 \) (Lonsdale, Rosenkranz, Peralta, et al., 2013). To protect against player attrition and preserve adequate statistical power, the sample size was inflated by 10%, thus a total sample of 80 female players was sought. Based on the sample size required for players, 8 coaches were needed, which would equate to a maximum of 10 players per coach, similar to a usual OYS setting.

5.3.4 Blinding
Research assistants, blinded to study hypotheses and treatment allocation, conducted baseline assessments prior to randomisation. Players were also blinded to study hypotheses and treatment allocation. After baseline assessments and randomisation, 4 coaches consented to attend coach education sessions (intervention) and 4 coaches served as controls. As such, it was not possible to keep coaches blinded in this study. Lastly, the author of this PhD thesis was blinded to participant (player and coach) allocation during analysis and conducted all analyses.

5.3.5 Randomisation

Coaches were randomly assigned to the site they were coaching by using simple randomisation; a computer-generated algorithm was used, ensuring an equal number of coaches at each site. Players, however, were not randomly allocated to a site; instead parental preference in site determined where the player would attend the basketball program, and this was predominantly based on location of the venue in relation to their residence.

Group randomisation for both players and coaches occurred following baseline assessments. Coaches were pair-matched using the average step counts (via pedometry) their group of players accumulated during two practices during baseline assessments (i.e., the two coaches with the two highest group step count averages during the practice sessions and the two coaches with the two lowest group step count averages during the practice sessions were paired together). Coaches were pair-matched to ensure that similar coaches (in terms of the average group step counts accumulated by their players
during the baseline practice sessions) were randomised into each arm of the study. Given that increasing MVPA was the primary outcome and that step rate from pedometry has been shown to be an accurate indicator of MVPA (Scruggs et al., 2003), matching coaches via group step counts was deemed appropriate. Using a computer-generated algorithm, one coach from each pair was allocated into the intervention arm and the other into the control arm.

Players at each site were randomly assigned, using simple randomisation to either the intervention or control arm through a computer-generated algorithm, ensuring equal groups. To avoid clustering effects associated with having the same coach in each session throughout the program players were randomised into different practice groups and coaches within their allocated arm for each practice session period for the duration of the program. Figure 5.1 illustrates the randomisation procedure for each practice session for one site.
Figure 5.1. Illustrates the randomisation procedure for each practice session for one site.

<table>
<thead>
<tr>
<th>Program Day 1 – Practice session 1 - Baseline</th>
<th>Coach 1</th>
<th>Coach 2</th>
<th>Coach 3</th>
<th>Coach 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>11 12 13 14 15 16 17 18 19 20</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Day 1 – Practice session 2 - Baseline</th>
<th>Coach 1</th>
<th>Coach 2</th>
<th>Coach 3</th>
<th>Coach 4</th>
</tr>
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<tbody>
<tr>
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<td>31 3 4 35 37 1 28 14 8 12</td>
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</table>

<table>
<thead>
<tr>
<th>Program Day 2 – Practice session 1</th>
<th>Coach 1 (intervention)</th>
<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>16 5 40 37 26 35 19 11 27 15</td>
<td>13 1 33 39 21 8 25 36 31 18</td>
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<td>10 28 4 9 38 7 2 24 32 14</td>
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</table>

<table>
<thead>
<tr>
<th>Program Day 2 – Practice session 2</th>
<th>Coach 1 (intervention)</th>
<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
</tr>
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<tr>
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<table>
<thead>
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<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>21 36 18 8 33 31 37 26 13 15</td>
<td>35 19 1 39 5 16 40 27 11 25</td>
<td>9 14 34 2 17 23 7 12 8 4</td>
<td>20 6 38 10 32 22 24 3 29 30</td>
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</table>

<table>
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<tr>
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<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
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</thead>
<tbody>
<tr>
<td>Players</td>
<td>33 21 26 16 1 27 37 25 5 31</td>
<td>36 35 40 18 11 39 15 13 8 19</td>
<td>38 12 34 2 28 6 10 23 17 7</td>
<td>9 29 22 4 14 32 3 24 30 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Day 4 – Practice session 1</th>
<th>Coach 1 (intervention)</th>
<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>33 40 18 31 37 8 15 21 26 11</td>
<td>27 19 35 39 36 13 1 25 5 16</td>
<td>4 10 30 7 12 34 6 22 23</td>
<td>28 9 2 32 24 14 17 20 38 29</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
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</thead>
<tbody>
<tr>
<td>Players</td>
<td>15 13 39 16 1 8 33 35 11</td>
<td>21 40 27 19 37 25 36 26 5 31</td>
<td>17 30 7 20 3 29 38 4 32</td>
<td>23 12 14 22 9 10 4 28 2 24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Day 5 – Practice session 1 – Follow up</th>
<th>Coach 1 (intervention)</th>
<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players</td>
<td>16 18 35 8 40 36 15 25 33 27</td>
<td>39 1 21 19 11 26 5 13 37 31</td>
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<td>2 38 32 7 14 23 20 6 22 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program Day 5 – Practice session 2 – Follow up</th>
<th>Coach 1 (intervention)</th>
<th>Coach 2 (intervention)</th>
<th>Coach 3 (control)</th>
<th>Coach 4 (control)</th>
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</thead>
<tbody>
<tr>
<td>Players</td>
<td>25 27 11 39 1 16 26 40 5 37</td>
<td>15 31 36 13 19 33 35 18 8 21</td>
<td>10 34 2 6 9 24 30 23 7 4</td>
<td>38 12 14 22 17 29 28 3 20 32</td>
</tr>
</tbody>
</table>
5.3.6 Study procedure

The University of Western Sydney School Holiday Basketball Program was a basketball program for girls that ran for 5 consecutive days, for 4 hours per day, over the school holiday period in September 2013 (Australian Spring). The basketball program ran simultaneously across 2 sports centres in Greater Western Sydney, Australia, with each site having 2 full-size basketball courts. At each site, the aim was to recruit 40 female players and 4 coaches, and the data collection team comprised 1 supervisor and 4 research assistants. This basketball program was developed specifically for the purposes of this study and is not an ongoing program run by the University of Western Sydney.

Parents/guardians who wanted to register their daughter(s) in the basketball program, and coaches who wanted to coach in the basketball program, initiated contact with the author of this thesis expressing their interest. Initial contact was made via phone, text message, email, or face-to-face. The author screened all interested participants for eligibility using a standardised script or email/message. Parents of players who were deemed eligible for inclusion were given a study information sheet (Appendix T), informed consent/assent form (Appendix U), an emergency contact form (Appendix V), and a parent questionnaire (described below) to complete (Appendix W). Coaches who were deemed eligible for inclusion were provided with a study information sheet (containing a basic description of primary study aim; see Appendix X), informed consent form (Appendix Y), and a coach questionnaire (described below).
to complete (Appendix Z). When all forms were completed and returned, the participant (player or coach) was enrolled into the study.

The program was structured to be the same each day (see Table 5.1) and included 2 practice sessions and 2 games. In each of the practice sessions, coaches were instructed to focus on 2 skills; however, the coach planned their own practice sessions to teach these skills. Each day, the first practice session focused on dribbling and defending skills and the second practice session focused on passing/catching and shooting skills. Coaches had half of a court to deliver their practice session. During each practice session, research assistants used SOFIT (McKenzie et al., 1991) to collect lesson context and leader behaviour data (Appendix AA). During this time, players and coaches also wore sealed pedometers, and research assistants recorded their step counts at the conclusion of each practice session (Appendix BB). These data were summarised and entered onto a coach feedback form (Appendix CC), where intervention coaches received a group average step count per minute and the percentage of time spent in each lesson context and leader behaviour according to SOFIT. This feedback was given to intervention coaches at the end of each day of the basketball program. A double round-robin tournament was created for the 2 games per day, which were played on a full court. During the designated breaks, players were free to do as they chose (e.g., talk among each other, eat, play basketball or other games of their choice).
Baseline assessment data were collected on the first day and follow up assessments were conducted on the fifth day of the basketball program (see Table 5.2 for a summary of the data collected). Following the first 2 days of the program, the 4 coaches allocated to the intervention arm of the study attended a coach education session.
<table>
<thead>
<tr>
<th>Data collected</th>
<th>Data collection instrument</th>
<th>When data were collected</th>
<th>Data collection day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity levels</td>
<td>Accelerometry</td>
<td>Duration of each program day</td>
<td>1-5</td>
</tr>
<tr>
<td></td>
<td>Pedometry</td>
<td>Duration of each practice session</td>
<td>1-5</td>
</tr>
<tr>
<td></td>
<td>SOFIT</td>
<td>Duration of each practice session</td>
<td>1-5</td>
</tr>
<tr>
<td>Lesson context</td>
<td>SOFIT</td>
<td>Duration of each practice session</td>
<td>1-5</td>
</tr>
<tr>
<td>Leader behaviour</td>
<td>SOFIT</td>
<td>Duration of each practice session</td>
<td>1-5</td>
</tr>
<tr>
<td>Player motivation</td>
<td>Situational Motivation Scale</td>
<td>Following practice session 2</td>
<td>1.5</td>
</tr>
<tr>
<td>Players’ perceived autonomy</td>
<td>Teacher as Social Context</td>
<td>Following practice session 2</td>
<td>1.5</td>
</tr>
<tr>
<td>support</td>
<td>Questionnaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Players’ anthropometric data</td>
<td>Stadiometer, scale, tape measure</td>
<td>Baseline</td>
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</tr>
<tr>
<td>Player demographic data</td>
<td>Parent questionnaire</td>
<td>Prior to study commencement</td>
<td>N/A</td>
</tr>
<tr>
<td>Coach demographic data</td>
<td>Coach questionnaire</td>
<td>Prior to study commencement</td>
<td>N/A</td>
</tr>
<tr>
<td>Process evaluation</td>
<td>Process evaluation</td>
<td>End of coach education session</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note. SOFIT = System for Observing Fitness Instruction time.*
5.3.7 Intervention

Although this study is the first intervention study in an OYS setting directed at increasing players’ MVPA, there have been several interventions conducted in a similar setting (physical education) with the same objective (see Lonsdale, Rosenkranz, Peralta, et al., 2013 for a recent systematic review and meta-analysis). Several intervention studies included in Lonsdale et al.’s systematic review and meta-analysis incorporated similar intervention components as the current intervention featured. For example, strategies to reduce management and instruction time (McKenzie et al., 2004; Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2007) in an effort to reduce inactivity, create leader awareness (McKenzie et al., 2004), modified drills where physical activity was more inherent (Young, Phillips, Yu, & Haythornthwaite, 2006), and preparation/organisation (Fairclough & Stratton, 2005; Verstraete et al., 2007). The authors’ findings indicated that physical-education-based interventions can increase the proportion of time students spent in MVPA while participating in physical education lessons (Lonsdale, Rosenkranz, Peralta, et al., 2013).

In the current study, coaches allocated into the intervention arm attended 2 coach education sessions. Each coach education session was approximately 2 hours in duration and took place in the afternoon following each of the first 2 days of the program. The author of this thesis conducted both coach education sessions, and a research assistant was also present. No specific theoretical framework was used in the current study;
However, the coach education sessions were informed by previous literature (described in detail below).

During the first coach education session (after day 1 of the program), approximately 20 minutes was spent providing coaches with information about MVPA (i.e., what is MVPA and how much should youth accumulate daily based on national guidelines). Further, the author of this thesis summarised findings of a previous study that examined girls’ MVPA in OYS (in terms of proportion of practice time and steps/min) (Guagliano et al., 2013). Coaches were informed of a study by Scruggs (2007), who found that 82-88 steps/min was approximately equivalent to spending 50% of the time physically active (in physical education) (Scruggs, 2007). In a physical education setting, spending 50% time in MVPA has been recommended as a target (United States Department of Health and Human Services, 2010). Since no such recommendation exists in OYS, and a similar proportion of time spent in MVPA has been found in OYS (Guagliano et al., 2013) and physical education (Dudley et al., 2012), Scruggs’ steps/min estimation was adopted as a guide for intervention coaches to gauge their players’ physical activity during the two practice sessions. Coaches, however, were not explicitly instructed to aim for a specific proportion of time in MVPA or steps/min. Coaches were also shown how time was typically spent during practice, based on Guagliano et al.’s (2013) findings. Their study broke practice sessions down into 6 mutually exclusive categories (management, knowledge delivery, fitness, skill practice, game play, and free play), based on SOFIT (described in detail below).
Coaches were then given approximately 15 minutes to reflect on their practice sessions. Coaches were prompted to consider how active they thought their players were during practice, how they spent their time during practice, and potential modifications they could make to some of their drills to increase opportunities for MVPA.

Next, coaches were presented with individualised feedback for each of their 2 practice sessions. All information provided on the coaches’ feedback form was explained to the coaches by the author (approximately 15 mins); which included group average steps/minute, proportion of practice time spent in each SOFIT lesson context category (described in next section), and leader behaviour recorded as occurrences per session (described in next section).

The next 30 minutes were spent discussing potential strategies that coaches could implement to increase opportunities for MVPA. More specifically, the importance of planning, conducting warm-ups and cool downs, dynamic stretching as opposed to static stretching, using small long-term groups, providing ample equipment, using circuits/grids as opposed to lines, and avoiding elimination games were discussed as potential strategies to increase opportunities for MVPA during practice.

Coaches were then presented with a case study. The case study was a short video of a basketball practice session. Coaches were asked to modify the drills in the video in order to increase MVPA. Once coaches had modified drills, each coach demonstrated their modified drill on a basketball court. Coaches had the remainder of the session to plan their practice sessions for the next day (approximately 20 minutes).
The beginning of the second coach education session (after day 2 of the program) was devoted to reviewing the strategies to increase MVPA that were discussed in the first coach education session (about 10 minutes). Coaches then reflected on their recent practice sessions for approximately 15 minutes (either alone or with one another). Coaches were prompted to reflect on the strategies they tried to incorporate into their practice sessions and their success in doing so. Similar to the first session, coaches were prompted to reflect on how active they thought their players were during practice, and how they spent their time during practice.

The next 30 minutes were spent discussing potential strategies coaches could implement to decrease inactivity during practice. More specifically, the author discussed potential strategies to decrease or modify management (e.g., drill transition, drink breaks) and instruction time to reduce inactive time. Self-monitoring (e.g., limit number of drills, limit number of times providing instruction, limit the time spent delivering instructions) and goal setting (e.g., setting proximal and distal goals for the basketball program) were also discussed as potential strategies that coaches could implement to decrease inactivity during their practice sessions.

Similar to the first coach education session, coaches were presented with a new video case study of a basketball practice session and were asked to modify the drills in the video in order to increase MVPA or decrease inactivity. Coaches were also asked to modify some of their commonly used drills. Once coaches had modified drills, each coach demonstrated their modified drill to each other on a basketball court (approximately 30 minutes). The remaining time (approximately 35 minutes) was
devoted to planning their practice sessions and completing a process evaluation questionnaire.

Intervention coaches continued to receive individualised feedback after each program day (i.e., on program days 3-5). Individualised feedback was furtively delivered to intervention coaches in an effort to avoid drawing attention to control coaches. Coaches allocated into the control arm of the study were asked to coach as usual. Control coaches had access to the same equipment (e.g., basketballs, pylons, coloured practice jerseys) as intervention coaches, but were not privy to any information provided during the coach education sessions or individualised feedback.

5.3.8 Outcome measures

5.3.8.1 Accelerometry

ActiGraph GT3X+ accelerometers (ActiGraph; Pensacola, FL) were used to assess physical activity levels in this study. In paediatric and adult populations, ActiGraph accelerometers have been shown to be valid and reliable devices for the measurement of physical activity levels (Plasqui & Westerterp, 2007; Trost et al., 2011). Accelerometers were initialised once at the start of the week and set to record data at a sampling rate of 30 Hz, as well as step counts. Accelerometers were synchronised with an external clock and initialised to start recording 1 hour before the start of the first day of the basketball program and stop recording data 1 hour after the fifth day of the basketball program. Start and finish times of practice sessions, games, and breaks were recorded. Players and coaches wore accelerometers, the same device for the duration of
the program. Female research assistants fitted players with an accelerometer. Accelerometers were placed over the right iliac crest and held in place using an adjustable elastic belt, prior to the start of each program day, and worn for the duration of the day. At the end of the fifth day, raw accelerometer counts were downloaded to a computer using ActiGraph software, integrated into 1-second epochs, and exported and saved to a Microsoft Excel file.

Evenson et al. cut-points (2008) have been recommended to estimate physical activity intensity in youth (Crouter et al., 2013; Trost et al., 2011). Freedson et al. cut-points (2005), however, have been used by much of the existing literature that has examined physical activity in OYS (Guagliano et al., 2013; Leek et al., 2011; Wickel & Eisenmann, 2007). Both cut-points were used in this study; Evenson et al. cut-points were used as the primary outcome and Freedson et al. cut-points were presented to facilitate comparisons with previous studies. Using Evenson et al. cut-points (2008), physical activity intensity was classified as the following (thresholds have been adjusted to account for 1-second epochs): inactive ≤1.67 counts per second; light physical activity ≥ 1.68 counts per second <38.25; moderate physical activity ≥38.26 counts per second <66.85; and vigorous physical activity ≥66.86 counts per second. Using Freedson et al. (2005) MET prediction equation physical activity intensity was classified as the following: inactive ≤100 counts/min; light physical activity ≥ 1.5 METs <4; moderate physical activity ≥4 METs <7; and vigorous physical activity ≥7 METs. To account for 1-second epochs, age-specific counts per minute were divided by 60. Although there is still some debate regarding suitable MET-intensity thresholds for children and adolescents (Trost et al., 2011), the thresholds selected for this study have
been previously used in a female paediatric population (Guagliano et al., 2013; Okely et al., 2011).

For coaches, Troiano et al. (2008) cut-points were used and physical activity intensity was classified as the following (thresholds have been adjusted to account for 1-second epochs): inactive $\leq 1.65$ counts per second; LPA $\geq 1.66$ counts per second $<33.65$; MPA $\geq 33.66$ counts per second $<99.96$; and VPA $\geq 99.97$ counts per second. Further, there were no issues to report regarding accelerometer wear time because all players and coaches wore accelerometers for the duration of each program day.

5.3.8.2 Pedometry

Two models of Yamax Digiwalker (Tokyo, Japan) pedometers were used in this study, the SW-200 and SW-700. Both the SW-200 and SW-700 models use the same pendulum mechanism to count steps (Schneider, Crouter, & Bassett, 2004). Studies have found that the SW series of Yamax Digiwalkers is sensitive to increases in physical activity, has a high level of agreement with observed steps, and is a valid assessment of the volume of physical activity in youth (Beets, Patton, & Edwards, 2005; Leenders et al., 1997; Trost, 2007). Players and coaches wore sealed pedometers over the right iliac crest, for the duration of both practice sessions that occurred daily. Pedometers were placed immediately adjacent to the accelerometer worn. Female research assistants assisted players with the placement of the pedometer. Coaches affixed their own pedometer, but a research assistant approved the placement of the coaches’ pedometer. Research assistants recorded individual step counts following each practice session and reset the pedometer. Pedometers were employed in this study to quickly provide
intervention coaches with feedback on their players’ physical activity levels during each
day’s practice sessions.

5.3.8.3 Direct observation

SOFIT is a widely used direct observation system that uses momentary time
sampling to generate data on players’ physical activity, lesson context, and leader
behaviour (McKenzie et al., 1991). Studies have shown that SOFIT has demonstrated
acceptable reliability and validity in paediatric populations (McKenzie et al., 1991;
Rowe et al., 1997). SOFIT can be easily implemented in an OYS setting, yet only one
peer-reviewed study that the author is aware of has used this direct observation system
in OYS (Guagliano et al., 2013).

Prior to session commencement, the observer implementing SOFIT, quasi-
randomly and furtively selected 4 (plus an alternate) players to observe for the duration
of the session (Dzewaltowski et al., 2010; Guagliano et al., 2013). Players were
observed for 4 minutes at a time, on a rotational basis. Physical activity levels, lesson
context, and leader behaviour were coded and recorded on paper every 20 seconds using
a looped voice recording that prompted the observer to observe and record. At the end of
each observe interval, lesson context was coded into only 1 of 6 mutually exclusive
categories: management, knowledge delivery, fitness, skill practice, game play, and free
play. Leader behaviour, however, is coded using a hierarchical format. Leader behaviour
was coded into 1 of 4 categories and included (in hierarchal order) promotes physical
activity (includes prompts of encouragement and praise) or discourages physical activity
(includes prompts that are sarcastic and punitive in nature), demonstrates physical
activity, and other. Promotes physical activity or discourages physical activity, therefore, is recorded if it occurs at any time during the 10-sec observe interval; whereas ‘other’ is only scored if the other categories are not observed during the 10-sec observe interval. The author of this thesis has been trained to use the observation technique and has collected SOFIT data for other peer-reviewed work (Guagliano et al., 2013). The author trained all research assistants to use SOFIT using recommended guidelines (McKenzie, 2012). Research assistants’ SOFIT coding accuracy was assessed against a pre-coded ‘gold standard’ video developed by McKenzie (2012). Coding accuracy was assessed using percent agreement, where a minimum of 80% agreement between scores was set as the minimum acceptable level of agreement (McKenzie, 2012). The research assistants demonstrated a high level of agreement compared to the ‘gold standard’ video (90% agreement).

5.3.8.4 Questionnaires

At baseline (day 1) and follow up (day 5), players were asked to complete a questionnaire (Appendix DD) assessing their perceptions of their coach’s autonomy supportive behaviour by completing 4 items from the Teacher as Social Context Questionnaire (Belmont, Skinner, Wellborn, & Connell, 1992; Taylor & Lonsdale, 2010). Players responded to questions on a 7-point Likert scale (1 = not true at all, 7 = very true). Scores on the Teacher as Social Context Questionnaire were averaged and ranged from 1 to 7, higher scores were indicative of greater perceived coach autonomy supportive behaviour.
On the same questionnaire, players also completed the 14-item Situational Motivation Scale, which assesses constructs of intrinsic motivation, identified regulation, external regulation, and amotivation (Standage, Duda, Treasure, & Prusak, 2003). Players responded to questions on a 7-point Likert scale (1 = not true at all, 7 = very true). Based on players’ average scores from the four subscales of the Situational Motivation Scale, a self-determination index (SDI) was created (SDI = 2*intrinsic motivation + identified motivation – external regulation – 2*amotivation, e.g., Lonsdale, Sabiston, Raedeke, Ha, and Sum (2009)). Scores on the Situational Motivation Scale can range from -18 to 18, where higher scores were indicative of greater self-determined motivation towards participation in a situation (i.e., basketball practice) (Lonsdale, Rosenkranz, Sanders, et al., 2013; Lonsdale et al., 2009). Both the Teacher as Social Context Questionnaire and the Situational Motivation Scale have received empirical support for reliability and validity (Guay, Vallerand, & Blanchard, 2000; Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011; Taylor & Lonsdale, 2010).

A demographic questionnaire was distributed to parents and coaches for descriptive data purposes. The questionnaire that was distributed to parents collected data on parents’ level of education, relationship status, and household income. The questionnaire also collected data on their daughter’s age, country of birth, cultural background, and OYS information (number of OYS played, level, number and minutes of practice sessions per week, and number and minutes of games per week). This questionnaire was only distributed to parents once, prior to the commencement of the study.
The questionnaire distributed to coaches collected data on age, sex, height, weight, country of birth, cultural background, highest education qualification, relationship status, OYS information (number of OYS played and coached, level, number and minutes of practice sessions per week, and number and minutes of games per week), physical activity information (number and time spent in vigorous, moderate, and light physical activity), and leisure-time information (time spent sleeping, sitting, standing, watching television, and using a computer). These data were only collected from coaches once, prior to commencement of the study. Coaches responded to questions on a 5-point Likert scale (1 = not at all, 5 = to a great extent) about coaching, regarding practice session planning, estimations on player physical activity during practice, estimations on percentage of time spent in each SOFIT lesson context (described above), perceived ability to modify practice sessions, perceived importance of physical activity during practice, intention to increase physical activity/reduce inactivity, and likelihood of increasing physical activity/reducing inactivity. These data were collected prior to the start of the study, after intervention end (day 3), and at follow up (day 5).

5.3.8.5 Anthropometric measures

Prior to measurement of height, weight, and waist circumference, players were asked to remove shoes and any heavy clothing. Standing height was measured to the nearest 0.1 cm using a portable stadiometer (PE87 portable stadiometer; Mentone Educational, Victoria, Australia). Weight was measured using a digital scale (EF 538 HealthStream digital scale; Aussie Fitness, Queensland, Australia) to the nearest 0.1 kg.
Using the Centers for Disease Control and Prevention growth charts, BMI was calculated and converted into age- and sex-specific percentiles (Kuczmarski et al., 2000). Waist circumference measurements were taken on the right side of the body by finding the midpoint between the lowest rib and the iliac crest (Canadian Society for Exercise Physiology, 2008). A non-elastic tape measure (Myotape; Mentone Educational, Victoria, Australia) was wrapped snugly around the waist and measurement was taken at the end of exhalation to the nearest 0.1 cm. All measurements were conducted in duplicate, and an average was recorded. A third measurement was taken if the first two measures differed by more than 0.5 cm or 0.5 kg and the average was recorded. Female research assistants collected all waist circumference measurements (see Appendix EE for the form used to collect all anthropometric data).

5.3.8.6 Process evaluation

A process evaluation was undertaken following the basketball program. Intervention coaches answered a process evaluation questionnaire (Appendix FF) after the second coach education session. The questionnaire assessed, using questions on a 5-point Likert scale (1 = not at all, 5 = to a great extent) and open-ended questions, feasibility and acceptability of the coach education sessions.

5.3.9 Statistical Analysis

All analyses were conducted using SPSS 21.0 (Chicago, IL, USA) and alpha was set at $p < 0.05$. All variables and residuals were checked for normality using the Shapiro-Wilk test. Independent samples $t$-tests and Mann-Whitney $U$-tests were then
conducted, as appropriate, to examine (1) baseline differences between groups on the primary and secondary outcomes and (2) baseline differences between players who completed the study and those lost to follow-up.

Linear mixed models, which have the advantage of being robust to the biases of missing data (Mallinckrodt, Watkin, Molenberghs, & Carroll, 2004), were used to examine the efficacy of the intervention on all primary and secondary outcomes and also to assess coaches’ physical activity levels. The fixed effects of experimental condition (intervention versus control), time (baseline versus follow-up), and a condition-by-time interaction were assessed on primary and secondary outcome variables. Also, baseline data were used as a covariate in each linear mixed model. The intention-to-treat principle was used in all mixed models, where data from all participants were included regardless of whether or not they completed follow-up assessments. Cohen’s $d$ was also calculated to display effect sizes for all primary and secondary outcomes.

5.4 Results

5.4.1 Preliminary analyses

The participant flowchart can be viewed in the Figure 5.2. A total of 76 players and 8 coaches were recruited into the study, provided written informed consent/assent, and completed baseline assessments. Players’ and coaches’ baseline characteristics are shown in Tables 5.3 and 5.4, respectively. There were no statistically significant differences between intervention and control groups for primary or secondary outcomes at baseline. Four players did not attend the basketball program during follow-up
assessments, 35 (92.1%) and 37 (97.4%) intervention and control players were retained, respectively. All coaches were retained from baseline to follow-up.

The four players who stopped attending the program had significantly lower SDI scores at baseline than those who completed the study (mean [standard deviation], -5.3[0.4] versus 8.7[4.4]). Residuals for all primary and secondary outcomes were approximately normally distributed.
Figure 5.2. Participant flowchart for the basketball program.

85 Players assessed for eligibility
11 Coaches assessed for eligibility

9 Players excluded
  6 Did not meet inclusion criteria
  3 Decided not to participate
  3 Coaches did not meet inclusion criteria

76 Players randomised
8 Coaches randomised

38 Players allocated to intervention
  4 Coaches allocated to intervention

3 Players lost to follow-up (no longer interested)
  0 Coaches lost to follow-up

38 Players included in analysis
  4 Coaches included in analysis

38 Players allocated to control
  4 Coaches allocated to control

1 Players lost to follow-up (no longer interested)
  0 Coaches lost to follow-up

38 Players included in analysis
  4 Coaches included in analysis
### Table 5.3. Baseline characteristics for players in the basketball program.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All players (N=76)</th>
<th>Intervention (n=38)</th>
<th>Control (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), years</td>
<td>10.5 (1.0)</td>
<td>10.9 (1.0)</td>
<td>10.2 (0.9)</td>
</tr>
<tr>
<td>Height, mean (SD), cm</td>
<td>147.2 (9.6)</td>
<td>150.5 (7.8)</td>
<td>147.1 (10.1)</td>
</tr>
<tr>
<td>Weight, mean (SD), kg</td>
<td>40.6 (10.4)</td>
<td>40.8 (9.9)</td>
<td>40.5 (10.9)</td>
</tr>
<tr>
<td>Waist circumference, mean (SD), cm</td>
<td>65.7 (8.2)</td>
<td>63.9 (6.3)</td>
<td>67.5 (9.4)</td>
</tr>
<tr>
<td>BMI, mean (SD), kg/m²</td>
<td>18.6 (3.5)</td>
<td>17.8 (3.1)</td>
<td>19.3 (3.8)</td>
</tr>
<tr>
<td>Players born in Australia, No. (%)</td>
<td>69 (90.8)</td>
<td>33 (86.8)</td>
<td>36 (94.7)</td>
</tr>
<tr>
<td>Ethnicity,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>50 (65.8)</td>
<td>24 (63.2)</td>
<td>26 (68.4)</td>
</tr>
<tr>
<td>European</td>
<td>12 (15.8)</td>
<td>6 (15.8)</td>
<td>6 (15.8)</td>
</tr>
<tr>
<td>Asian</td>
<td>10 (13.2)</td>
<td>6 (15.8)</td>
<td>4 (10.5)</td>
</tr>
<tr>
<td>Other</td>
<td>4 (5.3)</td>
<td>2 (5.3)</td>
<td>2 (5.3)</td>
</tr>
<tr>
<td>Plays OYS basketball, No. (%)</td>
<td>56 (73.7)</td>
<td>29 (76.3)</td>
<td>27 (71.1)</td>
</tr>
<tr>
<td>Number of practices/week, mean (SD), No.</td>
<td>1.3 (0.6)</td>
<td>1.3 (0.6)</td>
<td>1.4 (0.6)</td>
</tr>
<tr>
<td>Practices duration, mean (SD), mins</td>
<td>91.7 (39.5)</td>
<td>90.5 (40.5)</td>
<td>93.0 (42.7)</td>
</tr>
<tr>
<td>Number of games/week, mean (SD), No.</td>
<td>1.3 (0.5)</td>
<td>1.3 (0.5)</td>
<td>1.2 (0.4)</td>
</tr>
<tr>
<td>Game duration, mean (SD), mins</td>
<td>50.7 (18.9)</td>
<td>52.2 (20.8)</td>
<td>49.1 (16.9)</td>
</tr>
</tbody>
</table>

*Note. OYS, organised youth sports.*
Table 5.4. Baseline characteristics for coaches in the basketball program.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All coaches (N=8)</th>
<th>Intervention (n=4)</th>
<th>Control (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), years</td>
<td>19.3 (1.1)</td>
<td>19.0 (0.6)</td>
<td>19.5 (0.5)</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2 (25)</td>
<td>1 (25)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>Female</td>
<td>6 (75)</td>
<td>3 (75)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Height, mean (SD), cm</td>
<td>175.6 (9.3)</td>
<td>173.2 (3.7)</td>
<td>178.8 (5.8)</td>
</tr>
<tr>
<td>Weight, mean (SD), kg</td>
<td>74.6 (19.7)</td>
<td>66.5 (9.7)</td>
<td>82.8 (12.6)</td>
</tr>
<tr>
<td>BMI, mean (SD) kg/m²</td>
<td>23.7 (4.0)</td>
<td>21.8 (1.1)</td>
<td>25.7 (2.4)</td>
</tr>
<tr>
<td>Coaches born in Australia, No. (%)</td>
<td>7 (87.5)</td>
<td>4 (100)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Cultural background, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>7 (87.5)</td>
<td>4 (100)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (12.5)</td>
<td>0 (0)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>Coaching experience (SD), years</td>
<td>5.0 (0.8)</td>
<td>5.0 (0.8)</td>
<td>5.0 (0.8)</td>
</tr>
<tr>
<td>Plays OYS basketball, No. (%)</td>
<td>8 (100)</td>
<td>4 (100)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>Number of practices/week, mean (SD), No.</td>
<td>1.5 (1.1)</td>
<td>1.5 (1.0)</td>
<td>1.5 (1.3)</td>
</tr>
<tr>
<td>Practice duration, mean (SD), mins</td>
<td>105.0 (96.2)</td>
<td>90.0 (38.7)</td>
<td>120.0 (57.4)</td>
</tr>
<tr>
<td>Number of games/week, mean (SD), No.</td>
<td>1.3 (0.7)</td>
<td>1.0 (0)</td>
<td>1.5 (1.0)</td>
</tr>
<tr>
<td>Game duration, mean (SD), mins</td>
<td>50.6 (28.1)</td>
<td>40 (0)</td>
<td>61.3 (19.6)</td>
</tr>
<tr>
<td>Number of practices coached/week, mean (SD), No.</td>
<td>1.3 (0.5)</td>
<td>1.3 (0.5)</td>
<td>1.3 (0.5)</td>
</tr>
<tr>
<td>Practice duration, mean (SD), mins</td>
<td>63.8 (3.8)</td>
<td>60.0 (0)</td>
<td>67.5 (7.5)</td>
</tr>
</tbody>
</table>

*Note.* OYS, organised youth sports.
5.4.2 Primary and secondary outcomes – players

Primary and secondary outcomes related to the players are reported in Table 5.5 (physical activity intensity based on Evenson et al.’s cut-points). There was a significant condition-by-time interaction for the proportion of practice time spent in MVPA (mean difference [MD] = 14.6%; standard error [SE] = 2.2%; $d = 1.73$), vigorous physical activity (VPA, MD = 12.6%, SE = 1.9%, $d = 1.49$), moderate physical activity (MPA; MD = 2.0%, SE = 0.9%, $d = 0.24$), inactive (MD = -14.6%, SE = 2.3%, $d = -1.72$), and steps/min (MD = 20.3%, SE = 2.7%, $d = 2.40$). A significant condition-by-time interaction was not found for light physical activity (LPA; MD = 0%, SE = 1.1%, $d = -0.01$).

A significant within-group change over time was found in the intervention group, where the proportion of practice time spent in MVPA was increased by 15.1% (SE = 1.4%) from baseline to follow-up. Most of the increase in MVPA in the intervention group was due to an increase in the proportion of practice time spent in VPA compared to MPA (12.2%, SE = 1.2% versus 2.9%, SE = 0.4%, respectively). There was a significant reduction in the proportion of practice time spent inactive in the intervention group (-14.2%, SE = 1.6%) from baseline to follow-up. The intervention group also significantly increased steps/min from baseline to follow-up (21.4, SE = 1.7). No significant changes over time were found in the control group for any physical activity intensity or steps/min.
Table 5.5. Mean proportion of practice time and changes in physical activity intensity from baseline to follow-up - Evenson et al. (2008) cut-points.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condition</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>Change over time</th>
<th>Condition-by-time interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>%MVPA(^a)</td>
<td>Intervention</td>
<td>21.5</td>
<td>1.0</td>
<td>36.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Control</td>
<td>21.6</td>
<td>1.2</td>
<td>22.0</td>
<td>1.5</td>
<td>0.4</td>
</tr>
<tr>
<td>%VPA(^a)</td>
<td>Intervention</td>
<td>13.4</td>
<td>0.7</td>
<td>25.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Control</td>
<td>13.2</td>
<td>0.8</td>
<td>13.0</td>
<td>1.4</td>
<td>-0.2</td>
</tr>
<tr>
<td>%MPA(^a)</td>
<td>Intervention</td>
<td>8.1</td>
<td>0.3</td>
<td>11.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Control</td>
<td>8.5</td>
<td>0.4</td>
<td>9.0</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>%LPA(^a)</td>
<td>Intervention</td>
<td>26.1</td>
<td>0.9</td>
<td>25.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Control</td>
<td>26.2</td>
<td>0.8</td>
<td>25.3</td>
<td>0.8</td>
<td>-0.8</td>
</tr>
<tr>
<td>%INA(^a)</td>
<td>Intervention</td>
<td>52.4</td>
<td>1.5</td>
<td>38.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Control</td>
<td>52.2</td>
<td>1.6</td>
<td>52.7</td>
<td>1.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Steps/min</td>
<td>Intervention</td>
<td>32.1</td>
<td>1.2</td>
<td>53.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Control</td>
<td>31.7</td>
<td>1.4</td>
<td>33.2</td>
<td>1.8</td>
<td>1.5</td>
</tr>
<tr>
<td>SDI</td>
<td>Intervention</td>
<td>7.8</td>
<td>0.9</td>
<td>7.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Control</td>
<td>8.9</td>
<td>0.6</td>
<td>9.5</td>
<td>0.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Note.** %MVPA, proportion of practice time in moderate-to-vigorous physical activity; %VPA, proportion of practice time in vigorous physical activity; %MPA, proportion of practice time in moderate physical activity; %LPA, proportion of practice time in light physical activity; %INA, proportion of practice time inactive; Steps/min, steps per minute; SDI, self-determination index.

\(^a\)Physical activity intensity based on Evenson et al.’s (2008) cut-points.
The mean proportion of time and the changes from baseline to follow-up in physical activity intensity using Freedson et al.’s cut-points are reported in Table 5.6. Sensitivity analysis revealed that regardless of cut-point used (i.e., Evenson or Freedson et al.) the same physical activity intensity variables were found to have a significant condition-by-time interaction and significant within-group changes over time from baseline to follow-up (i.e., MVPA, VPA, MPA, inactivity).
Table 5.6. Mean proportion of practice time and changes in physical activity intensity from baseline to follow-up - Freedson et al. (2005) cut-points.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condition</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>Change over time</th>
<th>Condition-by-time interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>%MVPA a</td>
<td>Intervention</td>
<td>27.4</td>
<td>1.1</td>
<td>43.5</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>28.0</td>
<td>1.3</td>
<td>28.5</td>
<td>1.6</td>
</tr>
<tr>
<td>%VPA a</td>
<td>Intervention</td>
<td>14.7</td>
<td>0.8</td>
<td>27.6</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14.6</td>
<td>0.9</td>
<td>14.7</td>
<td>1.4</td>
</tr>
<tr>
<td>%MPA a</td>
<td>Intervention</td>
<td>12.7</td>
<td>0.5</td>
<td>16.0</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>13.4</td>
<td>0.6</td>
<td>13.8</td>
<td>0.5</td>
</tr>
<tr>
<td>%LPA a</td>
<td>Intervention</td>
<td>20.2</td>
<td>0.7</td>
<td>18.4</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>19.8</td>
<td>0.7</td>
<td>18.3</td>
<td>0.6</td>
</tr>
<tr>
<td>%INA a</td>
<td>Intervention</td>
<td>52.4</td>
<td>1.5</td>
<td>38.2</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>52.2</td>
<td>1.6</td>
<td>52.7</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Note. %MVPA, proportion of practice time in moderate-to-vigorous physical activity; %VPA, proportion of practice time in vigorous physical activity; %MPA, proportion of practice time in moderate physical activity; %LPA, proportion of practice time in light physical activity; %INA, proportion of practice time inactive; Steps/min, steps per minute; SDI, self-determination index.

a Physical activity intensity based on Freedson et al.’s (2005) cut-points.
No significant condition-by-time interaction was found for motivation (SDI; MD = -0.8, SE = 0.6, d = -0.15). Also, no significant change over time for motivation (SDI) from baseline to follow-up in the intervention and control groups was found.

5.4.3 Secondary outcomes – coaches

Secondary outcomes related to the coaches are reported in Table 5.7. There was a significant condition-by-time interaction on the proportion of practice time spent in management (MD = -6.4%, SE = 2.5%, d = -1.28). There were no other significant condition-by-time interactions found for any of the other lesson context variables (knowledge, MD = -7.3%, SE = 6.7%, d = -0.54; fitness, MD = -2.2%, SE = 2.1%, d = -0.52; skill practice, MD = 9.1%, SE = 2.8%, d = 1.63; game play, MD = 6.7%, SE = 4.3%, d = 0.78; and free play, MD = 0.15%, SE = 0.3%, d = 0.25). Regarding the leader behaviour variables, there was a significant condition-by-time interaction for promoting physical activity (MD = 6.1, SE = 2.8, d = 1.09) and demonstrating physical activity (MD = 6.6, SE = 2.8, d = 1.14), but not discouraging physical activity (MD = -0.13, SE = 0.5, d = -0.5).

A significant within-group change over time was found in the intervention group, where the proportion of practice time spent in management was decreased by 5.2% (SE = 1.7%) from baseline to follow-up. No other significant within-group changes over time were found for lesson context variables (i.e., knowledge, fitness, skill practice, game play, free play). There were significant within-group changes over time in the intervention group for promoting physical activity (MD = 4.9, SE = 1.0) and
demonstrating physical activity (MD = 6.4, SE = 2.8%). No significant within-group changes over time were found for discouraging physical activity.

Further, no significant condition-by-time interaction was found for autonomy support (MD = -0.2, SE = 0.2, $d = -0.5$). Also, no significant change over time for autonomy support from baseline to follow-up in the intervention and control groups was found.
Table 5.7. Mean proportion of practice time and changes in lesson context, leader behaviour, and players’ perceived autonomy support from baseline to follow-up.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condition</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>Change over time</th>
<th>Condition-by-time interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>Management</td>
<td>Intervention</td>
<td>15.0</td>
<td>2.6</td>
<td>9.8</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>15.1</td>
<td>1.9</td>
<td>16.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Intervention</td>
<td>22.9</td>
<td>4.2</td>
<td>16.1</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>22.5</td>
<td>1.7</td>
<td>23.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Fitness</td>
<td>Intervention</td>
<td>6.8</td>
<td>5.9</td>
<td>4.4</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>6.6</td>
<td>0.6</td>
<td>6.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Skill practice</td>
<td>Intervention</td>
<td>44.5</td>
<td>4.0</td>
<td>47.6</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>43.8</td>
<td>5.0</td>
<td>38.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Game play</td>
<td>Intervention</td>
<td>10.5</td>
<td>5.0</td>
<td>21.7</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>11.7</td>
<td>4.9</td>
<td>15.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Free play</td>
<td>Intervention</td>
<td>0.4</td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Promoting PA</td>
<td>Intervention</td>
<td>17.5</td>
<td>2.9</td>
<td>22.4</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>16.3</td>
<td>2.0</td>
<td>16.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Discouraging PA</td>
<td>Intervention</td>
<td>0.9</td>
<td>0.5</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>1.0</td>
<td>1.0</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Demonstrating PA</td>
<td>Intervention</td>
<td>8.9</td>
<td>0.9</td>
<td>14.3</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>8.1</td>
<td>1.5</td>
<td>7.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Intervention</td>
<td>4.5</td>
<td>1.0</td>
<td>4.2</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>4.2</td>
<td>1.0</td>
<td>4.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Note.* PA, physical activity. *a*Proportion of practice time in lesson context. *b*Occurrences per session.
5.4.4 Coaches’ physical activity levels

Table 5.8 presents the mean proportion of practice time and changes in coach physical activity intensity outcomes from baseline to follow-up. A significant condition-by-time interaction, in the intervention group, was found for VPA (MD = 3.1, SE = 0.8, $d = 1.93$). There was also a significant condition-by-time interaction, in the control group, for inactivity (MD = 23.5, SE = 9.9, $d = 1.19$). No significant condition-by-time interaction was found for MVPA (MD = 10.7, SE = 6.8, $d = 0.79$), MPA (MD = 7.8, SE = 6.3, $d = 0.62$), LPA (MD = 12.8, SE = 4.7, $d = 1.36$), or steps/min (MD = 11.3, SE = 7.8, $d = 0.72$).

A significant within-group change over time was found in the intervention group; these coaches increased the proportion of time spent in VPA by 4.0% (SE = 0.8) and increased their steps/min by 10.0 (SE = 4.7). There was also a significant within-group change over time found in the control group, where the proportion of time spent in LPA decreased (MD = -9.5%, SE = 3.8) and the proportion of time spent inactive increased (MD = 13.1%, SE = 4.1). No significant within-group change over time was found for MVPA or MPA.
Table 5.8. Mean proportion of practice time and changes in coach physical activity intensity outcomes from baseline to follow-up.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Condition</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>Change over time</th>
<th>Condition-by-time interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>%MVPA$^a$</td>
<td>Intervention</td>
<td>11.5</td>
<td>3.5</td>
<td>17.2</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>10.1</td>
<td>2.6</td>
<td>6.5</td>
<td>1.2</td>
</tr>
<tr>
<td>%VPA$^a$</td>
<td>Intervention</td>
<td>1.9</td>
<td>0.5</td>
<td>4.0</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>1.1</td>
<td>0.3</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>%MPA$^a$</td>
<td>Intervention</td>
<td>9.6</td>
<td>3.0</td>
<td>13.3</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>9.1</td>
<td>2.5</td>
<td>5.6</td>
<td>1.1</td>
</tr>
<tr>
<td>%LPA$^a$</td>
<td>Intervention</td>
<td>32.4</td>
<td>2.8</td>
<td>32.2</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>28.9</td>
<td>2.2</td>
<td>19.4</td>
<td>3.6</td>
</tr>
<tr>
<td>%INA$^a$</td>
<td>Intervention</td>
<td>56.1</td>
<td>5.3</td>
<td>50.6</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>60.9</td>
<td>4.6</td>
<td>74.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Steps/min</td>
<td>Intervention</td>
<td>25.9</td>
<td>5.1</td>
<td>35.9</td>
<td>8.4</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>20.3</td>
<td>5.8</td>
<td>14.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

*Note. %MVPA, proportion of practice time in moderate-to-vigorous physical activity; %VPA, proportion of practice time in vigorous physical activity; %MPA, proportion of practice time in moderate physical activity; %LPA, proportion of practice time in light physical activity; %INA, proportion of practice time inactive; Steps/min, steps per minute. $^a$Physical activity intensity based on Troiano et al.’s (2008) cut-points.*
5.5 Process evaluation

5.5.1 Process evaluation results for the coach education sessions

The results from the process evaluation, assessing the feasibility and acceptability of the coach education sessions among intervention coaches, are presented in Table 5.9. Overall, coaches found the coach education sessions important (mean score \( \pm SD = 3.8/5 \pm 1.0 \)), valuable (3.8/5 \( \pm 0.5 \)), informative (4.0/5 \( \pm 0.8 \)), interesting (3.5/5 \( \pm 0.6 \)), and beneficial (4.3/5 \( \pm 0.5 \)), and reported learning a great deal from the coach education sessions (4.3/5 \( \pm 0.5 \)). Of the topics discussed in the coach education sessions, most were very well received (mean score of 4/5 or greater). In particular, coaches reported that the most important/relevant topics discussed were step counts information and its association with target MVPA levels for a session (4.8/5 \( \pm 0.5 \)), Strategies to increase MVPA and reduce inactivity (both scoring 4.5/5 \( \pm 0.6 \)), and the coach feedback forms (4.5/5 \( \pm 0.6 \)). Practice session planning was scored as the least important/relevant topic discussed in the coach education sessions.
Table 5.9. Process evaluation results from intervention coaches regarding the coach education sessions.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the coach education sessions a range of topics were discussed, how</td>
<td></td>
</tr>
<tr>
<td>did you find each topic to be in relation to coaching girls in organised</td>
<td></td>
</tr>
<tr>
<td>youth sport?(^a)</td>
<td></td>
</tr>
<tr>
<td>Strategies to increase moderate-to-vigorous physical activity</td>
<td>4.5 (0.6)</td>
</tr>
<tr>
<td>Strategies to decrease inactivity</td>
<td>4.5 (0.6)</td>
</tr>
<tr>
<td>Practice session planning</td>
<td>3.0 (1.4)</td>
</tr>
<tr>
<td>Goal-setting</td>
<td>3.8 (1.0)</td>
</tr>
<tr>
<td>Self-monitoring</td>
<td>3.8 (1.0)</td>
</tr>
<tr>
<td>Feedback on physical activity levels and lesson contexts from practice</td>
<td>4.5 (0.6)</td>
</tr>
<tr>
<td>sessions</td>
<td></td>
</tr>
<tr>
<td>Reflecting on practice sessions</td>
<td>4.0 (0.0)</td>
</tr>
<tr>
<td>Step counts and its association with target MVPA levels for a session</td>
<td>4.8 (0.5)</td>
</tr>
<tr>
<td>Role playing scenarios/case studies</td>
<td>4.0 (0.8)</td>
</tr>
<tr>
<td>Overall, to what extent did you find the material delivered during the</td>
<td></td>
</tr>
<tr>
<td>coach education sessions to be… (^a)</td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td>3.8 (1.0)</td>
</tr>
<tr>
<td>Boring</td>
<td>1.0 (0.6)</td>
</tr>
<tr>
<td>Valuable</td>
<td>3.8 (0.5)</td>
</tr>
<tr>
<td>Informative</td>
<td>4.0 (0.8)</td>
</tr>
<tr>
<td>Interesting</td>
<td>3.5 (0.6)</td>
</tr>
<tr>
<td>A waste of time</td>
<td>1.0 (0.5)</td>
</tr>
<tr>
<td>Beneficial</td>
<td>4.3 (0.5)</td>
</tr>
<tr>
<td>Overall, to what extent did you intend to use the topics discussed in</td>
<td></td>
</tr>
<tr>
<td>future practice sessions? (^a)</td>
<td></td>
</tr>
<tr>
<td>Strategies to increase moderate-to-vigorous physical activity</td>
<td>4.5 (0.5)</td>
</tr>
<tr>
<td>Strategies to decrease inactivity</td>
<td>4.5 (0.5)</td>
</tr>
<tr>
<td>Practice session planning</td>
<td>3.0 (1.4)</td>
</tr>
<tr>
<td>Goal-setting</td>
<td>3.5 (1.0)</td>
</tr>
<tr>
<td>Self-monitoring</td>
<td>3.3 (1.3)</td>
</tr>
<tr>
<td>Feedback on physical activity levels and lesson contexts from practice</td>
<td>3.8 (1.0)</td>
</tr>
<tr>
<td>sessions</td>
<td></td>
</tr>
<tr>
<td>Reflecting on practice sessions</td>
<td>4.0 (0.8)</td>
</tr>
<tr>
<td>Step counts and its association with target MVPA levels for a session</td>
<td>2.3 (1.0)</td>
</tr>
<tr>
<td>Overall, how much did you learn from the coach education sessions? (^b)</td>
<td>4.3 (0.5)</td>
</tr>
</tbody>
</table>

\(^a\)= 1 = not at all; 5 = to a great extent; \(^b\)= 1 = nothing at all; 5 = a great deal.
Intervention coaches’ responses to the open-ended portion of the questionnaire are shown in Table 5.10. Coaches were given the opportunity to provide additional comments on the materials delivered during the coach education sessions. The information provided in the coach education sessions regarding current MVPA and inactivity in the OYS literature was well received. For example, a coach reported enjoying being presented with case studies, modifying the drills of the practice in the case study to increase MVPA, then sharing their modified drills with one another and demonstrated/practiced the drills on a basketball court in a gym.

5.5.2 Aspects coaches liked most about the coach education sessions

Most coaches reported receiving the coach feedback information (which included group average step counts/minute, a breakdown of the proportion of time they spent in each lesson context, and leader behaviour information from SOFIT) when asked which aspect(s) coaches liked most about the coach education sessions. Coaches reported using that information to see where they have improved/still need improvement, seeing how close they were to a 50% time MVPA target, and to plan for future sessions. One coach stated she enjoyed discussing and modifying drills with the other coaches in attendance.

5.5.3 Coaches’ intention to implement what they had learned in the coach education sessions
All coaches reported that they intended to implement approaches they had learned in the coach education sessions with other teams they coached. Coaches stated that they thought it would be easy for them to implement some of the strategies that were taught in the coach education sessions to modify their drills to increase MVPA and reduce inactivity. One coach claimed that she felt more mindful of her players’ physical activity levels, in particular when they were inactive (standing around).

5.5.4 Positives and/or negatives found with drill modification

Only 2 of the 4 intervention coaches responded to this question. One coach thought that after she had modified some of her drills, she found her players were tiring more quickly. This coach, however, did not perceive this to be a problem because she believed that her players were still having fun. Another coach reported that she felt her practice sessions flowed better by implementing more circuits at practice.

5.5.5 Aspects coaches liked least about the coach education sessions

Coaches claimed they would have liked the coach education sessions more if they were more specific to basketball. Another coach would have preferred more practical-based aspects included (e.g., gym-based activities).

5.5.6 Coaches’ suggestions for improvements or changes to the coach education sessions
Coaches’ would like to have more coaches involved in future coach education sessions. As mentioned above, one coach would like more practical-based aspects included in future.
Table 5.10. Intervention coaches’ responses to open-ended questions regarding the coach education sessions.

<table>
<thead>
<tr>
<th>Question</th>
<th>Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional comments on the materials delivered during the coach education sessions?</td>
<td>“Facts provided were good to prove that an increase in MVPA is necessary in basketball training sessions.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“Information provided was interesting and showed how inactive people are during basketball training, specifically girls.” (Intervention coach 2)</td>
</tr>
<tr>
<td></td>
<td>“I really enjoyed the case studies and then modifying drills based on the case study by role playing in the gym.” (Intervention coach 3)</td>
</tr>
<tr>
<td>What did you like most about coach education sessions?</td>
<td>“The feedback forms. Seeing where I’ve improved, what needs improvement, how much improvement, etc.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“Information provided about how many steps/min should be taken to spend 50% of time in MVPA during each training session – 82 to 88 steps are meant to be taken.” (Intervention coach 2)</td>
</tr>
<tr>
<td></td>
<td>“The swapping of training drills (from the other coaches in the coach education sessions) and ways to modify the activities to add more activity.” (Intervention coach 3)</td>
</tr>
<tr>
<td></td>
<td>“Feedback of training sessions (i.e., the percentages). This helped with planning for future sessions.” (Intervention coach 4)</td>
</tr>
<tr>
<td>Do you intend to use what you’ve learned in the coach education sessions with your other teams?</td>
<td>“Absolutely I hate when people are sitting around. I’ll definitely use the strategies we learned.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“Definitely, we learned some easy ways to change up our drills to get the kids more active.” (Intervention coach 2)</td>
</tr>
<tr>
<td></td>
<td>“It’s fairly easy to implement what we learned in the sessions given that we’re pretty much just altering drills that we use already anyways. I definitely have more ideas on how to do that.” (Intervention coach 3)</td>
</tr>
<tr>
<td></td>
<td>“Definitely I feel more mindful of things especially when they’re standing around.” (Intervention coach 4)</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Question</th>
<th>Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were there any positives or negatives when you modified drills?</td>
<td>“The kids get tired a lot quicker, but that’s because they haven’t really done this much at training before but they still seemed like they were having fun.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“the sessions seemed to flow nicer using more circuits.” (Intervention coach 2)</td>
</tr>
<tr>
<td>What did you like least about coach education sessions?</td>
<td>“Needs to be more specific towards basketball.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“Need to specify more towards the sport researching (basketball).” (Intervention coach 2)</td>
</tr>
<tr>
<td></td>
<td>“I would prefer to have more time for practical-based things in the gym.” (Intervention coach 3)</td>
</tr>
<tr>
<td>Do you have any suggestions for improvements or changes to be made for future coach education sessions?</td>
<td>“More coaches included and more specific to basketball.” (Intervention coach 1)</td>
</tr>
<tr>
<td></td>
<td>“More coaches to bounce ideas off of and to learn new ideas/drills from.” (Intervention coach 2)</td>
</tr>
<tr>
<td></td>
<td>“It would’ve been nice if the sessions were more practical-based and on-the-move.” (Intervention coach 3)</td>
</tr>
</tbody>
</table>
5.6 Discussion

Despite sport having been identified as a research priority in the area of youth physical activity and sedentary behaviour (Almond et al., 2013; Gillis et al., 2013), to the author’s knowledge, no RCTs have been conducted in OYS promoting physical activity. Primarily, this study aimed to assess the short-term efficacy of coach education on female basketball players’ MVPA during practice in an OYS context over a five-day basketball program. The secondary aims of this study were to assess whether coach education could lower the proportion of practice time players spent inactive, investigate effects on players’ motivation and perceived autonomy-support, and assess how time was spent during practice (lesson context) and leader behaviour, via SOFIT. This study’s findings provided strong support for the study hypotheses and the short-term efficacy of coach education on increasing time spent in MVPA and reducing time spent inactive without detrimental effects to players’ motivation or perceived autonomy support.

At baseline, the observed proportions of time spent in each physical activity intensity (i.e., MVPA, VPA, MPA, LPA, inactivity) were comparable to previous (cross-sectional) studies in OYS (Guagliano et al., 2013; Sacheck et al., 2011). From baseline to follow-up, players in the intervention group spent a significantly higher proportion of practice time in MVPA, VPA, and MPA, and a significantly lower proportion of practice time inactive, compared to the control group. The majority of the increase in proportion of time spent in MVPA in the intervention group at follow-up came from increases in VPA (as opposed to MPA). This is a noteworthy finding, as
recent studies have found that VPA (and no other physical activity intensity) was associated with a significant reduction in cardiometabolic risk in youth (Carson et al., 2014; Hay et al., 2012). In a previous study, VPA was negatively associated with body mass index, waist circumference, and systolic blood pressure, and positively associated with cardiorespiratory fitness (Hay et al., 2012). The study by Hay et al. (2012) indicated that accumulating approximately seven minutes (or more) of VPA daily significantly reduced the odds of overweight status and elevated systolic blood pressure; thus, VPA may assist in improving youth cardiometabolic profiles. VPA has also been shown to ameliorate negative airway health outcomes in youth (participants accumulated approximately eight to nine minutes of VPA per session over eight weeks) (Rosenkranz et al., 2012). This demonstrates an important benefit of VPA considering asthma is the most common chronic disease among youth (Lucas & Platts-Mills, 2006). Intervention players in the current study spent approximately 11.5 minutes of practice time in VPA each practice at follow-up, exceeding the amount of VPA that previous studies have suggested for players to incur health benefits (Carson et al., 2014; Hay et al., 2012).

Motivation is an important factor in OYS because it can affect the experiences and likelihood of youth participating in OYS in the future (Conroy, Kaye, & Coatsworth, 2006). Whilst not a topic discussed in the coach education sessions, players’ motivation and autonomy support was monitored based on findings that emerged from Study 2 (Chapter 4). Coaches who participated in Study 2 expressed concern about increasing girls’ MVPA because they thought it could result in reduced motivation to participate and/or dropout from OYS (Guagliano, Lonsdale, Rosenkranz,
et al., 2014). No significant changes in motivation (SDI) or autonomy support from baseline to follow-up were found for either intervention or control group. Thus, coaches can have greater confidence that increasing physical activity during practice does not necessarily have a negative effect on players’ motivation or perceived autonomy support towards OYS or their coaches.

Only one peer-reviewed study by Guagliano et al. (2013) has examined lesson context (i.e., management, knowledge delivery, fitness, skill practice, game play, free play) and leader behaviour (i.e., promoting, demonstrating, discouraging physical activity) at practice in OYS using SOFIT (McKenzie et al., 1991). Baseline mean values of each lesson context type and leader behaviour variable in the current study were comparable to the study conducted by Guagliano et al. (2013).

In the current study, coaches in the intervention group significantly decreased the proportion of practice time spent in management from baseline to follow-up, compared to the control group. Although the changes found in the other lesson context variables (i.e., knowledge delivery, fitness, skill practice, game play, free play) were not statistically significant, they were moving in the hypothesised directions. These are important findings, as Dudley et al. (2012) found negative correlations between MVPA and management/knowledge delivery and positive correlations between MVPA and game play. Thus, the reduction in proportion of time spent in management and knowledge delivery and increase in proportion of time spent in game play found may have contributed to the significant increases and decreases in proportion of time players spent in MVPA and inactive, respectively.
Coaches in the intervention group significantly increased the occurrences (per practice) of promoting and demonstrating physical activity from baseline to follow-up, compared to the control group. Studies have suggested that praise/encouragement is a major influence on youth physical activity (Beets, Cardinal, & Alderman, 2010) and youth with a positive exercise role model have higher perceived competence and enjoyment (Babkes & Weiss, 1999); therefore, increases in promoting and demonstrating physical activity may have influenced players’ MVPA. Given the lack of empirical evidence concerning lesson context and leader behaviour in an OYS setting, further research is warranted to investigate the effect of lesson context and leader behaviour on players’ (in)activity.

Reflecting on the information provided by the intervention coaches in the process evaluation regarding coach education sessions, overall, these sessions seemed to be very well received by the coaches. Coaches found the coach education sessions important, valuable, informative, interesting, and beneficial, and reported learning a great deal from these sessions. Delivering future interventions to coaches in OYS via coach education sessions, then, seems to be a promising avenue. Almost all of the coaches reported that receiving the coach feedback forms was the aspect of the intervention that they liked best. During the coach education sessions, coaches were instructed on how to interpret the information provided in these coach feedback forms (section 5.3.7). After the two coach education sessions, coaches appeared competent with their ability to interpret the data they were provided in the feedback forms, and reported using the information to modify their practice sessions and plan future practices. Coaches’ ability to quickly learn the implications of the data provided is a
promising finding and is in line with literature that suggests that feedback combined with effective instruction can be powerful for enhancing learning (Hattie & Timperley, 2007).

Some potential limitations should be considered when interpreting the current findings. First, conducting this study as an OYS basketball program (rather than using players’ usual competition teams and coaches) may have limited the generalisability of the findings, but it has increased the study’s internal validity because it allowed for the efficacy of the intervention to be tested in a more tightly controlled environment. Given that highly controlled studies are lacking in this area of OYS research, it was essential to first determine if this intervention was efficacious under optimum conditions before determining its effectiveness with intact community-based OYS teams. Further, conducting this study in the form of an OYS basketball program (rather than using players’ usual competition teams and coaches) allowed for randomisation at the individual level – assigning players to different practice groups and coaches within their allocated arm each practice session period. Conducting this study in this manner, may have introduced cross-classified clustering, however. Second, fewer participants than sought were recruited, which may be a reflection of the disparity of physical activity participation between boys and girls (Kahn et al., 2008; Nader et al., 2008). That said, more participants were recruited than needed for this study to be fully powered. Third, given the temporary nature of the basketball program, this study only investigated the short-term efficacy of coach education on player physical activity and did not allow for a follow up. Fourth, there was the possibility of contamination between the intervention and the control coaches given that all coaches, however, this was unavoidable. Lastly, a
convenience sample was used; therefore, there is the potential for selection bias. Based on the limitations mentioned above, the ability to generalise the current findings may be limited.

Despite these limitations, this RCT was novel and used objective measurement that allowed for a rigorous description of the physical activity levels that girls achieved during practice. Further strengths of this fully powered RCT included high internal validity, high retention rates, the use of linear mixed models (which allowed for the inclusion of all participants for analyses), and physical activity data presented using two cut-points (Evenson and Freedson). Future research should investigate potential mediators of players’ MVPA and inactivity in OYS, as studies have suggested mediation analysis can be very useful for informing the design and delivery of effective programs in the future (Cerin, Barnett, & Baranowski, 2009; Dewar et al., 2014; Kraemer, Wilson, Fairburn, & Agras, 2002; Lubans et al., 2012). The long-term effectiveness of coach education on physical activity intensity using a cluster randomised controlled trial and involving players’ regular competition coaches and teammates should also be investigated.

In the future, similar studies should consider adding motivational components to their coach education programs as several studies have found that choice, autonomy, and perceptions of success and mastery are positively associated with motivation (Blanchard, Mask, Vallerand, de la Sablonnière, & Provencher, 2007; Curran, Hill, & Niemiec, 2013; Fenton, Duda, Quested, & Barrett, 2014; Lonsdale, Rosenkranz, Sanders, et al., 2013; Lonsdale et al., 2009; Prusak, Treasure, Darst, & Pangrazi, 2004).
5.7 Conclusion

As far as the author is aware, this is the first RCT conducted in an OYS context designed to investigate the efficacy of coach education (relative to a standard-care control) on player physical activity. The current findings provided strong support for the short-term efficacy of coach education on increasing MVPA and reducing inactivity during practice without deleterious effects on players’ motivation or perceived autonomy support. This study’s findings provide an important first source of evidence that can be used as a framework to inform future interventions and strategies to increase MVPA and reduce inactivity during OYS.

5.8 Synopsis

This chapter presented the third study comprising this PhD thesis. The findings of the first RCT conducted in an OYS context aimed at determining the short-term efficacy of coach education on player physical activity were presented in this chapter. In the subsequent chapter (Chapter 6), the findings of a mediation analysis that investigated whether hypothesised variables mediated the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity are discussed. Conducting a mediation analysis is an important next step because it may identify the potential mechanisms through which the intervention (Study 3) achieved its effects.
Chapter 6

Study 4 - Mediators effecting moderate-to-vigorous physical activity and inactivity for girls from an intervention program delivered in an organised youth sports setting

A manuscript based on the findings from the study presented in Chapter 6 will be submitted for peer-review at *Preventive Medicine*.


**Authorship details:**

Guagliano (75%), Lonsdale (5%), Kolt (5%), Rosenkranz (5%), Parker (5%), Agho (5%)
6.1 Introduction

This chapter presents the final study in the series forming this PhD thesis. In the previous chapter, findings from an RCT aimed at determining the short-term efficacy of coach education on player physical activity were presented. The findings presented in Chapter 5 provided support for the short-term efficacy of coach education on increasing players’ time spent in MVPA and reducing time spent inactive. In this chapter, Chapter 6, variables hypothesised to have mediated the effect of the intervention (Study 3) on player MVPA/inactivity were investigated to gain insight into why the intervention was successful in achieving its aims. A manuscript based on the findings of this study will be submitted for peer-review to Preventive Medicine.

6.2 Background

It has been suggested that sports clubs could have a role in promoting physical activity (Kelly et al., 2014). More specifically, coaches may be able to increase their players’ physical activity levels as they carry considerable influence over their players, they are viewed as experts (Conroy & Coatsworth, 2006), and have consistent direct involvement with their players (Smith & Smoll, 1997). Previous literature, however, has shown that there is likely room for improvement regarding youth physical activity levels in OYS, where a large proportion of players’ time is spent inactive or in LPA (Guagliano et al., 2013; Leek et al., 2011; Sacheck et al., 2011). Accordingly, there has been a call to evaluate strategies for increasing MVPA in OYS (Leek et al., 2011) and Vella, Cliff, and Okely (2014) have also expressed a need for interventions that promote, in particular, girls’ participation in OYS.
In the previous chapter (Chapter 5, Study 3), findings were presented from an RCT aimed at determining the short-term efficacy of coach education on player physical activity. To the author’s knowledge, no study has tested a coach education program with a specific emphasis on physical activity in OYS. The study’s findings provided support for the short-term efficacy of coach education on increasing time spent in MVPA and reducing time spent inactive, without detrimental effects to players’ motivation or perceived autonomy support. The next step was to determine why the intervention was successful in improving players’ MVPA and reducing inactivity. One method for achieving this is by investigating how certain variables may have mediated the effect of the intervention on players’ physical (in)activity.

It was plausible that coaches’ physical activity levels, lesson context (i.e., management, knowledge delivery), and coaches’ behaviours (i.e., promoting, demonstrating, or discouraging physical activity) may have mediated the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity. As previously mentioned, coaches carry considerable influence over their players (Conroy & Coatsworth, 2006), particularly if the players admire their coach (Blomquist, 1986). Also, Babkes and Weiss (1999) found that youth players had higher perceived competence, enjoyment, and intrinsic motivation when they had a positive exercise role model. Moreover, praise and encouragement has been positively associated with the intensity of youth physical activity (Bauer et al., 2008; De Bourdeaudhuij et al., 2005; King, Tergerson, & Wilson, 2008; Springer, Kelder, & Hoelscher, 2006), the amount of youth physical activity (Cardon et al., 2005; McGuire, Hannan, Neumark-Sztainer, Cossrow, & Story, 2002; Strauss, Rodzilsky, Burack, & Colin, 2001), and sports...
participation (Fredricks & Eccles, 2005). Lastly, the role of potential mediators in the relationship between environment and physical activity has been frequently cited as a future research direction (Ding & Gebel, 2012; Kaczynski & Henderson, 2008; Lubans, Foster, & Biddle, 2008). Previous literature has suggested that lesson contexts, such as management/knowledge delivery were negatively correlated with MVPA (Dudley et al., 2012). Mediation analysis, therefore, can be useful for informing the design and delivery of more effective programs in the future by identifying the possible mechanisms through which an existing intervention achieved its effects (Cerin et al., 2009; Dewar et al., 2014; Kraemer et al., 2002; Lubans et al., 2012).

Baranowski and colleagues have argued that an improved evidence base regarding mediators for physical activity change in interventions targeting youth is needed (Baranowski, Anderson, & Carmack, 1998; Baranowski & Jago, 2005). Few intervention studies, however, have used mediation analysis to establish whether the changes in the hypothesised mediators were responsible for changes in the outcome(s) of interest in the literature related to physical activity promotion (Lubans, Morgan, Collins, Warren, & Callister, 2009). Figure 6.1A depicts the total effect of an independent variable (X) on a dependent variable (Y), which can be expressed as the sum of the direct and indirect effects (i.e., C = C’ +AB). Figure 6.1B illustrates the simplest form of mediation, how X affects Y through one or more intervening variables, or mediators (M). The A path represents the effect of X on the hypothesised M, whereas the B path represents the effect of M on Y controlling for X (Preacher & Hayes, 2008). The indirect effect from X to Y including M can be the computed as the product of A and B (i.e., AB). The C’ path can be expressed as the difference between the total effect
and the indirect effect (i.e., $C' = C - AB$). All paths are normally calculated with unstandardised regression coefficients (Preacher & Hayes, 2008), and it is assumed that when mediation is present, including $M$ will reduce the magnitude of the relationship between the $X$ and $Y$ (MacKinnon, Krull, & Lockwood, 2000). Conducting a mediation analysis is an important next step in the series of studies because it can provide insight on the causal mechanisms through which the intervention achieved its effects and potential areas for improvement or further research.
Figure 6.1. (A) Illustration of a direct effect. X affects Y. (B) Illustration of a mediation design. X is hypothesised to exert an indirect effect on Y through M. Figure by Preacher and Hayes (2008, p. 880).
6.2.1 Study aim

The aim of this study was to test whether hypothesised variables mediated the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity.

6.2.2 Study hypotheses

Two separate models were investigated where it was hypothesised that coaches’ physical activity levels, lesson context (i.e., management, knowledge delivery), and coaches’ behaviours (i.e., promoting physical activity, demonstrating physical activity, discouraging physical activity) mediated the effect of the intervention on players’ MVPA (model 1) and inactivity (model 2). The two hypothesised models are illustrated in Figures 6.2 and 6.3.
Figure 6.2. Hypothesised multiple mediation model effecting players’ MVPA.

- Condition (intervention vs. control)
- Coaches’ MVPA (proportion of time)
- Management (proportion of practice time)
- Knowledge delivery (proportion of practice time)
- Promoting physical activity (occurrences/practice)
- Demonstrating physical activity (occurrences/practice)
- Player MVPA (proportion of time)

A path
B path
C (C’) path
Figure 6.3. Hypothesised multiple mediation model effecting players’ inactivity.
6.3 Methods

Data collected from the RCT discussed in Chapter 5 were used to conduct this study. The methods used to conduct the RCT were described in details in the previous chapter, therefore, only a brief description of the methods is presented below.

6.3.1 Trial design

This study was a two-armed, parallel-group RCT, using a 1:1 allocation ratio. The primary aim of the RCT was to assess whether coach education, relative to a standard-care control, could increase the proportion of time players spent in MVPA during practices over a 5-day basketball program and the study was adequately powered to do so. The study received ethics approval from the Human Research Ethics Committee of the University of Western Sydney (approval number: H10215, Appendix O) and has been registered as a clinical trial with the Australian New Zealand Clinical Trials Registry (ACTRN12613001099718, Appendix P).

6.3.2 Participants

To be considered eligible for the RCT as a player, participants needed to be female, aged 9-12 years, and intend to attend the 5-day basketball program for its duration. For coaches to be eligible to coach in the program, basketball coaching credentials from the Australian Sports Commission’s NCAS (Australian Sports Commission, n.d.) and previous experience coaching girls basketball teams were required. All participants provided written informed consent/assent. A total of 76
players (mean ± standard deviation age = 10.5 ± 1.0 years) and 8 coaches (mean ± standard deviation age = 19.3 ± 1.1 years) participated in the RCT. Further baseline characteristics for players and coaches were presented earlier in Tables 5.3 and 5.4, respectively.

### 6.3.3 Study procedure and intervention

The basketball program ran for 5 consecutive days, for 4 hours per day, over the school holiday period in September 2013 (Australian Spring). The basketball program ran simultaneously across 2 sports centres in Greater Western Sydney, Australia, with each site having 2 full-size basketball courts. At each site, the aim was to recruit 40 female players and 4 coaches and the data collection team comprised 1 supervisor and 4 research assistants.

The program was structured the same each day (see Table 5.1) and included 2 practice sessions, 2 games, and 2 coach education sessions (on day 1 and 2). In each of the practice sessions, coaches were instructed to focus on 2 skills; however, the coach planned their own practice sessions to teach these skills. Intervention coaches were provided with feedback at the end of each program day as group average step counts, lesson context, and leader behaviour were generated from SOFIT (McKenzie et al., 1991).

Coaches allocated to the intervention arm attended 2 coach education sessions. Each coach education session was approximately 2 hours in duration and took place in the afternoon following each of the first 2 days of the program. During the 2 coach
education sessions, the following topics were discussed: MVPA (what it is, how much youth should accumulate based on national guidelines), strategies to increase MVPA and decrease inactivity during practice, self-monitoring, goal-setting, and suggested target step counts per minute based on guidelines published by Scruggs (2007). During each coach education session, coaches were given time to reflect on their practice sessions and to discuss their feedback form, and they were provided with case studies and opportunities to role play on a basketball court, and to plan their practice session for the next day. Coaches allocated into the control arm of the study were asked to coach as usual.

6.3.4 Outcome measures pertinent to the current study

6.3.4.1 Accelerometry

Physical activity was assessed using ActiGraph GT3X+ accelerometers (ActiGraph; Pensacola, FL). Accelerometers were worn by players and coaches for the duration of the basketball program; however, only the physical activity levels accumulated during practices were assessed in this study. Evenson et al. (2008) and Troiano et al. (2008) cut-points were used to process raw data and estimate physical activity intensities for players and coaches, respectively. All participants wore accelerometers over their right iliac crest, held in place using an adjustable elastic belt. Accelerometers were initialised once at the start of the week and set to record data at a sampling rate of 30 Hz and later integrated into 1-second epochs using ActiGraph software.
6.3.4.2 Direct observation

SOFIT is a widely used direct observation system that uses momentary time sampling to generate data on players’ physical activity, lesson context, and leader behaviour (McKenzie et al., 1991). Only lesson context and leader behaviour data were used in the current study due to the use of accelerometry, which provided physical activity data at the individual level.

6.3.5 Statistical analysis

All analyses were conducted in R version 3.1.1 (R Core Team, 2014) and ‘lme4’ (Bates, Maechler, Bolker, & Walker, 2014) and ‘arm’ (Gelman & Yu-sung, 2013) packages were used. Preliminary analyses were conducted in 2 steps in order to choose an appropriate model. A log-likelihood ratio test was used to compare nested models. In all cases, crossed random effects multilevel models were used in which practice sessions were nested within players and coaches, and both players and coaches were nested under site. Quasi-Bayes simulation (Gelman & Hill, 2006) was used for all estimates of uncertainty using 1,000 iterations. The first step compared linear growth to quadratic growth over 8 time points. Overall, there were 10 time points (i.e., 2 practices/day * 5 days), however, the third and fourth time point (practice sessions from day 2 of the basketball program) were excluded from this analysis because they occurred while coaches were receiving the intervention (i.e., coach education sessions, see Table 5.1 in previous chapter). The result of the log-likelihood ratio test revealed that a quadratic growth model fit the data better than a linear growth model, $\chi^2(1) = 10.6, p <0.01$, and
this was used as a basis of further analysis. Next, 3 models were considered from which
the treatment effect could be evaluated. Firstly, practice session MVPA/inactivity could
differ by treatment group from the pre- and post-test session. Second, session
MVPA/inactivity could differ across treatment groups both across pre- and post-
treatment session but also by overall growth trajectory. Finally, MVPA treatment groups
could differ in their overall growth trajectory at the post-treatment, for example, but not
at the pre-treatment. Log-likelihood ratio tests were used to compare these 3 models
where the simplest model was not significantly different from the model which also
included differences in growth trajectories ($\chi^2[1] = 0, p = 0.98$) or a model in which
trajectories differed by treatment group and pre- and post-treatment practice sessions ($\chi^2
[1] = 2.69 p = 0.10$). Accordingly, the simplest model exploring differences in practice
session MVPA/inactivity at pre- and post-treatment across treatment groups was
retained throughout the course of the analysis.

Multilevel mediation models were then used to explore the research hypotheses.
Using multilevel mediation models, regression coefficients were used to calculate: (1)
the intervention’s effect on the proposed mediators (A path); (2) the effect of the
proposed mediators on the outcome of interest (B path); (3) the total effect of the
intervention on the outcome (C path); (4) the direct intervention effect (C’ path); and (5)
the indirect intervention effects (AB). Quasi-Bayes simulation was used to calculate
95% confidence intervals, using 1,000 iterations (Gelman & Hill, 2006).
6.4 Results

The effect of the intervention on the hypothesised mediators and the association between changes in mediators and changes in players’ MVPA are shown in Table 6.1. The intervention effect on all proposed mediating variables (A path) was significant ($p < 0.05$) and in the hypothesised direction. There was a significant effect between changes in coach MVPA and player MVPA ($B = 0.26$, 95% CI = 0.14 to 0.38) which coincided with a significant indirect effect (AB = 1.80, 95% CI = 0.85 to 2.85, $p < 0.05$). The indirect effect was 13% of the intervention effect. Further, the relationship between changes in all of the remaining mediators and changes in player MVPA (B path) were not statistically significant, nor were their indirect effects (AB paths).
Table 6.1. Effect of the intervention on the hypothesised mediators and the association between changes in mediators and changes in players’ MVPA.

<table>
<thead>
<tr>
<th>Hypothesised mediators</th>
<th>Intervention effect on potential mediators</th>
<th>Association between mediators and players’ MVPA</th>
<th>Indirect effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95% CI</td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Coach MVPA (% time)</td>
<td>7.05</td>
<td>4.77 to 9.04*</td>
<td>0.26</td>
</tr>
<tr>
<td>Management (% time)</td>
<td>-6.59</td>
<td>-7.86 to -5.40*</td>
<td>-0.15</td>
</tr>
<tr>
<td>Knowledge delivery (% time)</td>
<td>-5.53</td>
<td>-8.39 to -2.72*</td>
<td>-0.04</td>
</tr>
<tr>
<td>Promoting PA (occurrences/session)</td>
<td>5.99</td>
<td>4.78 to 7.23*</td>
<td>0.25</td>
</tr>
<tr>
<td>Demonstrating PA (occurrences/session)</td>
<td>4.72</td>
<td>3.26 to 6.18*</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note. unstandardised regression coefficient of total effect (C path) = 13.70 (95% CI = 10.58 to 16.84); unstandardised regression coefficient of direct effect (C’ path) = 12.25 (95% CI = 8.78 to 15.90).

Abbreviations: CI, confidence interval; MVPA, moderate-to-vigorous physical activity; PA, physical activity.

* = p < 0.05.

A = unstandardised regression coefficient of treatment condition predicting hypothesised mediators.

B = unstandardised regression coefficient of hypothesised mediators predicting players’ MVPA.

AB = product-of-coefficients estimate.

Parametric bootstrap derived 95% confidence intervals of the indirect effect.

Proportion of intervention effect that was mediated.
The effect of the intervention on the hypothesised mediators and the association between changes in mediators and changes in players’ inactivity are shown in Table 6.2. The intervention effect on coach inactivity, management, and knowledge delivery was significant ($p < 0.05$), and in the hypothesised direction (A paths). Of the aforementioned mediating variables, only coach inactivity was significantly associated with player inactivity ($B = -0.23$, 95% CI = -0.14 to -0.31, $p < 0.05$). Coach inactivity was also the only mediating variable in this model to influence the effect of the intervention on player inactivity. Decreases in coach inactivity significantly mediated the effect of the intervention on player inactivity ($AB = -3.20$, 95% CI = -0.14 to -0.31). The indirect effect was 21% of the intervention effect, the highest of all hypothesised mediators. No significant effects were found on any path (i.e., A, B, or AB paths) of the mediation model for discouraging physical activity.
Table 6.2. Effect of the intervention on the hypothesised mediators and the association between changes in mediators and changes in players’ inactivity.

<table>
<thead>
<tr>
<th>Hypothesised mediators</th>
<th>Intervention effect on potential mediators</th>
<th>Association between mediators and players’ inactivity</th>
<th>Indirect effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*A 95% CI</td>
<td>*B 95% CI</td>
<td>*AB 95% CI</td>
</tr>
<tr>
<td>Coach inactivity (% time)</td>
<td>-14.22 (-18.05 to -10.74*)</td>
<td>-0.23 (-0.14 to -0.31*)</td>
<td>-3.20 (-4.70 to -1.86*)</td>
</tr>
<tr>
<td>Management (% time)</td>
<td>-6.59 (-7.70 to -5.19*)</td>
<td>0.15 (-0.12 to 0.42)</td>
<td>1.06 (-0.54 to 2.82)</td>
</tr>
<tr>
<td>Knowledge delivery (% time)</td>
<td>-5.53 (-8.37 to -2.77*)</td>
<td>-0.002 (-0.12 to 0.12)</td>
<td>0.004 (-0.73 to 0.70)</td>
</tr>
<tr>
<td>Discouraging PA (occurrences/session)</td>
<td>0.07 (-0.16 to 0.30)</td>
<td>1.12 (-0.05 to 2.48)</td>
<td>-0.07 (-0.44 to 0.23)</td>
</tr>
</tbody>
</table>

*Note.* unstandardised regression coefficient of total effect (C path) = -14.73 (95% CI = -18.54 to -11.18); unstandardised regression coefficient of direct effect (C’ path) = -12.18 (95% CI = -16.05 to -8.19).

Abbreviations: CI, confidence interval; MVPA, moderate-to-vigorous physical activity; PA, physical activity.

* = \( p < 0.05 \).

\( a \) = unstandardised regression coefficient of treatment condition predicting hypothesised mediators.

\( b \) = unstandardised regression coefficient of hypothesised mediators predicting players’ MVPA.

\( c \) = product-of-coefficients estimate.

\( d \) = Parametric bootstrap derived 95% confidence intervals of the indirect effect.

\( e \) = Proportion of intervention effect that was mediated.
6.5 Discussion

According to Lubans et al. (2009) few physical activity intervention studies have conducted a mediation analysis to investigate whether the changes in the hypothesised mediators were responsible for changes in the outcome(s) of interest. This practice could yield useful information for improving the design and delivery of future programs by identifying the potential mechanisms through which an intervention achieved its effects (Cerin et al., 2009; Dewar et al., 2014; Kraemer et al., 2002; Lubans et al., 2012).

Hence, the aim of this study was to identify variables that could mediate the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity.

The findings of the mediation analysis indicated that coaches’ MVPA and inactivity significantly mediated the effect of the intervention on players’ MVPA and inactivity. These findings suggest that when coaches increased their MVPA, it also increased players’ MVPA and when they increased their inactivity, it also increased players’ inactivity. These are important findings for a few reasons. First, they support the notion that coaches may be able to influence their players’ physical activity levels (as found in Study 2, see Chapter 4). Most coaches interviewed in Study 2 thought they had the potential to influence youth physical activity, particularly if the coach was currently involved in organised sports in some capacity (i.e., active participants during practice or currently playing in a team). As Conroy and Coatsworth (2006) and Smith and Smoll (1997) have suggested, perhaps this influence is due to players’ view of coaches as experts and consistent direct involvement with their players. As Babkes and Weiss (1999) have suggested being positive exercise role models may also have a
positive effect on player physical activity. Nevertheless, coach physical activity levels appear to be important for influencing their players’ physical activity levels. Secondly, while not intentionally aiming to do so, the intervention increased coaches’ MVPA and decreased their inactivity. These findings may be due to chance, but it opens up the possibility of expanding the scope of interventions in OYS to also promote coach physical activity. Concurrently promoting coach physical activity in OYS may be an appealing option considering a high proportion of Australian adults do not achieve the recommended minimum of 150 minutes and 75 minutes of MPA and VPA, respectively (Department of Health and Aging, 2014b). Also, males have been identified as an under-represented and hard-to-reach population for health promotion interventions (George et al., 2012). In OYS, male coaches are more prevalent than female coaches (Leberman & LaVoi, 2011) and thus may present an opportunity for coaches (male coaches in particular) to accumulate some MVPA along with their players. Accordingly further research is warranted in this area.

The remaining hypothesised mediators, from the two mediation models, were variables derived from SOFIT (McKenzie et al., 1991). More specifically, the mediators were lesson context variables (i.e., management, knowledge delivery) and leader behaviour variables (promoting, demonstrating, and discouraging physical activity). With the exception of discouraging physical activity, the intervention effect on all other lesson context and leader behaviour variables was significant and in the expected direction. The effect of the mediators on player MVPA and inactivity were not significant, however, nor was the indirect effect for any lesson context and leader behaviour. It is unclear why the effect of the mediators was negligible on player MVPA.
and inactivity, despite evidence showing: (1) negative correlations between management/knowledge delivery and MVPA (Dudley et al., 2012); (2) praise/encouragement as a major influencer of physical activity (Beets et al., 2010); and (3) higher perceived competence, enjoyment and intrinsic motivation in youth with a positive exercise role model (Babkes & Weiss, 1999). One potential reason for the null findings with regard to the lesson context and leader behaviour variables is SOFIT’s inability to capture changes in the quality of the data the direct observation system collects. Using the promoting physical activity (i.e., encouragement/praise) variable as an example, the number of occurrences that coaches promoted physical activity increased; however, no information is available regarding the quality of the comments made to the player. This information could potentially be important as generic encouragement/praise may not be as meaningful to the player as a specific comment. Recently, a new direct observation system designed specifically for use in OYS has been developed (Cohen, McDonald, McIver, Pate, & Trost, 2014), but it appears that this system may have the same limitation as SOFIT with regard to detecting changes in quality. The potential limitations of these direct observation systems deserves further exploration.

Some potential limitations of this study must be considered when interpreting the findings. SOFIT’s inability to capture changes in lesson context and leader behaviour, and the relatively small study sample are both limitations that may explain the null findings for the lesson context and leader behaviour variables. Despite these limitations, the strengths of this study include the use of objective measurement to assess physical
activity and a sophisticated statistical analysis (multilevel mediation models) to analyse the hypothesised mediators’ effect on players’ MVPA and inactivity for players.

6.6 Conclusion

In this study, a significant intervention effect was found for all hypothesised mediators (with the exception of discouraging physical activity). Additionally, coach MVPA and inactivity significantly mediated the effect of the intervention on player MVPA and inactivity, respectively. Consequently, OYS may present an appealing opportunity for researchers to concurrently promote players’ and coaches’ (male coaches in particular) MVPA. Further, strategies that provide researchers with the ability to capture changes in quality and not merely quantity in direct observation systems are needed.

6.7 Synopsis

Using two mediation models, this study identified variables that mediated the effect of the intervention on MVPA and inactivity for players in an OYS setting. The next chapter provides an overall synthesis of the work conducted (i.e., Studies 1 to 4) comprising this PhD thesis, and discusses implications, limitations, and future research with regard to promoting physical activity in an OYS setting.
Chapter 7

Discussion and conclusions
7.1 Introduction

This chapter provides an overview of the findings of the research comprising this PhD thesis (i.e., Studies 1 to 4). The strengths and limitations of each study and implications for future research are also further discussed in this chapter.

7.2 An overview of the studies conducted

The primary aim of this PhD thesis was to investigate mechanisms through which to improve the proportion of time players spent in MVPA during OYS. The secondary aims of this PhD thesis were to test methods to reduce the proportion of time players spent inactive during OYS and to understand coaches’ perceptions of themselves as being influential on players’ physical activity in OYS. A series of four distinct, yet associated, studies were conducted to achieve these aims.

The first of the four studies forming this thesis was presented in Chapter 3 (Guagliano et al., 2013). Study 1 was an observational study that examined players’ physical activity levels, lesson context, and leader behaviour during OYS practices and games. Participants were girls aged 11-17 years who played three of the most popular OYS for girls in Australia – netball, basketball, and soccer (Australian Bureau of Statistics, 2009). Previous research (Katzmarzyk & Malina, 1998; Leek et al., 2011; Sacheck et al., 2011; Wickel & Eisenmann, 2007) had not compared players’ physical activity levels during OYS practices and games or documented lesson context or leader behaviour during OYS. Study 1, therefore, contributed novel insight and addressed gaps in the literature regarding leader behaviour and physical activity levels of participants in OYS.
Coaches in OYS are well-positioned to influence the physical activity levels of OYS participants and studies have suggested that coaches can have a strong influence on their players, particularly if the coach is admired by their players (Blomquist, 1986; Conroy & Coatsworth, 2006; Smith & Smoll, 1997). The way coaches perceive themselves with regard to influencing girls’ physical activity, however, had not previously been addressed in the literature. Thus, Study 2, (presented in Chapter 4, Guagliano, Lonsdale, Rosenkranz, et al., 2014) was a qualitative investigation of coaches’ perceived ability to influence their players’ physical activity levels. Thirty coaches consented to take part in an in-depth semi-structured interview with the author of this thesis. This study provided unique insight into coaches’ perceptions and potential to be agents for the promotion of physical activity in OYS.

Study 3, presented in Chapter 5, was informed by Study 1 (Chapter 3, Guagliano et al., 2013) and Study 2 (Chapter 4, Guagliano, Lonsdale, Rosenkranz, et al., 2014). This two-armed parallel-group RCT primarily aimed to assess whether coach education, relative to a standard-care control, could increase the proportion of time players spent in MVPA during practices over a five-day basketball program. The secondary aims of this study were to assess whether coach education could lower the proportion of practice time players spent inactive, investigate intervention’s effect on players’ motivation and perceived autonomy support, and assess how time was spent during practice (lesson context), and leader behaviour. Study 3 was the first coach-based RCT of an intervention designed to increase players’ levels of physical activity gained through participation in OYS and the first response to a call by Leek et al. (2011) to evaluate strategies for increasing MVPA in OYS.
The fourth and final study forming this thesis was presented in Chapter 6. The aim of Study 4 was to test whether hypothesised variables mediated the effect of the intervention (discussed in Chapter 5) on players’ MVPA and inactivity during OYS practice sessions. Two separate models were investigated where it was hypothesised that coaches’ physical activity levels, lesson context (i.e., management, knowledge delivery), and coaches’ behaviours (i.e., promoting physical activity, demonstrating physical activity, discouraging physical activity) mediated the effect of the intervention on players’ MVPA and inactivity during practice sessions.

7.3 Main findings of the studies conducted

The main findings of this PhD research help to address gaps and advance an area that has, to date, been largely understudied despite the potential for major public health implications, given the high proportion of youth who participate in OYS globally. In Study 1, for the first time in the literature, players’ physical activity levels were compared during practices and games. Players achieved significantly higher levels of MVPA during practice compared to games. Findings from this study demonstrated that OYS appeared to make a substantial contribution to the recommended levels of physical activity of participating players – about one-third of the recommended 60 minutes of MVPA (Department of Health and Aging, 2014a, 2014c) for every hour of game play or practice time. That said, the majority of practice and game time was spent insufficiently active (inactive or in LPA). Generating contextual data using McKenzie et al.’s (1991) SOFIT allowed insight to be gained on how time was spent during OYS practices and games (lesson context data). Based on the lesson context data generated, findings
revealed that coaches spent a considerable proportion of practice time in management and instruction time, where it was unlikely youth were in MVPA (Dudley et al., 2012). It became evident that although OYS provides substantial MVPA to players, there was potential for improvement by increasing opportunity and quality of some lesson contexts (i.e., skill practice, game play, fitness). Decreasing the proportion of time coaches spent in management and instruction time was highlighted as other potential strategies to consider creating an environment that provides the most opportunity for physical activity.

The second study investigated coaches’ perceived ability to influence their players’ physical activity. The analysis of 30 in-depth semi-structured interviews suggested that most coaches thought that they had the potential to influence physical activity for their players in OYS. Also, coaches reported that they were conscious of their players’ physical activity levels, and had the ability to gauge their players’ physical activity levels. Despite spending little time preparing for practice sessions, coaches were able to identify numerous strategies that could be employed in their practices to increase opportunities to be active, reduce inactivity, and improve their efficiency and management of practice. Also of note, was that coaches reported being wary of increasing girls’ MVPA due to a belief that it could result in reduced motivation and dropout from OYS. Although this does not appear to be in line with player-reported reasons for dropping out of OYS, this finding should not be taken lightly, as it may be a determinant for the discontinuation of OYS participation in girls. Thus, this issue warrants further investigation. Nevertheless, findings from this study are encouraging in
that coaches believed they are capable of influencing players’ physical activity levels in OYS.

Study 3 findings provided strong support for the short-term efficacy of coach education for increasing time spent in MVPA and reducing time spent inactive without deleterious effects to players’ motivation or perceived autonomy support. In this study, the proportion of time intervention players spent in MVPA significantly increased whereas inactivity significantly decreased. Also, no significant changes were found players’ motivation or perceived autonomy support. The findings of this study do not support coaches’ perception (from Study 2) that players’ motivation will decline if MVPA is increased, at least in the short-term. Thus, coaches can have greater confidence that increasing physical activity during practice does not necessarily have a negative effect on players’ motivation or perceived autonomy support towards OYS or their coaches. Further, substantial increases in VPA were found (in the intervention group), which was an important finding because VPA has been associated with health benefits, over and above those benefits accrued from lower-intensity activity (Carson et al., 2014; Hay et al., 2012).

The fourth study investigated two models where it was hypothesised that coaches’ physical activity levels, lesson context, and coaches’ behaviours may mediate the effect of the intervention on players’ MVPA/inactivity. The findings of the mediation analysis indicated that only coaches’ MVPA and inactivity significantly mediated the effect of the intervention on players’ MVPA and inactivity. These findings suggest that when coaches increased their MVPA, players also increased their MVPA. In similar fashion, when coaches increased their inactivity, players also increased their
inactivity. No other hypothesised mediating variables mediated the effect of the intervention (Study 3) on players’ MVPA and inactivity. The finding that coaches’ physical activity intensity appeared to be important for influencing their players’ physical activity intensity was important because it supports the notion that coaches may be able to influence their players’ physical activity levels (as suggested in Study 2).

7.4 Strengths and limitations of the studies conducted

The strengths and limitations of the four studies forming this thesis should be considered when interpreting the findings. A particular strength common to all of the quantitative studies conducted (i.e., Studies 1, 3, 4) was the use of accelerometer data. Accelerometer data provided objective measures that allow for a rigorous description of the physical activity levels that players achieved in OYS, and could potentially be more accurate than self-report or direct observation (Saint-Maurice, Welk, Ihmels, & Richards Krapfl, 2011). Accelerometers do have some disadvantages, particularly in free-living situations where it is difficult to obtain information on participants’ location or type of physical activity (Matthews, Hagströmer, Pober, & Bowles, 2012). Accelerometers can be paired with devices, such as GPS, or physical activity diaries to obtain information on participants’ location or type of physical activity, but this increases participant burden. Within the relatively confined parameters of OYS, however, this was not an issue during this PhD research. Moving forward, greater consistency is necessary with regard to accelerometer cut-points used in order compare findings. Of the few studies available that have observed physical activity levels in OYS, a number of different accelerometer cut-points have been used (i.e., Evenson et al., 2008; Freedson et al., 2005; Puyau et al.,
Evenson et al. (2008) cut-points have been recommended to estimate physical activity intensity in youth (Crouter et al., 2013; Trost et al., 2011) and should be used in future research in order to have consistency among studies so that findings can be more readily compared.

There could be greater consistency with regard to epoch lengths as well. Of the identified studies investigating physical activity levels in OYS, all studies used varying epoch lengths, ranging from 1-second to 30-seconds (Leek et al., 2011; Sacheck et al., 2011; Wickel & Eisenmann, 2007). It is well known that in a paediatric population, short epoch lengths are needed to effectively capture the intermittent activity patterns of youth (Trost et al., 2005). Short epochs provide finer data resolution than long epoch lengths (e.g., 1-second vs. 60-second epochs); and Matthews et al. (2012) suggested epoch lengths should be set to values that are as short as possible (e.g., 1-second). The disadvantage of using a shorter epoch length is that it uses more of an accelerometer’s battery life. This, however, is likely not an issue in an OYS setting where data is likely to be collected over a one- to two-hour period (i.e., during practices or games). Further, the use of the short epoch provides better estimates of physical activity intensity (Matthews et al., 2012).

Focusing specifically on girls was also a strength of this body of research, as girls represent a high priority group for physical activity promotion (Camacho-Miñano et al., 2011). It is well documented that girls accumulate less physical activity than boys throughout childhood (Hardy et al., 2008; Troiano et al., 2008) and experience more marked declines in physical activity transitioning into adolescence than do boys (Kahn et al., 2008; Kimm et al., 2002; Nader et al., 2008). It has been argued that sex
stereotypes are reinforced in many physical activity contexts and they commonly
disadvantage girls because characteristics typically associated with masculinity such as
power, strength, speed, and aggressiveness are celebrated (Camacho-Miñano et al.,
2011; Loder & Hirsch, 2003). Further, girls often report that they prefer being physically
active without the presence of boys for many reasons. These include: (1) freedom from
comparison to boys and boys’ scrutiny and critical comments, (2) greater opportunity to
develop skills and relationships, (3) more enjoyment, (4) increased attention from
instructors, and (5) less concern about body image (Derry, 2002; Hannon & Ratcliffe,
2005, 2007; Olafson, 2002; Taylor et al., 2000; Whitehead & Biddle, 2008). Thus,
exploring avenues that allow girls to be physically active in the absence of boys is
imperative, and OYS may represent a good opportunity for girls this to occur.

A limitation common to all studies in the present thesis was the use of
convenience sampling. The use of convenience sampling allows for the potential for
selection bias, as the population may not be accurately represented. That said, a range of
sports (Studies 1 and 2), ages (Studies 1 and 2), and experience (Studies 1, 2, and 3)
were included in this PhD research.

There were several strengths and limitations associated with Study 1 (not noted
above). A particular strength of this study was that girls’ physical activity levels during
practice and games in OYS were observed in sports with some of the highest
participation rates in Australia. Limitations of this study included: (1) the study was not
designed for comparison between sports (2) physical activity findings were based on a
single observation period for each team, and (3) participants were recruited from only
one club for each sport, and thus the ability to generalise the current findings may be
limited. Future research could expand the evidence base by addressing the above limitations. Also, in the current literature, no study in an OYS setting has compared physical activity levels during OYS practices and games or documented lesson context or leader behaviour for boys. Thus, further researcher is warranted addressing these limitations.

The most noteworthy strength of Study 2 is the rigorous research methodology that was employed to ensure the trustworthiness of the data. Several suggested strategies (described in detail in Chapter 4) were used to strengthen the credibility, dependability, confirmability, and transferability of the data. Study 2 had two potential limitations that were not common to any of the other three studies. First, it is possible that coaches mainly offered socially desirable viewpoints during their interview because they perceived physical activity to be a desirable outcome in OYS. Unfortunately, it is unlikely that this limitation can be controlled for and avoided. Second, more male coaches were recruited to participate in Study 2 compared to female coaches. Female-coaching perspectives, therefore, may be underrepresented. Male coaches, however, are more prevalent than female coaches in OYS regardless of the sex of the team (Leberman & LaVoi, 2011). Coaches in Study 2 reported being aware of their players’ parental support; future research could explore the use of coaches in an effort to maintain parental support (particularly in adolescence) and to promote physical activity outside of OYS.

The strengths of Study 3 included high internal validity, high retention rates, and the use of linear mixed models (which allowed for the inclusion of all participants for analyses). Further, Study 3 was a fully powered RCT. This study was not without some
potential limitations, however. Firstly, given the short duration of the basketball program, Study 3 only investigated the short-term efficacy of coach education on player physical activity. Secondly, conducting Study 3 as an OYS basketball program (rather than using players’ usual competition teams and coaches) may have limited the ecological validity of the findings to broader contexts, but it increased the study’s internal validity because it allowed for the efficacy of the intervention to be tested in a more tightly controlled environment. Given that highly controlled studies are lacking in this area of OYS research (Camacho-Miñano et al., 2011; Priest et al., 2008), it was essential to first determine if this intervention was efficacious under optimum conditions before determining its effectiveness with intact community-based OYS teams. Lastly, analyses conducted in Study 3 should have accounted for clustering at the coach level. Nevertheless, Study 3 findings provided strong support for the short-term efficacy of coach education for increasing players’ physical activity levels. Thus, future research should investigate the effectiveness of this intervention with intact community-based OYS teams.

Few intervention studies have performed a mediation analysis to investigate whether the changes in the hypothesised mediators were responsible for changes in the outcome(s) of interest (Lubans et al., 2009). This practice could yield useful information for improving the design and delivery of future programs by identifying the potential mechanisms through which an intervention achieved (or failed to achieve) its effects (Cerin et al., 2009; Dewar et al., 2014; Kraemer et al., 2002; Lubans et al., 2012). The relative novelty and the information gained from mediation analysis, therefore, is a particular strength of Study 4. Also, this study used crossed random effects multilevel
modelling, which allowed for the analysis of multiple mediators to be incorporated in a single model while accounting for relevant levels of nesting. Thus, another strength of this study was the sophisticated statistical analysis that was used.

Of the hypothesised mediators, none of the lesson context or leader behaviour variables were found to mediate the effect of the intervention on players’ MVPA/inactivity. It is possible, then, that this study was limited by SOFIT’s inability to capture changes in quality lesson context and leader behaviour (only frequency). In addition, a relatively small study sample may also explain the null findings for the lesson context and leader behaviour variables. Moving forward, direct observation systems that are capable of capturing changes in quality as well as frequency are needed.

7.5 Future research and recommendations

Much of the research conducted forming this PhD thesis was novel and provided a valuable contribution to the field. That said, additional research is needed to continue to develop the evidence base in this setting. To summarise the suggestions provided from the section above, future research could:

- Build upon Study 1 findings by providing a comparison of girls’ physical activity levels among a wide range of sports.
- Compare physical activity levels during OYS practices and games and document lesson context and leader behaviour for boys.
- Investigate differences in youth physical activity levels between team and individual sports. In this PhD research only team-based sports were investigated.
- Explore the use of coaches for maintaining parental support and/or to promote physical activity outside of OYS.
- Investigate the effectiveness of the intervention in Study 3 with intact community-based OYS teams.
- Investigate approaches to enhance direct observation systems so that they are effective at capturing changes in quality as well as frequency of contextual variables.

Moving forward, it is important that future work in this area is rigorous and consistent to allow findings to be readily compared, particularly with regard the measurement and assessment of physical activity. As noted above, accelerometer cut-points and epoch lengths vary greatly in the current literature. Thus, based on current recommendations (Crouter et al., 2013; Trost et al., 2011), Evenson et al. (2008) cut-points are the most accurate for classifying physical activity intensity and should be used in future studies. According to Matthews et al. (2012) short epochs (e.g., 1-second) should also be used to provide high resolution physical activity data. Further, direct observation systems, despite their limitations, should be paired with accelerometry to provide important additional contextual information about the OYS setting.

### 7.6 Conclusion

Gillis et al. (2013) identified sport as a research priority in the area of youth physical activity and sedentary behaviour. The research presented in this thesis has aided in the growth of the literature in this area and provided evidence for the
aforementioned call for action. In summary, findings from this research have provided as series of firsts:

- This research provided the first comparison of players’ physical activity levels during practice and games within the same study, and the first insight into leader behaviours and how time is allocated during OYS practices and games (Study 1),
- This research provided the first investigation into whether coaches perceived themselves as influential on players’ physical activity during OYS (Study 2),
- This research included the first RCT designed to evaluate the short-term efficacy of coach education on players’ physical activity intensity in OYS (Study 3).
- This research provided the first insight into whether hypothesised variables mediated the effect of the intervention (from Study 3) on players’ MVPA and inactivity in an OYS setting (Study 4).

Further, all studies were conducted with a focus on girls’ physical activity levels. This is important because girls have been identified as a high priority group for physical activity promotion (Camacho-Miñano et al., 2011). It is well documented that girls accumulate less physical activity than boys throughout childhood (Hardy et al., 2008; Troiano et al., 2008) and experience more marked declines in physical activity transitioning into adolescence than do boys (Kimm et al., 2002; Nader et al., 2008). OYS may present an attractive opportunity for girls to be active, as suggested earlier by Vella, Cliff, and Okely (2014).
Additional research is still required to build a stronger evidence base for optimising physical activity in OYS. This unique research, however, demonstrated that there is room to increase MVPA in OYS, and despite coaches’ concerns that increasing MVPA may have a negative effect on players’ motivation, a brief coach education program significantly increased MVPA during practice without deleteriously affecting player motivation. Also, coaches’ physical activity intensity appeared to be important for influencing their players’ physical activity intensity, which is in line with coach perceptions. Thus, OYS is a promising setting for physical activity promotion and coaches are important agents that may influence the physical activity levels of participating youth. This research has provided strong evidence to address the aforementioned calls for action and has contributed to the wider body of evidence in an important setting which has global reach and major public health implications.
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Appendices
Girls' Physical Activity Levels during Organized Sports in Australia

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ABSTRACT

GUAGLIANO, J. M., R. E. ROSEINKRANZ, and G. S. KOLT. Girls’ Physical Activity Levels during Organized Sports in Australia. Med. Sci. Sports Exerc., Vol. 43, No. 1, pp. 166–172, 2013. Purpose: The primary aim of this study was to objectively estimate the physical activity (PA) levels of girls during organized sports (OS) and to compare these levels between games and practices for the same participants. The secondary aim of this study was to document lean mass content and muscle behavior during practices and games. Methods: Participants were 94 girls recruited from 10 teams in three OS (netball, basketball, and soccer) from the western suburbs of Sydney. Each participant wore an ActiGraph GT3X+ monitor for the duration of one practice and one game. The System for Observing Fitness Instruction Time was concurrently used to document lean mass content and muscle behavior. Results: Girls spent a significantly higher percentage of time in moderate-to-vigorous PA (MVPA) during practices compared with games (33.8% vs 30.0%; P = 0.03). Girls spent approximately 20 min·d−1 in MVPA during practices and approximately 18 min·d−1 in MVPA during games. An average of 2700 and 3700 steps per hour were accumulated during practices and games, respectively. However, girls spent roughly two-thirds of their OS time in light PA or sedentary. On the basis of the System for Observing Fitness Instruction Time findings, coaches spent a lot of practice time in management (15.0%) and knowledge delivery (18.0%). An average of 9.0 and 15.5 s, respectively, were spent in OS per hour, and approximately 30% of the 3700 steps that girls accumulated could be attributed to the OS. For this population, OS seems to be the major contributor to the energy expenditure of MVPA and steps for participating girls. OS alone, however, does not provide sufficient PA sufficient to meet daily recommendations for adolescent girls. Key Words: CHILDREN, ADOLESCENTS, YOUTH SPORTS, MVPA, ACCELEROMETER, SEDENTARY.

The benefits of regularly engaging in moderate-to-vigorous physical activity (MVPA) among children and adolescents are well established and include contributions to physical, mental, and social health outcomes (21). Public health guidelines state that children and adolescents should engage in 60 min of MVPA daily, which can be achieved cumulatively throughout the day in bouts (21). A considerable proportion of children and adolescents, however, fail to meet recommended levels of physical activity (PA) (5,12,22,25). This is particularly evident for girls; they are less physically active than boys (5,22), with the sharpest declines observed in adolescence (7,12).

Participation in organized sports (OS) has been recommended as an approach to increase PA (27). In Australia, yearly prevalence data indicate that approximately 69% of children (67% of girls) participate in at least one OS (including dance) outside of school hours (11). A recent systematic review found that children who participated in OS were more physically active than those who did not participate (13). However, the amount of PA that girls achieve during OS is unclear.

Of the few studies that have examined PA in OS, one study found that during soccer games, children were in MVPA for 33% of the match (13), and another study found that approximately 40% of practice time was spent in MVPA (9). However, children also spend high percentages of time during OS inactive in light PA (6,9).

Despite these findings that children may be less than optimally active during OS practices and games, OS contributed close to 25% of daily MVPA (18.2%). These studies provide evidence to suggest that OS can contribute substantially to MVPA levels; however, current literature has only examined PA in either OS practices or games. To date, a complete picture of OS is lacking, where PA has been examined in both practices and games for the same participants to provide comparisons between conditions. Furthermore, it remains unclear with respect to opportunity for PA.
how time is spent and how coaches conduct themselves during practices and games in OS.

The primary aim of this study was to objectively examine PA levels of girls during OS, and to compare the levels between games and practices for the same participants. The secondary aims of this study were to document lesson content and to coach behavior during practices and games.

**Methods**

**Participants.** A total of 94 girls aged between 11 and 17 yr (mean ± SD age = 13.4 ± 2.2 yr) participated in this study. Participants were recruited from OS clubs playing netball, basketball, and outdoor soccer in the western suburbs of Sydney, Australia. These three OS were chosen because of their popularity among girls in Australia (1). A convenience sample of 10 teams from these three OS was recruited (4 netball, 3 basketball, and 3 soccer). Initially, a member of the OS clubs executive committee was contacted by the primary investigator (JMG) to provide information about the study protocol. Interested clubs then provided the primary investigator with contact details of interested coaches. Detailed study information was then sent to coaches and parents. Participants were included based on their willingness to participate in the study. Before study commencement, informed consent and assent was obtained from coaches, parents, and athletes. The Human Research Ethics Committee of the University of Western Sydney approved this study.

**Protocol.** Between May and August 2011, a team consisting of the primary investigator (JMG) and a female research assistant observed practices and games of all participating teams. The team observed one practice and one game, except netball. The netball practice twice a week, with one of those practices dedicated solely to fitness. Therefore, an additional practice was observed (one fitness session and one skill session) for this sport. There was an average of 13 and 15 d between practice and game sessions for basketball and soccer, respectively, and an average of 11 d between observed practices, games, and fitness sessions for netball, respectively. Before the practice, participating girls were taken to a semiprivate measurement area to be assessed on height, weight, and waist circumference. After anthropometric measurements, girls were fitted with an accelerometer that was placed on the right hip (described in the next section) and worn for the duration of the practice. Most girls on each team were accelerometers across sports (football, 38/59; basketball, 28/56; and soccer, 28/48). In addition to accelerometry, the System for Observing Fitness Instruction Time (SOFIT) (11) direct observation system was used by the primary investigator (described in the Direct Observation section). The protocol for games was the same as practice protocols, except that anthropometric measures were not taken.

**Anthropometric measures.** Before measurement, girls were asked to remove shoes and heavy clothing. Standing height was measured to the nearest 0.1 cm using a portable stadiometer (H357 portable stadiometer, Mentor Education, Victoria, Australia). Weight was measured using a digital scale (BF-358 HealthStream digital scale; Audi Health, Queensland, Australia) to the nearest 0.1 kg. Body mass index (BMI) was calculated and converted into age- and sex-specific percentiles using the Centers for Disease Control and Prevention growth charts (8). Waist circumference was measured on the right side of the body by finding the midpoint between the lowest rib and the iliac crest. A nonelastic tape measure (Myrapap; Mentor Education) was wrapped snugly around the waist, and measurement was taken at the end of expiration to the nearest 0.1 cm. Measurements were conducted in duplicate for all assessments, and an average was recorded. A third measurement was taken if the first two measures differed by more than 0.5 cm or 0.5 kg, and the average was recorded. All anthropometric measures were used for descriptive purposes.

**Accelerometry.** The Actigraph GT3X accelerometer (Actigraph, Pensacola, FL) was used to assess PA levels in this study. Actigraph accelerometers are the most widely used accelerometers and have been shown to be valid and reliable devices for PA measurement in children and adolescents (13,63). Accelerometers were initially to record counts and steps with 5-s epochs specified to capture effectively the intermittent activity patterns of children and adolescents (24).

Accelerometers were synchronized with an external clock and initialized to start recording a minimum of 30 min before and after the scheduled practice and/or game time. Start and finish times were recorded for every practice and game via direct observation to trim excess data outside the recorded start and finish times. Participating coaches and athletes were instructed by the research team not to change activities or the way they practiced or played games during observation.

After each practice or game, raw accelerometer counts were uploaded to a computer using Actigraph software and saved to a Microsoft Excel file. Data outside the recorded start and finish time were discarded. Data that did not coincide with the direct observation records were checked for errors; all data between start and finish times for all practices and games were included in the analyses. Freedson’s MET prediction equation was used to determine PA intensity (4). The age-specific counts per minute were divided by 12 to account for our 5-s epochs. PA intensity was classified as follows: sedentary (SED) ≤100 counts per minute; light PA (LPA), 101-15 METS; moderate PA (MPA), ≥15 METS - 7; and vigorous PA (VPA), ≥7 METS. Although a strong consensus does not exist regarding appropriate selection of MET intensity thresholds for children and adolescents (23), those selected for this study have been used in an adolescent female population (15).

**Direct observation.** To complement accelerometry, SOFIT was used in this study to provide contextual data on PA in OS. SOFIT is a widely used direct observation system that uses continuous time sampling to generate data on participant PA, lesson content, and instructor (or for our
purposes, coach behavior (11). SOFIT has demonstrated acceptable reliability and validity in a pediatric population (11,17). Typically, SOFIT is used for structural PA sessions such as physical education classes, and OS provides a similar environment, led by a coach instead of a teacher. Although SOFIT can be easily implemented in an OS setting, only one report that we are aware of has used the direct observation system in OS (14).

With SOFIT, four plus one alternate) participants are quasi-randomly and flexibly selected before season commencement by dividing the total number of participants attending a given session by five to form selection order (e.g., 15/5 = 3, so every third participant is selected). On a manual basis, the PA levels, lesson context, and coach behavior were coded and recorded on paper every 20 s via a looped voice recording that prompted the observer to observe and record. However, PA data from SOFIT were not used in this study because of the availability of accelerometer data that provides PA levels at the individual level.

The OS lesson context was coded into one of six mutually exclusive categories: management, knowledge delivery, fitness, skill practice, game play, and free play at the end of each 10-s observation interval. Coach behavior was coded using a hierarchical format and included the following (in hierarchical order): promotes PA (includes prompts of encouragement and praise) or discourages PA (includes prompts that are negative and punitive in nature), demonstrates PA, and others. Therefore, promotes PA or discourages PA was recorded if it occurred at any time during the 10-s observation interval, whereas other words were only scored if the other categories were not observed during the 10-s observation interval. Multiple coding was only permitted if promotes PA or discourages PA and demonstrates PA were observed at any time during the 10-s observation interval. SOFIT was used at each practice and game. The primary investigator (JMG) was fully trained to use the observation technique and conducted all direct observations.

The implementation of SOFIT is important to this study. SOFIT has not been used in these particular sports; therefore, information regarding lesson context and coach behavior is unknown. In other words, skill level is spent and how coaches conduct themselves concerning PA during practices and games in OS is unknown (13). Generating data on lesson context and coach behavior is best achieved through direct observation, as self-report data may be unreliable or otherwise biased (11).

**Statistical analysis.** All statistical analyses were analyzed using the Statistical Package for the Social Sciences (Version 18.0; Chicago, IL). The mean differences between practices and games for each PA intensity (SED, LPA, MPA, VPA, and MVPA), steps per hour, lesson context variables, and coach behavior variables were analyzed using paired samples t-tests. ANOVA was used to examine the differences in means for the anthropometric measures collected for girls in each OS. Descriptive statistics included mean and SD values. Statistical significance was set at $P < 0.05$.

**RESULTS**

**Participant characteristics.** Table 1 displays physical characteristics of participants by sport. Physical characteristics were assumed for 93 (93.9%) of 94 participants, as one participant was missing data on height. The mean and SD age of the participants was 13.4 ± 2.2 yr. On the basis of age- and sex-specific growth charts, the average height (164.1 ± 8.1 cm), weight (56.9 ± 10.9 kg), and BMI (21.0 ± 2.2 kg m$^{-2}$) for all participating athletes corresponded approximately to the 75th percentile (8). Significant mean differences were found among sports for age, height, and BMI ($P < 0.05$).

**PA intensity during practice and games.** Table 2 displays PA intensity (percent time) and steps per hour at practice and games for each OS. Participants with intact data (attended both the observed practice and game) were 82 (87.2%) of 94 participants. The mean and SD intensity values, across OS, for practice was 23.6 ± 22.5 and 99.8 ± 13.7 min for games. Across OS, the overall mean for percent time in MVPA during practices was significantly higher ($r = 0.94$, $P < 0.05$) than during games, significant mean differences for percent time were found for each PA intensity across OS. During practices, the mean for percent time for VPA, MPA, and LPA were significantly higher than that during games (VPA: $r = 0.67$, $P < 0.05$; MPA: $r = 0.78$, $P < 0.05$; LPA: $r = 0.78$, $P < 0.05$). The mean percent time for SED was significantly lower ($r = -0.50$, $P < 0.001$) during practice than that during games.

**The percentage of time spent in MVPA during games was slightly more homogeneous than during practice.** The only significant mean difference for percent time in MVPA between practice and games was found in basketball ($r = -0.34$, $P < 0.05$). With regard to LPA and SED, across all OS, participants spent a greater percentage of time in LPA ($r = -0.67$, $P < 0.001$) and a lower percentage of time SED ($r = -0.48$, $P < 0.001$) in practice compared with games.

**Table 1. Physical characteristics of the athletes by sport.**

<table>
<thead>
<tr>
<th>Sport</th>
<th>All Sports ($n = 94$)</th>
<th>Football ($n = 27$)</th>
<th>Basketball ($n = 28$)</th>
<th>Soccer ($n = 20$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>13.4 ± 0.9</td>
<td>13.3 ± 0.9</td>
<td>13.5 ± 1.0</td>
<td>13.4 ± 0.9</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164.1 ± 9.1</td>
<td>163.9 ± 6.0</td>
<td>164.2 ± 10.3</td>
<td>163.5 ± 8.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>56.9 ± 10.9</td>
<td>56.4 ± 10.0</td>
<td>56.3 ± 10.3</td>
<td>56.9 ± 10.4</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>71.0 ± 7.2</td>
<td>71.1 ± 5.6</td>
<td>71.2 ± 5.6</td>
<td>72.9 ± 6.6</td>
</tr>
<tr>
<td>BMI (kg m$^{-2}$)</td>
<td>21.0 ± 2.2</td>
<td>20.9 ± 2.8</td>
<td>21.0 ± 2.7</td>
<td>22.0 ± 1.7</td>
</tr>
<tr>
<td>SED &amp; MVPA</td>
<td>0.6 ± 0.2</td>
<td>0.6 ± 0.4</td>
<td>0.6 ± 0.7</td>
<td>0.6 ± 0.5</td>
</tr>
</tbody>
</table>

*Values are presented as mean ± SD. $n$ = number of participants.

* Significant mean difference by sport ($P < 0.05$).
Out of the three OS observed, netball was the only sport that dedicated one whole practice solely to fitness. During fitness practices, the mean percentage of time spent in MVPA was significantly greater than regular (skill-based) netball practices ($t = 10.10, P < 0.001$) and games ($t = 8.73, P < 0.001$). Also, LPA and SED were significantly lower at fitness practices compared with regular practices (LPA: $t = 7.68, P < 0.001$; SED: $t = 2.89, P < 0.05$) and games (LPA: $t = 7.38, P < 0.001$; SED: $t = 4.49, P < 0.001$).

**Steps counts during practice and games.** Across OS, participants accumulated significantly more steps per hour during practice than during games ($t = 2.15, P < 0.05$) (see Table 2). Among sports, netball fitness practices provided significantly more steps per hour compared with regular netball practices ($t = 10.10, P < 0.001$) and games ($t = 9.50, P < 0.001$).

**OS contribution to recommended levels of PA.** On average, OS contributed 1.84 min h$^{-1}$ of MVPA during games (netball, 1.88 min h$^{-1}$; basketball, 1.83 min h$^{-1}$; soccer, 1.75 min h$^{-1}$) and 2.33 min h$^{-1}$ during practice (netball, 2.09 min h$^{-1}$; basketball, 2.13 min h$^{-1}$; soccer, 1.89 min h$^{-1}$). Large proportions of time, however, were spent in SED, on average 23.3 min h$^{-1}$ during games (netball, 20.9 min h$^{-1}$; basketball, 29.3 min h$^{-1}$; soccer, 19.3 min h$^{-1}$) and 18.1 min h$^{-1}$ during practice (netball, 19.0 min h$^{-1}$; basketball, 19.6 min h$^{-1}$; soccer, 14.1 min h$^{-1}$). Fitness practices provided approximately 27 min h$^{-1}$ of MVPA and 16.3 min h$^{-1}$ of SED.

Participants across sports accumulated 22.6% and 24.2% of the recommended 12,000 daily steps (26') in 1 hr of game play (netball, 21.5% daily steps; basketball, 20.1% daily steps; soccer, 28.4% daily steps) and practice time (netball, 22.6% daily steps; basketball, 22.5% daily steps; soccer, 29.9% daily steps), respectively. During netball fitness practices, approximately 34.3% of the recommended 12,000 steps per day were accumulated every hour.

**Lesson context.** A total of 20 sessions were observed: eight netball (four games and four practices), six basketball (three games and three practices), and six soccer sessions (three games and three practices). Four fitness practices were also observed but were not included in the overall comparison across OS because they were exclusive to netball. Table 3 displays lesson context as the percentage of a session that was spent in each category.

Across OS, the percentage of time spent in the SOFIT categories of management, knowledge delivery, and free play did not significantly differ between practice and games. The mean percentages for fitness and skill practice were significantly higher during practice compared with games (fitness: $t = 2.92, P < 0.05$; skill practice: $t = 4.66, P < 0.05$) and the

---

**TABLE 2:** Activity performed during practice and games.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Netball</th>
<th>Basketball</th>
<th>Soccer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>Practice</td>
<td>Game</td>
<td>Practice</td>
</tr>
<tr>
<td>MVPA</td>
<td>36.6 ± 5.5</td>
<td>33.8 ± 7.7</td>
<td>31.4 ± 4.9</td>
</tr>
<tr>
<td>YPA</td>
<td>14.9 ± 6.6</td>
<td>16.7 ± 6.4</td>
<td>15.3 ± 6.6</td>
</tr>
<tr>
<td>LPA</td>
<td>36.0 ± 5.7</td>
<td>39.0 ± 8.4</td>
<td>33.7 ± 4.2</td>
</tr>
<tr>
<td>SED</td>
<td>38.9 ± 14.4</td>
<td>40.1 ± 13.8</td>
<td>34.9 ± 11.9</td>
</tr>
</tbody>
</table>

Stages means not included in All Sports; mean ± SD values because they were exclusive to netball. Values are presented as mean ± SD.

**TABLE 3:** Lesson context and coach behavior during practice and games, based on direct observation by SOFIT.

<table>
<thead>
<tr>
<th>Lesson context (%)</th>
<th>Netball</th>
<th>Basketball</th>
<th>Soccer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>15.1 ± 3.9</td>
<td>15.0 ± 4.7</td>
<td>15.4 ± 3.8</td>
</tr>
<tr>
<td>Knowledge</td>
<td>8.8 ± 4.4</td>
<td>18.5 ± 13.7</td>
<td>6.3 ± 3.3</td>
</tr>
<tr>
<td>Fitness</td>
<td>32.1 ± 5.4</td>
<td>49.9 ± 35.8</td>
<td>59.6 ± 8.9</td>
</tr>
<tr>
<td>Skill practice</td>
<td>6.9 ± 4.6</td>
<td>34.9 ± 18.2</td>
<td>11.0 ± 3.2</td>
</tr>
<tr>
<td>Game play</td>
<td>66.4 ± 6.0</td>
<td>75.9 ± 8.5</td>
<td>8.5 ± 3.3</td>
</tr>
<tr>
<td>Free play</td>
<td>16.6 ± 5.4</td>
<td>22.5 ± 7.6</td>
<td>2.9 ± 0.9</td>
</tr>
<tr>
<td>Coach behavior (percentage of time)</td>
<td>50.0 ± 15.0</td>
<td>26.2 ± 15.0</td>
<td>21.7 ± 15.0</td>
</tr>
<tr>
<td>Observations PA</td>
<td>18.9 ± 5.9</td>
<td>13.5 ± 11.5</td>
<td>32.3 ± 6.0</td>
</tr>
<tr>
<td>Observations SK</td>
<td>17.8 ± 8.5</td>
<td>13.5 ± 11.5</td>
<td>32.3 ± 6.0</td>
</tr>
</tbody>
</table>

Stages means not included in All Sports; mean ± SD values because they were exclusive to netball. Values are presented as mean ± SD.

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mean percentages for game play were significantly higher during games compared with practice ($r = 6.99, p < 0.001$).

**Coach behavior.** Although there were more occurrences per hour of both promotion and encouragement of PA during games compared with practice, means were not significantly different. There were significantly fewer occurrences per hour of coaches demonstrating PA during games than during practice ($r = 295, p < 0.05$). These trends were consistent for across OS.

**DISCUSSION**

To our knowledge, this is the first study to examine PA in Australian OS and to compare mean proportions of PA levels of girls during practice and games in OS using the same participants. As far as we are aware, it is also the first to provide additional insight on lesson content and coach behavior during OS through the inclusion of SOFIT in the pre-revised literature.

Our observations of the three sports showed that girls achieved significantly higher levels of MVPA during practice compared with games; accumulating approximately 20 min h$^{-1}$ ($34\%$ time) in MVPA during practice and approximately 18 min h$^{-1}$ ($30\%$ time) in MVPA during games. The girls also accumulated an average of 2944 and 2701 steps per hour during practice and games, respectively. Therefore, for every hour of game play or practice time, girls accumulated approximately one third of the recommended 60 min of MVPA (21), and approximately one quarter of the 12,000 steps girls are recommended to accumulate daily (20). For this population, OS seems to make a substantial contribution to the recommended levels of PA of participating girls.

Our findings are compatible with the findings of earlier studies. Sackett et al. (18) found approximately $33\%$ of soccer games were spent in MVPA, whereas Leck et al. (9) examined PA levels during soccer and baseball/softball practices and found children spent $46\%$ of the practice time in MVPA across sports. Consistent with the present findings, practices may provide more MVPA compared with games. A possible explanation for this difference may be that coaches are better able to dictate the intensity of a practice compared with a game. Also, a larger proportion of the team can participate simultaneously and in smaller groups, which can provide increased opportunities for players to participate at a higher PA intensity during practice, compared with a game.

A study by Wickel and Eisman (28) sought to determine the contribution of OS (mean duration in OS $= 65$ min) to daily PA. Similar to our findings, OS contributed substantially to the amount of recommended MVPA on days where children participated in OS ($= 23\%$ or $26$ min) (26). The authors, however, indicated that this additional PA was not maintained on days without OS. These findings indicate that although OS alone does not provide amounts of PA sufficient to meet daily recommendations, it does provide an ideal opportunity to be physically active and to contribute to daily MVPA of participating children. Furthermore, evidence indicates that children who participate in OS are more active than those who do not and are more likely to meet recommended PA guidelines (13,20).

Although OS provides a substantial proportion of the recommended amounts of MVPA, there may be potential for improvement in the contribution that OS makes to daily MVPA. In our study, a considerable proportion of practice and game time was spent insufficiently active (SED or LPA). Significantly higher proportions of time were spent SED ($= 39\%$ vs $= 20\%$) during game time compared with practice and vice versa for LPA ($= 31\%$ vs $= 16\%$). On average, girls were SED or in LPA approximately 45 min h$^{-1}$ ($70\%$ time) during games and approximately 40 min h$^{-1}$ ($67\%$ time) during practice. This finding is consistent with other studies that have observed sizable proportions of game or practice time spent SED or in LPA (6,15,18,20). Thus, there are clear opportunities to increase MVPA, particularly during practice, in OS.

With the inclusion of SOFIT in this study, not only does it provide the first glimpse of how time is spent (lesson context) and coach behavior during these OS, it may also assist in identifying opportunities to increase MVPA, particularly during practice. To our knowledge, there are no peer-reviewed studies reporting the use of SOFIT in OS, and only one published report has used SOFIT in an OS setting, where rugby league and rugby union practices were observed (14). Rugby coaches spent similar percentages of practice time in activity ($= 26\%$) and game play ($= 20\%$) ($= 23\%$). This compared with present study findings across OS. However, coaches in the present study spent a considerably higher percentage of practice time in management ($= 15\%$) and knowledge delivery ($= 19\%$) and considerably lower percentage of practice time in skill practice ($= 33\%$) compared with rugby coaches.

Rugby players in the earlier report (14) spent a considerably higher percentage of time in skill practice compared with their participants. It is likely that PA levels are higher during practice; therefore, it is probable that rugby players had more opportunities to be physically active during practice. It is also likely that children would be relatively inactive while in management and knowledge delivery. This has recently been exhibited in a physical education setting, where coaches found a significant negative correlation between MVPA and time spent in management and knowledge delivery (2). Therefore, decreasing the percentage of time coaches spend in management and knowledge delivery may be a strategy to consider in helping create an environment that provides the most opportunity for PA.

Lastly, our findings indicate that coaches tended to promote PA (includes prompts of encouragement and praise) more frequently than they tended to discourage PA (includes prompts that are sarcastic and punitive in nature) during both games and practice. Coaches demonstrated PA more often during practice than during games. Although one report (14) has used SOFIT in OS, direct comparisons of coach
behavior could not be made due to differences in coding made by the authors for this phase of SOFIT. However, comparisons for promoting PA can be made with physical education teachers. Compared with physical education teachers, higher rates of promoting PA were found with coaches in the present study, which may lead to increased PA (3.0-19).

A few potential limitations should be considered when interpreting the current findings. First, the present study was not designed for comparison between sports but rather to describe PA levels of these three OS and to compare PA levels of children during games and practices. Second, a convenience sample was used; therefore, there is the potential for selection bias. Third, PA levels were based on a single observation period for each time, that is, one game, one practice, and one fitness practice (for royal). Lastly, the study was conducted from only one club for each sport, and thus our ability to generalize the current findings may be limited. Despite these limitations, the present study used objective measures that allow for a rigorous description of the PA levels that girls achieved during practice and games in OS with some of the highest participation rates in Australia.

In conclusion, both games and practices in OS seem to have made a substantial contribution to the accumulation of recommended amounts of daily MVPA and steps of participating girls. However, OS alone did not provide a sufficient amount of PA to meet daily recommendations for adolescent girls. Across OS, large proportions of time were spent in SED or LPA. Also, considerable percentages of time were spent in management and knowledge delivery. Therefore, there is room for improvement with regard to promoting PA levels in OS, particularly during practice, without compromising fundamental lessons and skills taught by coaches. This information on OS can be used as a platform on which to inform policies and to develop strategies to increase adolescent girls’ PA levels through OS. Because PA levels were not monitored on non-OS days in the current study, future research should examine the contribution of OS to PA levels during days of OS compared with non-OS days for those sports. Furthermore, support should be provided to coaches in an effort to increase MVPA and reduce SED time in OS, without interfering with fundamental learning opportunities and skill development that occur in OS.

The authors thank participating teams and their research assistants. They thank Dr. Chris Lomas for his constructive criticism of the manuscript.

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The authors have no conflict of interest to declare.

The results of the present study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

Main Features-Characteristics-of-participation?
OpenDocument.


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Increasing girls’ physical activity during an organised youth sport basketball program: a randomised controlled trial protocol

Justin M Guagliano*, Chris Lonsdale, Gregory S Kolt and Richard R Rosenkranz

Abstract

Background: Participation in organised youth sports (OYS) has been recommended as an opportunity to increase young peoples’ moderate-to-vigorous physical activity (MVPA) levels. Participants, however, spend a considerable proportion of time during OYS inactive. The purpose of this study, therefore, was to investigate whether coaches who attended coach education sessions (where education on increasing MVPA and decreasing inactivity during training was delivered) can increase players’ MVPA during training sessions over a 5-day basketball program compared to coaches who did not receive coach education sessions.

Methods/design: A convenience sample of 30 female players and 8 coaches were recruited into the UNS School Holiday Basketball Program in Greater Western Sydney, Australia. A two-arm, parallel-group randomised controlled trial was employed to investigate whether coaches who attended 2 coach education sessions (compared with a no-treatment control) can increase their players’ MVPA during training sessions over a 5-day basketball program. Objectively measured physical activity, directly observed lesson context and leader behaviour, player motivation, players’ perceived autonomy support, and coaching information (regarding training session planning, estimations on player physical activity and lesson context during training, perceived ability to modify training sessions, perceived importance of physical activity during training). Intention to increase physical activity/reduce inactivity, and likelihood of increasing physical activity/reducing inactivity were assessed at baseline (day 1) and at follow-up (day 5). Linear mixed models will be used to analyze between-arm differences in change from baseline to follow-up on all outcomes.

Discussion: The current trial protocol describes, to our knowledge, the first trial conducted in an OYS context to investigate the efficacy of an intervention, relative to a control, in increasing MVPA. This study’s findings will provide evidence to inform strategies targeting coaches to increase MVPA in OYS, which could have major public health implications, given the high proportion of children and adolescents who participate in OYS globally.

Trial registration: This trial is registered with the Australian New Zealand Clinical Trials Registry, ACTRN12613001099718.

Keywords: Moderate-to-vigorous physical activity, inactivity, Youth sport, Organized sport, Training, Coach, Children, Adolescents, Coach education
Background
Globally, high proportions of children and adolescents participate in organised youth sports (OYS) [1-3]. In Australia, yearly prevalence data indicate that approximately 60% of children (67% of girls) participate in at least one OYS (excluding dance) outside of school hours [4]. An array of physical and psychosocial health and developmental benefits are associated with children and adolescents' participation in OYS including, but not limited to, skill development, muscular strength and endurance, increased self-esteem, and positive peer relationships [5]. Given the high proportion of children who participate in OYS, coupled with the myriad health and developmental benefits associated with sports participation, OYS has the potential to be a powerful health-promoting environment for children and adolescents.

One of the most pertinent attributes of OYS is its potential to contribute considerably to levels of moderate-to-vigorous physical activity (MVPA) in children [6,7]. Given that a sizeable proportion of children and adolescents do not meet the recommended 60 minutes of daily MVPA [8-11], participating in OYS could have a major impact on public health outcomes related to activity levels. This is particularly important for girls, as research shows that they are less physically active than boys [8,10], with the most pronounced declines in physical activity participation observed in adolescence [10].

Although OYS may provide an ideal opportunity for children and adolescents to accumulate substantial amounts of MVPA, studies have found that children and adolescents spend large proportions of time during OYS inactive or in light physical activity [6,12,13]. Furthermore, using a direct observation system [14], Guagliano, Rosenkranz, and Kolt [6] observed that coaches spent a considerable proportion of training time managing and instructing their players, time when children and adolescents would be relatively inactive. There is potential, then, for coaches to be able to influence their players' physical activity levels particularly during training when coaches are better able to dictate the intensity of physical activity, as compared to during a game. That said, to our knowledge, no study has used coaches to promote physical activity in OYS. One study, however, explored OYS coaches’ perceptions on this topic and it appears that coaches have the potential to be ideal candidates to promote physical activity in OYS [15].

Methods/design
Trial design
This study is a two-armed, parallel-group RCT, using a 1:1 allocation ratio, designed to investigate whether coaches who attended coach education sessions (where education on increasing MVPA and decreasing inactivity during training was delivered) could increase their players' MVPA during training sessions over a 5-day basketball program compared to coaches who did not receive coach education sessions. The secondary aims were to (1) assess whether players who were coached by coaches who have attended coach education sessions spent a lower percentage of time inactive during training sessions compared to players who are coached by coaches who did not attend coach education sessions; and (2) to investigate motivational effects on player physical activity. We also investigated changes in coaches' awareness of player physical activity, how time was spent during training (lesson context), and leader behaviour.

Compared with a standard-care control coached as normal, we hypothesised that players who have been coached by coaches who have attended coach education sessions will (1) spend a greater percentage of time in moderate-to-vigorous physical activity; (2) spend a lower percentage of time inactive; and (3) not exhibit lower motivation scores. Also, we hypothesised that coaches who have attended coach education sessions will have a greater awareness of their players' physical activity.

Participants
We planned to recruit a convenience sample of 80 female players and 8 coaches into the UWS School Holiday Basketball Program. Players were recruited through the distribution of flyers to 5 OYS basketball clubs, 6 primary schools (private and Catholic), 3 community centres, 2 after-school programs, and social media (Facebook and Instagram) which are private social networks for UWS staff, were used. Coaches were recruited via flyers to 2 OYS basketball clubs and the UWS (undergraduate students). To be considered eligible for this study as a player, participants
needed to be female, aged 9–12 years, and intend to attend the program for its duration. For coaches to be eligible to coach in the program, basketball coaching credentials from the Australian Sports Commission's National Coaching Accreditation Scheme (NCAS) [17] and previous experience coaching girls basketball teams were required. Coaches were also informed that participation might involve attending 2 coach education sessions; however, no information was divulged regarding what the coach education sessions entailed. Coaches also received payment for their time, at a rate of AUD$25/hour (intervention coaches were also paid to attend coach education sessions at the same rate).

Sample size and power calculation
On the basis of an α of 0.05 and 80% power to detect a significant differential change in MVPA between groups, using an effect size of $d = 0.6$, a minimum sample size of 36 female players for each group was needed ($N = 72$). Our effect size is consistent with the findings of a recent systematic review and meta-analysis of interventions designed to increase children and adolescents' MVPA in a similar setting (physical education), $d = 0.62$ [18]. To protect against player attrition and preserve adequate statistical power, the sample size was inflated by 10%, thus a total sample of 80 female players was sought.

Blinding
Research assistants, blinded to study hypotheses and treatment allocation, conducted baseline assessments prior to randomisation. Players were also blinded to study hypotheses and treatment allocation. After baseline assessments and randomisation, 4 coaches were asked to attend coach
education sessions (intervention) and 4 coaches served as controls; therefore, it was not possible to keep coaches blinded in this study. Lastly, a member of the research team who was blinded to participant (player and coach) allocation conducted all analyses.

**Randomisation**

Coaches were randomly assigned to the site they were coaching by using simple randomisation; a computer-generated algorithm was used, ensuring an equal number of coaches at each site. Players, however, were not randomly allocated to a site; instead parental preference in site determined where the player would attend the basketball program, and this was predominantly based on location of the venue in relation to their residence.

Group randomisation for both players and coaches occurred following baseline assessments. Coaches were pair-matched using the average step counts of their group of players accumulated during two training sessions during baseline assessment (i.e., the two coaches with the two highest group step count averages during the training sessions and the two coaches with the two lowest group step count averages during the training sessions were paired together). Coaches were pair-matched to ensure that similar coaches (in terms of the average group step counts accumulated by their players during the baseline training sessions) were randomised into each arm of the study. Given that increasing MVPA was our primary outcome and that photometry has been shown to be an accurate indicator of MVPA [19], matching coaches via group step counts was appropriate. Using a computer-generated algorithm one coach from each pair was allocated into the intervention arm and the other into the control arm.

Players at each site were randomly assigned using simple randomisation to either the intervention or control arm through a computer-generated algorithm, ensuring equal groups. To avoid clustering effects associated with having the same coach in each session throughout the program, players were randomised into different training groups and coaches within their allocated arm for each training session period for the duration of the program. Figure 2 illustrates the randomisation procedure for each training session for one site.

**Study procedure**

The UWS School Holiday Basketball Program is a basketball program for girls that ran for 5 consecutive days, for 4 hours per day, over the school holiday period in September 2013 (Australian Spring). The basketball program ran simultaneously across 2 sports centres in Greater Western Sydney, Australia, with each site having 2 full-size basketball courts. At each site, aimed to recruit 40 female

**Figure 2** illustrates the randomisation procedure for each training session for one site. Note: numbers represent player identification numbers.
players and 4 coaches and the data collection team comprised 1 supervisor and 4 research assistants.

Parents/guardians who wanted to register their daughter(s) in the basketball program, and coaches who wanted to coach in the basketball program, initiated contact with the primary researcher (IMG) expressing their interest. Initial contact was made via phone, text message, email, or face-to-face. IMG screened all interested participants for eligibility using a standardized script or email message. Parents of players who were deemed eligible for inclusion were given a study information sheet, informed consent/assent form, an emergency contact form, and a parent questionnaire (described below) to complete. Coaches who were deemed eligible for inclusion were provided with a study information sheet (containing a basic description of primary study aim), informed consent form and a coach questionnaire (described below) to complete. When all forms were completed and returned, the participant (player or coach) was enrolled into the study.

The program was structured the same each day (see Table 1) and included 2 training sessions and 2 games. In each of the training sessions, coaches were instructed to focus on 2 skills; however, the coach planned their own training sessions to teach these skills. Each day, the first training session focused on dribbling and defending skills and the second training session focused on passing/catching and shooting skills. Coaches had half of a court to deliver their training session. During each training session, research assistants used the System for Observing Fitness Instruction Time (SOFIT) [14] to collect lesson context and coach behavior data. During this time, players and coaches also wore accelerometers, and research assistants recorded their step counts at the conclusion of each training session. These data were summarized and entered onto a coach feedback form, where intervention coaches received a group average step count per minute and the percentage of time spent in each lesson context and coach behavior according to SOFIT. This feedback was given to intervention coaches at the end of each day of the basketball program. A double round-robin tournament was created for the 2 games per day, which was played on a full court. During the designated breaks, players were free to do as they chose (e.g., talk amongst each other, eat, play basketball or other games of their choice).

Baseline assessments were collected on the first day and follow up assessments were collected on the fifth day of the basketball program (see Table 2 for a summary of the data collected). Following the first 2 days of the program, the 4 coaches allocated to the intervention arm of the study attended a coach education session.

**Intervention**

Although this study is the first intervention study in an OYS setting directed at increasing players' MVPA, there have been several interventions conducted in a similar setting (physical education) with the same objective (see Lonsdale et al. [18] for a recent systematic review and meta-analysis). Several intervention studies included in Lonsdale et al’s systematic review and meta-analysis incorporated similar intervention components as our intervention. For example, strategies to reduce management and instruction time [20,21] in an effort to reduce inactivity, create leader awareness [20], modified drills where physical activity was more inherent [22], and preparation/organisation [21,23]. The authors’ findings indicated that physical education based interventions can increase the proportion of time students spent in MVPA while participating in physical education lessons [18].

In the current study, coaches allocated into the intervention arm attended 2 coach education sessions. Each coach education session was approximately 2 hours in duration and took place in the afternoon following each of the first 2 days of the program. IMG conducted both coach education sessions. IMG is working towards a doctoral degree in the area of physical activity promotion in children and youth and has 4 years of experience coaching OYS teams. A research assistant was also present during both coach education sessions. The research assistant holds a doctoral degree in the area of physical activity promotion and also has previous experience (3 years) coaching OYS teams.

During the first coach education session (after day 1 of the program), approximately 20 minutes was spent providing coaches with information about MVPA (i.e., what it MVPA and how much should children accumulate daily based on national guidelines [24]). Further, IMG summarised findings of a previous study that examined girls’ MVPA in OYS (in terms of proportion of practice time and steps/min) [6]. Coaches were informed of a study by scrubga, who found that 82–88 steps/min was approximately equivalent to spending 50% of the time physically active (in physical education) [25]. In a physical education setting, spending 50% time in MVPA has been recommended as a target [26]. Since no such recommendation exists in OYS, and a similar proportion of time spent in MVPA has been found in OYS [6] and physical

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration (in minutes)</th>
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<tbody>
<tr>
<td>Training session 1</td>
<td>45</td>
</tr>
<tr>
<td>Break</td>
<td>15</td>
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<tr>
<td>Game 1</td>
<td>40</td>
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<tr>
<td>Break</td>
<td>15</td>
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<tr>
<td>Training session 2</td>
<td>45</td>
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<tr>
<td>Break</td>
<td>15</td>
</tr>
<tr>
<td>Game 2</td>
<td>40</td>
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</table>
education [27], we adopted Scruggs’ steps/min estimation as a guide for intervention coaches to gauge their athletes’ physical activity during the two training sessions. Coaches, however, were not explicitly instructed to aim for a specific proportion of time in MVPA or steps/min. Coaches were also shown how training time was typically spent during based on Gaiglano et al’s findings [6]. The aforementioned study [6] broke training sessions down into 6 mutually exclusive categories (management, knowledge delivery, fitness, skill practice, game play, and free play) based on the SOFIT [14] (described in detail below).

Coaches were then given roughly 15 minutes to reflect on their training sessions. Coaches were prompted to consider how active they thought their players were during training, how they spent their time during training, and potential modifications they could make to some of their drills to increase opportunities for MVPA.

Coaches were then presented with individualized feedback for each of their 2 training sessions. All information provided on the coaches’ feedback form was explained to the coaches by JMG (approximately 15 mins), which included: group average steps/minute, proportion of training time spent in each SOFIT lesson context (described in next section), and coach behaviour recorded as occurrences per session (described in next section).

The next 30 minutes were spent discussing potential strategies coaches could implement to increase opportunities for MVPA. More specifically, the importance of planning, conducting warm-ups and cool downs, dynamic stretching as opposed to static stretching, using small long-term groups, providing ample equipment, using circuits/ grids as opposed to lines, and avoiding elimination games were discussed as potential strategies to increase opportunities for MVPA during training.

Coaches were then presented with a case study. The case study was a short video of a basketball training session. Coaches were asked to modify the drills in the video in order to increase MVPA. Once coaches had modified drills, each coach demonstrated their modified drill on a basketball court. Coaches had the remainder of the session to plan their training sessions for the next day (roughly 20 minutes).

The beginning of the second coach education session (after day 2 of the program) was devoted to reviewing the strategies to increase MVPA that were discussed in the first coach education session (about 10 minutes). Coaches then reflected on their training sessions for approximately 15 minutes (either alone or with one another). Coaches were prompted to reflect on the strategies they tried to incorporate into their training sessions (and their success in doing so), and similar to the first session, how active they thought their players were during training, and how they spent their time during training.

The next 30 minutes were spent discussing potential strategies coaches could implement to decrease inactivity during training. More specifically, JMG discussed potential strategies to decrease or modify management (e.g., drill transition or drink breaks) and instruction time to reduce inactive time. Self-monitoring (e.g., limit number of drills, limit number of times providing instruction, or limit the time spent delivering instructions) and goal setting (e.g., setting proximal and distal goals for the basketball program) were also discussed as potential strategies that coaches could implement to decrease inactivity during their training sessions.

Similar to the first coach education session, coaches were presented with a video case study of a basketball training session and were asked to modify the drills in the
video in order to increase MVPA or decrease inactivity. Coaches were also asked to modify some of their commonly used drills. Once coaches had modified drills, each coach demonstrated their modified drill to each other on a basketball court (approximately 30 minutes). The remaining time (about 35 minutes) was devoted to planning their training sessions and completing a process evaluation questionnaire.

Intervention coaches continued to receive individualised feedback after each program day (i.e., on program days 3–5) individually. Feedback was delivered to intervention coaches in an effort to avoid raising suspicion among control coaches.

Coaches allocated into the control arm of the study were asked to coach as usual. Control coaches had access to the same equipment (e.g., basketballs, pylons, coloured training jerseys) as intervention coaches, but were not privy to any information provided during the coach education sessions or individual feedback.

Outcome measures

**Accelerometry**

ActiGraph GT3X+ accelerometers (ActiGraph, Pensacola, FL) were used to assess physical activity levels in this study. In a paediatric population, ActiGraph accelerometers have been shown to be valid and reliable devices for the measurement of physical activity levels [28,29]. Accelerometers were initialised once at the start of the week and set to record data at a sampling rate of 30 Hz, as well as step counts. Accelerometers were synchronized with an external clock and initialised to start recording 1 hour before the start of the first day of the basketball program and stop recording 1 hour after the fifth day of the basketball program. Start and finish times of training sessions, games, and breaks were recorded. Players and coaches were accelerometers. Female research assistants fitted players with an accelerometer. Accelerometers were placed over the right iliac crest and held in place using an adjustable elastic belt, prior to the start of each program day, and worn for the duration of the day. At the end of the fifth day, raw accelerometer counts were downloaded to a computer using ActiGraph software, integrated into 1-second epochs, and exported and saved to a Microsoft Excel file.

Everson cut-points [30] have been recommended to estimate physical activity intensity in children and adolescents [29,31]. Freedson cut-points [32]; however, have been used by much of the existing literature that has examined physical activity in OYS [6,7,12]. Both cut-points were used in this study. Everson cut-points were used as our primary outcome and Freedson cut-points were presented to facilitate comparisons with previous studies. Using Everson cut-points [30], physical activity intensity was classified as the following (thresholds have been adjusted to account for 1-second epochs): inactive ≤167 counts per second; light physical activity >168 counts per second ≤38.25; moderate physical activity ≥38.26 counts per second ≤66.85; and vigorous physical activity ≥66.86 counts per second [30]. Using Freedson’s metabolic equivalent of task (MET) prediction equation [32], physical activity intensity was classified as the following: inactive ≤100 counts/min; light physical activity ≥1.5 METs ≤4; moderate physical activity ≥4 METs <7; and vigorous physical activity ≥7 METs [32]. To account for our 1-second epochs, age-specific counts per minute were divided by 60. Although there is still some debate regarding suitable MET-intensity thresholds for children and adolescents [29], the thresholds selected for this study have been previously used in a female paediatric population [6,33].

**Pedometer**

Two models of Yamax Digiwalker (Tokyo, Japan) pedometers were used in this study, the SW-200 and SW-700. Both the SW-200 and SW-700 models use the same pendulum mechanism to count steps [34]. Studies have found that the SW series of Yamax Digiwalkers is sensitive to increases in physical activity, has a high level of agreement with observed steps, and is a valid assessment of the volume of physical activity in children [35–37]. Players and coaches were fitted pedometers over the right iliac crest, for the duration of both training sessions that occurred daily. Female research assistants assisted players with the placement of the pedometer. Research assistants recorded individual step counts following each training session and reset the pedometer. Pedometers were employed in this study to quickly provide intervention coaches with feedback on their players’ physical activity levels during that day’s training sessions.

**Direct observation**

SOFT is a widely used direct observation system that uses momentary time sampling to generate data on players’ physical activity, lesson context, and leader behaviour [14]. Studies have shown that SOFT has demonstrated acceptable reliability and validity in paediatric populations [14,38]. SOFT can be easily implemented in an OYS setting, yet only one peer-reviewed study that we are aware of (conducted by our research team) has used the direct observation system in OYS [6].

Prior to session commencement, the observer implementing SOFT, quasi-randomly and haphazardly selected 4 (plus an alternate) players to observe for the duration of the session [6,39]. Players were observed for 4 minutes at a time, on a rotational basis. Physical activity levels, lesson context, and leader behaviour were coded and recorded on paper every 20 seconds using a looped voice recording that prompted the observer to observe and
record. At the end of each observation interval, lesion context was coded into only 1 of 6 mutually exclusive categories: management, knowledge delivery, fitness, skill practice, game play, and free play. Lead behaviour, however, is coded using a hierarchical format. Lead behaviour was coded into 1 of 4 categories and included (in hierarchical order) promotes physical activity (includes prompts that are social, supportive, or positive in nature), demonstrates physical activity, and other. Promotes physical activity or discourages physical activity, therefore, is scored if it occurs at any time during the 10-sec observe interval; whereas “other” is only scored if the other categories are not observed during the 10-sec observe interval. JMG has been trained to use the observation technique and has collected SOFIT data for other peer-reviewed work [6]. JMG trained all research assistants to use SOFIT using recommended guidelines [40]. Research assistants’ SOFIT coding accuracy was assessed against a pre-coded ‘gold standard’ video developed by McKenzie [40]. Coding accuracy was assessed using percent agreement, where a minimum of 80% agreement between scores was set as the minimum acceptable level of agreement [40].

Questionnaires

At baseline (day 1) and follow up (day 5), players were asked to complete a questionnaire assessing their perceptions of their coach’s autonomy-supportive behaviour by completing 4 items from the Teacher as Social Context Questionnaire [41,42]. Players responded to questions on a 5-point Likert scale (1 = not at all, 5 = very true). Scores on the TASC were averaged and ranged from 1 to 7, higher scores were indicative of greater perceived coach autonomy-supportive behaviour.

Players also completed the 14-item Situational Motivation Scale which assesses construct of intrinsic motivation, identified regulation, external regulation, and amotivation [43]. Players responded to questions on a 7-point Likert scale (1 = not true at all, 7 = very true). Based on players’ average scores from the four subscales of the SIMS, a self-determination index (SDI) was created (SDI = 2*Intrinsic motivation + Identified motivation – External regulation – Amotivation, e.g. Lonsdale et al. [44]). Scores on the SIMS can range from -18 to 18, where higher scores were indicative of greater self-determined motivation towards participation in a situation (i.e., basketball practice) [44,45]. Both the Teacher as Social Context Questionnaire and the Situational Motivation Scale have received empirical support for reliability and validity [41,42,43].

A demographic questionnaire was distributed to parents and coaches for descriptive data purposes. The questionnaire that was distributed to parents collected data on parents’ level of education, relationship status, and household income. The questionnaire also collected data on their daughter’s age, country of birth, cultural background, and age information (number of OYS played level, number and minutes of training sessions per week, and number and minutes of games per week). This questionnaire was only distributed to parents once, prior to the commencement of the study.

The questionnaire distributed to coaches collected data on age, sex, height, weight, country of birth, cultural background, highest education qualification, relationship status, OYS information (number of OYS played level, number and minutes of training sessions per week, and number and minutes of games per week), physical activity information (number and time spent in vigorous, moderate, and light physical activity and leisure-time information (time spent sleeping, sitting, standing, watching television, and using a computer). These data were only collected from coaches once, prior to commencement of the study. Coaches responded to questions on a 5-point Likert scale (1 = not at all, 5 = to a great extent) about coaching, regarding training session planning, estimations on player physical activity during training estimations on percentage of time spent in each SOFIT lesson context (described above), perceived ability to modify training sessions, perceived importance of physical activity during training, intention to increase physical activity/reduce inactivity, and likelihood of increasing physical activity/reducing inactivity. These data were collected prior to the start of the study, after intervention end (day 3), and at follow up (day 5).

Anthropometric measures

Prior to measurement, players were asked to remove shoes and any heavy clothing. Standing height was measured to the nearest 0.1 cm using a portable stadiometer (PE97 portable stadiometer, Martone Educational, Victoria, Australia). Weight was measured using a digital scale (EF 558 HealthStream digital scale; Aussie Fitness, Queensland, Australia) to the nearest 0.1 kg. Using the Centers for Disease Control and Prevention growth charts, body mass index (BMI) was calculated and converted into age- and sex-specific percentiles [46]. Waist circumference measurements were taken on the right side of the body by finding the midpoint between the lowest rib and the iliac crest [46]. A non-elastic tape measure (Myotape; Martone Educational, Victoria, Australia) was wrapped snugly around the waist and measurement was taken at the end of exhalation to the nearest 0.1 cm. All measurements were conducted in duplicate and an average was recorded. A third measurement was taken if the first two measures differ by more than 0.5 cm or 0.5 kg and the average was recorded. Female research assistants collected all waist circumference measurements.
Process evaluation
A process evaluation was undertaken following the UWS School Holiday Basketball Program. The process evaluation assessed, using questions on a 5-point Likert scale (1 = not at all, 5 = to a great extent) and open-ended questions, the program’s feasibility and acceptability of the program amongst coaches.

Statistical analysis
All variables will be checked for normality using the Shapiro-Wilk test. Independent samples t-tests or Mann–Whitney U-tests will then be conducted, as appropriate, to examine: (1) baseline differences between groups and (2) baseline differences between players who completed the study and those lost to follow-up. If variables significantly differ between groups, they will be appropriately adjusted in the main analyses.

Linear mixed models will be used to analyse the differential change between groups on all outcomes from baseline to follow-up using baseline data as the covariate. Linear mixed models will be used because these models are robust enough to withstand the biases from missing data, and provide good control of Type I and Type II errors [50, All analyses will be conducted using SPSS 21.0 (Chicago, IL, USA). The level of significance will be set at p < 0.05.

Discussion
A number of studies have recently been published examining OYS clubs as a setting to promote health [51-53]. These studies illustrate the wide range of health-promoting capabilities OYS can provide and the importance of OYS clubs, yet only one study has acknowledged that OYS clubs could play a role in promoting physical activity [53]. Studies have shown that children and adolescents can accumulate considerable amounts of MVPA during OYS, however, the majority of time spent during OYS is either inactive or in a light physical activity intensity [67,122]. Thus, there is clearly an opportunity to optimise MVPA levels and reduce inactivity and light physical activity during OYS. If the intervention is successful, this study’s findings will support the use of coach education sessions to increase MVPA in OYS, which can have major public health implications given the high proportion of children and adolescents who participate in OYS globally [1-4].

This study is not without its limitations. First, this study only investigated the short-term efficacy of coach education on player physical activity as the basketball program took place over five consecutive days. Further, by conducting this study as an OYS basketball program (rather than using players’ usual competition teams and coaches) may have limited our generalisability; however, it has increased our internal validity by allowing us to test the efficacy of the intervention in a more tightly controlled environment. The decision to conduct this study in the form of an OYS basketball program (rather than using players’ usual competition teams and coaches) was made to allow us to individually randomise players to different training groups and coaches within their allocated arm each training session period. If this study were conducted in players’ usual competition, sampling would have had to place on three levels (player, coach, OYS club), each additional level, an additional source of sampling error causing power to drop. By forming an OYS basketball program and individually randomising players to different training groups and coaches, we avoided a clustering effect and thus a cluster randomised controlled trial study design that would require a much larger sample. Studies conducted in a similar setting have observed high inter-class correlations for MVPA (indicating a large clustering effect) [45,54]. Our sample size then would have been inflated considerably to reach sufficient power and account for the clustering which would not have been feasible. Despite this limitation, the present study employed a rigorous study design and used a high-resolution (1-second epochs) objective measurement to assess physical activity. Additionally, this study will provide insight on girls’ motivation, lesson content and leader behaviour (through SOFIT).

The current trial protocol presents, as far as we are aware, the first intervention to be conducted in an OYS context designed to investigate the efficacy of coach education sessions (relative to a no-treatment control) on increasing players’ MVPA and reducing inactivity during training. If the intervention is successful, this study’s findings will support the use of coach education sessions to increase MVPA in OYS, thus, this study’s protocol can be used as a starting point to inform future interventions and strategies to increase MVPA and reduce inactivity during OYS.

Abbreviations
MVPA: Moderate-to-vigorous physical activity; OYS: Organised youth sport; RCT: Randomised controlled trial; SDI: Self-determination index; SOFIT: System for Observing Fitness Instruction Time; UWS: University of Western Sydney, Sydney.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
All authors contributed to the study design, JMG managed data collection, performed sample size calculations, and drafted the manuscript. CL, GSK, and RFR reviewed and edited the manuscript. All authors approved the final manuscript.

Acknowledgements
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References


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Appendix D. Human Research Ethics Committee approval for Study 1.

UWS HUMAN RESEARCH ETHICS COMMITTEE

4 April 2011

Doctor Richard Rosenkranz,

School of Biomedical and Health Sciences

Dear Richard and Justin,

I wish to formally advise you that the Human Research Ethics Committee has approved your research proposal H8930 “Examining Girls’ Physical Activity Levels in Organised Sport” until 31 August 2012 with the provision of a final report on completion.

Please quote the project number and title as indicated above on all correspondence related to this project.

Yours sincerely

Dr Janette Perz

Chair, UWS Human Research Ethics Committee
Appendix E. Research assistant declaration form from Study 1.

School of Biomedical & Health Sciences
University of Western Sydney
Locked Bag 1797
Penrith South DC NSW 1797 Australia

Research Assistant Declaration

I, ______________________ collected waist circumference data as well as fit and removed accelerometers from all female participants on _____/____/2011.

Signature: ______________________

Witness: ______________________
Appendix F. Dialogue sheet for Study 1.

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Dialogue Sheet

Project Title: Examining Girls’ Physical Activity Levels within Organised Sports

Who is carrying out the study?
My name is Justin Guagliano and I am a Master’s student at the University of Western Sydney. I have two supervisors and their names are Dr. Ric Rosenkranz and Prof. Gregory Kolt.

What is the study about?
For this project, I am trying to learn more about the amount of physical activity that you achieve during your time playing organised sport. I also would like to see what your training sessions look like and what your coach does during training sessions and games.

What does the study involve?
If you decide you want to be in my study I would like:
- To watch one of your games and one training session and collect information about your physical activity levels, training sessions and some information about your coach as well.
- During the one game and one training session I come to watch I would also like you to wear a small gadget called an accelerometer (weighs the same as three $1 coins) on your hip that measures your physical activity levels. A trained female research assistant will put on and take off the accelerometer before and after the game or training session, males are specifically excluded from the process.
- I would like to collect your height, weight, and waist circumference at the one training session I come to watch. Waist circumference will be collected by a trained female research assistant, males are specifically excluded from this process.
- I would also like your parents or guardians to complete a short questionnaire.

How much time will the study take?
It will take about 10-20 minutes at the one training session that I come to watch to collect your height, weight, and waist circumference information, put on the accelerometer that you will wear during your training session, and for your parents or guardians to complete a short questionnaire. At the one game that I come to watch it will take about 5-10 minutes to put on the accelerometer that you will wear during your game.

Will the study benefit me?
This study will not have an immediately benefit to you but it may benefit other children in the future.

Will the study have any discomforts?
There should be no discomfort to you.

How is this study being paid for?
The study is being funded by the College of Health and Science - School of Biomedical and Health Sciences at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researcher and his supervisors will have access to information on participants.

**What if I have a concern?**
If you have any concerns you or your parent/guardian should first tell your coach who will then tell me.

**Can I withdraw from the study?**
Your participation in the study is entirely voluntary, you do not have to participate. If you want to be in the study now and change your mind later, that’s OK. You can stop at any time at which point all information I have collected will be destroyed.

**Ask the students if they have any further questions before commencement.**
Appendix G. Coach information sheet for Study 1.

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Participant Information Sheet (General)

Project Title: Examining Girls' Physical Activity Levels within Organised Sports

Who is carrying out the study?
You are invited to participate in a study conducted by Justin Guaglano, Master of Science student at the University of Western Sydney - School of Biomedical and Health Sciences.

Supervisors:
Dr. Ric Rosenkranz
Lecturer/Research Fellow
School of Biomedical and Health
University of Western Sydney

Prof. Gregory Kolt
Head of School
Sciences School of Biomedical and Health Sciences
University of Western Sydney

What is the study about?
The main purpose of this study is to examine physical activity levels of girls aged 9-14 during one of their organised sport games and one training session. This study will also examine training session context and coaching delivery methods.

What does the study involve?
For coaches, this study involves the completion of a short questionnaire. It also involves allowing the researcher to observe one game and one training session. For the athletes this study involves: the collection of anthropometric information (height, weight, waist circumference), wearing an accelerometer for one game and one training session, and the completion of a short questionnaire (by parent or guardian). The collection of waist circumference and the fitting and removal of the accelerometers (weights 27g or the weight of three $1 coins) will be done by a trained female research assistant, males are specifically excluded from this process.

How much time will the study take?
For coaches, the study will require approximately 10 minutes to complete the questionnaire. For athletes, approximately 10-20 minutes will be needed at one training session to collect child anthropometric information (height, weight, waist circumference), fit the child with their accelerometer to be worn for the duration of the training session, and to complete a short questionnaire (child's parent/guardian). At the one game observed by the researcher approximately 5-10 minutes will be needed to fit the children with their accelerometers to be worn for the duration of the game. No additional time needed for coaches during the observation of the game.

Will the study benefit me?
This study is targeted to examine the physical activity levels of the child participants therefore it will not the adults (coaches) involved.
Will the study involve any discomfort for me?
This study will not involve any discomfort.

How is this study being paid for?
The study is being funded by the College of Health and Science - School of Biomedical and Health Sciences at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants.

Can I withdraw from the study?
Participation is entirely voluntary: you are not obliged to be involved and - if you do participate - you can withdraw at any time without giving any reason and without any consequences.

Can I tell other people about the study?
Yes, you can tell other people about the study by providing them with the chief investigator’s contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

What if I require further information?
When you have read this information, Justin Guagliano will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact
Justin Guagliano
MSc. Student
Mobile: 0410 800 599
Email: j.guagliano@uws.edu.au

Dr. Ric Rosenkranz
Supervisor
Email: r.rosenkranz@uws.edu.au

Prof. Gregory Kolt
Supervisor
Email: g.kolt@uws.edu.au

What if I have a complaint?
This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is [enter approval number]

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02-4736 0883 Fax 02-4736 0013 or email humanethics@uws.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.
Appendix H. Parent information sheet for Study 1.

Human Research Ethics Committee
Office of Research Services

Participant Information Sheet (Parent/Caregiver)

Project Title: Examining Girls' Physical Activity Levels within Organised Sports

Who is carrying out the study?
You are invited to participate in a study conducted by Justin Guagliano, Master of Science student at the University of Western Sydney - School of Biomedical and Health Sciences.

Supervisors:
Dr. Ric Rosenkranz
Lecturer/Research Fellow
School of Biomedical and Health Sciences
University of Western Sydney

Prof. Gregory Kolt
Head of School
School of Biomedical and Health Sciences
University of Western Sydney

What is the study about?
The main purpose of this study is to examine physical activity levels of girls aged 9-14 during one of their organised sport games and one training session. This study will also examine training session context and coaching delivery methods.

What does the study involve?
For coaches, this study involves the completion of a short questionnaire. It also involves allowing the researcher to observe one game and one training session. For the athletes this study involves: the collection of anthropometric information (height, weight, waist circumference), wearing an accelerometer (weighs 27g or the same as three $1 coins), for one game and one training session, and the completion of a short questionnaire (by parent or guardian). The collection of waist circumference and the fitting and removal of the accelerometers will be done by a trained female research assistant, males are specifically excluded from this process.

How much time will the study take?
For coaches, the study will require approximately 10 minutes to complete the questionnaire. For athletes, approximately 10-20 minutes will be needed at one training session to collect child anthropometric information (height, weight, waist circumference), fit the child with their accelerometer to be worn for the duration of the training session, and to complete a short questionnaire (children's parent/guardian). At the one game observed by the researcher approximately 5-10 minutes will be needed to fit the children with their accelerometer to be worn for the duration of the game. No additional time needed for coaches during the observation of the game.

Documents will be stored in a locked cabinet in secure office space with swipe card entry. Digital information will be stored on a password protected computer also in secure office space with swipe card entry.
Children not participating in the study will participate in training and/or game play as normal during the time the research is being carried out.

**Will the study benefit me?**
Although, participants will not experience any immediate benefits associated with participation, data provided by participants will contribute to the development of an intervention which may increase physical activity levels of target population (females aged 9-14).

**Will the study have any discomforts?**
This study will not involve any discomfort.

**How is this study being paid for?**
The study is being funded by the College of Health and Science - School of Biomedical and Health Sciences at the University of Western Sydney.

**Will anyone else know the results? How will the results be disseminated?**
All aspects of the study, including results, will be confidential and only the researcher and his supervisors will have access to information on participants.

**Can I withdraw my child from the study?**
Your child’s participation in the study is entirely voluntary: you are not obliged to consent. Your child may withdraw from the study at any time or you may withdraw your child from the study at which point all records of your child’s participation will be destroyed.

**Can I tell other people about the study?**
Yes, you can tell other people about the study by providing them with the chief investigator’s contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

**What if I require further information?**
When you have read this information, Justin Guaglano will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact:

Justin Guaglano  
MSc. Student  
Mobile: 0410 800 509  
Email: j.guaglano@uws.edu.au

Dr. Ric Rosenkranz  
Supervisor  
Email: r.rosenkranz@uws.edu.au

Prof. Gregory Kolt  
Supervisor  
Email: g.kolt@uws.edu.au

**What if I have a complaint?**
This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is [enter approval number]

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02-4736 0883 Fax 02-4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.
Appendix I. Coach consent form for Study 1.

Participant Consent Form

Project Title: Examining Girls’ Physical Activity Levels within Organised Sports

I,........................................, consent to participate in the research project titled “Examining Girls’ Physical Activity Levels within Organised Sports”.

I acknowledge that:

I have read the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I consent to the researcher observing me during one game and one training session at some point during the course of the sport season. I also consent to complete a questionnaire truthfully and to the best of my knowledge.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher/s now or in the future.

Signed: ______________________________________

Name: ______________________________________

Date: ______________________________________

Return Address: _______________________________
Appendix J. Parent and child consent/assent form for Study 1.

Participant Consent Form for Parents/Caregivers

Project Title: Examining Girls' Physical Activity Levels within Organised Sports

I, [print name] ..........................................., give consent for my child [print name] ........................................ to participate in the research project titled 'Examining Girls' Physical Activity Levels within Organised Sports'.

I acknowledge that:
I have read the participant information sheet and have been given the opportunity to discuss the information and my child's involvement in the project with the researcher(s).

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I have discussed participation in the project with my child and my child agrees to their participation in the project.

I understand that my child's involvement is confidential and that the information gained during the study may be published but no information about my child will be used in any way that reveals my child's identity.

I understand that my child's participation in this project is voluntary. I can withdraw my child from the study at any time, without affecting their academic standing or relationship with the school and they are free to withdraw their participation at any time.

I consent to complete a questionnaire truthfully and to the best of my knowledge.

Please cross out any activity that you do not wish your child to participate in.
I give my consent to the researcher to:
- Observe my child during one game and one training session during the course of sport season.
- Collect anthropometric data such as: height, weight, and body mass index.
- Place an accelerometer (weighs 27g or the weight of three $1 coins) on the hip of my child to be worn for the duration of one game and one training session.

Signed (Parent/caregiver): _______________________________  Signed (child): _______________________________

Name: _______________________________ Name: _______________________________

Date: _______________________________ Date: _______________________________
Participant Consent Form

This is a project specific consent form. It restricts the use of the data collected to the named project by the named investigators.

Note: If not all of the text in the row is visible please `click your cursor` anywhere on the page to expand the row. To view guidance on what is required in each section `hover your cursor` over the bold text.

Project Title: Focusing in on organised sport coaches

I, ........................................, consent to participate in the research project titled ‘Focusing in on organised sport coaches’.

I acknowledge that:

I have read the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I agree to complete a questionnaire truthfully and to the best of my knowledge. I also consent to participating in a focus group session to discuss children’s physical activity levels and related issues in organised sport. I understand that focus group sessions will be audio-taped.

I understand that my involvement in this study will also help shape an upcoming intervention study.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher/s now or in the future.

Signed: __________________________

Name: __________________________

Date: __________________________

Return Address:

Justin Guagliano
School of Biomedical & Health Sciences
University of Western Sydney
Locked Bag 1797
Penrith South DC NSW 1797 Australia
Appendix L. Dialogue sheet for Study 2.

Human Research Ethics Committee
Office of Research Services

Dialogue Sheet

A dialogue sheet provides information about the project. It is similar to the information sheet but is written at the child/young person’s level of comprehension. It is verbally read to participating students immediately before commencement of the project.

Note: If not all of the text in the row is visible please ‘click your cursor’ anywhere on the page to expand the row. To view guidance on what is required in each section ‘hover your cursor’ over the bold text.

Project Title: Focusing in on organised sport coaches

Who is carrying out the study?
My name is Justin Guagliano and I am a Master’s student at the University of Western Sydney. I have two supervisors and their names are Dr. Ric Rosenkranz and Prof. Gregory Kolt.

What is the study about?
The purpose of this study is to assess coaches’ perceptions of their capability to promote health behaviours (physical activity, healthy eating, sun protection, not smoking) to their athletes, perceived barriers to health promotion efforts, and felt needs to improve physical activity levels during and outside of organised sport training using focus group research. Please note that your input from this study will also help shape an upcoming intervention study.

What does the study involve?
This study involves the completion of a short demographic questionnaire and participation in a focus group session. Focus group discussions will address your perceptions (as coaches) as health promoters, also your perceived barriers to physical activity for your players and your felt needs on improving physical activity levels during and outside of organised sport. Your input during these focus groups will help inform and shape an intervention study that will aim to improve physical activity in children and youth in organised sport. This focus group will be audio-taped to ensure we do not miss any or your valuable input.

How much time will the study take?
The focus group session will take a approximately 60-90 minutes and the short questionnaire will take approximately 5 minutes to complete.

Will the study benefit me?
Although, you will not experience any immediate benefits associated with participation, data provided by participants will contribute to the development of a intervention which may increase physical activity levels of the target population (females aged 11-15).

Will the study have any discomforts?
This study will not involve any discomfort.

How is this study being paid for?
The study is being funded by the College of Health and Science - School of Biomedical and Health Sciences at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the my supervisors and I will have access to information on participants.

Results will be disseminated through a manuscript submitted for publication as well as a dissertation. However, individual participants will not be identifiable in the manuscript.
A summary of the findings from this study will be made available to you upon request.

What if I have a concern?
If you have any questions or concerns feel free to e-mail or call myself or my supervisors (contact information can be found on the information sheets).

Can I withdraw from the study?
Your participation in the study is entirely voluntary, you do not have to participate. If you want to be in the study now and change your mind later, that's okay. You can stop at any time at which point, all of the information I have collected on you will be destroyed.

Ask if they have any further questions before commencement.
Appendix M. Coach information sheet for Study 2.

**Participant Information Sheet (General)**

An information sheet, which is tailored in format and language appropriate for the category of participant - adult, child, young adult, should be developed.

Note: If not all of the text in the row is visible please 'click your cursor' anywhere on the page to expand the row. To view guidance on what is required in each section 'hover your cursor' over the bold text. Further instructions are on the last page of this form.

**Project Title:** Focusing in on organised sport coaches

**Who is carrying out the study?**

You are invited to participate in a study conducted by Justin Guagliano, Master of Science candidate at the University of Western Sydney - School of Biomedical and Health Sciences.

**Supervisors:**

Dr. Ric Rosenkranz  
Lecturer/Research Fellow  
School of Biomedical and Health Sciences  
University of Western Sydney

Prof. Gregory Koit  
Head of School  
School of Biomedical and Health Sciences  
University of Western Sydney

**What is the study about?**

The purpose of this study is to assess coaches’ perceptions of their capability to promote health behaviours (physical activity, healthy eating, sun protection, not smoking) to their athletes, perceived barriers to health promotion efforts, and felt needs to improve physical activity levels during and outside of organised sport training using focus group research.

**What does the study involve?**

This study involves the completion of a short demographic questionnaire and participation in a focus group session. Focus group discussions will address coaches perceptions of themselves as health promoters, also perceived barriers to physical activity for your players and felt needs on improving physical activity levels during and outside of organised sport. Your input during these focus groups will help inform and shape an intervention study that will aim to improve physical activity in children and youth in organised sport. The focus group will be facilitated by the chief investigator. Lastly, this focus group will be audio-taped to ensure we do not miss any or your valuable input. Please note that your input from this study will also help shape an upcoming intervention study.

**How much time will the study take?**

The focus group session will take approximately 60-90 minutes and the short questionnaire will take approximately 5 minutes to complete.

**Will the study benefit me?**

Although, participants will not experience any immediate benefits associated with participation, data provided by participants will contribute to the development of a intervention which may increase physical activity levels of target population (females aged 11-15).
Will the study involve any discomfort for me?
This study will not involve any discomfort.

How is this study being paid for?
This study is being funded by the College of Health and Science - School of Biomedical and Health Sciences at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants.

Results will be disseminated through a manuscript submitted for publication as well as a dissertation. However, individual participants will not be identifiable in the manuscript.

A summary of the findings from this study will be made available to participants upon request.

Can I withdraw from the study?
Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without giving any reason and without any consequences.

Can I tell other people about the study?
Yes, you can tell other people about the study by providing them with the chief investigator's contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

What if I require further information?
When you have read this information, Justin Guagliano will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact:

Justin Guagliano  Dr. Ric Rosenkranz  Prof. Gregory Kolt
MSc.(Hons.) Candidate  Supervisor  Supervisor
Mobile: 0410 600 505  Email: r.rosenkranz@uws.edu.au  Email: g.kolt@uws.edu.au
Email: j.guagliano@uws.edu.au

What if I have a complaint?
This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is [enter approval number]

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02-4736 0883 Fax 02-4736 0013 or email humanethics@uws.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.
Appendix N. Human Research Ethics Committee approval for Study 2.

UWS HUMAN RESEARCH ETHICS COMMITTEE

26 August 2011

Doctor Richard Rosenkranz,
School of Biomedical and Health Sciences

Dear Richard and Justin,

I wish to formally advise you that the Human Research Ethics Committee has approved your research proposal H9262 "Focusing in on organised sport coaches", until 31 August 2012 with the provision of a progress report annually and a final report on completion.

Please quote the project number and title as indicated above on all correspondence related to this project.

This protocol covers the following researchers:
Richard Rosenkranz, Gregory Kott, Justin Guagliano.

Yours sincerely

[Signature]

Dr Anne Abraham
Chair, UWS Human Research Ethics Committee
Appendix O. Member checking form for Study 2.

School of Science and Health
University of Western Sydney
Locked Bag 1797
Parramatta NSW 2151

Member Verification Form

Participation is entirely voluntary. You are not obliged to be involved in the member checking process and if you do participate, you can withdraw at any time without giving any reason and without any consequences.

Member verification is important to this research because we want to ensure that you feel that the interview you participated in accurately reflects what you meant and it gives you the opportunity to add, change, or delete pieces from the transcripts.

Purpose:
Since you have participated in this study, I have transcribed our interview verbatim. The purpose of this member verification form is for you to read over the transcript of our interview and verify its content. You may add, change or delete anything that you feel does not accurately represent what you meant, anything you feel that was missed, or anything lost in translation.

What to do:

1. Read over the attached transcript.

2. Type notes directly on the transcript clarifying any major issues. Please make any changes in RED.

3. Fill out the second page of the member verification form.

4. Send the member verification form and corrected transcript back to Justin Guagliano by email: jguagliano@uws.edu.au.

Other notes:
Please check only one box:

☐ I verify this transcript accurately reflects the interview I participated in and have made no changes to the transcript.

☐ I verify this transcript accurately reflects the interview I participated in, however I have clarified/changed/deleted some aspects of the transcript.

☐ This transcript does not accurately reflect the interview I participated in.

Name (please print): ____________________________________________

Signature: ____________________________________________

Date: _____ / _____ / _______
Appendix P. Human Research Ethics Committee approval for Study 3.

Locked Bag 1767
Penrith NSW 2751 Australia

Office of Research Services

Our Reference 13/005470 | H10215

HUMAN RESEARCH ETHICS COMMITTEE

14 June 2013

Doctor Chris Lonsdale
School of Science and Health

Dear Chris

I wish to formally advise you that the Human Research Ethics Committee has approved your research proposal H10215 “Increasing girls’ physical activity during an organised youth sport basketball camp”, until 25 July 2014 with the provision of a progress report annually and a final report on completion.

Please quote the registration number and titled as indicated above in the subject line on all future correspondence related to this project.

This protocol covers the following researchers:
Chris Lonsdale, Richard Rosenkranz, Gregory Kolt, Justin Guagliano

Yours sincerely

[Signature]

Associate Professor Anne Abraham
Chair, Human Researcher Ethics Committee
Appendix Q. Australian New Zealand Clinical Trials Registry for Study 3.

Justin Guaglino

From: info@actr.org.au
Sent: Tuesday, 1 October 2013 11:58 AM
To: Justin Guaglino
Subject: Your ACTRN (registration number): ACTRN12613001099718

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Justin Guaglino,

Re: Increasing girls’ physical activity during an organised youth sport basketball camp: A randomised controlled trial

Thank you for submitting the above trial for inclusion in the Australian New Zealand Clinical Trials Registry (ANZCTR).

Your trial has now been successfully registered and allocated the ACTRN: ACTRN12613001099718

Date submitted: 22/09/2013 11:31:13 PM
Date registered: 1/10/2013 11:58:22 AM
Registered by: Justin Guaglino

**Please note that as your trial was registered after the first participant was enrolled, it does not fulfil the criteria for prospective registration and will therefore be marked as being Retrospectively Registered on our website.**

If you have already obtained Ethics approval for your trial, could you please send the ANZCTR a copy of at least one Ethics Committee approval letter? A copy of the letter can be sent to info@actr.org.au (by email) OR (61 2) 9565 1863, attention to ANZCTR (by fax).

Please be reminded that the quality and accuracy of the trial information submitted for registration is the responsibility of the trial’s Primary Sponsor or their representative (the Registrant). The ANZCTR allows you to update trial data, but please note that the original data lodged at the time of trial registration and the tracked history of any changes made will remain publicly available.

The ANZCTR is recognised as an ICMJE acceptable registry (http://www.icmje.org/fq.pdf) and a Primary Registry in the WHO registry network (http://www.who.int/ictrp/network/primary/en/index.html).

If you have any queries please send a message to info@actr.org.au or telephone +61 2 9562 5333.

Kind regards,
ANZCTR Staff
T: +61 2 9562 5333
F: +61 2 9565 1863
E: info@actr.org.au
W: www.ANZCTR.org.au
Appendix R. Participant flyer for parents and players for Study 3.
Girls of all skill levels are welcome!

UWS School Holiday Basketball Program is a fun and FREE basketball program for girls 9-12 years old. The program includes a variety of fun games, opportunities for skill development, and close interaction with certified basketball coaches with experience coaching girls.

By participating in this program your daughter will receive a FREE t-shirt and a participation medal. Plus, there will be draws for a chance to win family passes to see a Sydney Uni Flames game and an autographed poster of Australian professional basketball player, Lauren Jackson!

Date: During school holidays on September 23rd–27th. The basketball program will run from 9 a.m.–1 p.m. each day.

Please note: lunch, snacks, and drinks must be brought from home each day, as they will not be supplied.

Venues: Penrith Regional Valley Sports Centre or Blaxland High School Sports Centre
30 Herbert Street
Cambridge Park, NSW, 2747

3-9 Coughlan Road
Blaxland, NSW, 2774

Limited spots are available, this program is only open to the first 80 girls who register, so act fast and register your daughter today! To register, please email or call Justin. Registration is open until Sunday, September 15th.

The program will serve as a research project, forming part of Justin Guagliano’s PhD. More information about the project will be provided upon registration.

Justin Guagliano, PhD candidate
School of Science and Health
University of Western Sydney
Email: j.guagliano@uws.edu.au
Mobile: 0410 800 509
Appendix S. Participant flyer for parents and players for Study 3.

WANTED

WANTED FOR WHAT? JUSTIN GUAGLIANO, A PHD CANDIDATE FROM THE SCHOOL OF SCIENCE AND HEALTH, IS RUNNING A BASKETBALL CAMP FOR GIRLS AGED 9–12 AS PART OF A PHD PROJECT.

WHO DO WE NEED? WE ARE SEEKING CERTIFIED BASKETBALL COACHES TO COACH TEAMS OF GIRLS FOR THE DURATION OF A 5-DAY CAMP. COACHES MUST HAVE A BASKETBALL COACHING CERTIFICATE AND HAVE EXPERIENCE COACHING GIRLS BASKETBALL TEAMS. COACHES MUST BE WILLING TO ATTEND A 1–2 HOUR WORKSHOP ON THE FIRST 2 DAYS DURING THE WEEK OF THE CAMP. COACHES CURRENTLY COACHING AN U10 OR U12 GIRLS BASKETBALL TEAM ARE IDEAL, BUT NOT REQUIRED.

COACHES WILL BE PAID FOR THEIR TIME.

WHEN AND WHERE IS THE CAMP? THE BASKETBALL CAMP WILL TAKE PLACE DURING SEMESTER BREAK ON SEPTEMBER 23rd – 27th FROM 9AM – 1PM AT PENRITH VALLEY REGIONAL SPORTS CENTRE. WORKSHOP HOURS WILL BE FROM 2–4PM ON MONDAY SEPTEMBER 23rd AND TUESDAY SEPTEMBER 24th.

IF YOU ARE INTERESTING IN PARTICIPATING OR WOULD LIKE MORE INFORMATION, PLEASE CONTACT

JUSTIN GUAGLIANO AT
J.GUAGLIANO@UWS.EDU.AU OR 0410 300 509

University of Western Sydney
Faculty of Health
Appendix T. Parent information sheet for Study 3.

Participant Information Sheet (Parent/Caregiver)

An information sheet, which is tailored in format and language appropriate for the category of participant - adult, child, young adult, should be developed.

Note: if not all of the text in the row is visible please 'click your cursor' anywhere on the page to expand the row. To view guidance on what is required in each section 'hover your cursor' over the bold text. Further instructions are on the last page of this form.

Project Title: Increasing girls' physical activity during an organised youth sport basketball camp

Who is carrying out the study?
You are invited to participate in a study conducted by Justin Guagliano, PhD candidate in the School of Science and Health at the University of Western Sydney.

Supervisors:
Dr. Chris Lonsdale
Senior Lecturer
School of Science and Health
University of Western Sydney

Prof. Gregory Kolt
Dean of School
School of Science and Health
University of Western Sydney

Dr. Ric Rosenkranz
Assistant Professor
Department of Human Nutrition
Kansas State University

What is the study about?
The primary aim of this study is to assess whether coaches who attended coach education sessions can increase the percentage of time their female athletes' are spending moderately-to-vigorously physically active and reduce percentage of time their female athletes' are spending inactive over a 5-day basketball camp, compared to coaches who did not attend coach education sessions.

What does the study involve?
This study involves participating in a 5-day basketball camp, exclusively for girls. The basketball camp will be run by certified basketball coaches and have experience coaching girls. This study also involves filling out a brief questionnaire. Also, the collection of child anthropometric information (height, weight, waist circumference), this information will be collected by a female research assistant. Lastly, each day of the basketball camp children will be asked to wear a small device called an accelerometer (that weighs 19g, which is less than the weight of three $2 coins) on their hip and held with an elastic belt for the duration of the camp. This device will be used to measure physical activity intensity. A female research assistant will also be responsible for fitting the children with accelerometers.
How much time will the study take?
This is a girls only basketball camp that will run for 5 days, from Monday, September 23rd to Friday, September 27th, from 9:00 am to 1:00 pm.

Parents are asked to fill out a brief questionnaire, which will take less than 5 minutes to complete. Approximately 5 minutes will be needed on Monday, September 23rd to collect child anthropometric information (height, weight, waist circumference), this information will be collected by a female research assistant. Each day of the basketball camp children will be asked to wear an accelerometer on their hip, it is to be worn for the duration of each day at the basketball camp. A female research assistant will also be responsible for fitting the children with accelerometers.

Data will be stored in a locked cabinet in secure office space with swipe card entry. Digital information will be stored on a password protected computer also in secure office space with swipe card entry. Only Justin Guagliano and his supervisors will have access to this data.

Will the study benefit me?
This girls only basketball camp is free-of-charge.

Also, it is possible that your child may receive several health benefits from participating in this study.
- Participating girls will receive health benefits associated with being physically active while playing basketball, contributing to the daily 60 minutes of moderate-to-vigorous physical active recommended for children.
- Participating girls may receive other physical and/or psycho-social benefits from participating in this study, such as: increased confidence and competence as basketball players from skill acquisition; a better understanding of basketball tactics/strategy; a positive coaching experience; making new friends; being part of a team; and having fun through sport.

Will the study have any discomforts?
This study will not involve any discomfort, however, should your child feel uncomfortable or distressed at any time during the study period, she can withdraw at any time without giving any reason and without any consequences.

How is this study being paid for?
The study is being sponsored by the School of Science and Health at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants. Findings from this study will be published as part of Justin Guagliano's PhD thesis and in peer-reviewed journals and other scientific publications or presentations.

Can I withdraw my child from the study?
Your child's participation in the study is entirely voluntary: you are not obliged to consent. Your child may withdraw from the study at any time - or you may withdraw your child from the study at which point all written record of your child's participation will be destroyed. Please note, if you or your child choose to withdraw from the study, you will also be withdrawing from the basketball camp.

Can I tell other people about the study?
Yes, you can tell other people about the study by providing them with the chief investigator's contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.
What if I require further information?
When you have read this information, Justin Guagliano will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Justin Guagliano by email at j.guagliano@uws.edu.au or phone at 0410 800 509.

What if I have a complaint?
This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is [enter approval number].

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.
Appendix U. Parent and child consent/assent form for Study 3.

Participant Consent Form for Parents/Caregivers

This is a project specific consent form. It restricts the use of the data collected to the named project by the named investigators. Where projects involve young people capable of consenting, a separate consent form should be developed. A parental consent form is still required.

Note: If not all of the text in the row is visible please 'click your cursor' anywhere on the page to expand the row. To view guidance on what is required in each section 'hover your cursor' over the bold text.

Project Title: Increasing girls' physical activity during an organised youth sport basketball camp

I, [print name] .................................................., give consent for my child [print name] .................................................. to participate in the research project titled: 'Increasing girls' physical activity during an organised youth sport basketball camp'.

I acknowledge that:

I have read the participant information sheet and have been given the opportunity to discuss the information and my child's involvement in the project with the researcher/s.

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I have discussed participation in the project with my child and my child agrees to their participation in the project.

I understand that my child's involvement is confidential and that the information gained during the study may be published but no information about my child will be used in any way that reveals my child's identity.

I understand that my child's participation in this project is voluntary. I can withdraw my child from the study at any time, without affecting their relationship with the organisations involved and they are free to withdraw their participation at any time. Please note, if you or your child choose to withdraw from the study, you will also be withdrawing from the basketball camp.

I consent to complete a questionnaire truthfully and to the best of my knowledge.

Please cross out any activity that you do not wish your child to participate in.

I consent to my child's participation in partaking in this basketball camp. I also give my consent to allow the research team to:
- Observe my child during the basketball camp.
- Collect anthropometric data such as: height, weight, and waist circumference.
- Place an accelerometer (that weighs 19g, which is less than the weight of three $2 coins) on the hip of my child to be worn for the duration of basketball camp.
- Complete a questionnaire.

Signed (Parent/caregiver): ___________________________________________ Signed (child): ___________________________________________

Name: ___________________________________________ Name: ___________________________________________

Date: ______________________ Date: ______________________
Appendix V. Emergency contact form for Study 3.

Child Emergency Contact and Medical Information

<table>
<thead>
<tr>
<th>Child's Name</th>
<th>Date of Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent(s)/ Guardian(s) Name</td>
<td>Parent(s)/ Guardian(s) Name</td>
</tr>
<tr>
<td>Home Phone</td>
<td>Work Phone</td>
</tr>
<tr>
<td>Address</td>
<td></td>
</tr>
<tr>
<td>Suburb, Postcode</td>
<td></td>
</tr>
</tbody>
</table>

Alternative Emergency Contacts

<table>
<thead>
<tr>
<th>Primary Emergency Contact</th>
<th>Secondary Emergency Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Phone</td>
<td>Work Phone</td>
</tr>
<tr>
<td>Address</td>
<td></td>
</tr>
<tr>
<td>Suburb, Postcode</td>
<td></td>
</tr>
</tbody>
</table>

Medical Information

Allergies/Special Health Considerations

I authorise all medical and/or hospital procedures as may be performed or prescribed by the attending physician and/or paramedics for my child and waive my right to informed consent of treatment. This waiver applies only in the event that neither parent/guardian can be reached in the case of an emergency.

Parent(s)/Guardian(s) Signature: ___________________________ Date: ____________

I give permission for my child to participate in this basketball camp. I release the University of Western Sydney and individuals from the University of Western Sydney of liability in case of accident during activities related to this basketball camp, as long as normal safety procedures have been taken.

Parent(s)/Guardian(s) Signature: ___________________________ Date: ____________
Appendix W. Parent demographic questionnaire for Study 3.

Parent Questionnaire

Participation is entirely voluntary; your child is not obliged to be involved. If they do participate, you can withdraw your child at any time without giving any reason and without any consequences. Or if your child wishes to withdraw they may do so at any time without giving any reason and without any consequences.

- The information provided will be used for the purposes stated on the Participant Information Sheet for the study entitled ‘Increasing girls’ physical activity during an organised youth sport basketball camp’.
- All aspects of the study, including results, will be confidential and only the researcher and his supervisors will have access to information on participants. Once you have completed the questionnaire, this coversheet will be removed.
- Any reports or publications resulting from this study will not identify any individual who participated.
- Participation is entirely voluntary. There is no obligation to participate and withdrawal is permitted at any time without giving any reason and without any consequences.

Child’s Name (Print): ________________________________________________

Parent/Guardian’s Name (Print): ______________________________________

Signature: ______________________________________ Date: ____/09/13
Please fill in the blanks as clearly as possible or check the most appropriate box for the following questions.

**Questions about your child.**

1. How old is your child?
   
   ___________ years old.

2. In what country was your child born in?
   
   □ Australia  □ Other (please specify) _________________

3. Is your child of Aboriginal or Torres Strait Islander origin? (You can check more than one box)
   
   □ No  □ Yes, Aboriginal  □ Yes, Torres Strait Islander

4. What is your child’s cultural background? (i.e., Australian, Italian, Lebanese, etc.)
   
   ________________

5. **Not including school sports, does your child participate in at least one organised youth sport?**
   
   □ Yes  □ No → Please skip to question 7.

6. **Not including school sports, please list all organised youth sports your child participates in, the name of the association or club, the level of competition, and the amount of time spent your child spends playing organised youth sports/week.**

   **A)** Sport: _______________
   
   Association/club name: _______________
   
   □ Representative level  □ Club level  □ Other (please specify) _______________
   
   Number of training sessions/week: ______
   
   Number of minutes at training sessions/week: ______
   
   Number of games/week: ______
   
   Number of minutes at games/week: ______

   **___________________________**

   **B)** Sport: _______________
   
   Association/club name: _______________
   
   □ Representative level  □ Club level  □ Other (please specify) _______________
   
   Number of training sessions/week: ______
   
   Number of minutes at training sessions/week: ______
   
   Number of games/week: ______
   
   Number of minutes at games/week: ______

   **___________________________**

   **C)** Sport: _______________
   
   Association/club name: _______________
   
   □ Representative level  □ Club level  □ Other (please specify) _______________
   
   Number of training sessions/week: ______
   
   Number of minutes at training sessions/week: ______
   
   Number of games/week: ______
   
   Number of minutes at games/week: ______
Questions about you.

7. What is the highest educational qualification you have completed?
   - [ ] no school certificate or other qualifications
   - [ ] school or intermediate certificate (or equivalent)
   - [ ] higher school or leaving certificate (or equivalent)
   - [ ] trade/apprenticeship
   - [ ] certificate/diploma
   - [ ] university degree or higher

8. What best describes your current relationship status?
   - [ ] Single
   - [ ] Married
   - [ ] Single/di fact or living with partner
   - [ ] Widowed
   - [ ] Divorced
   - [ ] Separated

9. What is your yearly household income before tax, from all sources?
   - [ ] less than $20,000 per year
   - [ ] $20,000-$39,999 per year
   - [ ] $40,000-$59,999 per year
   - [ ] $60,000-$79,999 per year
   - [ ] $80,000-$99,999 per year
   - [ ] $100,000 or more per year
   - [ ] I prefer not to answer

You have completed the questionnaire. Please return the questionnaire to the researcher.

Thank you for participating!
Appendix X. Coach information sheet for Study 3.

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Participant Information Sheet (General)

Project Title: Increasing girls’ physical activity during an organised youth sport basketball camp

Who is carrying out the study?
You are invited to participate in a study conducted by Justin Guagliano, PhD candidate in the School of Science and Health at the University of Western Sydney.

Supervisors:
Dr. Chris Lonsdale
Senior Lecturer
School of Science and Health
University of Western Sydney

Prof. Gregory Kolt
Dean of School
School of Science and Health
University of Western Sydney

Dr. Ric Rosenkranz
Assistant Professor
Department of Human Nutrition
Kansas State University

What is the study about?
The primary aim of this study is to assess whether coaches who attended coach education sessions can increase the percentage of time their female athletes’ are spending moderately-to-vigorously physically active and reduce percentage of time their female athletes’ are spending inactive over a 5-day basketball camp; compared to coaches who did not attend coach education sessions.

What does the study involve?
This study involves coaching a 5-day girls basketball camp, where you may be requested to attend 2 coach education sessions. The girls you will be coaching will be 9-12 years old, you will be responsible for 10-12 girls.
Throughout the camp a member of the research team will periodically observe you while you are coaching. Also, you will also be asked to fill out a questionnaire and wear a small device called an accelerometer (weighs 19g, which is less than the weight of three $2 coins) that will be placed on your hip and held with an elastic belt for the duration of the camp. This device will be used to measure your physical activity intensity.
How much time will the study take?
The basketball camp will run for 5 days, from Monday, September 23rd to Friday, September 27th, from 9:00 am to 1:00 pm. If you are randomly allocated into the coach education group, you will be requested to attend 2 coach education sessions. The first session will be after camp on Monday, September 23rd, and the second sessions will be on Tuesday, September 24th - both sessions will last approximately 2 hours. The questionnaire will take less than 10 minutes to complete.

Will the study benefit me?
You will be paid, at a wage of $20/hour for your time, this includes coach educations sessions. You may also incorporate what you've learned during the coach education sessions/written material into your coaching philosophy which could positively impact your athletes' physical activity levels.

Will the study involve any discomfort for me?
This study will not involve any discomfort, however, should you feel uncomfortable or distressed at any time during the study period, you can withdraw at any time without giving any reason and without any consequences.

How is this study being paid for?
The study is being sponsored by the School of Science and Health at the University of Western Sydney.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants. Findings from this study will be published as part of Justin Guagliano's PhD thesis and in peer-reviewed journals and other scientific publications or presentations.

Can I withdraw from the study?
Participation is entirely voluntary; you are not obliged to be involved and - if you do participate - you can withdraw at any time without giving any reason and without any consequences. Please note: if you choose to withdraw from the study, you will also be withdrawing from the basketball camp.

Can I tell other people about the study?
Yes, you can tell other people about the study by providing them with the chief investigator's contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

What if I require further information?
When you have read this information, Justin Guagliano will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Justin Guagliano by email at j.guagliano@uws.edu.au or phone at 0410 800 509.

What if I have a complaint?
This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is H10215
If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.
Appendix Y. Coach consent form for Study 3.

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Participant Consent Form

Project Title: Increasing girls' physical activity during an organised youth sport basketball camp

I, _______________________, consent to participate in the research project titled 'Increasing girls' physical activity during an organised youth sport basketball camp'.

I acknowledge that:

I have read the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher(s).

The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

I consent to completing a questionnaire and coaching a five-day basketball program, where I may be requested to attend two coach education sessions. I also consent to being observed during the basketball program and wearing an accelerometer for the duration of the five-day basketball program.

I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.

I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher(s) now or in the future.

Signed: _______________________

Name: _______________________

Date: _______________________

Return Address: N/A

This study has been approved by the University of Western Sydney Human Research Ethics Committee.
The Approval number is: H10215

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix Z. Coach demographic questionnaire for Study 3.

Coach Questionnaire

I give my consent on the understanding that:

- The information provided will be used for the purposes stated on the Participant Information Sheet for the study entitled ‘Increasing girls’ physical activity during an organised youth sport basketball camp’.
- All aspects of the study, including results, will be confidential and only the researcher and his supervisors will have access to information on participants.
- Any reports or publications resulting from this study will not identify any individual who participated.
- Participation is entirely voluntary. There is no obligation to participate and withdrawal is permitted at any time without giving any reason and without any consequences.

Name (Print): ________________________________

Signature: ________________________________ Date: ___ / ___ /2013

Your participation is greatly appreciated!
Please fill in the blanks as clearly as possible or check the most appropriate box for the following questions.

**General Information**

1. **Age**
   
   ________ years and ________ months old.

2. **Sex**
   
   [ ] Male
   
   [ ] Female

3. **Height (without shoes or)**
   
   ________ cm OR ________ feet ________ inches

4. **Weight**
   
   ________ kg OR ________ pounds

5. **In what country were you born in?**
   
   [ ] Australia
   
   [ ] Other (please specify) __________

6. **Are you of Aboriginal or Torres Strait Islander origin? (You can check more than one box)**
   
   [ ] No
   
   [ ] Yes, Aboriginal
   
   [ ] Yes, Torres Strait Islander

7. **What is your cultural background? (i.e., Australian, Italian, Lebanese, etc.)**

   __________

8. **What is the highest educational qualification you have completed?**
   
   [ ] no school certificate or other qualifications
   
   [ ] school or intermediate certificate (or equivalent)
   
   [ ] higher school or leaving certificate (or equivalent)
   
   [ ] trade/apprenticeship
   
   [ ] certificate/diploma
   
   [ ] university degree or higher

9. **What best describes your current relationship status?**
   
   [ ] Single
   
   [ ] Married
   
   [ ] Widowed
   
   [ ] Divorced
   
   [ ] de facto/living with partner
   
   [ ] Separated

10. **What is your postcode?**

    __________
Physical Activity Information

11. Are you currently participating in at least one organised sport?
   □ Yes □ No → Please skip to question 13.

12. Please list all organised sports you participate in, the name of the association or club, the level of competition, and the amount of time spent you spend playing organised sports/week.

   A) Sport: __________________________  Association/club name: __________________________
      □ Representative level □ Club level □ Other (please specify): ________________
      Number of training sessions/week: _______  Number of minutes at training sessions/week: _______
      Number of games/week: _______  Number of minutes at games/week: _______

   B) Sport: __________________________  Association/club name: __________________________
      □ Representative level □ Club level □ Other (please specify): ________________
      Number of training sessions/week: _______  Number of minutes at training sessions/week: _______
      Number of games/week: _______  Number of minutes at games/week: _______

   C) Sport: __________________________  Association/club name: __________________________
      □ Representative level □ Club level □ Other (please specify): ________________
      Number of training sessions/week: _______  Number of minutes at training sessions/week: _______
      Number of games/week: _______  Number of minutes at games/week: _______

Coaching Information

13. Please list all coaching credentials/certifications that you currently possess?

14. How many years have you been coaching?
    _______ years.

15. Please list all organised youth sports that you currently coaching in?

16. Please list all age groups that you are currently coaching in? (e.g., U12, U14).

17. Are you currently coaching teams that are: (Check all that apply).
    □ Boys only □ Girls only □ Mixed (boys and girls on the same team)
18. How many training sessions do you usually run for each girl’s basketball team you coach per week?
   □ □ □ □ □ □
   □ □ □ □ □ □

19. How long are the training sessions you run for each girl’s basketball team you coach per week?
   □ □ □ □ □ □
   □ □ □ □ □ □

You have completed the questionnaire. Please return the questionnaire to the researcher.

Thank you for participating!
Appendix AA. SOFIT form for Study 3.

Date: _________________

Your initials: ___ ___  
Training session:  1  2 (circle)  
Coach name: ________________  
No. Of Players: ______

Start Time: ________________  
Stop Time: ________________

<table>
<thead>
<tr>
<th>Player</th>
<th>Interval</th>
<th>Activity</th>
<th>Lesson Context</th>
<th>Coach Behaviour</th>
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<td>PD O</td>
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<td>TWO</td>
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<td>THREE</td>
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<td></td>
<td>48</td>
<td>K F S G O</td>
<td>PD O</td>
<td></td>
</tr>
</tbody>
</table>

FOUR
## SOFIT SUMMARY FORM (ONE FOR EACH SESSION)

Your initials: __ __  
Training session:  1  2 (circle)  
Coach name: ____________  
Session length _______ mins

<table>
<thead>
<tr>
<th>Student Behavior</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
<th>%time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. lying down</td>
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<td>5. very active</td>
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</tbody>
</table>

### Lesson Context

- Management (M)
- Knowledge (K)
- Fitness activity (F)
- Skill practice activity (S)
- Game play activity (G)
- Other (O)

### Coach Behaviour

- Promotes physical activity (P)
- Demonstrates physical activity (D)
- Other (O)

Total
Appendix BB. Step count form for Study 3.

AVERAGE STEP COUNT FORM

Coach: ______________

Session length _______ mins: training session 1
Session length _______ mins: training session 2

<table>
<thead>
<tr>
<th>TRAINING SESSION 1</th>
<th>TRAINING SESSION 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>STEP COUNTS</td>
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</tbody>
</table>

AVERAGE STEP COUNTS
AVERAGE STEPS/MIN

AVERAGE STEP COUNTS
AVERAGE STEPS/MIN
Appendix CC. Coach feedback form for Study 3.

School of Science and Health
University of Western Sydney
Locked Bag 1797
Penrith NSW 2751 Australia

Your initials: ___ ___

**COACH FEEDBACK FORM**

Coach: ______________

<table>
<thead>
<tr>
<th>TRAINING SESSION 1</th>
<th>TRAINING SESSION 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AVERAGE STEPS/MIN</strong></td>
<td><strong>AVERAGE STEPS/MIN</strong></td>
</tr>
<tr>
<td>Steps/min</td>
<td>Steps/min</td>
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<tr>
<td><strong>LESSON CONTEXT</strong></td>
<td><strong>LESSON CONTEXT</strong></td>
</tr>
<tr>
<td>Management</td>
<td>%</td>
</tr>
<tr>
<td>Knowledge</td>
<td>%</td>
</tr>
<tr>
<td>Fitness activity</td>
<td>%</td>
</tr>
<tr>
<td>Skill practice activity</td>
<td>%</td>
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<tr>
<td>Game play activity</td>
<td>%</td>
</tr>
<tr>
<td>Other</td>
<td>%</td>
</tr>
<tr>
<td><strong>Coach Behaviour</strong></td>
<td><strong>Coach Behaviour</strong></td>
</tr>
<tr>
<td>Promotes physical activity</td>
<td>Promotes physical activity</td>
</tr>
<tr>
<td>Demonstrates physical activity</td>
<td>Demonstrates physical activity</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
</tr>
</tbody>
</table>
Appendix DD. Athlete questionnaire for Study 3.

Athlete Questionnaire

Remember:
- All the information you give us will be private and no one besides the researchers will see your information.
- Any reports or publications resulting from this study will not identify any person who participated.
- You do not have to participate in this study and you can stop participating in this study at any time without giving any reason.

Name (Print): ________________________________

Date: ____/09/2013
Please fill in the circle (●) that best describes your opinion of how true you think the statement is.

Remember there is no right or wrong answer and no one besides the researchers will see your answers.

### Why are you participating in today's basketball program?

<table>
<thead>
<tr>
<th></th>
<th>Not at All</th>
<th>Quite True</th>
<th>Very True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Because I think that this activity is interesting.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>2. Because I am doing it for my own good.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>3. Because I am supposed to do it</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>4. There may be good reasons to do this activity, but personally I don’t see any.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>5. Because I think that this activity is pleasant.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>6. Because I think this activity is good for me.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>7. Because it is something that I have to do.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>8. I do this activity but I am not sure if it is worth it.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>9. Because this activity is fun</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>10. I don’t know, I don’t see what the activity brings me</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>11. Because I feel good when doing this activity.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>12. Because I believe this activity is important for me.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>13. Because I feel that I have to do it.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>14. I do this activity, but I am not sure it is a good thing to pursue it.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
</tbody>
</table>

### During today's basketball camp...

<table>
<thead>
<tr>
<th></th>
<th>Not at All True</th>
<th>Quite True</th>
<th>Very True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The coach gives us choices about how we do the things in today's session.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>2. The coach talks about how we can use things we learn in today's session.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>3. The coach listens to our ideas in today's session.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>4. The coach praises us when we try hard in today's session.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
<tr>
<td>5. It seems like the coach is always telling us what to do in today's session.</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
<td>[ ] [ ] [ ] [ ] [ ] [ ]</td>
</tr>
</tbody>
</table>

329
Appendix EE. Anthropometric data collection form for Study 3.

ID Number

Site: Penrith

Anthropometric Data Sheet

Cover Sheet

Athlete Full Name: ____________________

Date Completed: 8/09/2013
Anthropometric Data Sheet Data

- **Height Data** (in centimetres to 0.1 cm):
  - Measure #1 _______ cm
  - Measure #2 _______ cm
  - Measure #3 _______ cm (Only necessary if measure #1 and #2 differ by more than 0.5 cm)

- **Weight Data** (in kilograms to 0.1 kg):
  - Measure #1 _______ kg
  - Measure #2 _______ kg
  - Measure #3 _______ kg (Only necessary if measure #1 and #2 differ by more than 0.5 kg)

- **Waist Circumference** (in centimetres to 0.1 cm):
  - Measure #1 _______ cm
  - Measure #2 _______ cm
  - Measure #3 _______ cm (Only necessary if measure #1 and #2 differ by more than 0.5 cm)

- Was there any problems collecting height/weight/waist circumference measurements (i.e. Hair, bulky clothing, etc.)?
  Comments:
  ____________________________________________________________
  ____________________________________________________________

- Accelerometer Number: _____________

- Form completed by: ____ ____ (initials)
Appendix FF. Process evaluation form for Study 3.

Process evaluation questionnaire

- The information provided will be used to inform our understanding of components of the coach education sessions.
- for the purposes stated on the Participant Information Sheet for the study entitled “Improving girls’ physical activity during an organized youth sport basketball camp”.
- All aspects of the study, including results, will be confidential and only the researcher and his supervisors will have access to information on participants. Once you have completed the questionnaire, this coversheet will be removed.
- Any reports or publications resulting from this study will not identify any individual who participated.
- Participation is entirely voluntary. There is no obligation to participate and withdrawal is permitted at any time without giving any reason and without any consequences.

Name (Print): ____________________________________________

Signature: ____________________________________________ Date: _____/06/2013
Please fill in the blanks as clearly as possible or circle the response you believe is most appropriate.

1. During the coach education sessions a range of topics were discussed, how important/relevant did you find each topic to be in relation to coaching girls in organised youth sport?

<table>
<thead>
<tr>
<th>Topic</th>
<th>Not at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies to increase moderate-to-vigorous physical activity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Strategies to decrease inactivity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Training session planning</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Goal-setting</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Self-monitoring</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Feedback on physical activity levels and lesson contexts from training sessions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Reflecting on training sessions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Step counts and its association with target M/PA Levels for a session</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

2. Overall, to what extent did you find the material delivered during the coach education sessions to be...

<table>
<thead>
<tr>
<th>Topic</th>
<th>Not at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Important?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Boring?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Valuable?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Informative?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Interesting?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>A waste of time?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Beneficial?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

3. Overall, to what extent did you intend to use the topics discussed in future training sessions?

<table>
<thead>
<tr>
<th>Topic</th>
<th>Not at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</thead>
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<td>2</td>
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<tr>
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<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Step counts and its association with target M/PA Levels for a session</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
4. Overall, how much did you learn from the coach education sessions?

<table>
<thead>
<tr>
<th>Nothing at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>A great deal</th>
</tr>
</thead>
</table>

5. Additional comments on the materials delivered during the coach education sessions?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

6. What did you like most about the coach education sessions?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

7. What did you like least about the coach education sessions?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

8. Do you have any suggestions for improvements or changes to be made to the coach education sessions?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
9. Do you intend to use what you've learned in the coach education sessions with your other teams?

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10. Were there any pros or cons when you modified drills?

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