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What factors influence levels of school playground physical activity in children from grades K-6?

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WHAT FACTORS INFLUENCE LEVELS OF SCHOOL PLAYGROUND PHYSICAL ACTIVITY IN CHILDREN FROM GRADES K-6?

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Declaration

I Anne-Maree Parrish, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Health Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Anne-Maree Parrish

8th February, 2010

Dedication

This work is dedicated to my wonderful family, my husband Greg and my four lovely children Tomas, Bethany, Emma and Simon. Simon was born during the course of this research; he has never known his mum ‘not to be doing a PhD’.
Thankyou all for your support: “I love you all very much: always forever no matter what”

To my very good friends Liz, Laura and Danielle, thankyou for your advice, encouragement and friendship- it will never be forgotten.

To the memory of my friend Linda Spall who died Friday 10 April 2009. Linda assisted with data collection in this research project.
A truly good person, we will miss her.

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Abstract

Background:

The number of overweight and obese children in Australia is a major public health concern (Commonwealth Scientific Industrial Research Organisation (CSIRO) Preventative Health National Research Flagship and the University of South Australia 2007). Despite efforts to address childhood obesity issues at an individual level, children's obesity levels are high and physical activity levels are decreasing (Salmon and Timperio 2007). In 2002, a ministerial round table of the World Health Organisation emphasised a need to create 'enabling environments' for children's physical activity in institutions such as schools. However, pressure to meet academic targets in the school curriculum often results in constrained timetabling of physical education classes, thereby limiting the amount of daily physical activity undertaken by children during the school day. Access to school playgrounds at recess and lunchtime provides an alternative environment to increase children's physical activity levels. Currently, such opportunities appear to be underutilised (Ernst 2003).

This research aimed to establish whether there were differences between playground physical activity levels of primary aged children in a convenience sample of 13 public primary schools (7 lower socioeconomic status (SES) and 6 average SES), with the purpose of comparing low and highly active schools to identify environmental, policy and psychosocial correlates that influence children's playground physical activity levels.

Method:

The Children's Activity Scanning Tool (CAST2) observational instrument was used to collect physical activity and environmental data (Zask, van Beurden et al. 2001). Each school was audited for additional physical environmental variables such as: fixed and non-fixed equipment, area of shade and playground size and surface type. Questionnaires were distributed to consenting students, teachers and principals; the items addressed school policy and psychosocial variables. A picture questionnaire instrument was developed to assess the playground physical activity preferences of young children. In addition, consenting students, teachers and principals were interviewed at the three least and the three most active schools in terms of student activity levels. Data from this study was analysed using multiple logistic

regression, odds ratios, Spearman's correlations, t-tests, non-parametric tests and qualitative data analysis.

Results:

A significant difference was found between the proportions of active children at 13 schools involved in the study, supporting the need to examine school environment variables to ascertain reasons for variability in children's playground physical activity levels. There was an association between activity and length of break time, indicating that restricted break times may limit one of the few outdoor opportunities available for children to be active. Children were significantly more active in unshaded areas, when non-fixed equipment and ground targets were present and on soft playground surfaces; their activity was affected by the weather. Males were more active than females. No significant differences were found between low and average socioeconomic groups. Children's activity preferences were significantly affected by psychosocial variables, such as fear of 'being bullied'. The results indicated that bullying had a considerable impact on children's playground physical activity levels, and may also affect children with poor fundamental movement skills. Teachers believed the presence of non-fixed equipment during break times created a more cohesive playground environment by preventing boredom and bullying. In addition, children's playground physical activity level was influenced by school policies; small changes to policy could potentially have marked effects on children's playground activity levels.

Conclusion:

There were several physical environmental variables which affected children's playground physical activity levels. The findings indicate that there were discrepancies between the activity levels of male and female children, which warrant further investigation. Notably, this study found no significant difference between the effects of lower or average SES school status on children's playground activity levels. Importantly the mixed methods used in this study provided a unique insight into policy and psychosocial determinants affecting children's school playground physical activity which had not been investigated previously. For example policies which influenced children's playground physical activity included: policies governing the length of active break time, 'no hat no play' and access to non-fixed equipment. Psychosocial factors which influenced children's playground physical activity included a 'fear of being bullied' and 'being too shy to play'. These findings raise the notion

that changes to the physical playground environment may be ineffective, if psychosocial and policy variables are not considered. Future research should investigate physical, policy and psychosocial barriers affecting children's school playground physical activity levels.

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Publications and Presentations

The following publications and presentation were a result of the research conducted for this thesis.

Publications in Refereed Journals

Chapter 2: **Parrish, A.M.** Iverson, D. Yeatman, H and Russell, K. Systematic review: methods used to assess playground activity in elementary school children. American Journal of Preventive Medicine. Submitted Feb 2010.

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Chapter 5: **Parrish, A.M.,** Iverson, D., Russell, K. and Yeatman, H (2010) The development of a unique physical activity self report for young children: challenges and lessons learned. Research in Sports Medicine, an International Journal. **18**(1): 71-83.

Chapter 6: **Parrish, A.M.**, Iverson, D., Russell, K. and Yeatman, H. School environment and psychosocial barriers affect children's playground physical activity levels. Journal of School Health. Under review. Submitted Dec 2009.

Chapter 7: **Parrish, A.M**., Yeatman, H., Iverson, D. and Russell, K. Using interviews and friendship pairs to better understand how school environments affect young children's playground physical activity levels. Health Education and Behavior. Under review. Submitted Feb 2010.

Conference Presentation

Chapter 4: **Parrish, A.M.,** Russell, K., Yeatman, H, and Iverson, D. Do Australian primary school environments affect children's playground physical activity levels? Oral presentation. International Conference on Childhood Obesity, Hong Kong. November 2008.

As the primary supervisor, I, Associate Professor Heather Yeatman, declare that the greater part of the work in each of the listed articles is attributed directly to the candidate, Anne-Maree Parrish. In each of the manuscripts, Anne-Maree contributed to study design, was solely responsible for data collection and primarily responsible for data analysis and data interpretation. The first draft of each manuscript was written by the candidate and she was then responsible for responding to the editing suggestions of her co-authors. The co-authors, Heather Yeatman, Professor Don Iverson and Associate Professor Ken Russell assisted in study design, data interpretation and editing of the manuscripts. In addition, Ken Russell assisted with aspects of data analysis. Anne-Maree has been solely responsible for submitting each manuscript for publication to the relevant journals, and has been primarily responsible for responding to reviewer's comments, with assistance from co-authors.

Anne-Maree Parrish	Associate Professor Heather Yeatman
Candidate	Primary Supervisor
February 2010	February 2010

List of Acronyms and Abbreviations

ANOVA	Analysis of Variance
BEACHES	Behaviours of Eating and Activity for Children's Health Evaluation System
BMI	Body Mass Index
CAP	Children's Activity Preference
CARS	Children's Activity Rating Scale
CAST	Children's Activity Scanning Tool
CI	Confidence Interval
CSIRO	Commonwealth Scientific Industrial Research Organisation
CSA	Computer Science Applications
CDPAQ	Computer Delivered Physical Activity Questionnaire
DW	Digiwalker
ECG	Electrocardiogram
EE	Energy Expenditure
FMS	Fundamental Movement Skills
HC	Hard Copy
HR	Heart Rate
ICC	Intraclass Correlation Coefficient
IRR	Inter Rater Reliability
M	Mean
MET	Metabolic Equivalent
$m \cdot min^{-1}$	Meters per minute
Mod	Moderate
MVPA	Moderate to Vigorous Physical Activity
N	Number
NHMRC	National Health and Medical Research Council
NSW	New South Wales
p	Statistical Significance ("p-value")
PA	Physical Activity
PE	Physical Education
P&F	Parents and Friends
r	Correlation Coefficient

SCT	Social Cognitive Theory
SD	Standard Deviation
SPW	Self Paced Walking
SEM	Standard Error of Mean
SES	Socioeconomic Status
SCT	Social Cognitive Theory
SOFIT	System for Observing Fitness Instruction Time
SOPLAY	System for Observing Play and Leisure Activity in Youth
sVo2	Scaled oxygen uptake
UK	United Kingdom
USA	United States of America
VPA	Vigorous Physical Activity
WL	Walk4Life

Table of Contents

Chapter 4: Do Australian primary school environments affect children's physical activity levels?

Chapter 5: The development of a unique physical activity self report for young children: challenges and lessons learned

Chapter 8: Conclusions and implications for future research

List of Figures and Tables

Figures:

Tables:

List of Appendices

CHAPTER 1

Introduction

1.1 Childhood obesity and physical activity levels – a brief background

Despite efforts to address childhood obesity issues at an individual level, childhood obesity rates remain high (Australian Government: Department of Health and Ageing 2007). In 2002, a ministerial round table of the World Health Organisation emphasised the need to create 'enabling environments' for children's physical activity in institutions such as schools (World Health Organization 2002). The macro-environment of the school plays a key role in children's physical activity levels and may be a medium to contributing to the reduction of childhood obesity. In Australia, the school environment is particularly important for promoting physical activity. It provides access to most children Australia wide, and is particularly important for girls as they obtain most of their activity during school hours (Rowlands, Pilgrim et al. 2008).

Determinants of physical activity include genetic, physiological, psychological, social, environmental and other factors (United States Department of Health and Human Services 1996; Sallis and Owen 1999). National Health and Medical Research Council guidelines highlight the importance of population based studies focusing on environmental changes which make it easier for people to incorporate physical activity into their lives (National Health and Medical Research Council 1997). Identifying the school environmental determinants that affect physical activity in children has the potential to provide valuable new information to assist our understanding of ways to ameliorate this public health issue (Owen, Leslie et al. 2000; Richter, Harris et al. 2000).

Several studies identified environmental variables, which may affect children's school playground physical activity levels. These variables include the size of the school and number of students, the layout of the school, the number of playing fields, hard courts, fixed and non fixed equipment, bike racks, indoor activity space, covered outdoor

areas, permanent markings on walls and ground, shaded areas and access to play areas and drinking water, type of teacher supervision accessibility to facilities, opportunities for activity and aesthetics (Sallis 2001; Thompson 2001; Cotter 2003; Bauer, Yang et al. 2004; Humpel, Owen et al. 2004; Barnett, O'Loughlin et al. 2006; Ridgers, Stratton et al. 2007)

Barriers are important determinants of children's physical activity (Thompson 2001). Barriers affecting physical activity in the school playground may include: lack of equipment, the weather, inappropriate uniforms, time, safety, individual physical disabilities, or psychosocial deterrents such as bullying, peer pressure and social networks (Weir 2001; Zask, van Beurden et al. 2001; Bauer, Yang et al. 2004; Glanz, Rimer et al. 2008; Willenberg, Ashbolt et al. 2010). Studies consistently indicate that males are more active than females (Trost, Pate et al. 2002; Riddoch, Bo Andersen et al. 2004; Rowlands, Pilgrim et al. 2008).

Psychosocial factors such as self efficacy, self esteem, outcome expectations, feeling safe, perceived physical competence can affect physical activity participation and enjoyment (Sallis 1999; Strauss 2001; Bauer, Yang et al. 2004; Heitzler, Martin et al. 2006). In addition, activity preference can influence activity levels. There are gender differences in activity preferences, children who report a preference and enjoyment of physical activity are more likely to be active (Salmon, Owen et al. 2003; Kinzie and Joseph 2008).

Schools are a key part of the community environment; they offer a reasonably safe, supervised environment, with facilities not ordinarily accessible to most children. Recess and lunch provide children with opportunities to be active on a daily basis, and to contribute to the health-related recommendations for children's physical activity of 60 minutes per day (Ridgers, Stratton et al. 2006; Australian Government: Department of Health and Ageing 2007). Since children appear not to compensate for missed physical activity, it is crucial to maximise opportunities for them to be active (Dale, Corbin et al. 2000). Historically, some of the most effective health behaviour strategies have been policy-driven environmental changes (Dietz, Bland et al. 2002). This study examined the school playground environment and policy variables that influence the physical activity levels of primary aged children.

1.2 Significance

Childhood obesity has become a serious issue in Western countries. Dramatic increases in Australian childhood obesity levels and physical inactivity are a major public health concern. Since 1985 the proportion of overweight and obese children has more than doubled (Baur 2003). In 2007, 17% of Australian children and adolescents were overweight and 6% were obese (Australian Government: Department of Health and Ageing 2007). The most recent estimates for children in New South Wales (NSW) Australia found that 26% of boys and 24% of girls were above a healthy weight range (New South Wales Centre for Overweight and Obesity 2006).

Childhood obesity is a modern illness resulting from behavioural, lifestyle and environmental factors. Health problems associated with childhood obesity were previously reserved for the adult population, but have become more common in children in recent decades. The problems include: hypertension, dyslipidaemia, chronic inflammation, increased blood clotting tendency, endothelial dysfunction and hyperinsulinaemia (United States Department of Health and Human Resources 2001; Ebbeling, Pawlak et al. 2002). In addition, there are several consequences of childhood obesity that are psychosocial in nature (Dietz 1998). Obese children are often discriminated against, and such discrimination worsens as they become older. By the age of six years, children have learned a societal message that overweight is undesirable (Edmunds, Waters et al. 2001). There is also a strong correlation between childhood and adult obesity, making early intervention critical in preventing lifelong health problems (Guo, Wu et al. 2002). Finally, regular physical activity in childhood increases the probability of becoming an active adult (Telama and Yang 2000; Telama, Yang et al. 2005).

In recent decades, the modern environment has created a sedentary lifestyle generated by social, economic and environmental changes. Such inactivity is associated with a higher body mass index and greater health risk (Muller, Koertzinger et al. 1999; Vincent, Pangrazi et al. 2003). Homework commitments, sedentary after school activities and time spent by children travelling to activities limit the amount of unstructured outdoor playtime (New South Wales Board of Studies 2001). Children's

physical activity levels in the urban environment are compromised by a lack of space for safe play areas (Editor 2001). 'Stranger danger' and the busyness of urban streets precipitate parental fear, resulting in parents preventing their children from walking to school and playing outdoors (Booth 2000). Physical activity also declines rapidly from childhood to adolescence (Trost, Pate et al. 2002). A few studies have investigated children's playground physical activity levels during school recess, revealing that children only spend around 50 percent of their play time in moderate or vigorous physical activity, thus not capitalising on this safe opportunity to be active (Sleap and Warburton 1996; McKenzie, Sallis et al. 1997; Sallis, McKenzie et al. 1997; Stratton 2000; Zask, van Beurden et al. 2001; Ridgers, Stratton et al. 2006).

This research assessed 14 Illawarra regional public primary schools (includes pilot), during recess and lunch to determine the physical activity level of children at each school. The psychosocial and institutional variables of school environments were examined to identify distinctions between the physical activity determinants of schools with low activity compared to those with high activity levels. The findings provide insight into which aspects of school environments are most likely to increase children's playground physical activity levels.

1.3 Thesis outline (also see Figure 1.1)

The primary aim of this thesis was to identify variables that affect the school playground physical activity levels of primary children during recess and lunch breaks by investigating the physical school playground environment, individual school culture, children's activity preferences and school policies. To address the research aims, it was necessary to conduct several studies. Therefore this thesis is a collection of quantitative and qualitative studies which were systematically conducted to assist the studies' aims. Chapters three to seven are papers that have either been published or submitted for publication in international peer reviewed journals.

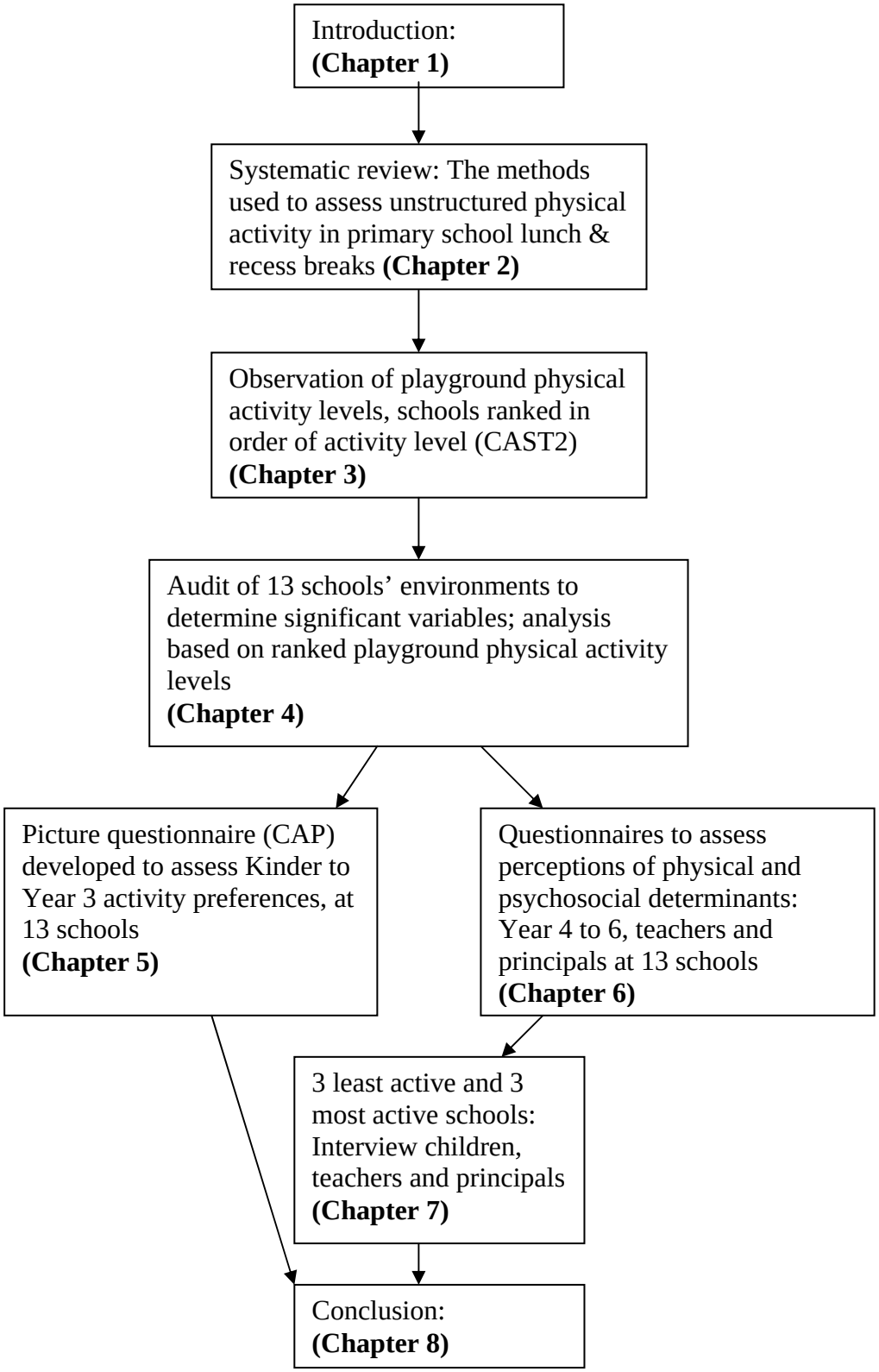
Measuring physical activity in the school playground environment is complex. A systematic review of the methods used to measure the unstructured playground activity levels of children in school break times assisted the choice of physical activity assessment methods for this research (Chapter 2). The study involved 13 Illawarra public primary schools, seven classified as lower and six average socioeconomic

status (SES). Chapter three describes how observational data were used to examine differences between schools in the proportions of physically active children in the playground environment. Chapter four results revealed which environmental correlates affected children's school playground physical activity levels.

Due to the lack of self report instruments designed to assess young children's physical activity levels (Kindergarten to Year 2), the Children's Activity Preference (CAP) questionnaire was developed and tested to explore young children's playground physical activity preferences, described in chapter five. In chapter six, questionnaires designed using Social Cognitive Theory (SCT) constructs examined responses from older primary aged students (Years 4-6), teachers and principals regarding physical and psychosocial determinants of children's school playground physical activity.

Results from chapter three enabled schools to be ranked according to the total proportion of active children in each school's playground during recess and lunch break. Using this ranking, interviews (student, teacher and principal) were conducted at three schools with low proportions of physically active children compared to three with higher proportions of physically active children (Chapter seven). Chapter eight integrates the results from chapters three to six. The implications of the findings are discussed within the context of the current literature, and the study limitations and recommendations for future research are presented.

Figure 1.1 Flow chart of study



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CHAPTER 2

A systematic review of the methods used to assess free play playground physical activity levels of primary school children during school recess and lunch

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2.1 Introduction

While regular physical activity is important for maintaining a healthy lifestyle, the modern environment promotes sedentary behaviour (Strong, Malina et al. 2005). Current guidelines recommend that children spend a minimum of 60 minutes each day engaging in moderate to vigorous physical activity (MVPA) (Australian Government: Department of Health and Ageing 2005) . In order to identify ways to make it easier for people to incorporate physical activity into their lives, the NHMRC guidelines recommend the need for population based studies that focus on environmental changes which would facilitate higher physical activity levels (NHMRC 1997).

There are fewer opportunities for children to be active given the competition from sedentary pastimes (Robinson 1999). While the school environment provides access to most children Australia wide, children's opportunities to be active at school are often limited. For example, participation in physical education and sport is usually restricted to two hours per week, and sometimes overriding academic alternatives encroach on the time allocated for physical education (Ernst 2003; New South Wales Department of Education and Training 2005). In Australia, there is some concern that the move towards a national curriculum with core learning areas in maths, english, science and language may reduce time for physical education (Penney, Emmel et al. 2008). The school playground is an alternative and ideal environment for children to be active. Based on current school policy regarding recess and lunch breaks, most Australian children can accumulate a combined maximum of 75 minutes of activity each day during recess and lunch (New South Wales Department of Education public

liaison officer 2009). The school playground is generally devoid of electronic sedentary pastimes, and can be structured to offer inducements for children to be active (e.g., playmates, equipment, playing fields). Currently the use of these school break-times to increase children's physical activity level appears to be underutilised (Sallis, Conway et al. 2001; Barnett, O'Loughlin et al. 2006).

The process of designing appropriate interventions to increase the physical activity levels of children in the school playground should start with an assessment of their current physical activity levels using psychometrically sound strategies and instruments. While a variety of instruments and strategies have been used to assess the playground activity levels of young children in the school playground environment, including pedometers, accelerometers, self report surveys, heart rate monitors and systematic observation, the psychometric properties of these instruments and strategies remains a contested issue (Ridley, Dollman et al. 2001; Zask, van Beurden et al. 2001; Lopes, Vasques et al. 2006; Ridgers, Stratton et al. 2006; Tudor-Locke, Lee et al. 2006).

The choice of which physical activity assessment approach to use to assess the physical activity level of children is influenced by the study design, the age of the participants, feasibility and cost (Kohl, Fulton et al. 2000). Thus, when selecting an instrument researchers must consider: the time required to apply, remove and download monitoring devices; the cost of instrument application for large groups of children; disruption to school personnel; and child reactivity and child tampering when using activity motion sensors (Trost, McIver et al. 2005; Corder, Ekelund et al. 2008; Parrish, Iverson et al. 2010). Measuring physical activity levels of young children in the school playground environment is additionally complicated as the playground environment is chaotic and influenced by a multitude of external and internal variables (Johns and Ha 1999; McKenzie, Marshall et al. 2000; Zask, van Beurden et al. 2001; Parrish, Iverson et al. 2009a). Since children's movements in the playground environment are typically erratic and unplanned, the assessment approach chosen must be able to accommodate assessment of children's sporadic activity patterns (Welk, Corbin et al. 2000).

School break-times (i.e., lunch and recess) provide children with opportunities to be physically active with their peers in free living, unstructured conditions. Although studies have examined the physical activity levels of children in a range of environments (Iannotti, Claytor et al. 2004; Hussey, Bell et al. 2007; Grow, Saelens et al. 2008; Manley 2008), there is limited research which has investigated the physical activity levels of children in the school playground.

The aim of this review was to identify, describe and compare approaches commonly used to assess the playground physical activity levels of primary/elementary children during school recess and lunch breaks.

2.2 Definitions

Four key definitions were used to guide the systematic review process. First, 'primary or elementary school children' was used to refer to participants between the ages of 4 and 12 years of age. Second, physical activity was defined as "…any bodily movement using skeletal muscles resulting in energy expenditure" (Caspersen, Powell et al. 1985, p. 126). Physical activity is typically further characterised by its frequency, intensity, duration and energy expenditure (Welk, Corbin et al. 2000). Third, 'playtime breaks, recess or lunch' were terms used to refer to the free time available to children between curricular class times, usually spent outdoors. Fourth, 'playgrounds' was used to refer to the outdoor areas at schools used by children during recess or lunch – this could include sporting fields, grassed, concrete or asphalt, bark/sand areas, fixed equipment and playground markings.

2.3 Methods

A systematic review of the literature was conducted to identify published articles and reports in which the playground physical activity levels of primary/elementary school children during school recess and lunch breaks was assessed. Two researchers conducted independent literature searches, using the same search strategies, to ensure completeness of the identification process. The search was based on the following key words: 'children' (aged between 4-12 years), 'primary', 'elementary', 'young', 'physical activity', 'observation', 'accelerometer', 'pedometer', 'questionnaire', 'heart rate monitor', 'school playground', 'lunch', 'recess' or 'break-times' and

'playgrounds' and 'parks'. The search was conducted in the following databases: Cochrane, CINAHL, Science Direct, Pub Med (Medline), Health Reference Centre-Academic, Proquest, and ERIC. In addition, the reference lists of all selected publications were reviewed for previously unidentified studies.

2.3.1 Inclusion criteria

Studies were included in the systematic review if: they were written in English and published between January 1990 and May 2009; study participants were children aged between 4 and 12 years (although the study did not have to include all of these age groups); the approach used to assess the free play physical activity levels in an unstructured setting was described; the data collected related specifically to the school playground setting during recess and lunch break; and the physical activity outcome measure was related specifically to the physical activity levels of children during the recess and lunch period, or both periods combined. Studies which measured physical activity in time periods other than recess and lunch were included if the physical activity levels during recess and lunch were also described.

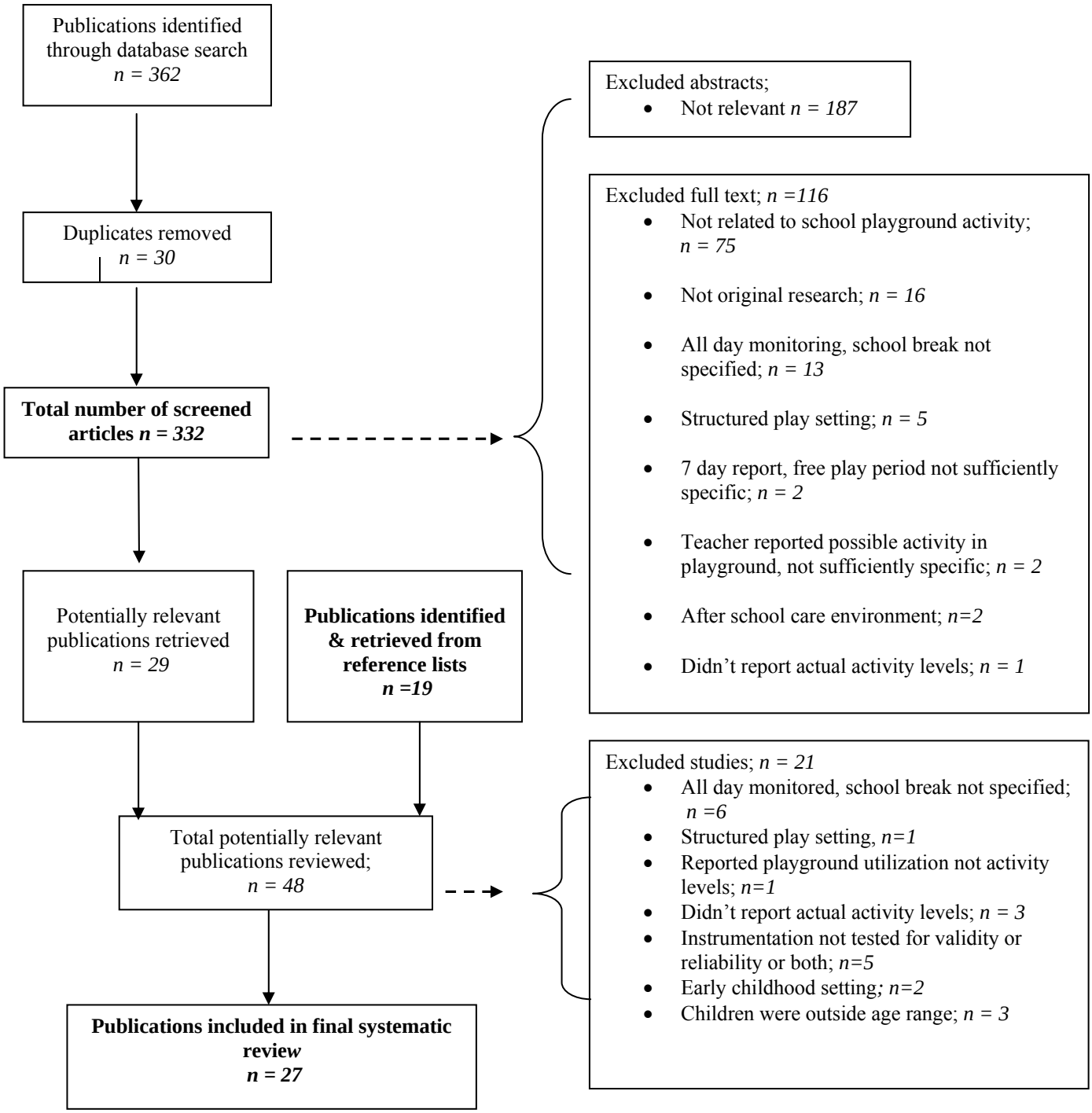
2.3.2 Exclusion criteria

Studies were excluded if: they involved students in the preschool, middle or high school setting; actual physical activity levels were not recorded (i.e. the teacher's perception of children's activity level was not considered to be sufficient); study outcomes reported only physical activity outside of school-time (i.e. after school care) or in a non-school setting; a structured game or intervention was conducted during the recess or lunch period thus rendering it to be a non- free play situation; and, the physical activity outcome measures did not specify the activity levels during the recess and lunch periods.

2.3.3 Instrument rating criteria

Table 2.7 was developed to provide an overall comparison of instruments, it should assist researchers to determine the most appropriate instrument for a given research project. The ratings was determined based on our interpretation of the data in tables 2.0 to 2.6 and additional information from the research literature (e.g. cost).

Figure 2.1 Flow chart of systematic review search strategy



2.4 Results

Of the 362 publications identified in the literature search (Figure 2.1), only 27 satisfied the inclusion and exclusion criteria and thus were included in the final analysis. Analysis of the 27 accepted publications revealed that the instruments and strategies used to evaluate children's school break time playground physical activity levels included: accelerometry, heart rate monitoring, pedometry, observation and self-report questionnaires. Studies which used heart rate monitors, accelerometers, pedometers, observation and self-report questionnaire are summarised in Tables 2.1 to 2.5 respectively; the studies are listed in order of sample size (smallest to largest). Four studies used two physical activity assessment methods (Table 2.6).

Eight studies used heart rate monitors to assess children's school break time playground physical activity. Heart rate monitors use the electrocardiogram (ECG) signal to detect heart rate using a transmitter which is worn around the chest (Kohl, Fulton et al. 2000; Janz 2002). Heart rate monitors can be used to estimate energy expenditure based on a linear relationship between heart rate and oxygen consumption (Sirard and Pate 2001). The monitors were used to quantify and observe physical activity, investigate seasonal variability in children's physical activity, to compare the physical activity of males and females, to investigate whether interventions such as playground markings had an effect on children's physical activity levels and to examine the number of days of monitoring required for heart rate monitoring (Stratton 1999; Stratton 2000; Ridgers, Stratton et al. 2005; Stratton and Mullan 2005; Ridgers, Stratton et al. 2006). In this review, heart rate monitors were validated in two studies (comparing ECG monitors to HR monitors) with values ranging from r=0.95-0.99 (Treiber, Musante et al. 1989; Godsen, Carroll et al. 1991); inter-instrument reliability was established in one study (r=0.97) (comparing the output of three Polar Vantage heart rate monitors on each participant) (Godsen, Carroll et al. 1991). The sample sizes using heart rate monitors for the studies in the review ranged from 27 to 270 participants, and data collection periods ranged from one to five days, making between-study comparisons difficult. Some of the studies were limited by their size, the length of data collection (e.g. one day) and incomplete data sets (Stratton 1999; Ridgers and Stratton 2005; Ridgers, Stratton et al. 2006). Girls' heart rates are generally 20 beats higher than boys, therefore studies that compare data need to

account for gender differences (Stratton 1999). Stratton (2000) found that some schools increased the length of their break time during the intervention; investigators need to account for such limitations. Studies using heart rate monitors to assess playground physical activity were summarised in Table 2.1.

Eight studies used accelerometers to measure children's playground physical activity levels. Accelerometers are positioned above the hip and attached to a belt worn around the waist. They measure human acceleration and deceleration (activity counts) (Corder, Ekelund et al. 2008). There are two types of accelerometers, single plane accelerometers (e.g. Computer Science Applications accelerometer-CSA) and three-dimensional accelerometers (e.g. Tritrac-R3D), both types are valid and reliable (Trost, McIver et al. 2005; Rowlands 2007). To date, studies have not compared both types of accelerometers, there is some evidence that the three-dimensional accelerometers might be more valid, but the difference is small (Trost, McIver et al. 2005; Rowlands 2007). In the studies within this review, accelerometers were used to assess physical activity levels during break time, assess whether children compensated for missed activity opportunities, compare differences between physical activity during break periods and physical education lessons, compare gender and SES differences in physical activity, characterise children's spontaneous physical activity and evaluate the effectiveness of interventions on children's physical activity levels (Sarkin, McKenzie et al. 1997; Dale, Corbin et al. 2000; Going, Thompson et al. 2003; Guinhouya, Hubert et al. 2005; Ridgers, Stratton et al. 2005; Lopes, Vasques et al. 2006; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). The accelerometers were validated in five studies with calculated values ranging from r=0.41 to 0.89 (accelerometers compared to a heart rate monitor), r=0.86-0.87 (accelerometers compared to energy expenditure) and r=0.43 (accelerometers compared to a metabolic equivalent) (Sallis, Buono et al. 1990; Janz 1994; Welk and Corbin 1995; Trost, Ward et al. 1998; Ott, Pate et al. 2000). Inter-instrument reliability was tested in four studies with values ranging from r=0.86 to 0.96 (Sallis, Buono et al. 1990; Welk and Corbin 1995; Trost, Ward et al. 1998; Ott, Pate et al. 2000). The sample sizes for studies using accelerometers ranged from 13 to 580 participants; data collection ranged from one to five days. Some studies were limited by: a short data collection period (e.g. one day), missing data, small sample size and being limited to one type of location (e.g. rural) (Sarkin, McKenzie et al. 1997;

Guinhouya, Hubert et al. 2005; Ridgers, Stratton et al. 2005; Lopes, Vasques et al. 2006). Guinhouya (2005) and colleagues reported problems with accelerometer accuracy. Dale and colleagues (2000) could not report energy expenditure due to the absence of appropriate equations at the time of their study. Some studies indicated the need for additional observational data to add social context to the physical activity data collected (Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Studies using accelerometers to assess playground physical activity were summarised in Table 2.2.

Five studies used pedometers to assess children's school break time playground physical activity. While pedometers are designed to be sensitive to ambulatory activity, they cannot discriminate between physical activity intensity levels (Tudor-Locke, Lee et al. 2006). Pedometers were used to determine inter-instrument reliability, to describe children's physical activity patterns, to determine gender differences in physical activity, and to examine the effectiveness of interventions on children's physical activity levels (Barfield, Rowe et al. 2004; Beighle, Charles et al. 2006; Tudor-Locke, Lee et al. 2006; Loucaides and Jago 2008; Loucaides, Jago et al. 2009). The pedometers were validated in three studies with calculated values ranging from r=0.734 (compared to a heart rate monitor in unregulated play) to r=0.985-0.997 (compared to observed self paced walking), r=0.782-0921 (compared the use of pedometers in treadmill and unregulated play to scaled oxygen uptake) and mean values were within ± 1% of actual steps at 80 $m \cdot min^{-1}$ (meters per minute) and above (compared to treadmill walking) (Eston, Rowlands et al. 1998; Crouter, Schneider et al. 2003; Beets, Patton et al. 2005). Inter-instrument reliability was tested in two studies where values were r=0.096 to 0.98 (during recess) and r=0.81 (during treadmill walking) (Crouter, Schneider et al. 2003; Barfield, Rowe et al. 2004). The sample sizes for studies using pedometers ranged from 71 to 270 participants; data collection ranged from four to five days. Some studies were limited by: small samples, children self recording data, a self selected sample, possible reactivity, the fact that pedometers did not capture activity intensity or duration of activity bouts, it was impossible to ensure instrument compliance, data collection was limited to one location and one season and in some cases school policy prevented individual data collection (Barfield, Rowe et al. 2004; Beighle and Pangrazi 2006; Tudor-Locke, Lee et al. 2006; Loucaides and Jago 2008; Loucaides, Jago et al. 2009). Beighle and

Pangazi (2006) reported that the environment of the school in their study was more conducive to physical activity then other schools and therefore results could not be generalized to the rest of the population. Studies using pedometers to assess playground physical activity were summarised in Table 2.3.

Four studies used observational techniques to assess children's school break time playground physical activity. Observational techniques involve personnel observing the activity levels of children and recording activity levels on hard copy or in a hand held device (Zask, van Beurden et al. 2001). Observational techniques were used to investigate the impact of home and school settings on children's physical activity levels, to determine children's activity levels, to determine which variables affect children's physical activity levels and to develop and validate a new observational technique (Sleap and Warburton 1996; Johns and Ha 1999; Zask, van Beurden et al. 2001; Parrish, Iverson et al. 2009a). Observational techniques were validated in three studies; values ranged from r=0.257 to 0.9, one study's mean r=0.64 (compared observation activity points to heart rates) and a second study's mean r=0.7 (compared observed activity to a video "gold standard") (O'Hara, Baranowski et al. 1989; Zask, van Beurden et al. 2001). Stratton and Mota (2000) found a negative correlation r=-0.41 (compared observation and heart rate during school recess). Inter-observer reliability was assessed in five studies; values ranged from r=0.71 to 0.99 (Puhl, Greaves et al. 1990; McKenzie 1991; Sleap and Warburton 1996; Zask, van Beurden et al. 2001; Parrish, Iverson et al. 2009a). The sample sizes for studies using observation ranged from 18 to 3912 participants and data collection ranged from one day of observation to 417.75 minutes/child. Some studies were limited by: a restricted physical environment (Johns and Ha 1999), a small sample (Sleap and Warburton 1996), low numbers of teachers encouraging children and a small sample of schools with soft play surfaces (Parrish, Iverson et al. 2009a), the length of data collection (Zask, van Beurden et al. 2001). Studies using observation to assess playground physical activity were summarised in Table 2.4

There was one self-report measure used in the identified studies. Self-report methods involve the participant recalling or diarising activity patterns (Kohl, Fulton et al. 2000). Self-reports can be self administered or interviewer-assisted (Sirard and Pate 2001). The self-report in this review was trialled in hard copy and electronic format.

Validity values between the Computer Delivered Physical Activity Questionnaire (CDPAQ), heart rates and Caltrac accelerometers were calculated to range from r=0.36 to 0.63 ($p<0.05$); correlations for the hard copy ranged from r=0.25 to 0.48 ($p<0.05$) (Ridley, Dollman et al. 2001). Test-retest reliability in the one reported study was r=0.98 ($p=0.001$), however the test-retest was taken on the same day, thus children may have remembered their original answers when they completed the retest (Ridley, Dollman et al. 2001). Ridley reported that the study was limited as: it was not suitable for children younger than ten years and that participants could forget to complete all sections of the hardcopy questionnaire (Ridley, Dollman et al. 2001). Details of this review are summarised in Table 2.5.

Table 2.6 summarises studies which used more than one measure of children's school playground physical activity levels. Stratton and Mota (1999) combined observation and heart rate monitors to assess children's physical activity. They found that correlation coefficients between the two measures were low and that it was difficult to synchronise the data due to the intermittent nature of children's activity. Scruggs (2003) used a small sample with a limited data collection period and found inconsistencies between heart rate monitors and pedometers. Ridgers and colleagues (2007) reported the same inconsistencies between heart rate monitors and accelerometers. In addition they had issues with missing data (Ridgers, Stratton et al. 2007). Stratton and Leonard (2002) believed the heart rate data did not provide adequate information about the types of activities involving children.

Table 2.1 Summary of studies using heart rate monitors to assess physical activity during school recess and lunch

Study	Participants	Physical activity assessment approach	Data collection	Psychometric properties	Limitations and comments
Stratton 1999 United Kingdom (UK)	27 children aged 7 to 11 years from one primary school; 13 girls & 14 boys.	Sports tester heart rate monitor (Electro-polar)	To quantify and observe Physical Activity (PA) and compare heart rates of males and females during summer and winter. Heart Rate (HR) data was collected from two children each day total number of days of data collection not stated.	Heart rate monitors validity established previously by Treiber (1989). Correlations between heart rate monitor and an Electro Cardio Graph (ECG) heart rates on cycle for 3 min periods were 0.97 to 0.99. Correlations for 3 x 1 min intervals on treadmill ranged from 0.94 to 0.99. Heart rate monitor and ECG heart correlations between heart rate monitor and ECG heart rates in children in a mix of activities (i.e. play ball, jog, climb) showed significant correlations of at least 0.98. 'Standard error of estimates' for all 3 studies were low ranging from 1.1 to 3.7 beats min^{-1}. For individuals, max differences ranged from 0 to 12.4 beats min^{-1} (Treibler et al 1989).	Studies should account for differences in boys and girls heart rates (Stratton 1999).
Ridgers et al 2006 (UK)	34 children aged 6 to 11 years from 2 schools; 19 girls & 15 boys.	Polar Team System Heart Rate monitor	To investigate seasonal variability of children's physical activity and examine how many days of monitoring are needed. Children's PA was assessed on 5 consecutive school days in winter and 5 consecutive days in summer.	Polar Vantage XL Heart Rate Monitors for reliability and validity established previously by Godsen (1991). Comparisons between Polar Vantage and ECG yielded values were within $\pm$ 6 beats/min for 95% of the time. Three monitors were worn by each participant yielding the same data over 97% of the time.	Small sample. Did not consider gender differences in activity. Only 20 of the 34 children provided complete data sets for analysis. Heart rate telemetry results can be affected by factors other than physical activity (Ridgers et al 2006)

Stratton 2000 (UK)	47 primary school children aged 5 to 7 years at 2 schools; 24 girls and 23 boys.	Heart rate telemetry (Electro-polar)	Pre and post assessment of PA levels following the introduction of playground markings during morning and afternoon recess to assess intervention effect on children's school playtime physical activity levels. PA was measured for 3 playtimes before and after markings were installed.	Heart Rate Monitors reliability and validity established previously (Treiber, Musante et al. 1989) refer to values in the table summary of Stratton 1999.	PA may have been affected by the fact that the schools increased the duration of playtime during the intervention. It is possible that factors other than the playground markings contributed to an increase in children's activity at the control school. Possibility of a novelty effect of playground markings (Stratton 2000).
Stratton and Mullan 2005 (UK)	99 children from 8 primary schools aged 4 to 11 years; 48 girls and 51 boys.	Sports Tester Polar-Electro 3000 Heart Rate Monitors (Electro-polar)	To investigate whether playground markings increased children's recess PA levels; quantify children's recess PA levels. Measurements during 3 breaks for 3 days.	Heart rate monitor's reliability and validity established previously (Treiber, Musante et al. 1989) refer to values in the table summary of Stratton 1999.	Heart rate telemetry results can be affected by factors other than physical activity. Heart rate telemetry can over estimate energy expenditure. Factors other than the intervention may have affected children's playground physical activity levels (Stratton and Mullan 2005).
Ridgers and Stratton 2005 (UK)	296 children aged 6-11 years; 147 girls & 149 boys.	Polar Team System Heart Rate (HR) monitor	To quantify PA levels of children during recess (including age and gender differences); assess how recess could contribute to PA levels. Children from 18 schools wore HR monitors for 1 day during school time.	Heart rate monitor's reliability and validity established previously (Godsen et al. 1991) see values in the table summary of Ridgers et al 2006.	Heart rate telemetry results can be affected by factors other than physical activity. Longer recording intervals are less sensitive to children's physical activity than shorter intervals. Children may react to monitors. PA was only monitored on one day (Ridgers and Stratton 2005).

Table 2.2 Summary of studies using accelerometers to assess physical activity during school recess and lunch

Study	Participants	Physical assessment approach	Data collection	Psychometric properties	Limitations and comments
Guinhouya et al 2005 (France)	13 children aged 8 to 10 years; 8 girls & 5 boys.	CSA accelerometers	To analyse the significance of the recess period: Changes were made to the length of the recess (over a 3 week period) and non-fixed equipment was introduced. Assessed PA during recess periods (either for 2 x 15 mins/day or 2 x 20 mins /day or 1x 15 and 1x 20 mins/day), data was collected in the third week.	Accelerometer reliability and validity previously examined (Trost, Ward et al. 1998). Treadmill walking and running in children; Intraclass Correlation Coefficient (ICC) reliability coefficient for 2 CSA monitors at all speeds was r = 0.87. Correlations between CSA activity counts and energy expenditure (EE) were r =0.86 and r=0.87 respectively ($p<0.001$).	Small sample. The participants were all from a rural environment. Believed there were limitations related to accelerometer accuracy. (Guinhouya et al 2005).
Dale et al 2000 United States of America (USA)	78 children aged 9 years in 3rd and 4th grades; 40 girls & 38 boys.	CSA accelerometers	To assess if children compensate for missed opportunities to be active; each child wore an accelerometer for 4 days (using 1 min epochs) over a 14-week period during school days (recess and lunch were identified)	Accelerometer reliability and validity established previously (Trost, Ward et al. 1998), see values in the table summary of Guinhouya 2005.	Energy expenditure was not recorded. At the time of the study, there was an absence of appropriate equations to predict energy expenditure using accelerometry (Dale et al 2000). .
Sarkin et al 1997 (USA)	110 5th grade children in 4 classes at one elementary school; 61 girls & 49 boys.	Caltrac accelerometers	Assessed PA during Physical Education (PE) and the longest recess period for 3 days; 26 children monitored/week. Examined gender differences in PA in different PA settings.	Accelerometer reliability and validity established previously (Sallis, Buono et al. 1990). Correlations between the Caltrac accelerometer and a heart rate monitor were r=0.54 ($p<0.001$) for day 1 and r=0.42 ($p<0.02$) for day 2. Inter-instrument reliability in the field setting was r=0.96. Laboratory reliability of 2 Caltrac accelerometers was	Limited sample size. Included students from one school only. Strength was the assessment of physical activity in two different settings using an objective measure of physical activity and that data were collected over multiple days (Sarkin et al 1997).

				r=0.89.	
Lopes et al 2006 (Portugal)	271 children aged 6 to 10 years at 5 primary schools; 131 girls & 140 boys.	MTI Actigraph Accelerometers (formerly CSA Accelerometer) (Model 7164)	To characterise children's spontaneous activity, they assessed 1 hr of physical activity at home and 30 mins during school recess over 4 days	Accelerometer reliability and validity established previously; see above (Trost, Ward et al. 1998).	The study was limited to recess only; therefore inferences should not be drawn regarding children's overall physical activity (Lopes et al 2006).
Ridgers, Stratton and Fairclough 2005 (UK)	228 children aged 5 to 10 yrs at 23 schools; 112 girls & 116 boys.	MTI Actigraph Accelerometers	To compare PA differences in boys and girls and assess whether 50% PA target for recess was achieved. Children wore accelerometers for 1 day during school time (10 children per school).	Accelerometer reliability and validity established previously (Ott, Pate et al. 2000). Correlations between the CSA output and predicted 'metabolic equivalent' (MET) were r = 0.43 ($p<0.001$) and for heart rate r = 0.64 ($p< 0.001$). CSA and Tritrac accelerometer correlated with one another r = 0.86 ($p<0.001$).	There was a number of missing data at follow-up measure points. This was due to HR technical difficulties and student absence. Combined HR and accelerometry to quantify physical activity produced differing results (Ridgers, Stratton et al. 2005).
Verstraete, et al 2006 (Belgium)	235 children at 7 elementary schools; 114 girls & 121 boys.	MTI Actigraph accelerometers	To evaluate the effect of game equipment on children's PA during recess and lunch for one day; pre and post test design (3 months after equipment was introduced).	Accelerometer validity established previously (Janz 1994). Validity correlation coefficient between accelerometry and heart rate telemetry for each monitored day ranged from 0.50 to 0.74 ($p<0.05$). Between day stability of individual stability measures was not significant (r= -0.23 to 0.53) ($p\geq0.05$).	May be limited by quasi-experimental design. Teachers' encouragement of equipment use was not investigated (Verstraete, et al 2006).
Ridgers et al 2007 (UK)	297 elementary children from 26 schools; 147 girls & 150 boys.	MTI Actigraph Accelerometers (Model 7164)	To investigate whether playground redesign impacts on children's moderate to vigorous physical activity (MVPA) & vigorous physical activity (VPA) levels, and to determine if school and pupil level variables influence the intervention effect; 15	Accelerometer reliability and validity established previously, see values in the table summary of Ridgers et al (2005).	Did not control the amount of equipment available to children. Teacher involvement was not monitored. Stated that there is a need for additional observational data to examine the social context of the school playground variables (Ridgers, Stratton et al. 2007).

			intervention & 11 SES matched control schools. PA assessed one day pre and post intervention.		
Going et al 2003 (USA)	580 elementary children in 5th grade. Number of schools was not clearly defined for this subsample. Gender of children was not stated.	TriTrac-R3D accelerometers	School intervention to increase PA during PE and school recess. Accelerometer fitted to child for 24hrs.	Accelerometer reliability and validity established previously (Welk and Corbin 1995). Correlations between TriTrac and Caltrac monitor averaged r= 0.88 across 3 days and mean correlations between TriTrac and a heart rate monitor averaged r=0.58 across 3 days (using Fisher's Z transformation). Correlations between TriTrac and a heart rate monitor across different time periods in the school day were highly variable with mean values ranging from r=0.41 to r=0.89 using Fisher's Z transformation. The highest mean values (3 days) across different time periods in the school day were found during free play with values ranging from 0.8 to 0.89 ($p<0.01$).	Only measured physical activity on one day. Methodology protocols need to be refined to ensure changes in children's physical activity can be detected (Going et al 2003).

Table 2.3 Summary of studies using pedometers to assess physical activity during school recess and lunch

Study	Participants	Physical assessment approach	Data collection	Psychometric properties	Limitations and comments
Barfield et al 2004 (USA)	71 children in grades 2 to 5 at one elementary school; 29 girls & 42 boys.	Two Yamax Pedometers	Determine inter-instrument reliability. Monitored Mon-Fri for 1 week (8.15am-2.30pm). Pedometer steps recorded for classroom, recess & physical education (PE).	Intraclass Correlation Coefficient (ICC)=0.96 (95% Confidence Intervals (CI), 0.94-0.97) for entire week, ICC=0.98 (95%CI 0.97-0.99) for recess. While mean count differences between the left and right pedometers were significant ($p<0.05$) (re: total time and recess time differing by 3% to 5% of the lower mean value), they were clinically unimportant.	Testing was limited to in-school activity (Barfield et al 2004).
Tudor-Locke et al 2006 (USA)	81 elementary children in 6th grade at one school; 53 girls & 28 boys.	Walk4life (WL) pedometers	To describe children's PA patterns during PE, recess, lunch and before and after school; to describe gender specific patterns during PE and breaks. Children wore pedometers for 4 days and were prompted to record step count at the end of each period.	Pedometer reliability and validity established previously (Crouter, Schneider et al. 2003). For comparisons between right and left side placement WL ICC=0.81 (95%CI). WL significant differed from actual steps at 54 and 67 $m \cdot min^{-1}$, but accurate at 80 $m \cdot min^{-1}$ with mean values within ± 1% of actual steps. For distance travelled WL was significantly different at 54, 67 and 107 $m \cdot min^{-1}$ ($p <0.05$), but most accurate at 80 and 94 $m \cdot min^{-1}$.	Small self-selected sample of children from a single grade at one school. The presence of research staff in the school may have resulted in the children being reactive. The fact that children self recorded pedometer data may have affected results. Pedometers do not capture PA intensity (Tudor-Locke et al 2006).
Loucaides et al 2008 (Cyprus)	247 children mean age 11.1 years (± 0.3) in grades 5 and 6 at 3 elementary schools; 123 girls & 124 boys.	Digiwalker (DW) Yamax Pedometers	To describe gender determined PA activity and examine differences in the school day. Children wore pedometers for 4 days.	Pedometer validity established previously (Eston, Rowlands et al. 1998). When correlated with scaled oxygen uptake (sVo2: oxygen uptake expressed as a ratio of body mass raised to the power of 0.75) the ankle and hip DW were significant ($p<0.001$) but the wrist pedometer was not. Treadmill activities, DW correlation was $r=0.782$ ($p<0.001$). Unregulated play correlation with sVo2 was 0.921	Pedometers do not capture data related to activities such as swimming or bicycling. Pedometers do not provide information about intensity, frequency and duration of PA bouts. The children recorded their own steps which may have affected the results. It is impossible to guarantee that children wore the pedometers for the whole day.

				($p<0.005$).	Distance covered walking to school was not assessed. Participants were only recruited from three schools within one geographic region and were only assessed during winter (Loucaides et al 2008).
Loucaides et al 2009 (Cyprus)	247 children aged 11 years in grades 5 and 6 at 3 schools; 115 girls & 117 boys (had complete data at follow-up; gender of remaining children is unknown).	Digiwalker (DW) Yamax Pedometers	To examine effectiveness of interventions (2 interventions & one control) Intervention: playground markings, equipment, and playground space at 2 intervention schools. PA measured for 4 days prior and post intervention (4 weeks after). Recess results reported.	Pedometer validity established (Eston, Rowlands et al. 1998), see above.	Children recorded their own steps, which is open to participant error. Only a small number of schools to investigate the effect of the intervention (Loucaides et al 2009).
Beighle et al 2006 (USA)	271 children; mean age girls was 9.6 ($\pm$ 0.9) years and 9.5 ($\pm$ 0.9) years from 3rd, 4th and 5th grade from one elementary school; 150 girls & 121 boys.	Walk4Life (WL) Pedometers	To determine pedometer steps and activity time during recess and outside of school for 4 days (15 min recess)	Pedometer validity established previously (Beets, Patton et al. 2005). ICC's during self paced walking (SPW), for observed steps, Digiwalker (DW) 200 and WL pedometers were ICC=0.985-0.997 (95% CI). For observed walking and pedometer steps ICC$\leq$ 0.72 (95% CI). For pedometer time the WL and observed steps during SPW, ICC=0.997-0.998 (95% CI). For treadmill walking WL within 5.3% of actual time (all speeds).	Length of time that students wore the pedometers is not available. Used a gross estimate of out-of-school time for when students were active. School policy prevented individual data collection. The study school had an environment which was more conducive for physical activity which affects whether it can be generalised to the rest of the population (Beighle et al 2006).

Table 2.4 Summary of studies using observation to assess physical activity during school recess and lunch

Study	Participants	Physical assessment approach	Data collection	Psychometric properties	Limitations and comments
Johns and Ha 1999 (Hong Kong)	40 children aged 6 to 8 years; grade and number of schools not stated; 25 girls & 15 boys.	Behaviours of Eating and Activity for Children's Health Evaluation System (BEACHES) observational instrument	To investigate the impact home and school settings have on physical activity; assessed 1 hr at home and 30 mins during school recess over 4 days	Reliability and validity previously established (McKenzie, Sallis et al. 1991). Inter-observer reliability (home observations) for activity level: Mean % agreement 94%, Kappa Median 0.91 (range 0.69-1.0). Inter-observer reliability (video observations) for activity level: Mean % agreement 93%, Kappa Median 0.86 (range 0.47-1.0). Validation of activity coding system to estimate energy expenditure (using heart watches to monitor heart rate) associated with each activity category. Heart rate increased with each activity code increment, mean heart rates ranged from 99 beats/min for lying to 153 beats/min for very active.	Children's physical activity is limited by the restricted physical environment.
Sleap & Warburton 1996 (UK)	179 primary children aged 5 to 11 years; grade and number of schools not stated; 93 girls & 86 boys.	Children's Physical Activity Form (CPAF), observational tool	To determine the physical activity levels of a sample of young children. Observations were carried out during school break times, PE lessons and outside of school. Longitudinal 1988-1993 total 74,777 mins observation, average observation time per child 417.75 mins	Instrument previously validity established (O'Hara, Baranowski et al. 1989). Mean correlation between activity points and heart rates in a time series analysis was r=0.641 (min r=0.257, max r=0.9); the average percentage of variance was 43.9% and 34 of the 36 correlations were significant $p<0.05$. Sleap and Warburton (1996) found observer reliability	It was not a large sample, but it offers a reasonable cross-section of the population. Observation provides a useful insight into the lifestyles of children (Sleap & Warburton 1996).

				r=0.797, p<0.001.	
Parrish et al 2009a (Australia)	2946 children from 13 primary schools in Kinder to 6th grade; number of boys and girls not stated.	Children's Activity Scanning Tool: CAST2 a momentary time sampling observational instrument.	To determine which environmental variables affected children's playground physical activity levels. Physical activity was measured for 3 days at each school.	Reliability and validity established previously (Zask, van Beurden et al. 2001) (see in table below). Additional instrument calibration for observer consistency at 9 schools: Spearman's correlation coefficient *r*=0.71-0.99. Inter-rater reliability using Chronbach's Alpha ranged from 0.965-1.0. Confidence intervals (95%) estimated correlation coefficients between scores of pairs of observers least lower bound 0.718 and greatest upper bound value 1.0 (Parrish, Iverson et al. 2009a)	Small sample of schools with soft-play surfaces in the study results. There was a small number of teachers observed to be encouraging activity in the study results (Parrish et al 2009).
Zask et al 2001 (Australia)	3,912 primary children from 18 primary schools in Kinder to 6th grade; number of boys and girls not stated.	Children's Activity Scanning Tool (CAST) a momentary time sampling observational instrument.	The development, validation and use of the CAST instrument to assess the playground PA levels of children, including gender differences. Each school was observed for one day.	Inter Rater Reliability (IRR) category identification: agreement for student activity level 72-100% (M=96.1%) κ ranged from 0.07-1, 2/3 of the comparisons returned κ > 0.95. IRR for the number of children in each activity overall value for all categories was *r*=0.79, p value not stated. Cast validity in measuring MVPA, on a single-scan level the field measure was a valid and positive predictor of the video gold standard r=0.7, (p<0.001). IRR and video gold standard r= 0.91 and 0.89 for each of the 2 observers.	The instrument had not been tested in different sized and different types of playgrounds. The chaotic nature of the school in break times makes observation difficult. Schools were surveyed twice on the same day (Zask et al 2001).

Table 2.5 Summary of studies using questionnaires/self report to assess physical activity during school recess and lunch

Study	Participants	Physical assessment approach	Data collection	Psychometric properties	Comments
Ridley et al 2001 (Australia)	30 primary school children from one primary school; mean age 11.96 years (± 0.53); 15 girls & 15 boys.	Test the reliability and validity of a computer-delivered physical activity questionnaire (CDPAQ) using HR monitors and Caltrac accelerometers. Includes data re: recess and lunch.	A computerized 1 day PA recall questionnaire (Computer delivered physical activity questionnaire: CDPAQ) was developed and trialled on 10-12 year old children. Hard copy (HC) and computer versions were tested. Same day test-retest reliability. Validity was assessed with Caltrac Accelerometers and Polar Accurex Plus Polar PE2000 HR monitors. Computer data includes recess and lunch.	Validity values between the CDPAQ survey, heart rates and Caltrac accelerometers ranged from r=0.36 to 0.63 ($p<0.05$). Correlations for the hard copy ranged from r=0.25-0.48 ($p<0.05$). Test retest reliability r=0.98 ($p=0.001$).	Limitation of the HC is that participants may forget or neglect to answer some of the questions. Not suitable for children younger than 10 years of age (Ridley et al 2001).

Table 2.6 Summary of 2 physical assessment methodologies to assess physical activity during school recess and lunch

Study	Participants	Physical assessment approach	Data collection	Psychometric properties	Comments
Stratton & Mota 1999 (Portugal and UK)	9 English & 9 Portuguese school girls aged 10 years.	Children's Activity Rating Scale (CARS) and Polar Sportstester HR monitor	To examine the relationship between movement behaviour and heart rate of participants during school playtime. Each child's HR and CARS was assessed for one morning recess/day	Heart rate monitor's reliability and validity established previously (Treiber, Musante et al. 1989). CARS observation tool reliability established previously (Puhl, Greaves et al. 1990). Mean observer agreement between observers for paired observations in the field was 84.1 $\pm$ 10.1%. Stratton and Mota (2000) found that comparison between HR monitor and CARS using time series correlation coefficients were low for majority of girls; only one was significant r=-0.41 ($p<0.01$), which paradoxically suggesting lower levels of movement generated a higher heart rate (Stratton and Mota 1999). This data contrasted with results of OHara et al (1989) who found a number of correlation coefficients between heart rate monitors and CARS that were greater than r=0.6. However, children were involved in high intensity activity which may generate fewer errors when matching heart rate telemetry to observation (Stratton and Mota 1999).	Heart rate and observation were difficult to synchronise due to intermittent nature of children's activity. Therefore, combining HR and observation may only serve to confuse the interpretation of children's physical activity in the playground setting (Stratton and Mota 1999).
Scruggs et al 2003	27 children aged 11years; 17 girls	Polar Vantage XL heart rate monitors (also known as Sports	To assess whether there were differences in children's	Digi walker pedometers reliability and validity	Small sample of only one class at one school and a limited data

(USA)	& 10 boys.	tester) and Yamax SW-701 Digiwalker (DW) Yamax pedometer	physiological response and physical activity measure when comparing fitness and recess breaks. Fitness breaks were for 1 hour and recess and lunch were 15 to 20 mins each. PA was assessed for 3 days.	previously established Loucaides et al 2008 Polar Vantage XL Heart Rate Monitors for reliability and validity established previously (Godsen et al 1991) see reference on table 2.1.	collection period. Inconsistencies between HR monitor and pedometer measures which are likely due to the nature of instrument measurement, as pedometers measure vertical body movement and heart rate telemetry measures the participant's physiological response to activity. Need for research to be able to categorise pedometer steps as activity intensity (Scruggs, Beveridge et al. 2003).
Stratton and Leonard 2002 (UK)	47 children aged 5 to 7 years.	Sport Tester Polar-Electro 3000 Heart Rate monitors and Energy Expenditure.	Assessing the effect of playground markings on children's PA and energy expenditure during recess at 2 primary schools (1 control and 1 intervention). Energy expenditure and heart rate monitoring were assessed prior to and post intervention (4 weeks after). PA was measured for 3 playtimes before and after markings were installed.	Heart Rate Monitors reliability and validity established previously (Treiber, Musante et al. 1989) see Table 2.1. Eston et al (1998) found that heart rate monitors correlated significantly with scaled oxygen uptake (sVo2) ($p<0.001$).	HR does not provide information about the types of activity and whether the intervention affected physical activity levels or the difference between the types of activity in children from different age categories. The duration of the play period was extended during the intervention time by school staff. Possible novelty effect of the playground markings (Stratton and Leonard 2002).
Ridgers, Stratton, Fairclough and Twisk 2007 (UK)	470 children from elementary schools; 238 girls & 232 boys	Polar Team System Heart Rate (HR) monitor and MTI Actigraph Accelerometers	To investigate and evaluate the effect of interventions and covariates on children's recess PA. Assessed for 1 day at baseline, 6 weeks and 6 months. 26 schools in the study; 15 Intervention schools given playground markings, physical structures and separate zones for differing activity levels	Polar Vantage XL Heart Rate Monitors for reliability and validity established previously (Godsen et al 1991); see reference on table 2.1. Accelerometer reliability and validity established previously (Ott, Pate et al. 2000); see Table 2.2.	Differing results between HR monitors and accelerometers most likely due to the difference between physiological and mechanical measures of activity There was missing data at follow up, due to technical difficulties and child absence (Ridgers et al 2007).

2.5 Discussion

This review examined five approaches for assessing the playground physical activity levels of children during recess and lunch including: accelerometers, heart rate monitors, pedometers, observation and questionnaire. The studies identified a range of strengths, limitations and issues associated with the use of these approaches.

Mechanical monitoring includes accelerometers, pedometers and heart rate monitors which are capable of measuring the frequency, intensity and duration of bodily movement (Rowlands, Pilgrim et al. 2008). Mechanical monitoring prevents over-reporting of individual physical activity data, as may be found in self reports (Rowlands 2007). Mechanical monitoring is not reliant on memory, which is important when assessing children (Rowlands 2007). Mechanical monitoring has contributed to a better understanding of children's activity patterns (Leenders, Nelson et al. 2003; Rowlands, Pilgrim et al. 2008). However, they can be problematic if devices are not fitted correctly and if children tamper with the devices (Sirard and Pate 2001). There are issues of compliance, where children do not wear the devices for the assigned assessment period (Rowlands, Pilgrim et al. 2008). In addition, data may be affected when physical activity is assessed in large numbers of children with a limited numbers of devices. In this instance, a small number of children would be assessed each day, resulting in physical activity assessment occurring over several days or weeks. Therefore results may be affected by changes in the school environment (e.g. weather or equipment access) (Stratton 1999).

Heart rate monitors are unobtrusive and have minimal participant and experimenter burden in small to moderate studies (Sirard and Pate 2001). Heart rate monitors can be used to assess activity in varied activity profiles such as cycling or rowing (Corder, Ekelund et al. 2008). Heart rate monitors are more costly than other measures (e.g. pedometers), especially in larger studies (Corder, Ekelund et al. 2008). Studies involving heart rate monitors, can be affected by the reactive nature of children, especially in short-term data collection situations (Stratton 2000). The use of heart rate monitors as a physical activity measure is reliant on having the same participant present for several days to produce valid and reliable results; however, data sets are invariably affected by student absence in the school setting. Heart rate monitors are not preferred for estimating low or sedentary activity as they can be affected by emotional states including stress, some medications, and possibly

outside temperatures (Livingstone, Coward et al. 1992; Epstein, Paluch et al. 1996). As many students spend a large amount of play time being sedentary during break times, heart rate monitors may not be suitable for measuring children's activity in the school playground setting (Corder, Ekelund et al. 2008; Parrish, Iverson et al. 2009a). In some cases heart rate monitors elicit problems with 60-second cycle interference and lose data from signal interruptions (Welk, Corbin et al. 2000). In this review, heart rate monitor reliability and validity was assessed in two previous studies. The studies found that correlations between heart rate monitors and electro cardio graphs were very good, the standard error of estimates were low and reliability data was high (Treiber, Musante et al. 1989; Ridgers, Stratton et al. 2006) (refer to table 2.1). Ridgers and Stratton (2005) found that longer recording intervals were less sensitive to children's physical activity than shorter intervals. Using data from Table 2.1 and from the literature, a summary of the strengths and weaknesses of heart rate monitor use in the school playground environment is provided in Table 2.7. This summary indicates that heart rate monitors were valid and reliable, they capture activity intensity, they are expensive in larger studies and are relatively feasible; however, researchers must consider the difference between the heart rates of boys and girls.

Accelerometers can provide valid and reliable estimates of energy expenditure in children (Trost, Ward et al. 1998; Puyau, Adolph et al. 2002; Hussey, Bell et al. 2007). Accelerometry is the most common method of physical activity assessment in youth (Corder, Ekelund et al. 2008). There are several different types of accelerometers, all makes are equally accurate (Trost, McIver et al. 2005). Early model accelerometers recorded data for one minute intervals, some newer models can record data every second, allowing sporadic activity to be measured. This is particularly important when considering the sporadic activity patterns of children (Rowlands, Pilgrim et al. 2008). In the past, accelerometers did not provide an accurately measure of total energy expenditure (Welk, Corbin et al. 2000), however, more recent models are more reliable particularly when the monitor is assessed across a range of activities or when classifying activity intensity (e.g. light, moderate vigorous) (Rowlands, Pilgrim et al. 2008). Total energy expenditure cannot be accurately assessed for upper body movement (throwing, catching, lifting), however, registered accelerometer counts may provide an estimate of energy expenditure (Janz 2006). This may affect results in the school playground setting when children climb on fixed playground equipment, and should be acknowledged in study limitations (Parrish A.M. et al 2009a). Accelerometers are cost effective when used in small to moderate sized

studies. However, fitting large numbers of accelerometers to large groups of children in the school environment can be challenging, disruptive, time consuming and costly (Trost, McIver et al. 2005; Parrish, Iverson et al. 2009a). Researchers must consider the cost of maintenance, and the purchase of a computer interface, software, pouches and belts (Trost, McIver et al. 2005). Accurate data collection is reliant on the same child participating for the length of the study, which is often affected by student absence (Parrish, Iverson et al. 2009a). In addition, there is a potential that children may be reactive to accelerometers (Trost, McIver et al. 2005). There are no standard "cut-points" for activity categories (i.e. sedentary, moderately active and vigorously active) when analyzing accelerometer data, making between-study comparisons difficult where different cut-point equations have been used (Freedson, et al 1998, Puyua, et al 2002). To address these issues Trost and colleagues (2000) recommend a minimum of four to five days of monitoring to achieve a reliable estimate of children's physical activity. In this review, accelerometer validity and reliability had been established in previous studies. Correlations between accelerometers and heart rate monitors were reasonable. Inter- instrument reliability was very good. Using data from Table 2.2 and from the literature, a summary of the strengths and weaknesses of accelerometer for use in the school playground environment is provided in Table 2.7. The review found that accelerometers were valid and reliable, they capture activity intensity, they are relatively feasible but expensive in larger studies.

In the past decade, pedometers have become more sophisticated at estimating physical activity, and there are now several models which yield valid scores of physical activity (Eston et al 1998, Crouter et al 2003, Barfield, et al 2004, Beets et al 2005). Pedometers are considered a low cost objective monitoring tool and useful in large populations (Trost, McIver et al. 2005; Corder, Ekelund et al. 2008). Pedometers provide an estimate of total steps using vertical acceleration, however many pedometers do not measure the time it took to accumulate the steps (Corder, Ekelund et al. 2008). Some newer devices provide more information about time, which is useful when assessing children's activity patterns (Beighle and Pangrazi 2006). In general pedometers are not useful in studies assessing activity intensity, duration or frequency of physical activity (Corder, Ekelund et al. 2008).
In this review, some studies relied on participants to record step counts which may result in recording errors, and is not recommended (Tudor-Locke et al 2006, Loucaides et al 2008, Loucaides et al 2009). Pedometers may not produce accurate data in the school playground setting when children play games using their upper body such as climbing. In this review,

pedometer validity was assessed in three studies and inter-instrument reliability in two studies. Instrument validity and reliability were good. Using data from Table 2.3 and from the literature, a summary of the strengths and weaknesses of pedometer use in the school playground environment is provided in Table 2.7. The review found that pedometers were valid and reliable; they are relatively feasible, they are reasonably affordable in larger studies, however they do not provide a measure of activity intensity.

Although observational techniques do not mechanically monitor activity, they can yield valid and reliable scores in studies involving children (Johns and Ha 1999; Zask, van Beurden et al. 2001). Observational techniques have the advantage of being able to assess additional variables in the playground environment such as social and behavioural aspects of physical activity, including teacher interaction and playground equipment (Parrish, Russell et al. 2009b), which may explain substantial variance in unstructured settings (Sallis 2009). In addition, observers can assess physical activity levels whilst children perform a range of activities using upper body movements (Parrish, Russell et al. 2009b). Observation can be used in small and large studies (Johns and Ha 1999, Zask et al 2001). Observation methods are less invasive as they should not require direct contact with individuals and they do not disrupt the school routine. Observational studies may be limited, however, in that observers are restricted to a section of the playground for each assessment period (Zask et al 2001). The assessment of child gender can be difficult in some Australian schools as male and female sports uniforms are often quite similar (i.e. shirt, shorts and broad hat). In addition, children may move during scanning and be counted twice in one sweep (Parrish et al 2009a). The cost of observational techniques can vary depending upon whether the observers are volunteers (e.g. research students) or paid employees and on the length of the data collection period. In this review, validity of observation techniques was assessed in three studies and inter-instrument reliability in five studies. Instrument validity was reasonable and reliability was good. Using data from Table 2.4 and from the literature, a summary of the strengths and weaknesses of observation techniques in the school playground environment is provided in Table 2.7. The review found that observation was valid and reliable; feasible, reasonably affordable in larger studies and it provides a measure of activity intensity.

Self-report measures have the advantage of being inexpensive, unobtrusive and versatile, especially in large populations. Self-report methods can have inaccuracies associated with

participant recall, especially in the unstructured chaotic setting of the school playground (Sirard and Pate 2001). Activity categorization and quantification may also be difficult for children, especially if activity recall is required for more than one day (Sirard and Pate 2001). Hard copy self-reports can be limited if children neglect to answer parts of the survey (Ridley et al 2001). In this review, self report validity and reliability was assessed in one study. Validity was fair and reliability results were very good, however, the test-retest reliability was implemented on the same day which may affect reliability results. Using data from Table 2.5 and from the literature, a summary of the strengths and weaknesses of self report for use in the school playground environment is provided in Table 2.7. The review found that the self report was not as valid and reliable as the other physical activity measures, it was inexpensive, feasible, appropriate in larger studies and its ability to capture activity intensity was fair.

A summary of instrument strengths and weaknesses were recorded in Table 2.7. This review found that observation and all mechanical means of physical activity assessment were valid and reliable. As there was only one survey, the results were limited, validity was not as strong as the other methods and whilst the reliability results were very good, the test-retest was carried out on the same day. There were potential difficulties with compliance, reactivity, tampering and missing data with all forms of mechanical monitoring Accelerometers and heart rate monitors were more expensive than pedometers. Observation could be expensive if staff must be employed to gather observational data. Self report is generally the least expensive form of data collection. Mechanical monitoring is not preferred for large populations, as the devices can be costly and labour intensive to fit and monitor. Heart rate monitors, accelerometers and observation are capable of capturing activity intensity, pedometers are not. Self reports are limited by the child's ability to understand activity intensity. The choice of physical assessment instrument in the school playground setting should be directed by the study location, objectives, sample size, feasibility, funding and whether there is a need to categorise physical activity intensity. Table 2.7 was designed to assist researchers in their selection of school playground physical activity assessment instrument and was based on our interpretation of the data in Tables 2.0 to 2.6 and additional information from the research literature (e.g. cost).

Table 2.7 Summary of instrument strengths and weaknesses

Instrument	Valid/Reliable	Cost	Feasibility	Appropriate for large sample	Captures activity intensity
Heart rate monitors	√√√	√	√√	√	√√√
Accelerometers	√√√	√	√√	√	√√√
Pedometers	√√√	√√	√√	√√	X
Observation	√√	√√	√√√	√√√	√√√
Survey	√	√√√	√√√	√√√	√

Key: X= doesn't apply, √=average, √√=good, √√√= very good

NB: the cost of an observational instrument may vary, depending upon whether observers are paid or volunteers and on the length of the study.

The research described in this thesis used a large sample of young children (2946 children at 13 primary schools), it was cost restricted, it aimed to measure physical activity intensity, it assessed the environmental variables affecting children's school playground physical activity and it required additional information about the social context of physical activity data. Observation was the most appropriate form of physical activity data collection for the research described in this thesis.

2.6 Conclusion

This review aimed to describe and compare approaches used to assess playground physical activity levels of primary/elementary children during school recess and lunch breaks. There were five different data collection approaches used to assess school playground physical activity. Inter-instrument comparison was difficult, as validation and reliability testing was varied. An instrument rating criteria was developed to allow a summary of instrument strengths and weaknesses. The results indicate that the choice of physical assessment instrument should be directed by study location, objectives, sample size, feasibility, and funding and whether there is a need to categorise physical activity intensity. This review justified the appropriateness of observation for data collection described in the remaining chapters of this thesis.

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CHAPTER 3

Observing children's playground activity levels at 13 Illawarra primary schools using CAST2

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3.1 Introduction

Regular physical activity in children and adolescents yields physical and mental health benefits that track at low and moderate levels into adulthood (Zask, van Beurden et al. 2001; New South Wales Health 2003). The amount of daily physical activity undertaken by children has declined dramatically over the last 30 years (Malina 1996; Sallis, Conway et al. 2001). Children's physical activity levels in the urban environment are compromised by a lack of space for safe play areas. 'Stranger danger' and the busyness of urban streets precipitate parental fear consequently preventing their children from walking to school and playing outdoors (Sallis, McKenzie et al. 1997; Booth 2000). Children's activity is further jeopardised by domestic sedentary pastimes including television, computers and play stations (Salmon, Ball et al. 2005).

In 2002, a ministerial round table of The World Health Organization emphasised the need to create 'enabling environments' for children's physical activity in institutions such as schools (World Health Organization 2002). The macro-environment of the school plays a key role in children's physical activity levels and may be a setting to reduce escalating rates of obesity. Most children Australia wide access schools, therefore schools represent a prime medium for the promotion of physical activity (Bauer, Yang et al. 2004) . However, children's physical activity at school can be limited by curriculum pressure to meet academic targets, resulting in constrained timetabling of physical education classes (Evans 2003; van Beurden, Barnett et al. 2003). Access to school playgrounds at recess and lunchtime provides an alternative environment to increase children's physical activity levels. Currently, such

opportunities appear to be underutilised (Ernst 2003). Studies show that children spend around 50 percent or less of their school break time in moderate or vigorous activity (MVPA) (Sleap and Warburton 1996; McKenzie, Sallis et al. 1997; Stratton 2000; Ridgers, Stratton et al. 2006). Several studies have indicated that primary school aged boys were more physically active than girls were during recess (Stone, McKenzie et al. 1998; Zask, van Beurden et al. 2001; Inchley, Currie et al. 2005). In Australia, the school environment is particularly important for girls as they obtain most of their activity during school hours (Rowlands, Pilgrim et al. 2008).

Physical activity is measured in various ways including self-report, electronic or mechanical monitoring, direct observation, indirect calorimetry, doubly labelled water, and direct calorimetry (Kohl, Fulton et al. 2000). Choice of physical activity assessment depends upon the specific research question and the age of the participants (Kohl, Fulton et al. 2000). The instrument must be accurate enough to assess activity patterns yet sensitive enough to monitor intermittent activity, especially when used in children (Kohl 2002). The environmental complexity of the school playground makes it difficult to gather children's physical activity data as they move in undirected chaotic conditions (McKenzie, Marshall et al. 2000; Zask, van Beurden et al. 2001). Direct observation and mechanical monitoring are the best methods for monitoring activity patterns in large groups of young children (Kohl, Fulton et al. 2000). However, monitors are extremely costly for large groups of participants and can be inconvenient for the user (Kohl 2002).

Direct observation is the most practical, economic, non-invasive and valid measure of children's physical activity in large populations. Although direct observation can be reactive, it is successful in situations where participants are in a defined area such as the school playground (Kohl, Fulton et al. 2000). There are several direct observation tools which are sufficiently reliable and valid (Sleap and Warburton 1996; Kohl, Fulton et al. 2000; Kohl 2002). However, to date only two instruments have been specifically designed to measure school playground activity: the System for Observing Play and Leisure Activity in Youth (SOPLAY) (McKenzie 2002) and the Children's Activity Scanning Tool (CAST) (Zask, van Beurden et al. 2001; New South Wales Health 2003). These instruments make use of SOFIT (System for Observing Fitness Instruction Time) activity categories, which are a valid and reliable

estimate of energy expenditure (McKenzie 2002). Both instruments utilize non-invasive checklists to calculate playground physical activity levels. CAST and SOPLAY have similar limitations. The cost of gathering large amounts of data can be high, if observers are employed. To date neither instrument has been used extensively in research. SOPLAY was developed for middle school children (aged 11-14 years). SOPLAY 'code' validity was established using heart rate monitors, but to date there are no field based validity studies.

The CAST instrument was preferred for this research as it was field tested for validity and reliability in the Australian environment and developed for primary aged children (5-12yr olds). Originally CAST required five observers to monitor five categories of activity (lying down, sitting, standing, walking or equivalent energy expenditure and more vigorous than walking) [1]. The instrument was modified in 2004 by Budgen and colleagues (Budgen, Furber et al. 2004) to use three instead of five observers as only one observer was required to monitor the three sedentary categories combined (lying down, sitting and standing) and named CAST2. CAST2 is a momentary time sampling technique developed to measure children's physical activity levels in a school playground environment. CAST2 uses continuous 75 second scans of the break period, which may be more reliable than intermittent scans. In each 75 second period the observers scan the playground first for children's activity and a second time for equipment availability/usage, teacher presence/behaviour. Temperature and humidity are measured at the start of each break. CAST2 reliability and validity were field tested in the 'Move it Groove it' program at 18 Primary schools (children aged 5-12 yrs) using a Gold Standard Video (New South Wales Health 2003). In previous research, Zask et al (2001) indicated that one day of observational data collection was insufficient for accurate assessment of school playground physical activity. McKenzie (1997) found that 3 to 4 days of data collection provided adequate sampling for reliability.

This study aimed to determine whether there were significant differences between the proportions of MVPA children at 13 schools. If significant differences exist, school environmental and policy variables will subsequently be compared as part of a larger study. In addition, this study assesses: if there is an association between playground activity and length of break time; instrument inter-rater reliability obtained from observer instrument calibration; and the number of days of observation required for

adequate sampling of observational data. Finally, the study examines disparities between playground activity levels of males and females and between schools with lower and average SES.

3.2 Methods

Public schools in the Illawarra region of NSW were classified by the Department of Education as lower SES or average SES based on the income of families whose children attended the school. From a list of schools with average and low SES, six and four schools respectively were randomly selected using a random table of numbers (Edwards 1968). In addition, three schools designated as the most disadvantaged in this region, were included. This resulted in the inclusion of 13 public schools (2946 children) in the study (refer to table 1). Passive consent was gained at participating schools. All families were informed of the research and its risks, and were given the opportunity to prevent their child from being included in observational data collection.

In Australia, there are two breaks during the school day (the shorter is referred to as recess and the longer is lunch). To account for daily changes in the school or physical environment, children were observed for the same three days of the week at each school (Tuesday, Wednesday and Thursday) (4 breaks). The first recess break and all three lunch breaks were used to calculate the proportions of active children at each of the 13 schools. One school had incorrect data in one recess period and one recess break was used for instrument calibration.

Observations did not proceed during inclement weather; in this event, the observations were rescheduled for another day. Most observations occurred during autumn (15th February 2005 until 9th June 2005). Schools ranged in size from 27 to 588 students (see Table 3) and the largest school was the only school with more than 400 children. The school populations comprised two different age categories, infants (Kindergarten to Year 3: 4-9 years old) and primary students (Year 4 to Year 6: 10-13 years old). Temperature and humidity were recorded immediately prior to the commencement of each break (Zask, van Beurden et al. 2001).

Observers were trained to use CAST2 (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2004) at a full day training course and practised its use during three days of observation at a pilot school. The first day of training included category identification using the System for Observing Fitness Instruction Time (SOFIT)(McKenzie 2002), use of the CAST scoring instrument, use of school maps to segment playground areas for observational viewing and guided field practice.

Prior to the commencement of scanning at each school (i.e. Day 1), the playground was segmented and observers agreed on the location, size and boundaries of each target area. Three observers rotated between all playground segmented areas over the 3 days of observations. The number of times that the observers moved during one break period was dependent upon the size of the school playground, the number of children playing in the playground and the number of supervised playground areas available for play. If observers were required to move to a different vantage point during the one break, the time spent at each vantage point was evenly distributed and movement between vantage points was considered.

Three observers stood beside each other and simultaneously scanned the predetermined viewing area from right to left in one continuous sweep. Observers held a pen (to assist their view) in an extended arm and counted the number of children in their assigned activity category as their arm moved in one motion over the segmented viewing area. Each observer scanned one of the activity categories (low, mod and high) per day and observers changed allocated categories each day. Two scans occurred during each 75 second scanning period until the break ended (timing was assisted by an audio taped signal). In the first scan the numbers of active/inactive children were counted and recorded. Then observers simultaneously scanned the playground a second time to record teacher presence/behaviour, equipment availability and equipment usage. Scanning data were recorded on a CAST2 scoring sheet after each scan. A new scan began at the commencement of each 75 second interval. Observations alternated between males and females for each 75 second interval.

It was possible for the same child to be counted twice in the one scan if the child moved as the observers swept the scanning area. The specific ages of the children

involved in scans were not known. At some schools infants and primary children played in separate areas, however in most instances all children shared the same play areas. Observations rotated through all playground areas, ensuring that children of all age groups were included in the data set.
When monitoring teacher categories, observers indicated whether the teacher was encouraging, observing or managing playground activity. Equipment categories were used to record the number of balls, the number of children playing with balls and the number of fixed and non-fixed equipment. Children were considered to be playing with a ball if they were engaged in a game with a ball (even if they were not in physical contact with the ball at the moment of scanning).

3.3 Statistical Analysis

To account for schools that were smaller, or had less break time, proportions of low, moderate and highly active children were calculated using the sum of active children, divided by the sum of all children scanned for each school. Multiple comparisons were performed to find which schools differed significantly. The proportions of active children were compared across each of the 13 schools in the study. In previous research, gender differences in activity levels consistently showed that males are more active than females in the school playground environment (Stone, McKenzie et al. 1998; McKenzie, Marshall et al. 2000; Zask, van Beurden et al. 2001). In this study, odds ratios were used to examine whether school playground activity levels of males and females were consistent with the previous findings.

McKenzie (McKenzie, Marshall et al. 2000) noted that three days of observation provided adequate sampling for reliability when assessing males and four days were needed for females. A limitation noted by Zask and colleagues (2001) when CAST2 was originally developed was that each school was only surveyed on one day (2 breaks). In this study an analysis of variance was conducted on the mean proportions from the three days of observed activity to determine whether one day of activity data was representative of three days of activity data.

In this study the CAST2 instrument was calibrated during one recess at nine of the 13 schools to maintain observer consistency (inter-rater reliability). At eight of the nine

schools, three observers stood beside each other and simultaneously scanned the playground monitoring moderately active children during 20 second scans, as additional monitorings of teachers or the environment were not required for instrument calibration (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2007). At one small school (N=27) only two observers scanned the playground during reliability testing. Scanning alternated between males and females [1.] Moderate activity category was the most difficult category to count. Children were moving and as there were more moderately than highly active children, it was therefore a greater test of reliability. To test the inter-rater reliability of the CAST2 instrument for instrument calibration, Spearman's correlation coefficients were calculated in SPSS (version 13) for each scanning period between each pair of observers (i.e. observers 1&2, 2&3 and 3&1).

This study examined associations between school level SES and children's playground physical activity by logistic regression. The analysis was performed using GenStat (10th edition).To determine whether the amount of time children spent in the playground during a break period was significantly associated with the proportions of active children, a Spearman's correlation analysis was conducted in SPSS (version 13). This study was approved by the University of Wollongong Human Ethics committee and the NSW Department of Education and Training.

3.4 Results

Only six of the 42 days of scanning were rescheduled due to inclement weather. In total, 2946 children aged between four and 13 years participated in the study. Total time available for scanning break times at the thirteen schools over a three day period ranged from 55 to 130 minutes (mean 97.5 mins). There were a total of 1013 scans over the duration of the study.

3.4.1 Age groupings

The proportions of children in infants classes (Kinder to year three) were similar across the 13 schools involved in the study (minimum= 0.4639, maximum 0.6296).

Table 3.1 Composition of age groupings at the 13 schools

School	Infants (K-Yr3)	Primary (Yr4-Yr6)	Total
A	195	185	380
B	45	52	97
C	88	52	140
D	169	151	320
E	91	65	156
F	205	166	371
G	86	46	132
H	312	276	588
I	89	76	165
J	38	37	75
K	17	10	27
L	105	95	200
M	155	140	295

3.4.2 Ranking of schools by activity level

The proportions of children who were moderately or highly active at the observed schools ranged from 0.4 to 0.7 (mean=0.58, SD= 0.1) (Table 3.1). The difference between these proportions at the most and least active schools was significant ($p < 0.0001$). From the multiple comparisons, it was seen that the school with the least proportion of active children (i.e. School F) was significantly different from all other schools (School F v schools A, B, C, D, E $p < 0.001$, School F v G $p = 0.0002$, School F v J $p= 0.0003$).

Table 3.2 Schools SES status and proportions of active children

Ranking: most to least active	School	Proportions of MVPA children	SES status of school
1	B	0.70366	Low SES
2	E	0.69081	Low SES
3	K	0.68924	Average SES
4	D	0.65438	Average SES
5	I	0.62889	Average SES
6	L	0.60952	Low SES
7	C	0.59481	Average SES
8	H	0.57103	Average SES
9	A	0.53051	Low SES
10	M	0.50681	Low SES
11	G	0.47318	Low SES
12	J	0.45899	Average SES
13	F	0.39988	Low SES

NB: MVPA refers to Moderate or Vigorous Physical Activity

3.4.3 Gender differences in activity

The odds ratio of boys being MVPA in the school playground relative to girls ranged from 0.8581 to 2.137. At 12 of the 13 schools, the odds ratio favoured boys being more active than girls. Notably, the school at which the odds ratio of girls being MVPA in the school playground was greater relative to boys, was at the school with the lowest number of students (N=27).

Table 3.3 The odds ratios of boys being moderate to vigorously physically active (MVPA) relative to girls.

School	Odds of boys being MVPA relative to girls
A	1.601
B	1.784
C	1.449
D	1.9
E	2.137
F	1.057
G	2.088
H	1.79
I	1.185
J	1.203
K	0.858
L	1.941
M	1.648

NB: MVPA refers to moderate or vigorous physical activity

3.4.4 Analysis of the number of days of scanning

To address the question of the number of days of observation required for adequate sampling, an analysis of variance of the mean proportions of MVPA children for the three days of activity was calculated for each of the 13 schools. At six of the 13 schools there was not a significant difference between the mean of the three days of activity (significance ranged from p=0.143 to p=0.814). At four of the schools there were significant differences between the mean proportions of the 3 days of activity (significance ranged from p=0.001 to p=0.015). At the three remaining schools, the differences were not significant but approached significance (i.e., p=0.075, p=0.08, p=0.093).

3.4.5 Instrument calibration for observer consistency

Spearman correlations coefficients between pairs of observers at the nine schools ranged from 0.71 to 0.99, with eight of the nine schools producing correlations coefficients above 0.91. Inter-rater reliability determined by Cronbach's Alpha ranged from 0.965 to 1.0 across the nine schools. Note: at one small school (N=27) only two

observers were available for playground instrument calibration (i.e. one recess period), but all observers were present for all other observational data collection at that school (including lunch on the same day).

Confidence intervals (95%) were used to estimate the true values of the correlation coefficient between the scores of pairs of observers. For these confidence intervals, the least value of all lower bounds was 0.718 and the greatest value of all upper bounds was 1.0. However, 22 of the 25 lower endpoints of the confidence intervals were above 0.915.

Table 3.4 Instrument calibration: 95% confidence intervals for correlations between observers when observing moderate PA in playgrounds at recess

School	No of pupils	No of scans in break	When surveyed (out of 13)	Observers	Correlation Coefficient	95% "CI"
M	295	32	1st	1 & 2	0.966	0.930-0.983
				2 & 3	0.853	0.718-0.926
				3 & 1	0.900	0.804-0.950
A	380	19	4th	1 & 2	0.967	0.915-0.988
				2 & 3	0.987	0.966-0.995
				3 & 1	0.979	0.946-0.992
C	140	40	5th	1 & 2	0.993	0.987-0.996
				2 & 3	0.973	0.949-0.986
				3 & 1	0.978	0.959-0.988
I	165	66	6th	1&2	0.963	0.941-0.977
				2 & 3	0.969	0.949-0.981
				3 & 1	0.997	0.995-0.998
H	588	40	8th	1 & 2	0.996	0.991-0.998
				2 & 3	0.996	0.991-0.998
				3 & 1	1.000	1.000
K	27	27	11th	1&2	0.981	0.959-0.991
B	97	40	12th	1&2	0.945	0.899-0.971
				2 & 3	0.986	0.974-0.993
				3 & 1	0.973	0.950-0.986
L	200	14	13th	1&2	0.980	0.935-0.993
				2 & 3	0.997	0.990-0.999
				3 & 1	0.978	0.931-0.993
E	156	40	14th	1&2	0.994	0.989-0.997
				2 & 3	0.988	0.978-0.994
				3 & 1	0.995	0.991-0.998

NB: Only 2 observers were used during reliability testing for one recess at School K.

3.4.6 Socioeconomic status and proportions of active children

A logistic regression demonstrated that there was no significant difference between the effects of the two socioeconomic school groupings on playground activity levels of the children involved in the study. The deviance ratio (on 1 and 11 degrees of freedom) equaled 0.48 (p= 0.503) (Refer to Table 2 for school SES status).

3.4.7 Time spent in school playground

Spearman's correlation coefficients indicate the proportion of active children at each school and the actual number of minutes the children spent in the playground during the observational data collection showed a positive correlation r=0.318 (p=0.289). The relationship is significant if a Spearman's correlation is run with all schools except one outlier r=0.603, (p=0.038).

3.5 Discussion

CAST2 was used to determine whether there were significant differences between the playground physical activity levels of children at 13 primary schools. There is a dearth of knowledge regarding the school environmental variables which contribute to children's playground activity levels. One method of exploring possible variables is to compare different school environments. However, first there must be evidence that a difference exists between the proportions of active children in school playgrounds. This study found significant differences between the proportions of active children, which varied from 40-70 percent at 13 primary schools, confirming that comparing school environments is an appropriate method of ascertaining reasons for variability in physical activity. Notably, it is important to find ways of increasing playground activity in schools where the recess period is clearly underutilised and activity levels are as low as 40%.

It was not possible to record the specific age of the children involved in scans. However, observers rotated through all playground areas to include all age groupings in the data set and there were similar proportions of older and younger children at all of the schools in the study. A challenge for future research is to consider ways to segment younger and older children during observation to ascertain the effect of this variable.

Previous research has acknowledged the complexity of gathering observational data in the chaotic environment of school playgrounds (McKenzie, Marshall et al. 2000; Zask, van Beurden et al. 2001). One consequence of this is the possibility of counting children more than once during one observational scan. It is a limitation of collecting data in a real world environment of the school playground (as in CAST2).

The 75 second scanning periods for observational data collection (CAST2) used in this study reflected the protocol used in previous research (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2004). Observers were trained to segment the playground for scanning, allowing for adequate data collection during the 75 second interval. This time interval was found to be satisfactory during this research. No problems were reported by the observers in recording the required data in this time frame.

The time available for children to be active during school break times may be important in achieving children's recommended daily physical activity. At school, children have been shown to be MVPA during physical education (PE) for only 18% of class time and PE classes are sometimes replaced by other academic curriculum (Coe, Pivarnik et al. 2006; Waring, Warburton et al. 2007). Opportunities for children to be active at home are limited by their sedentary activities (i.e. TV, computers, and play stations). Modern home environments also often lack space for adequate outdoor activity. Thus school break times give children a daily opportunity to be active, in a secure spacious environment, devoid of sedentary screen pastimes. There were noticeable disparities between total breaks times at the 13 schools (55 to 130 minutes over the three-day period; mean 97.5 mins). Restricted school break times may remove one of the few outdoor opportunities available for children to be active.

Undertaking research in school environments makes it difficult to compare like variables, as schools are so diverse. Disparities were found between break times and student numbers at the 13 schools. To reduce confounding, data analysis involved comparing proportions of active children, rather than actual student numbers. The overall proportion of children who were moderately or highly active at the observed schools were 56%, which is similar to previous research (Sleap and Warburton 1996; McKenzie, Sallis et al. 1997; Stratton 2000; Ridgers, Stratton et al. 2006). However, there were significant differences between the most and least active schools (40-70%).

Closer examination of the school environments may disclose the reasons for this discrepancy.

The results of this study confirm a need to address gender differences in physical activity, particularly as previous studies have found that girls partake in most of their activity during school hours (Rowlands, Pilgrim et al. 2008). Outdoor play is ball based and therefore more conducive to male activity. Altering outdoor environments may make active play more attractive to girls. If appropriate equipment and space were available, girls may prefer activities such as dance. It is also possible that boys may be more aggressive or in their play intimidate girls (Epstein, Kehily et al. 2001). Designated play areas for girls might increase their opportunities to be active. In Australia, uniforms worn by girls in primary school (i.e. dresses, skirts, tights) may restrict their movement and discourage active play. Raising school and parent boards' awareness of gender differences in activity may influence decision making about girls' uniforms. There are many unanswered questions regarding gender discrepancy in playground physical activity, warranting further investigation.

In this study, an analysis of variance of the mean proportions of active children for three days of observed activity indicated that one day of activity data did not adequately represent three days of activity data. It is recommended that a minimum of three days of data collection is required for observational data.

This study was unique in testing CAST2 under a wide range of circumstances, in different sized schools and playgrounds (Zask, van Beurden et al. 2001). CAST2 instrument calibration indicated that correlations between observers were consistently high, strengthening previous reliability analysis of the instrument (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2004). The findings thus confirm that the CAST2 instrument is a suitable observational tool for physical activity analysis of Australian primary school playgrounds. However, instrument calibration may have been limited by having only two of the three observers calibrate the CAST2 instrument at one small school in the study (N=27). This was not in keeping with the instrument design, but unavoidable due to staffing issues. Furthermore, future reliability analysis may be improved by having observers calibrate all three activity categories (low, moderate and high) instead of moderate alone.

This study was designed to focus on physical activity in schools in low and average SES areas as previous studies have found an association between lower socioeconomic status and lower levels of primary aged children's physical activity (Inchley, Currie et al. 2005). An Australian study, Spinks et al (2006), found no association between children's daily physical activity and SES. It is interesting to note that, of the 13 schools in this study, two of the three most active and four of the five least active schools were rated lower SES. However, a logistic regression indicated no significant difference between the socioeconomic school groupings in terms of levels of physical activity.

This research found positive associations between the proportion of active children at each school and the number of minutes they were allowed to play during break time. Notably, total time available for play ranged from 55 to 130 minutes at the 13 schools (3 day period). Ensuring children have adequate time to play in break times may increase their overall activity levels.

3.6 Conclusion

In this study, a significant difference was found between the proportions of active children at 13 schools in one region, providing support for the need to examine school environment variables to ascertain reasons for variability in children's playground physical activity levels. The association between activity and length of break time indicates that restricted break times may remove one of the few outdoor opportunities available for children to be active. The findings indicate that a minimum of three days of observation are required for adequate sampling of observational data. Inter-rater reliability for observer instrument calibration (CAST2) was confirmed by findings of consistently high correlations between observers. Discrepancies between the activity levels of males and females foster unanswered questions related to gender, warranting further investigation. Finally the study found no significant difference between the effects of lower or average SES on children's playground activity levels.

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CHAPTER 4

Do Australian primary school environments affect children's physical activity levels?

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4.1 Introduction

Physical activity is an important part of children's development and health. Research suggests that there is a relationship between low activity and high body mass index (BMI) in children (Vincent, Pangrazi et al. 2003). National guidelines indicate that children should be active for a minimum of 60 minutes each day (Australian Government Department of Health and Ageing 2007). The World Health Organization (2002) has emphasized a need to create 'enabling environments' in institutions such as schools to encourage increased levels of physical activity. In Australia, as in most developed countries, the school environment is particularly important for promoting physical activity as most children attend school. If school environmental factors that increase activity in the school environment can be identified, all school children may benefit.

Several studies identified environmental variables, which may affect children's playground physical activity levels. These variables include: the size of the school and number of students, layout of the school, weather, number of playing fields, hard courts, fixed and non fixed equipment, bike racks, covered outdoor areas and amount of shade, permanent markings on walls and ground, access to play areas and drinking water, type of teacher supervision, playground aesthetics, gender of students and time constraints (Sallis, Conway et al. 2001; Thompson 2001; Humpel 2002; Cotter 2003; Bauer, Yang et al. 2004). The purpose of this research was to determine which environmental correlates have an effect on children's physical activity levels in school playgrounds.

4.2 Methods

Six schools categorised as average Socioeconomic Status (SES) and four schools categorised as low SES were randomly selected (Edwards 1968) from a list of public schools in the Illawarra region of New South Wales (NSW); in addition, three schools designated as the most disadvantaged in the region were included in the sample (total schools N = 13; total children N = 2946). Schools ranged in size from 27 to 588 students. Physical activity and environmental data were collected during playground observations using the momentary time sampling technique of the Children's Activity Scanning Tool (CAST2) (Zask, van Beurden et al. 2001). Children were observed for the same three days of the week at each school (Tuesday, Wednesday and Thursday - 6 breaks) during autumn (15th February 2005 - 9th June 2005). Observations did not proceed during inclement weather; in this event, the observations were rescheduled for another day. Temperature and humidity were recorded prior to the commencement of each break.

Observers were trained to collect playground physical activity data using the CAST2 observational instrument at a full day training course and at a pilot school (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2007). The playground was segmented on the first day of observation with observers rotating between all playground areas, thereby ensuring all age groups were included in the data set. The three observers stood beside each other and simultaneously scanned from right to left in one continuous sweep. Each observer scanned one of the activity categories (low, mod and high) per day; observers changed allocated categories each day. Monitoring alternated between males and females. Two scans occurred during each 75 second interval until the break ended (using an audio taped signal). In the first scan the numbers of active/inactive children were counted and recorded. During the second scan teacher presence/behaviour, equipment availability and equipment usage were recorded.

Environmental variables were manually collected at each of the 13 schools involved in this study. School playground environments were measured with a trundle wheel and data were recorded and transferred into Microsoft Excel (2003). The number of students attending each school was also recorded. Environmental variables included the total school area (excluding buildings), the total area (in square metres) available for children to play, the surface type (e.g. grass, concrete/asphalt) and the amount of shade within these two categories. The amount of shade at each school was calculated by measuring the perimeter of the tree foliage

or shade dwelling, as shade migrates with the movement of the sun. All external fixed equipment was manually counted and recorded (e.g. climbing frames, netball posts, and soccer goals), including painted wall and floor games/targets. All non-fixed equipment (e.g. balls, ropes, hoops) were manually counted. Whether children had access to fixed and non-fixed equipment during the break was recorded.

4.3 Statistical analysis

The data were analysed in GenStat (Payne, Murray et al. 2007) using multiple logistic regression. The dependent variable was the number of MVPA (Moderate or Vigorously Physically Active) children during break times at each school. The independent variables were all environmental data:

(1) Time - time officially allocated to the recess and lunch break, the number of minutes children were allowed to play and shorter or longer breaks in the day;

(2) Area – total school area and the area available for play;

(3) Shading - if the 'area' categories were covered, partly covered or not covered;

(4) Non-fixed equipment - free or limited access to non-fixed equipment where non-fixed equipment was deemed limited when access was restricted to a part of the day or week, or could only be accessed by specific student groups (infants or primary) or the amount of equipment was limited (e.g. only balls);

(5) Outdoor fixed equipment - the number of painted wall targets, painted floor targets, fixed equipment (e.g. climbing frames), netball hoops, basketball board/hoops and other outdoor equipment; the number of children playing with balls included children who were actively involved with a ball, even if not in direct contact with the ball (e.g. playing soccer);

(6) Surface type - grass, concrete/asphalt, a combination of grass and concrete/asphalt, a combination of grass and sand/bark and soft play flooring (rubber based material designed for flooring under fixed playground areas);

(7) Teacher involvement - whether the teacher was observing, managing, or encouraging the children in their play.

(8) Weather – temperature and humidity and

(9) Gender of children being observed

4.4 Results

The odds of children being active were affected by time; the odds ratio when there was more official time allocated for recess and lunch was 1.037 ($p<0.001$), the longer that the children played the more that MVPA gradually declined (odds ratio of 0.9609, $p<0.001$) and the odds ratio for shorter (recess) rather than longer (lunch) breaks were 0.7788 ($p=0.005$). The odds of children being active were affected by the amount of shade; the odds ratio for unshaded versus shaded areas were 1.638 ($p<0.001$). The odds of children being active were affected by access to non-fixed equipment; the odds ratio was 1.202 ($p=0.008$) when children had free access to non-fixed equipment. The odds of children being active were affected by the availability of balls; the odds ratio for each additional child involved in ball play was 1.036 ($p<0.001$). However the number of balls available for play did not significantly impact on children's playground physical activity levels. The odds of children being active were affected by the presence of outdoor fixed equipment: the odds ratio in playground areas where painted ground targets were present was 1.077 ($p<0.001$) compared to areas without ground targets, and 0.8924 ($p=0.002$) in playground areas where painted wall targets were present compared to areas where there were no wall targets. The odds of children being active were affected by the type of playground surface; the odds ratio for soft play surfaces was 4.088 ($p<0.001$), and 1.346 ($p=0.007$) for a combination of bark, sand and grass, compared to grass alone. The odds of children being active were affected by teacher involvement; the odds ratio when a teacher managed children in the playground was 0.7816 ($p=0.003$) and 0.9048 ($p=0.003$) for a teacher observing them compared to areas where a teacher was not present. However there were no significant effects if teachers were encouraging children to be active. The odds of children being active were affected by the weather; the odds ratio for higher compared to lower temperatures was 0.964 ($p=0.005$) and 0.7389 ($p=0.007$) when it had been raining before playtime compared to dry conditions. The odds of children being active were affected by gender; the odds ratio of girls being active compared to boys was 0.7399 ($p<0.001$).

Variables for which no significance was found included: teachers encouraging children in the playground, humidity, total school area, total area available for play, the total shaded area for the entire school, covered play areas, concrete/asphalt surfaces, the number of balls in the playground and the availability or number of fixed equipment, netball hoops, basketball hoops and other fixed playground equipment, and the number of children playing on fixed equipment.

4.5 Discussion

Similar to other research, this research found that children were more active for each additional minute of time officially allocated to recess and lunch break (Zask, van Beurden et al. 2001; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Children were less active in shorter breaks which may indicate that children were allowed to access more or larger playground areas during the longer breaks, resulting in more active pastimes (i.e. football, netball). Some schools offer sedentary activities during break times (i.e. access to such as library or computer labs). To maximise the physical activity benefits gained in longer breaks, schools should restrict or withdraw access to sedentary activities. In addition, playtime is often used as punishment (i.e. detention, 'no hat no play') (Poulter 2006). Preventing children from accessing the school playground as a form of punishment should be reconsidered as opportunities for children to be active are already scarce (Pellegrini and Bohn 2005). Whilst this form of punishment is easy to administer, it may be counter productive, as the child misses out on active play which may encourage misbehaviour (Poulter 2006). An alternatives for 'no hat no play' could be 'no hat, play in the shade'. In addition, the length of the recess period are sometimes affected by pressure to meet curricula targets, however Banner (2005) found that limiting recess offered no significant gain in test scores and that the benefits of recess outweighed the potential loss of class time.

The longer that the children played, the more that MVPA gradually declined. This was a similar result to that of McKenzie and colleagues (1997) and may indicate that children gradually tire after longer periods of play affecting MVPA levels. Future research could investigate the ideal amount of time allocated to recess and lunch periods to take maximum advantage of children's MVPA. It is possible that children may accumulate more MVPA by having two 45 minute break periods as opposed to one period of 60 mins and one of 30 mins.

Similar to Pellegrini and Smith (1993), the current study found children's playground physical activity increased when they had access to larger playground areas (e.g. sporting fields), and children were significantly more active in unshaded or partly shaded areas, such as sporting fields. Furthermore, children were more active when involved in ball play and most active ball games (i.e. soccer, netball/basketball) occur on sporting fields. Access to large playground areas such as sporting fields is important for increasing playground physical activity levels of children. It was surprising, that the total area available for play did not

significantly contribute to children's playground physical activity levels. This may indicate that playground access is a more important determinant of children's playground physical activity than total playground area.

As in previous research, this study showed that children were significantly more active when they were involved in ball games, had free access to non-fixed equipment and when ground targets were present (Stratton 2000; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Providing non-fixed equipment, painted floor targets and encouraging balls games are practical low cost initiatives that can be introduced in all schools to increase children's physical activity levels.

It is possible that children's school playground activity is restrained by risk of injury (Banner 2005). Sosin and colleagues (1993) found the risk of equipment-related fall injuries was six times greater over asphalt than sand. The current study found that the type of playground surface (soft-play or combination of bark, grass and sand) significantly affected the playground activity levels of children. These results should be considered when new schools are designed or old schools refurbished. Children are often prevented from running on concrete or asphalt, but are allowed to be active on surfaces which have a lower risk of injury (i.e. soft play surface or bark and sand). More awareness of such variables in school planning and design has the potential to affect the activity levels of large numbers of children.

Some variables which significantly affect children's playground activity levels are impossible to change (i.e. weather). Children were found to be significantly less active when temperatures were high or if it had been raining before the break. Being aware that a wet playground environment or high temperatures reduces MVPA can encourage opportunities for alternative play environments. Frequently children stay in classrooms in bad weather; schools that have large halls or under cover playground areas could utilise this environment to encourage active play in inclement weather.

The finding that girls are less active than boys during school break times, is consistent with other playground activity research (Zask, van Beurden et al. 2001; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Tudor-Locke and colleagues (2006) found that girls were as active as boys in physical education lessons, but less active during lunch break. It is possible that physical, psychosocial or environmental variables hamper female activity (e.g.,

wearing dresses or boys being more dominant in play). The fact that females were 30% less active than boys is disturbing and clearly requires further investigation.

The odds of children being active were greater in unshaded or partly shaded areas. Most playing fields used for ball games (for soccer, football, basketball) were in unshaded areas, which may explain higher levels of activity in areas without shade. Also, most of the covered shade areas had concrete flooring where children are discouraged from running due to risk of injury (Banner 2005). Similar to previous research, children were significantly more active: when involved in ball games, if they had free access to non-fixed equipment and if they played where ground targets were present (Stratton 2000; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Providing non-fixed equipment, painted floor targets and encouraging balls games are practical initiatives that can effectively increase children's physical activity levels.

Verstrate and colleagues (2006) recommend that future research should investigate the effect of teachers encouraging children in the playground. It is surprising that there was no effect when teachers encouraged children in this study, however it may be due to the limited numbers of teachers who were observed encouraging playground activity during the time of observational data collection. When teachers were managing or observing in the playground, children's activity declined. This may be the result of playground discipline, or it may indicate that children prefer unstructured and unorganised play.

4.6 Conclusion

This research found that the amount of official time allocated to breaks, and the length of the break, significantly affected the playground physical activity level of children. The more time children had to be MVPA, the more activity gradually declined. Children were significantly more active when they had access to larger playground areas and they played in unshaded or partly shaded areas. Children were significantly more active when they were involved in ball games, had free access to non-fixed equipment and when ground targets were present and children were more active when involved in ball play. Children were significantly more active on soft-play surfaces. The total area available for play did not significantly contribute to children's playground physical activity levels. Children were found to be significantly less active when temperatures were high or if it had been raining before the break. Female

students were less active than males during break times. When teachers were managing or observing in the playground, children's activity declined and there was no effect when teachers encouraged children, however this may be due to limited numbers observed.

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CHAPTER 5

The development of a unique physical activity self report for young children: challenges and lessons learned

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5.1 Introduction

The number of overweight and obese children in Australian is a major public health concern (Commonwealth Scientific Industrial Research Organisation 2007). The economic and emotional costs of treating obesity are high. Modern changes to social, economic and fixed environments promote sedentary lifestyles. Despite efforts to address childhood obesity issues at an individual level, children's obesity levels are high and physical activity levels are decreasing (Booth 2000). In 2002, a ministerial round table of the World Health Organisation emphasised a need to create 'enabling environments' for children's physical activity in institutions such as schools. The macro-environment of the school plays a key role in children's physical activity and may be a medium to reduce obesity (Gorman, Lackney et al. 2007). Schools offer a reasonably safe, supervised environment with facilities not usually accessible to children at home. In Australia, the school environment is particularly important for promoting physical activity as it is accessed by most children.

Self-report instruments are a means of assessing physical activity in the school situation. Physical activity self-reports have some limitations as they: rely on participant recall, are open to misinterpretation, usually measure planned leisure activity and often don't consider the varied/unpredictable activity patterns of children (Kohl, Fulton et al. 2000). However, they have the advantage of being inexpensive, unobtrusive and versatile and are convenient for administration to large populations.

Few self-report instruments assess physical activity in young children (i.e. younger than 4th grade) and there are no known self-report instruments for children younger than seven years of age. Questionnaires designed for this age group are completed by either teachers or parents, creating a risk of misinterpretation or bias. Existing self-report instruments are often inappropriate for younger children (i.e. younger than 7 years) as they require children to recall physical activities, complete activity diaries and categorise activities by intensity (Kohl, Fulton et al. 2000; Welk, Dzewaltowski et al. 2004; Treuth, Hou et al. 2005). While some instruments have been designed to be age-appropriate (e.g. video assisted or picture cards), they still require children to recall activity or classify activities according to frequency, which is inappropriate for younger children (i.e. younger than 7 years of age) (Tremblay, Inman et al. 2001; Sherwood, Story et al. 2003). Evans and colleagues (2007) advise questionnaire design for young children should be mindful of their limited attention span. Henerson and collegues (1987) further note that questionnaires for young children should consider their inability to understand questions, recommending that response options be presented in a picture format.

Several studies emphasise the importance of children's activity preference when considering their activity levels (Frömel, Formánková et al. 2002; Salmon, Owen et al. 2003; Atlantis, Salmon et al. 2007; Hill and Hannon 2008; Veitch and Salmon 2010). In a review, Sallis and colleagues (2000) found that children's (3-12 years) preferences for activity were positively associated with physical activity. Thus an alternative to recalling activity is to have children report on their activity preferences. When trying to make changes or encourage healthy behaviour such as physical activity, it is important to consider theory. Bandura notes that people are more likely to modify their behaviour if it is rewarding (Nutbeam and Harris 2004). Furthermore, while adults organise children's school physical activity, they usually do so without assessing children's activity preferences. If children were offered opportunities to participate in their preferred activity, it may increase their self-efficacy and their likelihood of participation.

Due to the lack of instruments to assess young children's physical activity, this study aimed to: develop a self-report instrument for young children which was: age appropriate, appealing to young children, not reliant on memory recall, mindful of

their limited attention span and their limited ability to read/comprehend, and quick and convenient to administer (Evans, Brauchle et al. 2007). The instrument will assess the reliability and validity of the self report instrument, compare children's activity preference categories (low, moderate and high) and actual observed playground physical activity levels.

5.2 Methods

5.2.1 Development of the Children's Activity Picture (CAP) questionnaire

The play activities of children at two schools (one school classified as lower socio-economic status (SES) and the other as average SES) were monitored. From the playground activities observed, a set of nine pictures was developed to ensure that children had a choice of activity preference for three levels of physical activity: low, moderate and high. An artist (Packham, M) constructed line drawings of the selected playground activities, with three drawings for each activity category (e.g. low activity- board games, moderate activity- playing on fixed equipment, high activity-skipping) from the CAST2 observational instrument (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2004). Each illustration included children of both genders. The draft of the CAP instrument was reviewed by five experts to assess face-validity of the activities in each of the categories (See Appendix 1).

5.2.2 Reliability testing of CAP

The CAP questionnaire was trialled in two schools, where teachers administered the questionnaire during class time. Children from Kindergarten to Year 3 (N=439) were invited to participate in the study. Parental consent was gained prior to the distribution of the questionnaire. Teachers were instructed to have children circle or colour their three favourite activities. The questionnaire was completed by the children within a ten minute time frame and on two separate occasions (2 weeks apart) to assess test-retest reliability. Children provided their name, age and gender on the questionnaire. On both test occasions the children were asked to circle only three preferred pictures. Picture activity preference categories were allocated a score (low activity illustration =1, moderate activity illustration =2, high activity illustration =3); each child's three preferences were tallied (yielding a score between three and nine). A Spearman's rank

correlation between children's first and second questionnaire preference was performed using the SPSS (version 13.0) computer software package.

5.2.3 Comparison of Actigraph accelerometer activity data and CAP picture preference activity level

Thirty children from the lower SES school wore Actigraph accelerometers at recess and lunchtime for three consecutive days. Parental consent was gained prior to the accelerometers being fitted. Accelerometers were worn in the same week that the CAP questionnaire was distributed. Efforts were made to evenly distribute accelerometers across all four grades (Kindergarten to Year 3).

The accelerometers were fastened to a belt and worn around the child's waist above the right hip. Each accelerometer was taped into its pouch to prevent child tampering. Children were issued the same accelerometer each day. Activity counts (recorded activity between 11.00-11.25am and 1.15-1.50pm) were downloaded to Actigraph software package (MTI Health Services 2004) each night and stored in Microsoft Office Excel. Accelerometer time sampling intervals (epochs) were set at 60 seconds as in previous studies (Puyau, Adolph et al. 2002). Only those children who wore the accelerometer for three entire recess and lunch periods and successfully completed a picture questionnaire were included in the analysis.

Previous research involving accelerometers showed disagreement about the best equation for age specific cut-off-points for converting activity counts to corresponding activity categories (i.e. low, moderate, vigorous) (Freedson, Melanson et al. 1998; Puyau, Adolph et al. 2002). Consequently, we used the sum of all Actigraph accelerometer activity counts over the recess and lunch period for three days. This allowed the total activity of each child to be ranked and matched to the child's picture questionnaire illustration score. A Spearman's rank order correlation using SPSS (Version 13.0 software) was calculated between total Actigraph accelerometer counts and the child's total score from the CAP.

5.2.4 Comparison of CAP preferences to observed playground activity at 13 Illawarra schools

Thirteen schools in the Illawarra region of NSW Australia participated in the study component that assessed the consistency between stated activity preferences and observed playground activity. From a list of schools with average and low SES status, six and four schools, respectively, were randomly selected using a table of random numbers (Edwards 1968). In addition, three schools were included as they were designated as being the most disadvantaged in the area. In total, 1597 children aged between four and nine years were invited to participate in this study component. Passive informed consent was gained from participating schools.

Each school was involved in the study for a period of three consecutive days between February and June 2005. Teachers distributed the CAP instrument to children during class time over the first two days of data collection. The children were asked to indicate their age and gender on the questionnaire, and to circle three (only) of their favourite playground activities.

The playground observational data were gathered using CAST2. This is a momentary time sampling observational instrument which has been shown to be valid and reliable, yielding intra-class correlations of 0.94 and 0.77 for moderate and vigorous physical activity respectively, and an overall inter-rater reliability of 0.79 (Zask, van Beurden et al. 2001). In a later study, Spearman correlations coefficients between pairs of observers at nine schools ranged from 0.71 to 0.99, with eight of the nine schools producing correlations coefficients above 0.91. Inter-rater reliability determined by Cronbach's Alpha ranged from 0.965 to 1.0 across the nine schools in the study (Parrish, Iverson et al. 2009).

CAST2 observers were trained at a full-day training course and practised using the instrument over three days at a pilot school (Zask, van Beurden et al. 2001; Budgen, Furber et al. 2004; Parrish, Iverson et al. 2009). Training day instruction included category identification (SOFIT categories) (McKenzie 2002), use of the CAST scoring instrument, use of school maps to segment playground areas for observational viewing, and guided field practice. Data collection involved three trained observers standing beside each other and simultaneously scanning predetermined playground

viewing areas from right to left in one continuous sweep. Each observer scanned one of the activity categories (low, mod and high) per day; observers changed allocated categories each day. The observers stood beside each other and held a pen in an extended hand (to assist their view) and counted the number of children in their assigned category. Two scans occurred during each 75 second scanning period until the break ended (timing was assisted by an audio taped signal). In the first scan, the numbers of active/inactive children were counted and recorded. Observers then simultaneously scanned the playground a second time to record teacher presence/behaviour, equipment availability and equipment usage. Scanning data were recorded on a CAST2 scoring sheet after each scan. A new scan began at the commencement of each 75 second interval. Observations alternated between males and females for each 75 second interval. The specific ages of the children involved in scans were not known, and it was possible for a child to be counted twice in the one scan if they moved during the 75 second observation scan period. In most instances, children of all ages shared the same play areas. CAST2 observational data was collected during three lunch and three recess periods. However, the final data included only three lunch breaks and one recess break, due to incomplete data at one of the schools involved in the study and the collection of CAST2 reliability data during the other recess period. CAST2 data and CAP questionnaire data were collected during the same time.

CAST2 observational data were analysed using SAS computer software (version 9.1). The number of active children in each scan was divided by the total number of children in the scan, to ensure that smaller schools were not disadvantaged.

The activity preferences for each child at each of the 13 schools were tallied to determine the proportions of children who preferred low (score of 3, 4 or 5), moderate (score of 6 or 7) and high level activities (score of 8 or 9). Proportions were compiled in Microsoft Office Excel (2003). A Spearman's correlation was calculated in SPSS (Version 13) between the CAST2 observed proportions of active children and the proportions of active preferences of the children (for each school).

To determine if there were differences between the activity preferences of each age group (i.e., 4, 5, 6, 7, 8 and 9 year olds), a Kruskal-Wallis test was performed. The

activity preferences of children from lower SES schools were compared to the activity preferences of children from average socioeconomic schools using a Mann-Whitney test. Chi square analysis (SPSS-Version 13.0) determined if there was an association between male and female activity preferences.

Each component of this study was approved by the University of Wollongong Human Ethics committee and the NSW Department of Education and Training.

5.3 Results

5.3.1 CAP reliability

Of the 439 children invited to complete the CAP questionnaire, data was gathered from 91 children (49 females and 42 males) on both occasions (response rate of 0.21). Spearman's correlation showed a significant positive correlation between the two administrations of CAP ($r = 0.407$, $N = 91$, $p < 0.0001$).

5.3.2 CAP validity

Of the 30 initial participants, validity data were only available for 18 children (60% of children). One child refused participation after the first day, eight were absent for at least one of the three days, and three children did not complete the CAP questionnaire. Spearman's rank correlation coefficient produced a positive but non-significant correlation between the children's matched activity preference scores and the total Actigraph accelerometer counts ($r = 0.299$, $N = 18$, $p = 0.228$).

5.3.3 Comparison of CAP activity preferences to observed playground activities

The CAP questionnaire was completed by 629 children (285 males and 317 females; 27 children did not indicate their gender), yielding a response rate of 39.4 percent. The proportions of children who preferred sedentary pictures ranged from 0.11 to 0.38 across the 13 schools (mean =0.23, SD =0.08); the proportion of children who preferred moderate activity pictures ranged from 0.4 to 0.73 (mean =0.53, SD =0.1); and the proportion of children who preferred high activity pictures ranged from 0.16 to 0.33 (mean =0.24, SD =0.06).

Across the 13 schools, the proportion of children who were sedentary as determined by observation ranged from 0.3 to 0.6 (mean =0.42, SD =0.1); the proportion who

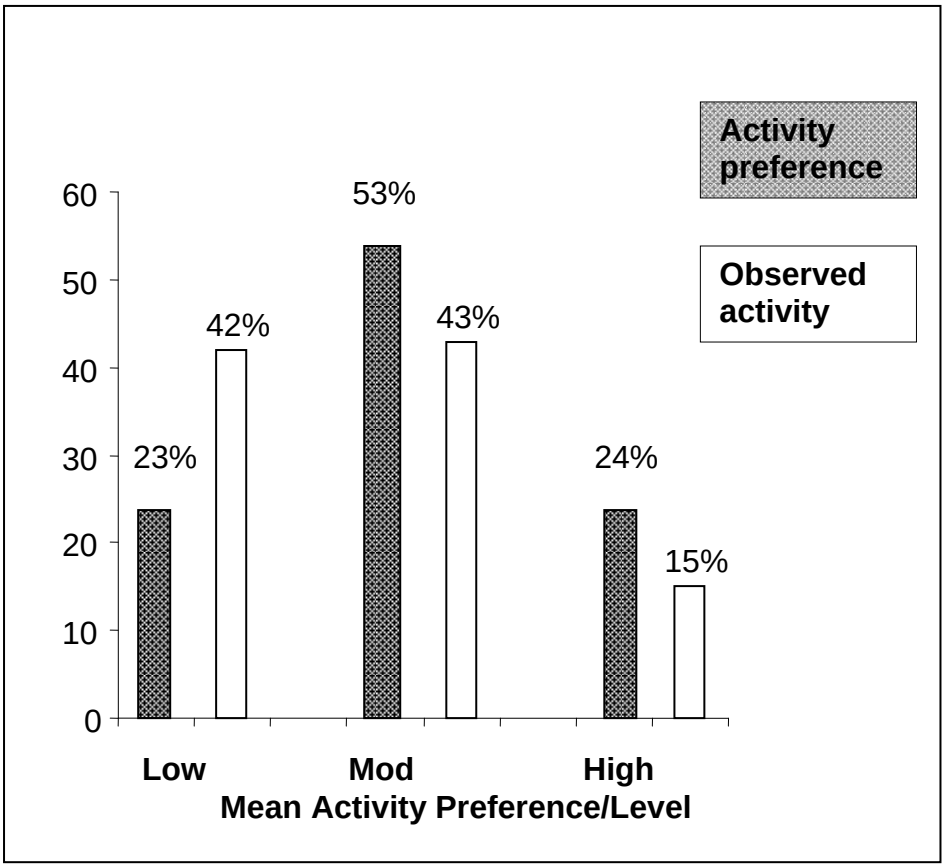
were moderately active ranged from 0.32 to 0.54 (mean =0.43, SD =0.07); and the proportion who were highly active ranged from 0.08 to 0.22 (mean =0.15, SD =0.04).

Table 5.1 Comparing percentages of picture preferences and observed playground activity levels at each school (N=13)

School	Percentage Low Picture Preference	Percentage Low Activity: CAST2	Percentage Moderate Picture Preference	Percentage Moderate Activity: CAST2	Percentage of High Picture Preference	Percentage High Activity: CAST2
A	26%	47%	58%	38%	16%	15%
B	15%	30%	58%	49%	28%	22%
C	28%	41%	41%	41%	30%	18%
D	27%	35%	53%	51%	20%	15%
E	14%	31%	67%	54%	19%	15%
F	29%	60%	48%	32%	23%	8%
G	22%	53%	57%	34%	22%	14%
H	16%	43%	56%	46%	28%	11%
I	15%	37%	60%	47%	25%	15%
J	38%	54%	41%	33%	21%	13%
K	27%	31%	40%	50%	33%	19%
L	30%	38%	40%	48%	30%	14%
M	11%	49%	73%	39%	16%	11%
Overall mean	23%	42%	53%	43%	24%	15%

Figure 5.1 illustrates a comparison between the percentages of observed playground activity and children's picture preferences.

Figure 5.1 Percentages of mean observed activity and mean activity preferences



Spearman's correlation revealed no association between activity preferences and CAST2 observational data (low preferences/activity r = - 0.379, p =0.201; moderate preferences/activity r = 0.044, p =0.886; high preferences/activity r =0.374, p =0.209).

Since activity preference data for each age group were not normally distributed, the data were analysed using a Kruskal-Wallis test. The results indicated no significant difference between children's activity picture preferences across all age groups (4-9 yr olds, $\chi^2 = 8.391$, df =5, p =0.136).

The odds ratio of boys engaging in Moderate to Vigorous Physical Activity (MVPA) in the school playground relative to girls ranged from 0.8581 to 2.137. At 12 of the 13 schools the odds ratio favoured boys being more active than girls. However, Chi-

squared analysis of male and female picture questionnaire preferences revealed no significant difference between activity preferences (χ^2 =6.809, df =6, p =0.339). In addition a Mann-Whitney test indicated that there was no significant difference between the activity picture preferences of children at lower compared to average SES schools (Z = -0.458, p =0.647).

5.4 Discussion

The purpose of this study was to develop an instrument which assessed young children's activity preferences and to ensure that it was: age appropriate, appealing to young children, not reliant on memory recall, mindful of their limited attention span and their limited ability to read/comprehend, and quick and convenient to administer. Experience suggests the CAP questionnaire satisfied these criteria. The CAP instrument was completed without difficulty by children as young as 4 years of age and without the assistance of an adult. It does not rely on memory recall, which is difficult for young children. It was also convenient, quick and inexpensive to use. The results indicate that most children showed a preference for moderate or highly active pastimes during recess and lunchtimes at school.

It is uncommon for self-report questionnaires to survey groups of young children (4-9yrs). Most existing instruments rely on proxy reports completed by the child's parent or teacher (Stanley, Boshoff et al. 2007). However, self-report gives the child the opportunity to indicate their true preference without bias from a third party. Some self-report instruments designed for older children present similar modest reliability coefficiencies to that of the CAP questionnaire (i.e. r = 0.407), even with the advantage of surveying children with a more mature intellect (Janz, Witt et al. 1995; Treuth, Sherwood et al. 2003). This highlights the difficulty associated with achieving high significant reliability coefficients when surveying very young children.

Reliability of CAP may have been affected by several factors: it surveyed a younger group of children than most studies, parents and teachers were not involved in questionnaire completion, and the duration between test-retest was longer than in many studies. For example, Treuth and colleagues (2003) found that same day test-retests of a self-report had a reliability of r=0.98, but lower correlations (r=0.24) when

the test-retest period was three days for the same self-report. We used a two week test-retest period. However, a shorter test-retest period is not recommended as it may not give a true indication of instrument reliability. While CAP's reliability coefficient was statistically significant, it did not achieve the desired minimal level of 0.7. As this instrument is in its infancy, further refinement and testing of CAP may increase its reliability coefficient.

Only a small sample of children was fitted with Actigraph accelerometers to determine whether there was an association between their picture preference activity levels and their actual playground activity. Whilst validity results were modest, it is anticipated that correlation coefficients may improve if future research involves a larger sample, and more days of accelerometer monitoring.

Little is known about the school break time playground activity preferences of young children. This research found that children indicated a preference for moderate or highly active pastimes in the school playground. This is an interesting finding given concern about the need to increase children's overall activity levels. If children had preferred sedentary activities, motivating them to be active would be much more difficult.

However, children's preference for activities of moderate or high intensity was not consistent with observed playground activity data (CAST2). There are several variables which may have influenced this result. Rowlands and colleagues (2008) found that mean durations of children's activity decreased as activity intensity increased (11.0 ± 1.3 seconds for $\geq$ light activity to 6.1 ± 1.0 seconds for $\geq$ vigorous activity) and continuous bouts of activity lasting 20 minutes or more are low to non-existent (Trost, Pate et al. 2002). This suggests that, while young children may indicate they prefer moderate or high intensity activities, they play in short bouts of activity which may not reflect their overall activity. Alternatively, children may have preferred the activities pictured on the CAP questionnaire but, in some schools, could not access the equipment in the playground. Therefore, their actual activity may not have reflected their preference. Future instrument development could provide a template which may be modified to suit each school environment.

Furthermore, CAP preferences were taken from young children, but the playground observed activity (CAST2) data included the entire student population (including older children) as it was not possible to separate the age groupings in the school yard situation. Thus comparisons between activity preferences and activity data may have been more consistent if the activity data only included the younger group of children.

There is limited research regarding whether children's physical activity preferences change with age. In this study, children's activity picture preferences across all age groups (4-9 year olds) were not significantly different from one another. In a study of eighth graders compared to sixth and seventh graders, Harrell and colleagues (2003) found a significant difference between the activity preferences of older and younger children (older children preferred sedentary activities). However, children in the present study were younger than the fourth grade. It has been shown that physical activity does not decline until fourth and fifth grades (Sallis, Alcaraz et al. 1999). Therefore it is possible that this finding may indicate that preferences for activity do not decline until the fourth grade, thereby explaining similar activity preferences across four to nine year old children. These findings suggest the need for future research.

Some studies report an association between SES and children's physical activity levels; however most of these studies tended to survey older American children (9-12 years) (Epstein, Paluch et al. 1996; Pratt, Macera et al. 1999). Results of these studies differ from the CAP preference data, which showed that the activity preferences of children from lower and average SES schools were similar. This may indicate that children have similar preferences for physical activity, but children from lower SES schools may have restricted access to physical activity opportunities.

Male and female activity preferences were not significantly different from each other. However the observational data (CAST2) indicated that males were generally more active than females (it should be noted that CAST2 data reflected the activity of all children (K-year 6)). It was not possible in this study to determine if boys were more active than girls in the younger age group alone (4-9 years). Other studies also found males to be more active than females (Sallis, Prochaska et al. 2000; Riddoch, Bo Andersen et al. 2004). If both genders have similar activity preferences but females

are less active than males, it may be that physical or environmental variables hamper female activity (e.g. wearing dresses or boys being more dominant in play). This finding provides grounding for future research.

It could be argued that the number of pictures on the CAP questionnaire (N=9) placed limitations on children's choices. However, a choice of too many illustrations has been shown to be a source of confusion for young children (Evans, Brauchle et al. 2007).

Data collection activities are infrequently discussed in research reports, but need to be considered when investigating young children in the school setting. Collecting data in the school setting is difficult, as indicated by the problem related to collecting validity data in this study. Data collection is complicated by school absence, classroom administration and school routines, time restrictions and the necessity to interact with multiple children, administrators, teachers and principals. Researchers need to be aware that the data collection process in the school setting may not always proceed according to plan; this suggests the need to test the acceptability and viability of different data collection methods.

5.5 Conclusion

The CAP instrument is a unique self-report instrument designed for young children. Whilst the CAP questionnaire has several limitations, it provides a starting point for future development in an area of research that is truly in its infancy. This research contributes to the investigation of self-report methods for assessing young children's playground physical activity preferences.

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CHAPTER 6

Psychosocial barriers affect children's school playground physical activity levels

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6.1 Introduction

The importance of physical activity throughout the lifespan is well recognised. Maintaining an active lifestyle reduces the risk of premature death (Yu, Yarnell et al. 2003). Physical activity declines in the adolescent years, making early intervention in younger children a priority (Trost, Pate et al. 2002). The significance of physical activity in the health of children emphasises the need to promote physical activity opportunities. The Australian guidelines recommend that children be active for a minimum 60 minutes each day (Australian Government Department of Health and Ageing 2007). The home environment contains many sedentary distractions, which are not present in the school yard. School break-times (i.e. recess and lunch) total approximately 90 minutes, providing an ideal opportunity for children to be active. To date, few studies have investigated the determinants which affect children's school playground physical activity levels (Stratton and Mullan 2005; Ridgers, Stratton et al. 2006; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007). Gaining an understanding of the effects of playground variables on children's physical activity, as perceived by students and teachers, provides direction for future intervention studies.

A larger study conducted by the author (Parrish, Russell et al. 2009) investigated the influence of environmental variables on children's playground physical activity levels. Variables which were shown to significantly increase children's playground physical activity include: time allocated to break periods, unshaded areas, access to non-fixed equipment, children playing with a ball, painted ground targets and soft play surfaces.

Bauer and colleagues (2004) found that teasing and bullying were significant barriers affecting children's activity in physical education classes. Psychosocial barriers may influence the physical activity levels of children in school playgrounds. Previous studies involving children and adolescents have used the Social Cognitive Theory (SCT) as a guide to assess children's health behaviour (Reynolds, Hinton et al. 1999; Strauss, Rodzilsky et al. 2001; Winters, Petosa et al. 2003; Petosa, Hortz et al. 2005). Social Cognitive Theory (Bandura 2004) guides influences from multiple domains including the effect of observational learning, psychological, environmental and self regulation (Glanz, Rimer et al. 2008). SCT concepts were used to generate issues associated with children's playground physical activity behaviour.

The purpose of this study was to identify physical and psycho-social determinants of children's school break-time playground physical activity as perceived by students, teachers and principals

6.2 Methods

From a list of public schools in the Illawarra region of New South Wales with average and low Socio Economic Status (SES), six and four schools respectively were randomly selected using a table of random numbers (Edwards 1968). In addition, three schools designated as being the most disadvantaged in this region were included (N=13 schools). Public schools were classified by the Department of Education as low SES or average SES based on the income of families whose children attended the school. Principals, students and teachers from 13 public schools were invited to complete a questionnaire as part of the larger study at their school (Parrish, Iverson et al. 2009; Parrish, Russell et al. 2009).

Questionnaire administration was tested during a pilot study in one primary school (December 2004). As in the larger study, questionnaires were administered over a three day period at each school; activity related observational and environmental data were collected on the same days. The student questionnaires took approximately 10 to 15 minutes to complete and were administered in class by the teacher. Principal and teacher questionnaires took approximately 15 minutes to complete. All student and

teacher questionnaires were anonymous; it was not possible to maintain anonymity with the principals, as there was only one principal at each school.

There were 15 questions on the principal, 12 on the teacher and 11 on the student questionnaires, which related to SCT constructs (Glanz 2002; Glanz, Rimer et al. 2008). The SCT constructs were used to generate questions for the survey. 'Reciprocal determinism' raised questions about children's activity levels and the relationship between their activity and the playground environment. Observational learning' generated questions about teacher involvement in the playground and whether children were active in the same way as their friends. 'Behavioural capacity' generated questions about teaching children to be active in the playground. 'Reinforcement' generated questions about encouraging children to be active in the playground. 'Outcome expectations' generated questions about the effects of playground bullying on playground physical activity levels. 'Self-efficacy' generated questions about children's confidence in being active in the school playground. The questions relating to relevant SCT constructs are summarised in tables in Appendix B.

The questionnaires addressed similar themes. Students were asked: their activity and equipment preference, rules that affected their play, their opinion of their school's playground aesthetics, whether they are good at their chosen activities and whether they and their friends are active and the barriers preventing them from being active. Barriers preventing children from being active included: the weather, lack of time, lack of equipment or space, their uniform, 'not liking being active', being 'too shy' and being worried that they might get bullied or hurt (refer to Table 6.1). Teachers were asked: whether they should encourage and teach children about being active in the playground during breaks, if their school's facilities, policies and curriculum support children's playground activity, whether children at their school are active, if they were active, if they participate in the playground with children, what facilities would improve activity and their preference for school subject matter and the barriers that prevent children being active. The barriers included: poor equipment maintenance, student uniforms, potential for children to be bullied or injured, a lack of time for students to be active, lack of staff to monitor students, policies affecting activity (e.g. 'no hat no play'), lack of equipment, space and games courts (Refer to Table 6.2). Principals were asked: if they were active, if children at their school are

active, if safety policies and bullying affect playground activity, if the staff, students and parents and friends (P&F) should be involved in playground development, if there is a purchasing plan for playground equipment and whether it is a priority, if the school prides itself on a particular sporting activity, barriers preventing children from being active in the playground and whether there are regular equipment maintenance checks. In addition, teachers and principals were asked how long they had been teaching. Respondents were also asked to indicate their gender; students were asked if they had a disability.

The teacher and principal questionnaires used several rating systems. A five point likert scale (i.e. strongly agree to strongly disagree), was used to answer questions relating to school policies and barriers affecting children's playground physical activity. In addition, the teacher questionnaire used a three point likert scale (important, somewhat important, not important) to indicate the barriers which prevented them from being actively involved with children in the playground. Teachers were also asked to rank their preference for subject matter (e.g. creative arts, mathematics, physical education). Principals used a five point likert scale to indicate how often equipment is maintained (Never, 1 yr, 3yr, 5yr, as required). Students were asked to indicate their activity preferences with a tick. They circled a two point likert scale when asked about school aesthetics (e.g. too much concrete, not much concrete) and a three point likert scale when asked about playground physical activity (e.g. no, maybe, yes).

Physical activity data was collected using the momentary time sampling observational technique of the Children's Activity Scanning Tool (CAST2) (Zask, van Beurden et al. 2001). Data was collected for three days at each school involved in the study. The questionnaires were administered during the same week that the observational data was collected.

Each component of this study was approved by the University of Wollongong Human Ethics committee and the NSW Department of Education and Training.

6.3 Statistical analysis

All of the questionnaires responses were analysed for frequencies in the SAS statistical software package (version 9.1). To analyse the children's activity preference, the six preferences were given a ranking based on the level of activity pictured (i.e. low =1, moderate =2, high=3). Each child's total children's activity preference score was compared to the score that they gave for the barriers that they indicated hindered them from being active in the school playground using independent samples t tests (SPSS version 13.0).

Teachers were asked to rank whether they thought children at their school were active during recess and lunch using a 5 point Likert scale (i.e. strongly agree = 1, agree =2, neutral =3, disagree = 4, strongly disagree = 5). This score was used to compare the teacher's perception of the children's playground activity levels and the barriers they believed prevented children from being active in their school playground using a Mann-Whitney U test (SPSS version 13.0). In addition, the analysis included finding a Spearman's correlation between the total proportion of active children calculated from observational data and the mean of the significant variables for each school (SPSS version 13).

6.4 Results

Nine principals (of 13) completed the principal questionnaire (response rate of 69%). Three females and one male principal worked at the lower SES schools and one female and four males worked at average SES schools. The mean number of years spent teaching was 27.3 years (range 15-35yrs). All principals agreed that students at their school should be active (66% principals strongly agreed). Eight of nine principals believed themselves to be an active person.

Eighty four of a potential 152 teachers completed the teacher questionnaire (response rate of 55%), including ten males and 74 females. Forty nine (of a possible 91) teachers were from schools classified lower SES and 35 (of a possible 61) teachers were from schools which were average SES.

Of a possible 1352 students, 468 completed the student questionnaire (response rate of 35%), including 197 males and 271 females. There were 259 students from schools classified lower SES and 209 from average SES schools. Five of the students indicated they suffered from asthma (in response to whether they had a disability). Table 6.1 shows the proportion of all student respondents indicating barriers to being active in the playground during recess and lunch times.

Table 6.1 Combined proportions of students (i.e. from all schools) indicating barriers to playground physical activity

Barrier	Total students	Total indicating barrier	Proportion	SD
i) weather	468	351	0.75	0.433
ii) no time	468	205	0.44	0.497
Physical barriers				
iii) lack of fixed equipment	468	105	0.22	0.418
iv) lack of non-fixed equipment	468	49	0.10	0.306
v) no space	468	53	0.11	0.317
vi) uniform	467	100	0.21	0.411
Psychosocial barriers				
vii) don't like being active	468	44	0.09	0.292
viii) might get bullied	468	100	0.21	0.410
ix) might get hurt	468	83	0.18	0.382
x) I'm too shy	468	19	0.04	0.198

Table 6.2 shows the proportion of all teacher respondents who indicated barriers to students being active in the playground during recess and lunch times.

Table 6.2 Combined proportions of all teacher respondents indicating barriers to student playground physical activity

Barriers	Total number teachers	Total indicating barrier	Proportion	SD
i) lack of time	84	13	0.15	0.364
ii) lack of staff	84	33	0.39	0.491
iii) policies affecting activity	84	18	0.21	0.413
Physical barriers				
iv) lack of fixed equipment	84	27	0.32	0.470
v) lack of non-fixed equipment	84	22	0.26	0.442
vi) lack of games courts and nets	84	35	0.42	0.496
vii) lack of space	84	21	0.25	0.436
viii) lack of playground markings	84	36	0.43	0.498
ix) student uniforms	84	2	0.02	0.153
x) equipment maintenance	84	22	0.26	0.442
Psychosocial barriers				
xi) potential to be bullied	84	20	0.24	0.428
xii) potential for injury	84	33	0.39	0.491

When asked to indicate whether the following variables affected children's playground physical activity levels at their school: two principals (of 9) believed that the potential for injury prevented children from being active, and one principal believed that bullying prevented some children from being active. Three (of 9) principals planned for the purchase of playground equipment and four principals believed that the purchase of non-fixed equipment was a priority at their school. Non-fixed equipment was replaced annually at two schools and as required at the remaining schools.

An independent samples t-test was used to compare the mean value of the children's activity preference scores to the mean value of the scores they gave for barriers preventing them from being active. There was a significant difference when comparing the mean of children's activity (Table 6.3) of the children who: i) indicated

that they liked being active and those who did not like being active; ii) indicated that they were not affected by other children who may bully them and those who were affected by children who might bully them; iii) indicated that they were not scared of getting hurt and those who were scared of getting hurt; and iv) indicated that they were not too shy to play with other children and those that were too shy to play with other children. Males indicated a greater preference for active games than females.

Table 6.3 Summary of significant barriers affecting student playground activity preferences

Variable	t	p	N	Mean	SD	SE Mean
Number with no response			391	5.06	1.068	0.054
Response: they don't like being active	**4.356**	**0.001**	40	4.28	1.198	0.189
Number with no response			340	5.04	1.081	0.059
Response: I might get bullied	**1.989**	**0.047**	91	4.78	1.162	0.122
Number with no response			356	5.05	1.076	0.057
Response: I don't want to get hurt	**2.761**	**0.006**	75	4.67	1.178	0.136
Number with no response			416	5.01	1.093	0.054
Response: I'm too shy to play with others	**2.580**	**0.01**	15	4.27	1.163	0.300
Being Male			179	5.21	1.065	0.080
Being Female	**3.679**	**0.001**	252	4.82	1.102	0.069

The barriers which were not significantly related to the children's activity preferences included: the weather, their uniform, fixed equipment, non-fixed equipment, playground space, time available for play and additional scribed barriers. A Spearman's correlation between the total observed proportion of active children (N=13 schools) and the mean of each of the significant variables for each school (don't like being active, may be bullied, might get hurt and too shy) were not significant. In addition, there were no significant differences between low and average SES schools or gender groupings.

A Mann-Whitney U test was used to compare the teacher's ranking of the children's playground activity level (of the children at their school) of the teachers who indicated a lack of fixed playground equipment was not a barrier to the children's playground activity to the corresponding ranking of those that believed it was. A Mann-Whitney U test was used to compare the teacher's ranking of the children's playground activity level (of the children at their school) of the teachers who indicated that a lack of non-fixed playground equipment was not a barrier to the children's playground activity to the corresponding ranking of those that believed it was. A Mann-Whitney U tests was used to compare the teacher's ranking of the children's playground activity level (of the children at their school) of the teachers who indicated a that a lack of games courts was not a barrier to the children's playground activity to the corresponding ranking of those that believed it was. A summary of the results are presented in Table 6.4. Eighty seven percent of teachers agreed or strongly agreed that children at their school were active during break times.

Table 6.4 Summary of significant barriers affecting children's perceived playground activity levels as indicated by teachers

Variable		**N**	**U**	**p**
Lack of fixed equipment	Not a barrier	57		
	Barrier	27	**-2.605**	**0.009**
Lack of non-fixed equipment	Not a barrier	62		
	Barrier	22	**-2.239**	**0.025**
Lack of games courts	Not a barrier	49		
	Barrier	35	**-2.516**	**0.012**

The barriers which were not significantly related to the teacher's ranking of the children's playground activity levels at their school were: lack of playground space, lack of break time, lack of playground markings, lack of staff to supervise during breaks, children's uniform, school yard bullying, the potential for children to be injured, equipment maintenance, policies restricting play and 'other' barriers.

6.5 Discussion

Lack of time (44%), and the weather (75%) were indicated by the highest proportion of children as barriers affecting playground activity levels during recess and lunch. These findings are consistent with previous research (Thompson, Davis et al. 2001; Bauer, Yang et al. 2004). Whilst intervention is difficult, there are changes schools may consider to improve activity levels. When the weather is too cold or wet, schools could provide access to indoor halls, non-fixed equipment and sheltered outdoor areas, in preference to keeping children inside the classroom playing sedentary games. To maximise time available to play, schools could ensure that children are not required to sit and eat for extended periods of time. For example, older children may be able to get up to play earlier than younger children (who generally take longer to eat). The addition of an extra five minutes per day to break periods creates 50 minutes of extra activity for children each week.

One in five children (0.18 female, 0.26 males) believed that their school uniform prevented them from being active during break times. This is consistent with concerns voiced by participants in a study by Dudley et al (2007). In contrast, only two percent of teachers indicated a school uniform was a barrier to activity. It is interesting that similar numbers of males and females believed their uniform affected playground activity levels, even though females could be seen as most affected as they are often required to wear a dress on non-sport days. Adults prescribe the type of uniform children are required to wear; if teachers do not believe that the school uniform is an issue, this may indicate that children need to have more input into their chosen uniform. A reassessment of school uniform policy which considers student preference may increase school playground activity levels.

Farley et al (2007) found that children's physical activity increases if they are given a safe play space. Several studies have noted that bullying may impact on children's physical activity levels (Wechsler, Devereaux et al. 2000; Weir 2001; Bauer, Yang et al. 2004). Notably one in five children indicated that a fear of being bullied affected their playground activity level during recess and lunch. In addition, a fear of being bullied was significantly related to children's playground activity preferences ($t=1.989$, $p= 0.047$). One in five teachers believed bullying affected children's activity preferences. There was no significance between the teachers ranking of children's playground activity levels and their perception of school yard bullying. Only one principal believed that bullying prevented some children from being active in the playground during break times at their school. If principals do not believe bullying affects children's playground activity levels, measures to address this issue may be inadequate. To date, previous research has not investigated the effect of bullying on playground physical activity levels of children. These findings indicate that targeting playground bullying may potentially increase children's physical activity levels during school break times.

In this study, males showed a greater preference for more active games than females ($t=3.62$, $p=0.001$). There is strong evidence which indicates females are less active than males in the school playground (Zask, van Beurden et al. 2001; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007; Parrish, Russell et al. 2009). It is important to identify variables which may impact on females' playground activity levels. It is possible males dominate playground activity choices and corresponding areas of the school playground, or that playground design and equipment are more suited to male preferences. It is important to consider gender preferences to ensure that females are being offered activities that appeal to them (Kinzie and Joseph 2008). It is also possible that there is a need to focus on females when teaching fundamental movement skills to ensure females have adequate levels of self-efficacy to participate in playground games.

Previous research indicated that children were significantly more active on soft-play surfaces (Parrish, Russell et al. 2009). In this study, some children indicated that their activity preferences were significantly affected by a 'fear of getting hurt' ($t=2.761$, $p=0.006$). This may have prevented them from being active in the playground during

break times. However, no significance was found between teachers ranking of children's playground activity levels and children's potential to be injured, and only two principals believed the potential for injury prevented children from being active. It is important that school staff are aware of children's concerns. Future research should investigate the variables which cause the children to fear getting hurt, so that their fear can be appropriately addressed and potentially increase their playground activity level.

This study indicated that children who said they were 'too shy to play with others,' and another group that 'did not like being active', showed a significant preference for less active playground games than the other children during break times. An awareness of the children whose attitudes are reflected in this way could allow teaching staff to target these groups of children. Future research could investigate why the children 'feel too shy to play' and 'don't like being active', to allow interventions to appropriately target these populations.

Several studies highlight the importance of access to non-fixed equipment to promote children's playground physical activity (Thompson, Davis et al. 2001; Barnett, O'Loughlin et al. 2006; Willenberg, Ashbolt et al. 2010). A significant number of teachers believed that a lack of non-fixed equipment was a barrier affecting children's playground activity levels. However, only one third of school principals planned the purchase of playground equipment, and less than half the principals (4 of 9) believed the purchase of non-fixed equipment should be a high priority at their school. As non-fixed equipment has a significant effect on children's playground activity levels (Parrish et al. 2008), it is important for school principals and staff to consider regularly purchasing, maintaining and distributing non-fixed equipment to children during break times.

All of the barriers which significantly affected the activity preference of children were psychosocial, in contrast to physical playground barriers identified by the teachers. The beliefs of the teachers are in keeping with the focus of previous research which indicates that physical barriers affect children's activity levels (Zask, van Beurden et al. 2001; McKenzie 2002; Lanningham-Foster, Foster et al. 2008). This research, however, suggests that children may be more affected by psychosocial rather than

physical variables. Current measures to change or improve the physical environment may be wasted if psychosocial issues are not addressed. The findings from this research suggest future research should investigate psychosocial barriers to children's school playground activity levels.

6.6 Conclusion

The purpose of this study was to develop self-report questionnaires for primary aged children and staff using the SCT constructs with the intention of identifying physical and psycho-social determinants which affect children's break-time playground physical activity. The findings from this research indicate that a lack of time, the weather and school uniforms were barriers to school playground activity. These factors were mentioned by high proportions of children, and therefore should be considered when designing interventions to increase children's school playground activity levels. However, some children's activity preference were significantly affected by psychosocial variables, such as 'being bullied', 'fear of getting hurt', 'not liking activity' or 'being too shy to play'. In addition, a significant number of males showed a greater preference for more active games than females. Current measures to change or improve the physical environment may be wasted if psychosocial issues are not addressed. The findings suggest future research should investigate both physical and psychosocial barriers affecting children's school playground activity levels.

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CHAPTER 7

Using interviews and friendship pairs to better understand how school environments affect young children's playground physical activity levels

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7.1 Introduction

Children are increasingly exhibiting cardiovascular and cancer risk factors which may be attributed to decreasing levels of physical activity (Tomkinson 2007; Dobbins, De Corby et al. 2009). School-based interventions can effectively contribute to children's daily physical activity (Dobbins, De Corby et al. 2009); however, classroom curriculum demands can limit time available for physical activity. The school break-time playground environment is an ideal alternative to focus interventions for increasing children's physical activity levels. Currently, such opportunities appear to be underutilised (Ernst 2003).

Barriers preventing playground physical activity are important determinants of children's physical activity behaviour (Thompson, Davis et al. 2001). Barriers that have been identified include: poorly maintained or lack of equipment, temperature, inappropriate clothing, individual physical disabilities, or psychosocial deterrents such as bullying, peer pressure, gender and social networks (Thompson, Davis et al. 2001; Weir 2001; Glanz, Rimer et al. 2002; Bauer, Yang et al. 2004; Parrish, Russell et al. 2009b). Children may show a preference for quiet areas, as large numbers of children in playground space sometimes frighten younger children (Blatchford and Sharp 1994). Other factors which may influence children's physical activity participation include adult support and involvement, teacher confidence in teaching physical activity and activity preferences (Thompson, Davis et al. 2001). Variables which have been found to be strongly associated with youth physical activity levels include self-

efficacy, perceived physical competence, outcome expectations (or perceived benefits), intentions to be active, enjoyment of physical activity, social support from family and friends, and spending time in environments that facilitate physical activity (Sallis, Alcaraz et al. 1999; Strauss, Rodzilsky et al. 2001).

From 1997, the New South Wales Department of Education and Training (NSWDET) began a self-evaluation process, allowing schools autonomy to make decisions and policies relating to individual schools. Policies and policy implementation are considered to be as important as the physical environment in influencing children's playground physical activity levels (Kolbe, Collins et al. 1995; Schmid, Pratt et al. 1995; Dietz, Bland et al. 2002; New South Wales Department of Education and Training 2002; Jones, Brener et al. 2003). The National Safe Schools framework addresses the physical and emotional safety and well-being of all Australian students (The Student Learning and Support Services Taskforce 2003). It encourages policies which ensure students' physical, social and emotional well being and refers to issues such as bullying, harassment and child protection (The Student Learning and Support Services Taskforce 2003).

Whilst there is limited research investigating children's playground physical activity preferences and associated physical activity levels, providing opportunities for children to participate in their preferred activity may increase their likelihood of participation. In a survey of after-school activity preferences, Eyler (2006) found that many children preferred ballgames, chasings and jump rope.

The primary purpose of the present study was to explore teachers' and students' views of the physical environmental variables that affect children's playground physical activity. A larger study, including the actual playground observation of children in 13 schools conducted by the author, identified the physical environmental variables which significantly increased children's playground physical activity (Parrish, Russell et al. 2009b). These included time allocated to break periods, unshaded areas, access to non-fixed equipment, children playing with a ball, painted ground targets and soft play surfaces. Variables which significantly decreased children's playground physical activity included teachers managing or observing children, hotter temperatures and being female. Non-environmental variables which influenced children's playground

physical activity levels were also identified. A qualitative research approach including individual and paired interviews was adopted.

Interviews are regarded as an acceptable and effective method of gathering information from adults and children (Borra, Kelly et al. 2003; Bruss, Morris et al. 2003; Jago, Brockman et al. 2009). Porcellato and colleagues (2002) examined the appropriateness of focus groups with young children, and concluded that focus groups with young children were viable, but needed to be small, homogenous and interactive to maintain a high level of interest and participation. Paired interviews (Friendship pairs) meet these criteria and represent a viable alternative for collecting qualitative data from children. Paired interviews have been successfully used in children as young as 5 years of age (Mayall 2000). For example, Thompson (2001) used paired interviews of children to measure attitudes and perceptions about physical activity and motivations to proactively change their activity levels.

The Social Cognitive Theory (SCT) guided the qualitative component of this thesis. Its basis is the interaction between the individual and their environment (Glanz, Rimer et al. 2008). The SCT construct reciprocal determinism describes the way that the individual, their behaviour and the environment interact to influence health behaviour. The SCT has been widely used in health promotion to assess health determinants and guide research methodology (Nutbeam and Harris 2004). The SCT has been used in similar research which investigates influences from multiple domains (Stucky-Ropp 1993; McGahee, Kemp et al. 2000; Strauss, Rodzilsky et al. 2001). In another component of this research, the SCT generated questions for student, teacher and principal surveys (Parrish, Iverson et al. submitted for publication). Responses to the survey questions guided the interview questions. In this way, the interview questions were grounded within the context of SCT. Interview questions addressed children's individual self-efficacy and teachers' perception of children's confidence in performing physical activity skills (Fundamental Movement Skills: FMS). The SCT emphasizes the importance of Observational Learning and its impact on the behaviour of others. Observational Learning explains how teachers or older children may encourage younger children to participate in activity by being physically active themselves. Self efficacy is the individual's confidence in performing a behaviour to bring about desired outcomes (Glanz, Rimer et al. 2008). This construct can be adapted for use in the teaching situation, where there is a need for positive learning

experiences to encourage positive outcomes for children involved in physical activity (Glanz, Rimer et al. 2008). Outcome Expectations describes beliefs in the value of behavioural choices (Glanz, Rimer et al. 2008). This construct could be used to understand a situation where a child does not want to participate in school playground activity after having witnessed other children being teased or bullied. The child's outcome expectations of participation in playground activity may be different if a teacher was there to monitor playground behaviour.

7.2 Methods

7.2.1 Interview data collection

This study used an extreme-case sampling method to allow participant responses from the least and most active schools to be considered (Patton 1990). Observational data gathered from 13 primary schools, as part of the larger study (Parrish, Iverson et al. 2009a), was used to determine the three most active schools (68 to 70 percent of their break-time was spent being physically active; this result was observed in two lower SES and one average SES school), and the three least active schools (40 to 50 percent of their break-time was spent being physically active; this result was observed in two lower SES and one average SES). A convenience sample of these six schools was invited to participate in the interview component of the study. One of the least active schools (lower SES) chose not to participate in the interview process, thus the next least active school (lower SES) was then invited to participate and subsequently accepted the invitation. None of the schools was informed of the activity levels or rankings of children's playground physical activity level data.

Demonstrating rigour in qualitative research is essential. This study used a cross-section of perspectives from teachers, principals and students who volunteered to participate. The results presented include extensive sequences from the original transcripts (Mays and Pope 1995). The methodological steps in data collection, the use of recordings and the systematic computer analysis were executed to maintain consistency. In addition, quantitative data gathered as part of the larger study complemented findings of the interview component (triangulation), which is further indication of rigour (Seale and Silverman 1997; Long and Johnson 2000).

The principal, three teachers and 20 students in grades 4-6 from each of the six schools, were invited to participate in the interview process. Children participated only if they had written parental consent. Teachers and principals gave verbal consent. Where possible, efforts were made to distribute as evenly as possible the number of children from each year in the interviews (i.e. Yrs 4, 5 and 6). The children were interviewed in pairs, with an attempt to ensure that each child was interviewed with a friend of the same age. Classroom teachers and students arranged the interview pairs based on students who had consented to be in the study. There were a possible 14 interviews at each school (10 pairs of students, three teachers and the principal).

Interview questions were generated from an analysis of questionnaires which had been distributed to consenting students, teachers and principals in term one of the 2005 school year (Summer), when the observational data were collected (as part of the larger study) (Parrish, Russell et al. 2009b). The questionnaires were developed to enhance the understanding of findings about environmental factors. Questions focused on children's activity and activity preferences, school facilities and the playground environment, the effect of bullying, and school policies affecting playground physical activity.

Interview data were collected in the last term of the school year (late Spring). The interview questions were different for each group (i.e. students, teachers and principals), but followed similar themes. Children were asked about their playground activity preferences; how temperatures, other children and teachers affected their playground activity, how playground equipment affected their activity, and their opinion of the appearance of a 'nice' school playground. Teachers were asked: how long they had been teaching, how they interact with children during break times, how school policies and programs encourage playground activity, the effect of bullying on playground activity levels, how barriers preventing them from participating with children in the playground affect children's activity, playground aesthetics and its effect on children's activity levels, their opinion of reported playground activity levels, and finally how children's Fundamental Movement Skills (FMS) affect their playground activity levels. Principals were asked: how many years they had been teaching, if there is a popular school activity which affected playground activity levels, the effect of playground markings, equipment and aesthetics on activity levels,

the effect of policies and bullying on playground activity levels, and the ideal amount of break-time for children to be physically activity.

The interviews were semi-structured. Students and teachers were asked nine open ended questions, principals were asked ten. Principal and teacher interviews lasted for approximately 15 to 20 minutes and student interviews approximately 10 to 15 minutes. Permission was gained from each participant to record the interview on audio cassette prior to the interview. Each child was asked if she/he was comfortable with their pair and the interview situation, and was assured that they were not required to respond to each question. Participants were informed that they could withdraw from the interview at any stage. To ensure consistency, all interviews were conducted by the same researcher (Anne-Maree Parrish) using the same interview script for each category of interview (i.e. students, teachers and principals) (Long and Johnson 2000). All recordings were transcribed verbatim. A second researcher checked the transcriptions for accuracy. Ethics approval was granted by the University of Wollongong Human Ethics Committee and the NSW Department of Education and Training in November 2005.

7.2.2 Analysis

Interview data were transcribed verbatim and analysis was assisted by the use of NVivo version 7 (NVivo 2007). To ensure consistency, each interview was read and manually coded by the researcher (Mays and Pope 1995; Patton 2002). Separate libraries were created for students, teachers and principals. The themes were generated from participants' responses to the interview questions. Initial responses were categorised and grouped to allow for the development of themes. A small number of free nodes remained when the analysis was complete; these responses were considered individually.

7.3 Results

Six principals (three male and three female), 16 teachers (all female) and 50 students (21 male and 29 female) agreed to be interviewed. No students from the smallest school (N=27) were interviewed, as consent was not granted by the parents. However, the school's only teacher and principal participated in the interviews.

By the end of the interview process, data saturation had been reached, as themes and issues being raised by the participants were the same as from those participants preceding them. The range of issues generated from the responses across the entire school were grouped into like themes including playground equipment and aesthetics, length of break time, children's playground activity levels and preferences, teacher playground participation, bullying and school policies and FMS. These themes are presented below.

Whilst all efforts were made to encourage children to respond within their comfort zones, not all students responded to all questions. In two cases, a child was involved in a paired interview twice. This only occurred when there were uneven numbers of consenting children to form a pair. In this situation, a child functioned as a support for the other child and did not respond to the interview questions. However, they were involved as a respondent in their previous interview. None of the participants refused to be interviewed or stopped the interview during progress.

The paired interview format was deemed to be a favourable way of interviewing young children. None of the children refused to be interviewed, the children seemed to enjoy the discussion, and most children contributed in a meaningful way. The support of a friend seemed to make them more comfortable during the interview process.

7.3.1 Playground equipment and aesthetics

There was an overwhelming response to the use of non-fixed equipment in the playground during break time to increase children's physical activity. Five principals believed that non-fixed equipment increased children's activity levels, making statements such as:

> *"Busy kids are happy kids" (PC46)*

One principal believed that free access to non-fixed equipment and unrestricted access to all playground areas increased children's playground physical activity levels. Principals also believed playground markings positively influenced children's playground activity and behaviour:

> *"for the lonely child you always find one kid playing hopscotch on their own"(PC47-48) a*nd *"I think the playground markings increase the level of*

desirable playground activity, I mean the absence of playground markings and the absence of sporting equipment they're still active but they're doing often inappropriate things.(PW31-35)"

None of the teacher interview questions made direct reference to non-fixed equipment; however, when asked to identify school policies which encourage activity, 11 of the 16 teachers said 'access to non-fixed equipment' (nine of these teachers were from lower SES schools). One teacher noted that non-fixed equipment assists in the prevention of playground behavioural problems:

"active kids or busy kids stay out of trouble, or they are more likely to stay out of trouble. We did the activity bins. We had all that bought, all that sports equipment and put them into bins" (T1W31-35).

All of the children believed that non-fixed equipment makes children more active. One child stated:

"There would be no playing equipment and there would be just cement and grass, nothing to play with, so you can't really play games without it. But kids like to play with fixed equipment and normal equipment" (S4S18-23).

Another child indicated that non-fixed equipment prevents playground bullying:

"*It helps them to be more playful and not bullying and stuff" (S3W42).*

Thirteen teachers believed that an aesthetically pleasing playground encouraged children's playground activity. One teacher stated:

"If they are in a playground with lots of fantastic equipment and fixed equipment and sporting equipment then they're more likely to use it to have a positive attitude towards it. I think it has a really huge effect" (T3S190-194).

Children were asked what they thought a nice school playground looked like. Children identified variables such as fixed equipment, grass, flowers, trees and no litter. However, they also mentioned psychosocial variables such as 'people who trust you', no fighting, no dangerous things, playing nicely together and access to a 'quiet place'.

Children were asked what type of clothing they preferred to wear while playing. All of the children preferred to play in some form of t-shirt and shorts; some girls preferred a skirt or shorts and t-shirt.

7.3.2 Length of break time

Two principals from the least active schools in the study allocated less 'time for play' during break times. One school allocated 30 minutes of break-time for the children to eat, leaving only 40 minutes for play. Principals at the most active schools allocated less eating time (approximately 10 minutes) and 50 to 60 minutes for play. One principal believed that too much time during the lunch break caused children to fight:

> *"They couldn't occupy themselves gainfully and meaningfully for 45 minutes, the children couldn't manage; there were too many fights and disputes" (PW201-204).*

However, to ensure children still had adequate time to play, he decreased the time allocated to lunch and increased the recess break.

7.3.3 Children's playground activity levels and preferences

Children were asked three things they liked to play during recess and lunch. The results are presented in Table 7.1. Of the 23 activities that children identified as their favourite break time activities, there were only three sedentary activities (see Table 7.1). The first seven most preferred pastimes were 'active'. Ten of the 23 preferences for children's break-time playground activity (Table 7.1) involved a ball.

Table 7.1 Children's break-time activity preferences

Activity preference	Total children (of 50)	Activity level	Relies on balls	Relies on non-fixed
Handball	22	Active	√	√
Tip/chasing	15	Active		
Soccer	14	Active	√	√
Football	13	Active	√	√
Cricket	12	Active	√	√
Running	8	Active		
Skipping	8	Active		√
Sit and talk	7	Sedentary		
Basketball	7	Active	√	√
Balls	4	Active	√	√
Hula hoops	4	Active		√
Paddlebat	3	Active	√	√
Dance	3	Active		
Netball	2	Active	√	√
Volleyball	2	Active	√	√
Walk and talk	2	Active		
Hide and seek	1	Active		
Brandings	1	Active	√	√
British bulldogs	1	Active		
Wrestling	1	Active		
Sit play/Yugio cards	1	Sedentary		
Fixed equipment	1	Active		
Pop-stars/singing	1	Sedentary		

7.3.4 Teacher playground participation

Most teachers believed that 'teacher presence' positively affected children's playground physical activity:

> "*They are heaps more active because they don't get into a huff and walk off and think they've been treated unfairly. So just being there and being out, intervening occasionally when needed keeps them active"(T1C36-42).*

However, most teachers found it difficult to participate in the playground with children and monitor the playground at the same time. When asked what would assist teachers to participate with the children during break times, some teachers suggested having someone else to do their duty such as a teacher's aide or parent; others believed that most teachers do not dress in a way that allows them to participate (i.e. high heeled shoes, etc). When asked if a lack of facilities to shower and change was a barrier to participating with children during breaks, none of the teachers believed it was. Most teachers believed they wouldn't have time to use these facilities even if they were available.

Almost half of the children (21 of 50) believed playing with a teacher made them more active:

> *"For me, yes because like if a teacher gets involved, it's… basically makes you more activated and it wants you, like it psychs you up a bit and you want to go and play with your teacher. And like, she can teach you how good she can play" (S1C163-167).*

7.3.5 Bullying

Principals at five of the six schools believed that bullying was an issue.

> *"I think bullying is an issue at every school um yes it, it will always be an issue. I think that while there is a zero tolerance policy it happens behind the scenes" (PS75-77).*

The one principal who believed bullying wasn't an issue at their school had only been at the school for approximately five weeks. Four schools had anti-bullying policies and two had policies in development. When asked if bullying impacts on children's playground physical activity, four principals believed it did.

> *"Um it probably does impact on some children's physical, physical activities we've got a couple of very physical boys who don't appreciate their own strength and their own force and that's an issue that constantly arises um*

probably some of the lighter kids wouldn't join in those more physical games because of physical bullying"(PS80-85).

All except one of the teachers believed that bullying was an issue at their school and more than half the teachers believed bullying affected playground physical activity levels.

"You'll see the bigger kids or the bully kids say, it's me and these 2 (the best players) against you's. You know they pick all the best players on their team and then the other kids just get beaten and pummelled and then they just get really upset and they don't want to play any more"(T2BS82-87).

The children were asked whether other children affect how they play during break times. Six children were positively influenced by other children, but half of the children felt other children negatively affected their play. One child stated:

"They're silly and they call me names, they throw balls at me and that interferes with my game. They run in and interrupt the game" (S5BS30-33).

Others said younger children hindered their play by getting in their way:

"*Sometimes the little kids run into the game. Usually we have to stop playing until they go away or something" (S2S49-51).*

Some children described incidents of teasing, cheating, being silly, being 'smart-alecs', annoying them, children deliberately bumping them, limited space and disputes in games. Those who were positively influenced believed that other children were nice to them and encouraged them to have fun:

"It's better to play around with people because you've got a better game, whatever game it is. It's just…you have more fun" (S1C58-60).

7.3.6 School policy

Some schools had policies which directly influenced children's activity levels. One school offered fitness programs during class time, which they believed were mimicked in the playground. Some schools limited sedentary activities (such as computer labs) during break times. One school provided safe areas for younger children to play. Two teachers (one from the least and one from the most active school) believed that policies to encourage activity weren't needed, as they thought

children at their school were active enough. One teacher (from the least active school) said:

> *"But they don't seem to need a lot of encouragement to get up and go out and run around" (T2K30-31).*

Some schools had policies which had a negative effect on children's playground activity levels. Two schools had 'No Hat No Play' policies, where children have to sit in the shade for the break time if they do not bring their hat. Another school had 'no running on concrete' and 'no ball games under covered areas' policies. Some schools limited play time during break periods.

7.3.7 Fundamental movement skills

The teachers were asked if children have sufficient fundamental movement skills and if they thought this affected children's playground activity. Seven teachers stated that fundamental movement skills are taught to younger children (4 to 9 years of age) at their school and that it made a difference to the way children participated in physical activity, as the children were more confident. Four teachers from schools where fundamental movement skills were not a focus (three lower SES), noticed that children often lacked basic skills such as throwing, catching, skipping, hopping and this affected their playground physical activity.

Several teachers observed that overweight or obese children were less likely to participate in active games. One teacher linked a lack of fundamental movement skills to an increased chance of being bullied:

> *"Teachers believed the key was to introduce these skills as early as possible, by the time a child is in year six they are embarrassed about their lack of skills and less likely to participate. Definitely comes back to what I was saying before about the bullying and um children that are not active at recess and lunch because they don't have those fundamental movement skills and if you don't have them then they don't want to get involved because they're not skilled in those areas so they don't want to be ridiculed in one sense and they don't want to put themselves in a situation where they feel uncomfortable"(T1K184-191).*

In general most students were confident in their ability with the games they chose to play at recess and lunch. However just over half (28 of 50) said that there were games that they do not play during breaks but would if they were better at them.

> "*I'd like to play better at running games. I'm really slow at running" (S1S87-88).*

To establish whether children were influenced by what their friends played, students were asked if their friends play the same games as they did at recess and lunch. Approximately half of the children (27 of 50) said that they played the same games as their friends. However, 18 children identified an activity that they would like to play during break times if their friends liked the same game.

> *"sometimes I like playing hand ball but they don't, so I just play with them"(S3W157-161).*

7.4 Discussion

To date, studies have not used qualitative data collection techniques when identifying children's school playground physical activity determinants. Several key findings from the interview component of this study highlight the importance of this methodology and its contribution to the current literature. The issue of playground bullying and its effect on playground physical activity levels were a major determinant identified by students, teachers and principals. The effect of bullying was deemed to reduce when children had access to non-fixed equipment, and to negatively affect children with poor FMS. In addition, children's playground physical activity was influenced by school policy to which small changes may have a marked effect on children's activity levels. Importantly, these findings raise the notion that multiple changes to the physical playground environment may be ineffective, if psychosocial and policy variables are not considered.

Bullying appeared to have an effect on the playground activity levels of children. Children indicated that other 'children wreck their games in the playground' and when asked 'what a nice playground looks like' some children made reference to psychosocial variables such as: 'no fights, feeling safe, people you can trust'. Some teachers stated that non-fixed equipment assisted in creating a more cohesive environment and reduced bullying. In addition, several teachers noted in schools

where FMS were not a focus, a child's lack of FMS skills increased their chance of being bullied.

Whilst there are many studies which have investigated the incidence of bullying in the school playground (Craig, Pepler et al. 2000; Malone and Tranter 2003; Leff, Costigan et al. 2004), none have linked bullying and children's school playground physical activity levels. In contrast to the questionnaire component of this study, where principals did not believe that bullying affected playground physical activity levels, during the interviews principals, teachers and students indicated that bullying impacted on playground physical activity levels. Almost half the children stated that bullying affected the way that they played during break times. Three of the four schools where principals believed bullying impacted on children's playground activity levels were schools with the lowest levels of observed playground physical activity.

Previous research indicates an association between FMS and the use of similar skills in the playground or an increase in children's interest in physical activity (Blatchford and Sharp 1994; Okely, Booth et al. 2001; Salmon, Timperio et al. 2005). These finding are supported by this research as children seemed to play games in which they were confident. The teachers believed that children benefited from being taught sound FMS from an early age, and that a lack of FMS affected their participation in playground physical activity. Ensuring children are taught fundamental movement skills in early schooling may increase playground physical activity levels.

Free access to non-fixed equipment was believed to markedly increase children's break time playground activity during the environmental data collection. This finding was strongly supported by principal, teacher and student interview data. In addition, 13 of the 23 games preferred by children in break times involved non-fixed equipment (Table 7.1). Ten of the activities most preferred by children involved a ball (Table 7.1). These observations are supported by the environmental findings, which indicated that children involved in ball play were significantly more active (Parrish, Russell et al. 2009b). In addition, principals, teachers and children agreed that non-fixed equipment created a more cohesive playground environment and prevented boredom and bullying. Playground markings were generally seen to positively affect playground activity, which supports previous findings (Parrish, Russell et al. 2009b).

Policies relating to 'time available for play' can impact on children's playground physical activity. It is recommended that children be offered the maximum time available for play as it significantly affects their activity levels (Parrish, Russell et al. 2009b). Some schools allowed children to play as soon as their food was eaten, while others had a 10-20 minute compulsory 'sitting time' for eating. A revision of individual school policies has the potential to increase children's playground activity levels.

School policies reflect safety issues, which in turn may affect physical activity levels. Australia has high levels of skin cancer, and most schools have policies for skin protection such as 'No Hat, No Play'; children are required to wear a hat or they are punished by not being allowed to play. Whilst this policy is effective in managing children's sun protection, it affects children's physical activity levels, which is another important health determinant. A different form of consequence such as the 'No hat, play in the shade' policy still gives children an opportunity to be active, whilst maintaining skin protection. Small changes to school policy could have a marked effect on children's physical activity levels.

Little is known about how children's clothing affects playground physical activity levels. It is possible that school uniforms restrict children's playground physical activity levels. Most Australian children are required to wear school uniforms; males generally wear shorts and a shirt, and most females wear dresses. Most children are required to wear a different uniform on sports days (1 or 2 days of each week). The fact that children are required to wear a different uniform to be active on sports day, indicates that they are usually not dressed appropriately for physical activity. In addition, it is well documented that males are more active in school playground break times than females (Zask, van Beurden et al. 2001; Verstraete, Cardon et al. 2006; Ridgers, Stratton et al. 2007; Parrish, Russell et al. 2009b), which may indicate that uniforms restrict females playground physical activity levels. When asked: 'what is the best type of clothing to play in' nearly all of the students (N = 28, both males and females) showed a preference for shorts and a t-shirt (an additional seven females preferred shorts or skirt and a t-shirt). A revision of school uniform policy may increase all children's playground physical activity levels; in particular the female population.

The children indicated a preference for active playground games, yet children from the least active schools spent less than half their playtime being active. It is possible that a combination of policy, environmental or psychosocial barriers at their school prevented them from being involved in the games they prefer.

Previous research indicates that children and adults are more likely to be active in aesthetically pleasing environments (McLellan 1999; Sallis, Conway et al. 2001; Humpel, Owen et al. 2002). Nearly all of the teachers agreed that playground aesthetics positively affected children's playground activity. The main variable that children identified as part of a 'nice' playground is fixed equipment. This is surprising given that only one child indicated a preference for playing on fixed equipment during break times. It was also surprising that a number of children made reference to psychosocial variables when asked 'what a nice playground looks like' such as: no fights, people you can trust, play nicely and feeling safe. These variables have not been identified in previous research.

Approximately half the children believed playing with a teacher made them want to be more active. Approximately half the teachers believed teacher presence had a positive effect on children's physical activity levels. Teachers believed that children were more active if the teacher acted as a referee in their games. This finding contrasts with previous environmental findings (Parrish, Russell et al. 2009b), which indicated that children's playground activity decreased when teachers managed or observed their play. It may indicate that whilst children enjoy teachers participating in their games, when teachers begin to manage play, children's activity decreases. There were however limited opportunities where teachers participated in children's games. Most teachers indicated that it was not possible to participate in activity while they had a responsibility to monitor the playground.

Teachers were asked if the absence of change and shower facilities affected them wanting to participate with children. Most either indicated that this did not affect them or that they would not have time to use the facilities anyway. These results indicate that the introduction of change or shower facilities to encourage teachers to participate in the playground with children is not warranted. Interventions focusing on playground physical activity may need to address playground bullying to be effective.

The impact of playground bullying on children's playground physical activity levels warrants further investigation.

A limitation of this study was the larger number of students from lower SES than from average SES. The lower numbers of average SES students responses may have limited the range of students perceptions reported as influencing physical activity in schools. In addition, interview data may have been limited, as schools were from one geographic region of NSW Australia.

7.5 Conclusions

Previous research has not used qualitative data collection techniques when identifying children's school playground physical activity determinants. The findings from this research highlight the importance of this methodology and its contribution to the current literature. Several key determinants were identified. The issue of bullying was deemed to have a considerable impact on children's playground physical activity levels and may also affect children with poor fundamental movement skills. The presence of non-fixed equipment was believed to create a more cohesive playground environment by preventing boredom and bullying. In addition, children's playground physical activity was influenced by school policy to which small changes may have a marked effect on children's activity levels. Importantly, these findings raise the notion that multiple changes to the physical playground environment may be ineffective, if psychosocial and policy variables are not considered.

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CHAPTER 8

Conclusions and implications for future research

8.1 Research summary

The purpose of this research was to identify variables that affect the school playground physical activity levels of primary children during recess and lunch breaks. The multi method approach was unique and a strength of this study. It provided important, new insight and confirmation of previous findings about variables affecting primary school children's physical activity levels during break times. The results of this study supported previous findings that: males were generally more active than females; access to non-fixed equipment and ground targets significantly affected the activity levels of children; and that teachers believed a lack of FMS affected children's participation in playground physical activity. New information indicated that: children were less active in shorter breaks and more active in unshaded areas; there were marked differences in the length of time children were allowed to play during the breaks at the 13 schools in the study (55-130 minutes over 3 days); children are sometimes prevented from playing as a form of punishment; children were significantly more active on soft play surfaces; and of particular importance, that psychosocial variables such as bullying affected the playground physical activity levels of children.

The studies within the thesis include: a systematic review of the methods used to measure the unstructured playground activity levels of children in school break times (Chapter 2), observational data to compare differences between the proportions of MVPA children at the 13 schools (Chapter 3), to determine which environmental correlates affect children's school playground physical activity levels (Chapter 4), the development of a 'picture questionnaire instrument' (CAP) to assess young children's playground physical activity preferences (Chapter 5), an investigation of the physical and psychosocial determinants of children's school playground physical activity using questionnaires (Chapter 6) and qualitative data to further investigate psycho-social determinants of the factors affecting children's school playground physical activity levels (Chapter 7).

The purpose of the systematic review (Chapter 2) was to describe and compare existing approaches to assess the playground physical activity levels of primary/elementary children

during school recess and lunch breaks, and in doing so inform future research. The results revealed different approaches to collecting data in the school playground environment, making between-study comparisons difficult. The choice of physical assessment instrument should be directed by study objectives, sample size, and design. Studies may also be limited by the availability of funding to support data collection.

In chapter three, the CAST2 observational instrument was used to rank 13 schools to determine if there were significant differences between the proportions of moderately or highly active children in school playgrounds, including noting differences in the proportions of active males and females. Significant differences were found between the proportions of active children at the 13 schools involved in the study. The overall proportion of children who were moderately or highly active was 56%; however, individual school proportions ranged from 40 to70%. This finding disclosed the necessity to compare different school environments to determine the cause of disparities in the proportions of active children during break times; especially in schools where the recess period was clearly underutilised and activity levels were as low as 40%. In addition, this study assessed: instrument inter-rater reliability; associations between playground activity and length of break time; and, differences between playground activity levels of males and females and differences between schools with lower and average SES. There were noticeable disparities between total break times at the 13 schools, indicating that restricted school break times remove one of the few outdoor opportunities for children to be active. CAST2 instrument calibration indicated that correlations between observers were consistently high, supporting previous reliability analysis of the instrument. An analysis of variance of the mean proportions of three days of observed activity indicated that one day of activity data did not adequately represent three days of activity data. Thus it is recommended that a minimum of three days of data collection is appropriate for observational data. The results of this study confirm a need to address gender but not socioeconomic differences in physical activity.

In chapter four, school playgrounds were compared to determine which physical environmental correlates had an effect on children's physical activity levels, using the CAST2 determined proportions of active children for each of the 13 schools. Environmental variables were recorded for each school, including the availability of play areas, shade areas, fixed and non-fixed equipment, temperature/humidity and length of break time. The findings indicated

that children were more active for each additional minute of time officially allocated to recess and lunch break. The longer the children played the more the MVPA gradually declined. Children were more active in the playground when they had access to larger playground areas (e.g. sporting fields) and played in unshaded or partly shaded areas. Children were significantly more active when they were involved in ball games, had free access to non-fixed equipment and when ground targets were present. The type of playground surface significantly affected the playground activity levels of children when children played on soft-play rubber surfaces. The total area available for play did not significantly contribute to children's playground physical activity levels. Children were significantly less active when temperatures were high or if it had been raining before the break. Female students were less active than males during break times. When teachers were managing or observing in the playground, children's activity declined. There was no effect when teachers encouraged children, but this finding may have been due to limited numbers.

The study in chapter five was motivated by a lack of self-report instruments to assess young children's physical activity levels. The study aimed to develop a self-report instrument which was quick and convenient to administer, age appropriate, appealing to young children, not reliant on memory recall, and mindful of their limited attention span and their limited ability to read/comprehend. The newly developed instrument is unique as there are no physical activity self-report instruments designed for children of this age. It assessed the reliability and validity of the CAP self report instrument, compared children's activity preference categories (low, moderate and high) and actual observed playground physical activity levels. Results indicated that children preferred moderate or highly active games in the school playground; unfortunately preferences did not correlate with actual playground physical activity levels. There was no difference between activity picture preferences across all age groups (4-9 year olds). Activity preferences of gender and SES groupings were not significantly different from each another. The CAP instrument's reliability coefficient was statistically significant but did not achieve the desired minimal level, $r = 0.7$. Low instrument reliability of CAP may have been affected by several factors: the study involved a younger group of children than most studies; parents and teachers were not involved in questionnaire completion; and the duration between test-retest was longer than in most studies. However, a shorter test-retest period is not recommended as it may not give a true indication of instrument reliability. As this instrument was only recently developed, further refinement and testing of CAP may increase its reliability coefficient. While validity results were modest, it is anticipated that correlation

coefficients may improve if future research involves a larger sample, and more days of accelerometer monitoring. Whilst the CAP questionnaire has several limitations, it contributes to the investigation of self-report methods for assessing young children's playground physical activity preferences.

To date, there has been little exploration of the psychosocial determinants of children's playground physical activity levels. The purpose of the study in chapter six was to develop self-report questionnaires for primary aged children and teaching staff using the Social Cognitive Theory to identify physical and psycho-social determinants which affect children's break-time playground physical activity. The findings indicate that high proportions of children believed that a lack of time, the weather and school uniforms were barriers to school playground activity. Children's physical activity preference was significantly affected by psychosocial variables, such as 'being bullied', 'fear of getting hurt', 'not liking activity' or 'being too shy to play'. In addition, males showed a greater preference for more active games than females. Notably whilst one in five children believed that bullying prevented them from being active in the playground during break times, only one of nine principals believed bullying prevented children from being active. A significant number of teachers believed that a lack of non-fixed equipment was a barrier affecting children's playground activity levels. However, only one third of school principals planned the purchase of playground equipment and less than half of the principals believed the purchase of non-fixed equipment should be a high priority at their school. It was interesting that all the barriers which significantly affected the activity preference of children were psychosocial, in contrast to physical playground barriers identified by the teachers. Results suggest that children's playground physical activity may be greatly affected by psychosocial determinants. Current measures to change or improve the physical environment of school playgrounds may be wasted if psychosocial issues are also not addressed.

The purpose of the final chapter was to explore in greater detail staff and student opinions of factors which influence the school playground activity levels of children. Previous research has not used qualitative data collection techniques when identifying children's school playground physical activity determinants. The findings from this research highlight the importance of this methodology. Several key determinants were identified. The issue of bullying was deemed to have a considerable impact on children's playground physical activity levels, and may also affect children with poor fundamental movement skills. The presence of

non-fixed equipment was believed to create a more cohesive playground environment by preventing boredom and bullying. In addition, children's playground physical activity was influenced by school policy to which small changes may have a marked effect on children's activity levels.

8.2 Limitations

The results of the research should be interpreted cautiously given the limitations. A limitation of the CAST2 observational strategy, which was not previously recognised by Zask and colleagues (2001), is that the same children may have been counted more than once during an observational scan, if they moved within the viewing area. An additional limitation is that the reliability analysis of the CAST2 instrument in this study involved observers calibrating only moderate activity; low and high activity levels were not calibrated. Non-significant associations between children's playground physical activity and observations of teachers encouraging children in the school playground may have been limited by the small sample. The effect of the soft-play playground surface was highly significant; however it is recommended that this variable is further researched due to the limited numbers of schools in this study with a soft-play playground surface.

Only a small sample of children was involved in validating the CAP questionnaire instrument against accelerometers. Results may have been improved with a larger sample. In addition, children may have indicated a picture preference on the CAP questionnaire but, in some schools, could not access the preference in their school playground. Future instrument development could provide a template which may be modified to suit each school environment. The number of pictures on the CAP questionnaire could have limited children's choices.

There were inconsistencies and incomplete data related to the reported numbers of males and female students at each of the schools in the study. Finally the research design for the interviews resulted in a larger number of students from lower SES than from average SES; the findings may have been affected by this variable.

8.3 Suggestions for future research

This research poses the question: how can the 75 minutes available each day in break times be used to increase children's playground activity? Several key determinants were identified by this research and may have the potential to increase children's opportunities to be active in the school playground during break times. These include policy, physical environmental and psycho-social determinants.

Zask (2001) found that longer break times increase children's playground physical activity. Each school is autonomous in the allocation of break time and the use of the break period for play. Departmental policy allows up to 75 minutes a day for recess and lunch time, however, there were marked differences in the length of time children were allowed to play during the breaks at the 13 schools in the study (55-130 minutes over 3 days). In addition, there were differences in the overall time that schools allocate to recess and lunch. For instance, some schools may have a long lunch break, but their policy required children to sit for extended periods of time to eat lunch before playing. Each school could reassess their policies governing school break times to ensure that children are not sitting unnecessarily. For instance it has been observed that older children eat their lunch faster than younger children. In this instance, children could be allowed to play when their lunch has been eaten. In addition, it is possible that teaching staff and administrators are unaware of disparities between school break times, time available for play and the contribution that break-time can make to children's decreasing opportunities for activity. A change in awareness of the importance of using break time to increase children's physical activity could be brought about by providing information at in-service courses, conferences and during initial University training. It may be necessary to implement policy with a minimum requirement for the amount of time allocated to recess and lunch to ensure children have adequate time to play and be active. In addition, future research could address the reasons for the disparities between break-times in different school environments.

Activity during the recess and lunch periods can be restricted for many reasons. Children are sometimes prevented from playing as a form of punishment. In many Australian schools children are punished for not having a school hat due to the 'No Hat No Play' policy. Whilst this policy is important for sun safety, a compromise could be 'No Hat, play in the shade' policy. This would ensure children are still restricted in their play, but not confined to

sedentary behaviour for the entire break period. Furthermore, some schools allow access to sedentary pastimes such as computer labs during the break period, which jeopardises one of the few screen free times available for many children, further limiting opportunities for activity. Children already spend the majority of the school day being sedentary; therefore, it is recommended that schools should be encouraged to have policies which discourage sedentary past times during school break periods.

The teachers believed that children benefited from being taught sound Fundamental Movement Skills (FMS) from an early age, and that a lack of FMS affected their participation in playground physical activity. Bauer (2004) found some children were embarrassed about their physical activity competencies. The findings from this study indicate that FMS are not being taught at an early age in all schools. Children who are not confident with these skills may not participate and could be fearful of being bullied or teased. Policy which ensures children are taught fundamental movement skills in early schooling may increase playground physical activity levels.

In addition, it is possible that many teachers are not confident in their ability to teach physical education, including FMS (Dudley 2007). Some Australian states provide specialist primary trained physical education teachers. Currently this resource is not available in New South Wales. Providing such a resource Australia wide could potentially positively influence most children's playground activity levels.

It is possible that children's school playground activity is restrained by risk of injury. It is not uncommon to hear teachers telling students not to run in the playground, especially on hard surfaces. Findings from this study indicate that children were significantly more active on soft play surfaces such as shredded rubber surfacing, or a combination of bark, sand and grass. Future research should investigate this variable on a wider scale. It is possible that new schools designed using large areas of soft-play surfacing may have the advantage of reducing injury and increasing physical activity levels.

As found in previous research, access to non-fixed equipment and ground targets significantly affected the activity levels of children (Sallis 2001; Ridgers, Stratton et al. 2007; Willenberg, Ashbolt et al. 2010), yet the distribution of school funding to the purchase of these resources is often limited. There is a need to create an awareness of the importance of purchasing non-

fixed equipment at all schools and to ensure that department and government level funding is used for this purpose. Policy may be introduced to influence where funding is spent to ensure it is allocated for the purchase and maintenance of non-fixed playground equipment at all schools. At the school level, free access to non-fixed equipment is important. It is imperative that undergraduate teachers and current staff are aware of the importance of this intervention. Future research could directly assess the impact of a study which allocates non-fixed equipment to intervention versus control schools (no equipment) to assess the impact on children's school playground activity levels.

Children were less active in shorter breaks and more active in unshaded areas. Often children are not allowed to access sporting fields in shorter breaks or in the first half of lunch due to staffing restrictions. If funding were made available for additional support staff to assist with playground monitoring, children could have wider access to playground areas thereby potentially increasing their daily physical activity levels. If more playground staff were available, it could provide more opportunity for staff to participate with the children. High proportions of children indicated that they liked to play with the teachers and several staff indicated they would participate with the children if they were not restricted to monitoring the playground. Alternatively, changes to supervision scheduling may improve children's daily activity levels.

As found in previous studies, a common theme throughout this research was gender differences in activity levels; males were generally found to be more active than females (Trost, Pate et al. 2002; Riddoch, Bo Andersen et al. 2004; Rowlands, Pilgrim et al. 2008). Weir (Weir 2001) found that one in five children are affected by bullying. The findings from this research indicate one in five children was deterred from being active in the playground, as they fear being bullied. It is possible that males dominate the playground. It may be necessary to provide opportunities for females to play in areas of the playground away from males. In addition, males showed a greater preference for more active pastimes. It is possible that current outdoor activities are directed towards male preferences; for example few schools provide the equipment or opportunity for dance in break times, which is a more female oriented activity. Both genders preferred to wear shorts and a t-shirt as a uniform. Uniforms may restrict the activity levels of all children, but in particular that of girls (e.g. dresses, skirts, tights, leather shoes). In addition, most schools have a different uniform for sport or physical education, which suggests children require certain clothing to be active. Only two percent of

teachers thought that children's school uniform restricted their playground activity, indicating that there is a need to increase the awareness of school and parental boards regarding uniforms. If school and parental boards were made aware of gender differences in activity, it may influence decision making about girls' uniforms. There are many unanswered questions regarding gender discrepancies in playground physical activity, warranting further investigation.

To date, research has not investigated the effect of psychosocial variables such as bullying on playground physical activity levels of children; it is possible that environmental interventions may not be successful if psychosocial factors are not considered. All of the barriers which significantly affected the activity preference of children (in years 4 to 6) were psychosocial. Physical environmental interventions designed to increase children's playground physical activity may need to incorporate policy and psychosocial variables to be successful. Future playground research should consider physical, policy and psychosocial variables to ensure all determinants of playground activity levels are addressed.

The purpose of this research was to identify determinants that affect the school playground physical activity levels of primary children during recess and lunch breaks. The findings suggest that future assessment of the physical activity levels of children in the school playground environment should consider policy, physical environmental and psycho-social determinants.

8.4 Where to next?

Future research could investigate the effect of interventions designed to prevent school playground bullying and their impact on children's physical activity levels. Research could investigate the effect of interventions which implement environmental changes to school playgrounds (e.g. non fixed equipment, playground markings or soft play surfaces) and their impact on children's playground physical activity levels. Interventions could assess the effect of school policy changes (e.g. length of break time, no hat no play, time available for play, access to large playground areas) on children's playground physical activity levels. An intervention could target females by making gender specific changes (e.g. changes to uniforms, gender specific activities and play areas, access to equipment) and assess its impact

on the physical activity levels of female students. Research investigating children's FMS, could assess whether skill competence affects children's playground physical activity levels.

Table 8.1 Key recommendations for schools

1. Children believed that a lack of time prevented them from being active and were found to be more active during longer breaks. Due to the noticeable difference in school break times at the schools involved in the study, it is recommended that schools reassess their break times; in particular, the time available for children to be active.
2. Children were more active in larger playground areas (e.g. sporting fields). It is recommended that schools reassess policies to allow children as much access to sporting fields as possible.
3. A significant number of teachers believed a lack of non-fixed equipment was a barrier affecting children's playground physical activity. Non-fixed equipment was believed to create a more cohesive playground environment. Children preferred moderate or highly active games and were more active when they had free access to: non-fixed equipment, playground markings and balls. It is recommended that schools consider the use of such items to encourage playground physical activity.
4. Some children believed 'a fear of getting hurt' prevented them from being active. Children were significantly more active on rubber based soft play surfaces. It is recommended that new schools or schools that are upgrading playgrounds should consider incorporating a soft play surface in playground areas.
5. One in five children believed that bullying prevented them from being active in the playground during break times. It is recommended that playground bullying policies are introduced and their implementation and outcomes regularly monitored.
6. Children believed school uniforms were a barrier to them being active. Most children preferred to where a polo shirt and shorts. It is recommended that schools consider reassessing their uniform to encourage playground physical activity.
7. Boys were generally more active than girls. It is recommended that schools provide opportunities for girls to be active, which may involve gender specific activities (such as dance) or areas set aside for girls to play. Note: It is also possible girls are more restricted by their uniform than boys.
8. Some schools where Fundamental Movement Skills (FMS) were not a focus found that children lacked basic skills which may affect their playground physical activity. In addition, children with poor FMS may be affected by playground bullying. It is recommended that schools incorporate FMS into the curriculum from kindergarten onwards.
9. Some schools have 'no hat, no play' policies. It is recommended that schools introduce 'no hat, play in the shade' policies to encourage activity during break times.
10. There were disparities between schools in regard to the amount of time children had to sit and eat before playing. It is recommended that schools reassess allocated eating time to ensure children have as much time as possible to be active. It may be necessary to consider the difference between 'eating time' required by younger and older children.
11. Schools should discourage the use of sedentary pass times (e.g. access to computer labs) during break times.

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Appendices

Appendix A: CAST Tool Training manual

Children's Activity Scanning Tool Manual

Children Activity Scanning Tool

A training manual for the IH research project

Prepared by Pip Budgen

Acknowledgements
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24 November 2003

PHYSICAL ACTIVITY MEASURING TOOLS

1. SOFIT (System for Observing Fitness Instruction Time)

SOFIT is an objective tool for assessing the quality of physical education instruction (1). It is a comprehensive system that provides a measure of student activity, lesson context, and teacher behavior during class time.

SOFIT involves the direct observation of lessons by trained observers and has been used to assess physical education in over 300 schools throughout the United States. These include the CATCH (3,4,5) M-SPAN, and SPARK (2,8) Projects which are three intervention studies supported by the National Institutes of Health. The main focus of SOFIT is on the coding of student physical activity levels and selected environmental factors (lesson context and teacher behavior) that are associated with opportunities for students to be physically activity and become physically fit.

SOFIT student physical activity codes have been validated by both heart rate monitors (1,10) and CALTRAC accelerometers (6). Lesson context categories have been developed from definitions used commonly in physical education evaluation research (9). Reliabilities for independent trained observers have consistently exceeded 90% agreement on all SOFIT categories, which indicates the measures are accurate (1,2,4,5,8).

SOFIT enables teachers and researchers to make judgments about physical education lessons, particularly as they relate to program goals.

The SOFIT System--Technical Description

Student physical activity engagement.
A decision regarding the physical activity levels of individual students is made. Each student's involvement decision determines his/her **level of physical activity** (active engagement level). The engagement level provides an estimate of the intensity of the student's physical activity. While the CATCH (3, 5) and MIGI (11) programs used 5 activity codes, it is proposed that the IAHS playground activity project will amalgamate codes 1, 2 and 3 into a 'non-active' level while retaining the codes for moderate PA (walking) and running (vigorous PA). The higher the code, the higher the student's rate of energy expenditure. See table below for a quick reference to activities and their corresponding codes.

2. CAST 1 (Children Activity Scanning Tool)

In all the projects mentioned above SOFIT was used to gauge PA levels in PE classes and other aspects of PE classes like lesson context were also recorded. However, for the IH project SOFIT categories will only form the basis to using the CAST instrument in the playground.

Thus, a decision regarding the activity level of each student in the playground will be made by every observer as they scan the playground. See the following table for a summary of PA levels used in CAST:

Using CAST in the field
CAST is an instrument that uses the SOFIT categories to assess PA levels of children in school playgrounds. It was developed in the NRAHS as part of the MIGI project (11).

The following is an extract from a paper published on the use of CAST (13, pp 403-404):

> "The Child Activity Scanning Tool (CAST) was developed to assess PA levels, equipment availability/use and teacher presence/behaviour during school break times of recess and lunch. It used a team of five observers to simultaneously and repeatedly scan a play area every 75 seconds (by audio taped signal) until the break ended. For full viewing coverage, each playground was divided into discrete areas which were given equal scanning time. For each scan, all observers simultaneously swept the area visually in the same direction. All schools had a designated eating time at the start of the lunch break that was not included in the observation.
>
> Scans alternately focused on boys and girls. The task of each observer was to first scan the designated area for the number of boys or girls engaged in one of five PA levels according to the SOFIT instrument…. Each observer was also allocated an equipment or teacher category to observe and record on their second sweep. Equipment categories were: number of balls in the area, number of children playing ball games ie focused on a ball (eye contact and body language/direction) and/or actively manipulating the ball, number of children playing with non-fixed equipment other than balls, number of children playing on fixed equipment. Teacher behaviour/presence categories were: number of teachers present in area, number of teachers encouraging PA ie verbal encouragement/feedback or teacher's participation in activities, number of teachers observing including passive supervision, number of teachers managing including discipline, allocating equipment and active involvement in playground supervision.
>
> Prior to each scanning session, temperature and humidity (by hygrometer; for heat stress level) and 'wet' or 'dry' day ('wet' if evidence of rain prior to or during observation) were recorded along with numbers of available equipment items..."

3. CAST 2 (Children Activity Scanning Tool)

CAST (2) is used in a similar way, but only 3 PA categories will be recorded. That is, the categories of lying, sitting and standing are merged into a category ‘non-active’.

The team’s size can be 3 or 4 observers. If 4 observers are used, 3 observers can record the 3 new categories of PA while 1 observer can count the total number of children in the playground. After finishing the first sweep measuring the PA levels, a second sweep for equipment usage and availability and teacher behaviour can be undertaken. Intervals between scans may need to be longer because the observation team will be smaller, but will still need to record equipment usage and teacher behaviour (which may require another sweep in each scan).

Activity Categories:	Non-active; moderate; vigorous
Equipment categories:	no. playing with a ball No. playing with equipment (skipping ropes, frisbes etc) No. playing on fixed equipment No of balls in playground
Teacher Categories:	Encourages – shows support Observes – is present in the playground Manages – actively organising the activity

CAST CATEGORY				
1 NOT ACTIVE			**2 MODERATE**	**3 VIGOROUS**
(Lying)	**(Sitting)**	**(Standing)**		
Face up	On ground/flat	Free	Straight	Straight
Face down	On seat/object	Leaning on	Side ways	Side gallop
On side	Sitting on legs w feet flat on ground	Shift weight one foot to other	Sliding	Kick
Feet up (lean)		Slow shuffle	Crawl	Vigorous crawl
		Stationary in squat	Strong stretches	Tumbling
		On all fours	Going into or up from squat	Swinging from arms
		Bouncing ball while sitting	Throw frisby	Self propel on swing
		Bent over stationary	Throw ball above shoulders	Chin ups
		Being pushed on swing	Going into or up from bend	Skip
		Gentle stretches	Bouncing ball while standing	Push Ups
		Sitting on legs w feet up on toes	Hang	Walking +bouncing ball
		Sitting on one leg other foot out front.	‘Lazy’ block (netball defence)	Jump

CAST CATEGORY & EXCEPTIONS				
1 (Lying)	**1 (Sitting)**	**1 (Standing)**	**2 (Walking)**	**3 (Running)**
Rolling 2/3	Sliding 1/2/3	Into squat 2	Skip 3	
Tumbling 2/3	Bouncing 2/3	Up from squat 2	Shuffling 1	
Push ups 3	Into squat 2	On tip toes 2		
	Sit ups 2/3	Throw ball above shoulders 2/3		

Using the scoring sheet

Good quality data is essential to the evaluation of your project. As part of the team you can ensure that quality is achieved and maintained. Please don't leave the site until your team leader has checked that your records are complete and readable.

Fields to be recorded:

Total kids enrolled Get this information from the school's office or principal.

Total teachers employed Include all full time, part time and casual teachers.

Starting and finishing times Sometimes there is a gap between break and scanning commencement, so we provided 2 separate entries for break commencement and finish and for scanning commencement and finish. You may want to comment if there is a big difference eg scanning stopped as we ran out of batteries/interrupted by rain. Check that all members of your team have recorded the same time.

Observer Team Identifier String together all first and lastname initial of all team members.

Wet or dry If there is evidence of there having been rain earlier on the day or if it is raining at the time of observation then circle 'wet' otherwise circle 'dry'.

Temp dry bulb These are taken from the wet/dry thermometer apparatus as

Temp wet bulb described in the attached 'Wet Globe Thermometer
Humidity Procedures'

N children by CAST category Record number of boys or girls observed in each scan in the activity level which has been assigned to you.

No. balls Total number of balls in the playground on this scan.

No. play ball Number of kids of gender being scanned (boy/girl) who are engaged in a ball-based activity.

No. play equipment Number of kids of gender being scanned (boys/girl) who are engaged in an activity using non-fixed equipment.

No. play equipment Number of kids of gender being scanned (boys/girl) who are engaged in an activity using fixed equipment.

Teacher behaviour Encourages – shows verbal or non verbal gestures supporting participation eg clapping, pat on back, cheering
Observes – is present in the playground
Manages – actively organising the activity
Enter the number of teachers engaged in each behaviour on this scan.

Please note:

	No active		**Moderate active**		**Vigorous active**	
Boys 1	**3**	**7**	**2**	**5**	**1**	**2**
Girls 1	**4**	**2**	**1**	**7**	**0**	**3**

- **This indicates that in the first 2 scans there were:**
  37 boys and 42 girls sedentary

  25 boys and 17 girls moderately active

  12 boys and 3 girls vigorously active

- **Unlike all other entries which alternate between boys and girls, the number of balls in the whole playground will be recorded each time.**

- **Please don't leave any fields blank on the front page of the scoring sheet unless instructed to do so by your team leader. (Eg: If you check and can see no monkey bars then enter a zero (0) to indicate that you did check. A blank will make it difficult to know what actually occurred).**

- If you accidently enter a wrong number, make sure that the correct entry is readable. (It may be clearer to put the correct value in a margin with an arrow pointing to the original spaces rather than try to squash it in where there is not enough space).

- **If you miss a score enter a (-) in the space rather than leaving it blank.**

- **All scans need to be completed in the same direction eg right to left.**

- **All scans need to start at the same time.**

- **If possible jot down any other relevant information that may add to the school playground picture eg school training for 'jump rope for heart', children at choir practice, all girls wearing shorts.**

Logistics:

- **Person 1 scans :** **not active and**
  # playing with equipment

- **Person 2 scans** **moderate**
  # playing on fixed equipment

- **Person 3 scans** **vigorous**
  # playing with ball

- **Person 4 scans** **total girls/boys**
  # balls

  teacher behaviour

- **if only 3 people scan: activity categories**
- **if only 2 people scan total and sedentary**

Children Activity Scanning Tool (CAST 2) Scoring Sheet

Date:		**School name:**	
Total kids enrolled:		**Total number of teachers employed by school:**	
Time break started:		**Time break ended:**	
Time scanning started:		**Time scanning ended:**	
Observer team identifier:			
Wet □ Dry □	**Temp dry bulb:**	**Temp wet bulb:**	**Humidity:**
N fixed equipment components:			
Painted targets on walls		**Painted targets (ground)**	
Monkey bars		**Slippery Dips**	
Netball hoops		**Basketball boards/hoops**	
Other			

Play area & Break #	Scans	N of children in each category								Equipment usage						Equip Avail.		Teachers behaviour		
		1 Not activ		2 Mod erate		3 Vigo rous		Indiv Total		No. play ball		No. play Equip		No. Play fix		N Balls		Enc oura ge	Obs erve	Mana ges
	BOYS1																			
	GIRLS1																			
	BOYS2																			
	GIRLS2																			
	BOYS3																			
	GIRLS3																			
	BOYS4																			
	GIRLS4																			
	BOYS5																			
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	BOYS19																			
	GIRLS19																			
	BOYS20																			
	GIRLS20																			

CAST Team Task List

Task	Done
Get to the school at least 30 minutes prior to recess/lunch commencement	
Notify reception that you have arrived (you may need to sign the school's visitors book)	
Fill in the school and observation details	
Check whether there is a special allocated eating time in the start of the recess/lunch period	
Allocate who observes which category and circle them (or highlight) for each observer	
Ensure every observer has enough blank forms	
Ensure your team has a copy of the school site map.	
Walk around the whole playground area checking for potential hidden play areas	
Decide on observation positions and movement between them. Make sure you spend an even amount of time in each 'vantage point' and allow time to move between them (eg for a 23 minutes recess period with three 'vantage points' when movement between them takes a minute, allow 7 minutes per location + 1.5 minutes of moving between them). Mark locations on the site map	
Designate a time keeper/announcer	
The time keeper keeps a walkman on and calls "now" when s/he hears the sound or uses a tape deck	
Decide direction of 'sweeping' the playground areas you observe. Mark it on the school site map using arrows.	
Collect all record forms at the end of the observation and enter into the raw data folder	
Check and record number of children attending school on observation day (may need to be done by phone later)	
Check and record whether other activities took place (eg choir practice) and estimated number of children participating	

THINGS TO NOTE:

- Once you start counting children in the 'sweeping' direction, don't go back
- The number of children participating in ball games (No. play ball) is the hardest to determine
- Children that are waiting their turn to do an activity within a game are counted even if they are not currently hitting/batting etc.
- Any children in the game area whose body language suggests they are part of the game (ie turning towards where ball is, eye contact) are counted even if they are currently passive. If you are at all uncertain whether they are participating in a game, do not count them.

If you are asked what you are doing by a child or a teacher always give the following answers:

· **Teachers:** Tell them you are observing physical activity in the playground. If asked further, say you are looking at what activities children are engaged in. If they want more information (which is very unlikely), please give them the project officers' contact numbers.

· **Children:** Tell them we are looking at what kids do in the playground.

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Appendix B: Questions derived from the Social Cognitive Theory (SCT)

Table (i). Questions for Children derived from the SCT

First Question: Do you know what Physical Activity and being active means?

SCT Constructs	Examples of questions derived from construct
Environment	1.What do you need to play with/on at recess and lunch?
Behavioural capability	2.Do you like to be active? 3.Are you good at being active?
Outcome expectancies	4.What may stop you from being active and why?
Self control	5.Do you think being active is important and why?
Observational learning	6.Who do you copy in the playground?
Reinforcement	7.In what ways do the teachers and school encourage you to be active?
Self-efficacy	8.What do you like to play at playtime?
Reciprocal determinism	

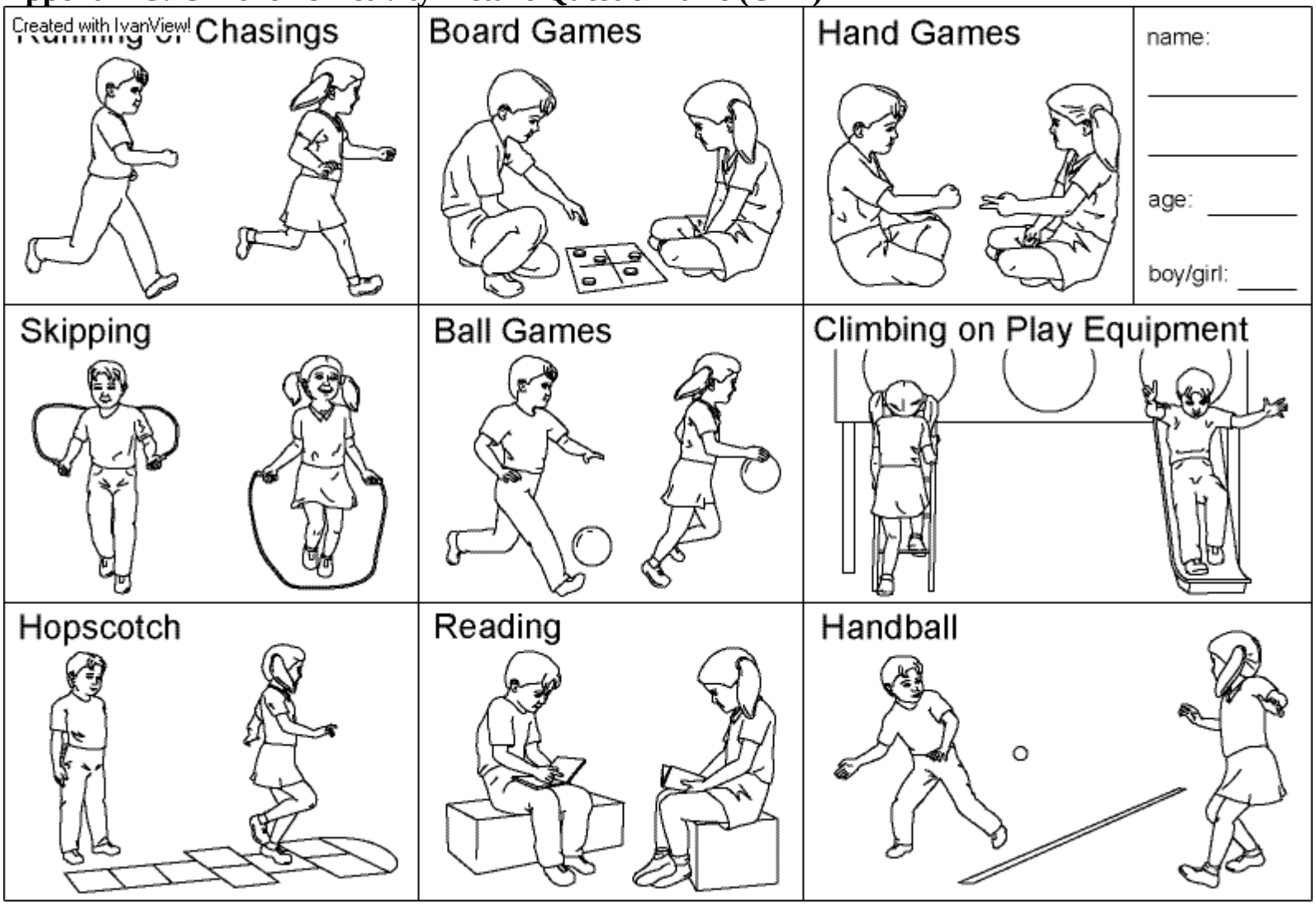
Table (ii). Questions for Teachers derived from the SCT

SCT Constructs	Examples of questions derived from construct
Environment	1.Does the school environment adequately support you to encourage all children to be active? 2.Do you feel that the curriculum and policies support physical activity in your school and in schools in general? 3.What school policies exist which may affect physical activity levels? i.e.: no hat no play, rainy day
Behavioural capability	4. Do you like to be Physically active?
Outcome expectancies	5. Is there anything in the school environment which discourages from timetabling more PA i.e. Your uniform
Self control	
Observational learning	6.Do you participate with the children in the playground at recess and lunch?
Reinforcement	7.What priority do you give to PA in the curriculum? 8.Do you believe that schools/teachers have a responsibility to encourage PA in break times? 9.Are most PA activities followed through with? Why or why not?
Self-efficacy	10.How do you encourage children to be physically active?
Reciprocal determinism	

Table (iii). Questions for Principals derived from the SCT

SCT Constructs	**Examples of questions derived from construct**
Environment	How does the Dept of Ed support your school in relation to PA? What percentage of the school budget is allocated to equipment for use in the playground and how is it obtained? Does your school or the Dept of Ed conduct regular documented safety checks of school equipment?
Behavioural capability	
Outcome expectancies	Does your school have any specific policies to encourage PA at recess and lunch? Would these be reflected in the classroom programming? Has your school specifically addressed concerns about physical activity/childhood obesity and have policies been implemented as a result?
Self control Observational learning Reinforcement Self-efficacy Reciprocal determinism	

Appendix C: Children's Activity Picture Questionnaire (CAP)



Appendix D: Student questionnaire

Class: _____
Name of school: _____
Are you a boy or a girl? _____
Do you have any physical disabilities, which stop you from being active? Yes/No
(Put a circle around your answer)

1. Tick the things that show a person is being active
    - Play on the Playground equipment___
    - Ball games (like hand ball, football or netball) ___
    - Sit and play (like cards)___
    - Running games (like tip)___
    - Games drawn on the ground (like hopscotch)___
    - Sit and talk___

2. Please tick **two** things you most like to **do** at recess and lunch?
    - Play on the Playground equipment___
    - Ball games (like hand ball, football or netball)___
    - Sit and play (like cards)___
    - Running games (like tip)___
    - Games drawn on the ground (like hopscotch)___
    - Sit and talk___

3. Tick the things you would like to play with, but you don't have at your school?
    - Balls___
    - Skipping ropes___
    - Hoops___
    - Frizbees___
    - Bats___
    - Basketball/Netball ring__
    - Soccer nets___
    - Football posts___

4. Tick the things you would like to play with at your school but can't because of school rules:
    - Balls___
    - Skipping ropes___
    - Hoops___
    - Frizbees___
    - Bats___
    - Basketball/Netball ring__
    - Soccer nets___
    - Football posts___

5. Tick the things in this list that might stop you being active in the playground at recess and lunch.
    - The weather is too hot or cold___
    - My uniform___
    - I don't like being active___
    - Other children might bully me in the playground___
    - There is no climbing playground___
    - There is no equipment (balls, hoops, Frisbees)___
    - There is no space to play___
    - There is not enough time at recess and lunch___
    - I don't want to get hurt___
    - I'm too shy to play with the other children___
    - Are there any other things - (please write them down)

To answer the following questions circle your best answer.
For example: If you think that you get too many presents at Christmas time:

Too many presents **------Just right amount ----Not enough presents**

6. What do you think about the way that your playground looks?
    - Too much concrete- -------just right amount------Not much concrete
    - Too much grass---------- just right amount --------Not much grass
    - Too many trees------- just right amount ----------Not many trees
    - Too many gardens------ just right amount -------- Not many gardens
    - Lots of equipment----- just right amount ------Not much equipment
    - Painted games on walls---- just right amount ---No painted games on walls
    - Gardens & grass kept nice--------Gardens & Grass not kept nice

Please circle your best answer for each question

For example: I like ice cream
No……Maybe… **Yes**

7. I think it is important to be active

   No…….Maybe…….Yes

8. I am good at the games I play at recess and lunch

   No…….Maybe…….Yes

9. My friends are active at school

   No…….Maybe…….Yes

10. I like to be active in the same way as my friends

    No…….Maybe…….Yes

11. The Teachers like us to be active at recess and lunch
    No…….Maybe…….Yes

Appendix E: Teacher questionnaire

Name of School: _____
How many years have you been teaching? _____
Are you male or female? _____

Pick a number from the scale to indicate how much you agree or disagree with each statement and write it in the space near the question.

1 = Strongly agree
2 = Agree
3 = Neutral
4 = Disagree
5 = Strongly disagree

1. Teachers should encourage the children to be active at recess and lunch. …__
2. Teachers in my school should teach children about being active in the playground……..……..…….…..__
3. This school's facilities support activity at recess and lunch……..…....__
4. This school's policies and curriculum support playground activity…….__
5. These policies/curriculum are being implemented……..……__
6. Children at my school are active at recess and lunch…….…….__
7. I am a physically active person……...__
8. Teachers in my school should participate in activity with the children at recess and lunch…….……..…….__
9. Which barriers prevent children at your school from being active at recess and lunch? (**Tick the appropriate answers)**

    - Lack of fixed equipment ……...__
    - Lack of non fixed equipment ……__
    - Lack of games courts and nets……..…….__
    - Lack of space…….……__
    - Lack of time……...……__
    - Lack of playground markings (games). ……__
    - Number of staff to supervise all playground areas……__
    - Their uniform……__
    - School yard bullying……..…__
    - Potential for injury…….__
    - Equipment maintenance…….__
    - Policies restricting play……..__
    - Other/s_____……...__

10. What types of facilities do you think would improve activity levels at this school?
    - Fixed equipment…….__
    - Nonfixed equipment……...__
    - Playground markings……..__
    - Games courts and nets……__

- Other/s_____……...__

11. Would you like to participate in the playground with the children but are prevented by (please tick the answers that pertain to you and rank their importance):

- Unsuitable clothing ___
  Very important…. Somewhat important…Not important

- Weather ___
  Very important…. Somewhat important…Not important

- Get sweaty and uncomfortable ___
  Very important…. Somewhat important…Not important

- There is nowhere to shower ___
  Very important…. Somewhat important…Not important

- There is not enough time to shower ___
  Very important…. Somewhat important…Not important

- Too hard to participate and supervise children in the playground ___
  Very important…. Somewhat important…Not important

12. Number your preference for subject matter: from 1(first) to 7(last):

- Creative arts……..……__
- English……..……__
- PDHPE……...……..……__
- Mathematics……...……..……__
- Science and Technology……..__
- Human Society and its Environment……..……__
- Languages……..……..__

Appendix F: Principal questionnaire

Name of School: _____
How many years have you been teaching? _____
Are you male or female? _____
How many boys and girls attend this school? Boys_____Girls_____

Pick a number from the scale to indicate how much you agree or disagree with each statement and write it in the space near the question.

1 = Strongly agree
2 = Agree
3 = Neutral
4 = Disagree
5 = Strongly disagree

1. Children at my school should be active at recess and lunch…….....__
2. I am a physically active person…….....__
3. Children's activity levels are restricted by safety policies at this school …__
4. Bullying prevents some children from being active at this school……..__
5. The staff, students and P&C play an active role in developing the playground environment of this school…….……__
6. Some policies in this school make direct reference to children's playground physical activity……..__
7. School maintenance checks are recorded…….__
8. This school prides itself in a particular Activity (i.e.: soccer)…….…..__
9. There is a plan for the purchase of school playground equipment…….__
10. The purchase of playground equipment is a high priority at this school...__
11. How important are the following barriers in preventing children at this school from being active at recess and lunch?
    - Lack of fixed equipment ……...__
    - Lack of non fixed equipment ……__
    - Lack of games courts and nets……..…….__
    - Lack of space…….……__
    - Lack of time……...……__
    - Lack of playground markings (games). ……__
    - Number of staff to supervise playground areas….……__
    - Their uniform……__
    - School yard bullying……..…__
    - Potential for injury…….__
    - Equipment maintenance…….__
    - Policies restricting play……..__

Other/s_____…….__

Please circle the relevant answer

12. Policies at this school are evaluated:
    Never. 1yr. 3yr. 5yr. As required.

13. The school conducts maintenance checks of the playground and equipment
    Never. 1yr. 3yr. 5yr. As required.
14. How often is non-fixed equipment replaced?
    Never. 1yr. 3yr. 5yr. As required.
15. How often is equipment for PA purchased?
    Never. 1yr. 3yr. 5yr. As required.

Appendix G: Interview questions for student paired interviews

1. What do you think being active or physically active means?

2. Do you think that having things to play with at recess and lunch (i.e.: balls, ropes, fixed equipment) makes children in your school more active? Why?

3. How do you change the way that you play when the weather is very hot or very cold?

4. How do other children affect the way that you play?

5. What is the best type of clothes to play in?

6. What do you think a nice school playground looks like?

7. Tell me 3 things you like to play at recess and lunch? Are you good at these things? Is there an activity that you don't play but would like to if you were better at it?

8. Do you and your friends like to play the same games as each other at recess and lunch? What other games would you play if your friends liked playing them?

9. Are there any teachers that play with you at recess and lunch? Does playing with teachers or an adult make you want to be more active?

Appendix H: Interview questions for teacher interviews

1. How many years have you been teaching at this school?

2. In what ways do teachers participate in the playground with children at recess and lunchtime? To what extent does this affect children's activity levels?

3. In what ways do your schools policies and programs encourage children to be active at recess and lunch?

4. Our preliminary statistics have shown that a high proportion of children at many of the schools we have observed are not active at recess and lunch. Does this surprise you? Why?

5. Is bullying an issue at your school? If so do you think it impacts on children's physical activity? What policies are in place to address this issue?

6. Our preliminary research found that inappropriate clothing; discomfort after being active and the absence of time or facilities to shower and change have been indicated by many teachers as barriers to participating with the children at recess and lunch. To what extent are these things a concern to you? What would be a solution to these problems?

7. Our preliminary research indicates that one of the greatest barriers preventing teachers from playing with children at recess and lunch is the fact that they could not supervise and play with the children at the same time. What could be a solution to this problem?

8. To what extent do you think that an aesthetically pleasing school environment affects children's playground physical activity?

9. Research has show that children who lack Fundamental Movement Skills are sometimes hindered in participating in sporting activity? To what extent is does this affect children at your school?

Appendix I: Interview questions for principal interviews

1. How many years have you been teaching at this school?

2. Is there a particular activity that is very popular at your school? Can you please talk to me about this activity; the extent to which children are involved in it and how you think it might affect the overall activity of children at your school?

3. Our preliminary research indicates that children at many of the schools participating in the study felt that there were not enough playground markings on walls and the ground. To what extent do you think "playground markings" increases the level of playground activity at this school?

4. Can you please describe any safety policies at this school that may impact on children's playground activity? Why were these policies developed?

5. Can you please describe the aesthetics or look of your school's playgrounds and how you think this may influence children's activities?

6. Is bullying an issue at your school? If so do you think it impacts on children's physical activity? What policies are in place to address this issue?

7. Availability and maintenance of fixed and non-fixed equipment can influence children's activities. Can you please talk about the equipment at your school and how you manage it?

8. Do you have a plan for the purchase of playground equipment? Is the purchase of playground equipment a priority at this school? Do you think playground equipment encourages children to be more active at recess and lunch?

9. Ideally how much time should children have at recess and lunch to be physically active? How much time is available to them at this school? What are the reasons for this?

10. In what ways do your schools policies and programs encourage children to be active at recess and lunch?

Appendix J: Required documentation for research in primary schools

REQUIRED DOCUMENTATION FOR RESEARCH IN PRIMARY SCHOOLS

4.1 Proposal outline *(original, 2 copies)*

An outline of the research proposal should be provided. This should indicate:

- the research questions or hypotheses
- the context and background for the research
- the means by which the data/information will be gathered
- the participants from whom the data/information will be gathered
- the methods for ensuring the privacy of participants
- a time line for the research.

4.2 Letter to principals *(original, 2 copies)*

Approaches to Principals seeking approval to gather data in the schools for which they are responsible must be accompanied by a letter outlining the nature of the research and the commitment required of school personnel. A copy of this letter must be included with the proposal.

4.3 Research instruments *(original, 2 copies)*

The researcher must submit copies of interview schedules, questionnaires or other data collection instruments (including tests or stimulus materials). These are to be in the final form proposed for use. Where modifications are made, the researcher must submit the revised copies before they are used.

4.4 Information / consent letter *(original, 2 copies)*

The researcher is required to provide an information letter for distribution to all participants, and their primary caregivers if they are under 18 years of age. If the participants are likely to be under the age of 18, the letter must include a section which allows the primary caregiver to provide informed consent.

In addition to satisfying the requirements of Section 3.2 of the *Criteria for Approving Applications* the information /consent letter must clearly indicate the status of the researcher and the researcher's institutional affiliation. Where researchers intend to collect information which enables participants to be identified by the researcher, the procedures for storing, accessing and disposing of data, as outlined in Section 3.1, should be described in consent /information letters.

4.5 A list of schools that will be invited to take part in the research *(original, 2 copies)*

So that the Department can keep track of the impact of research on schools, researchers are required to submit a list of the names of schools that will be invited to take part in the research. The Department reserves the right to require changes to the list. This may be necessary if, for example, it is considered that the school has already had excessive research demands placed upon it.

4.6 University human research ethics committee approval *(original, 2 copies)*

It is assumed that research proposals from university staff and students have been or are being assessed by the appropriate university authorities as well as being submitted to the Department. Accordingly, if the university requires submission to its human research ethics committee, a copy of the committee's approval must be submitted before final approval can be given by the Department. (The university research ethics committees is asked not to make Departmental approval a condition for the university research ethics committee's approval or, alternatively, to grant approval subject to approval by the Department.)

As stated earlier, the Department is happy to consider the proposal at the same time as the university ethics committee is making its own assessment. The Department's final approval will be withheld until notification of the approval of the university ethics committee is supplied to the Department.

4.7 Additional documentation *(original, 2 copies)*

In addition to the above, researchers are required to submit completed copies of *Forms A, B, C and D*

Form A - Application to Conduct Research

The application cover sheet contains the essential details of the proposal and the researcher(s). It is important that all sections are completed. Any incomplete information will cause delays in having the research approved.

All researchers must complete and sign Form A to acknowledge that the information supplied is correct, that they agree to conduct the research in accordance with the *Criteria for Approving Applications*, and that they and their representatives will maintain the confidentiality of all information collected from participants.

Form B – Confidential Declaration by Principal Researcher

The Department has an obligation to ensure that students will be protected from all forms of abuse and that all people who come into contact with students in Government schools have read and acknowledged their responsibilities as set out in the documents entitled:

- *(DN/01/00051): Protecting and Supporting Children and Young People – Revised Procedures, December 2000*

- *(PD/2002/00022): Handling Allegations Against Department of Education and Training Employees in the Area of Child Protection, 1 January 2003*

All researchers must sign Form B declaring that they (and any assistants working with them and/or on their behalf) are aware of the special responsibilities associated with undertaking research with children, in particular, responsibilities in relation to the Department's child protection policies; that they have not been convicted of a serious sex offence as defined by Section 5 of the *Child Protection (Prohibited Employment) Act 1998* and that there are no other circumstances or reasons that would preclude them undertaking research with children and young people.

The Department acknowledges that it may not be possible for principal researchers to ascertain whether assistants working on their behalf satisfy the criteria outlined in *Form B*. In such cases they should require all assistants to complete *Form B* and the principal researcher should retain the completed forms with the project records.

Form C - Agreement to Provide Reports

Researchers are required to provide the Director of Strategic Research with a report of their findings. This report will be forwarded to the appropriate State Office Directorate for information. The Department may also wish to disseminate the research findings more widely throughout schools in NSW. If re-drafting of the report is required for wider dissemination, this will be done in consultation with the researcher.

Researchers are also required to provide participating schools, or other public school education and training precincts with a summary of their findings, if requested.

Form D – Referee's Report (two separate reports required)

It is the responsibility of staff at the sponsoring research institution to examine all research proposals to consider their quality, appropriateness and adequacy. Ethical issues also need to be considered, especially in relation to protecting the privacy of the people providing information and the confidentiality of the schools taking part. The researcher's capacity to handle the research should also be considered. **Two** separate, completed referees' reports must accompany proposals. Where the research is part of the requirements for the award of a university degree, at least one of the referees must be the research student's supervisor.

Form A

Application to Conduct Research

Principal Researcher..... **Title** .....

Contact Name (if different from above)
…….....

Address .....…….**Postcode**.....

Telephone ……..... **Fax** .....

E-mail address (if applicable).....……..

Title of Proposal
.....

.....
.

Precis of Proposal.....

.....
.

.....
.

.....……
…

Have you previously applied to conduct this or similar research within Government Schools?

(Yes/ No) .....

If 'Yes', state where and when .....

Is the proposed research part of a University course? (Yes/ No) ..... **If 'Yes'**

Degree .....…….**University** .....

Supervisor .....…..**Department** ……..….

Faculty.....

Will the findings of the research be primarily used for commercial gain? (Yes / No) .....

I declare that the above information is correct. I declare that I have read the Criteria for Approving Applications in the Department's *Research Guidelines* and agree to abide by them in the conduct of this study. I undertake to ensure that I, and any assistants working with me and/or on my behalf, will maintain the confidentiality of all information collected from participants.

.....	…….....
Signature of Principal Researcher	Date

Strategic Research Directorate, June 2001

Form B

Confidential Declaration by Principal Researcher

a) I am aware of the special responsibilities associated with undertaking research with children, in particular, responsibilities in relation to the Department's child protection policies.

b) I declare that I have not been convicted of a serious sex offence as defined by Section 5 of the *Child Protection (Prohibited Employment) Act 1998*.

c) I declare that there are no other circumstances or reasons that would preclude my undertaking research with children and young people.

d) In relation to assistants conducting research with children and young people with me and/or on my behalf, I will ensure that:

- **they will be made aware of the special responsibilities associated with undertaking research with children, in particular, responsibilities in relation the Department's child protection policies.**
- **they have not been convicted of a serious sex offence as defined by Section 5 of the *Child Protection (Prohibited Employment) Act 1998.***
- **there are no other circumstances or reasons that would preclude them undertaking research with children and young people.**

e) I am aware that I may be required to provide a criminal record check if it is considered necessary to verify the above information.

…….. ……

Signature of Principal Researcher **Date**

Strategic Research Directorate, June 2001

Form C

Agreement to Provide Reports

As Principal Researcher:

I agree to provide the NSW Department of Education and Training with a report of the findings of the proposed study.

I grant the NSW Department of Education and Training the right to disseminate this report to personnel in State Office directorates of the Department.

I agree to provide participating schools with a summary of the study findings.

I understand that, if the Department wishes to disseminate the report more widely, this will be done in consultation with me.

…… ……

Signature of Principal Researcher **Date**

Strategic Research Directorate, June 2001

Form D

Referee's Report

Name of Principal Researcher
……

Title of proposed research
……

Name of Referee
.....

Referee's position .....
Institution.....

Referee's address
.....

..... **Post Code**.....

Telephone ..... **Fax** ..... **E- mail address**
…….....

Relationship to researcher.....

Please comment on the following aspects of the proposal, in relation to the *Criteria for Approving Applications*.

Significance, purpose and value of the research
……

……
……

……
……

Appropriateness of the research design.....

.....
.....

.....
.....

Methodological adequacy and viability
……

.....
.....

.....
.....

Ethical considerations.....
.

.....
.....

To what extent do you consider the principal researcher to be capable of undertaking the research described in the attached proposal?

.....……
…….

…….....
.....

Referee's signature ..... **Date** .....……

Appendix K: School information sheet

UNIVERSITY OF WOLLONGONG

School information sheet

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

Background
In the world obesity summit of 2000 it was noted with concern that physical activity levels in children are declining. The purpose of the study is to obtain more detailed information about children's playground physical activity. Your school is being approached as it was selected on the basis of a random sampling procedure of all Illawarra schools.

The study
A research student from the University of Wollongong is conducting the study. In the first phase of the study, 20 Illawarra Primary Schools from the public sector will be invited to participate in the initial phase of the study. The research team will visit each school on 3 separate days to observe children's physical activity during recess and lunch. Principals, Teachers and Students from each school will be invited to complete a questionnaire. Students wishing to participate must have parental consent prior to completing the questionnaire.

At the completion of the first phase of the study 6 schools will be invited to participate in an in-depth study. This will involve a short interview with the principal, 4-6 consenting teachers and 6-8 friendship pair interviews with students from Years 4, 5 and 6.

Purpose
The purpose of the study is to obtain more detailed information about children's playground physical activity.

Study benefits
The study will provide valuable information about physical activity in our primary aged children. It will provide a historical reference for future research into playground activity. It will contribute to our understanding of the factors, which influence physical activity.

The School Playground Assessment

What tests will be taken?
Phase 1.
The school playground assessment will be conducted over 3 days. The children will be observed during the recess and lunchtime period each day. All principals, teachers and students will have the opportunity to complete a questionnaire. The researcher

team will carry out all playground and environment observations. They will assess the playground fixed and non-fixed equipment. The researcher will photograph and measure the playground while it is free of children. This will include any outdoor areas where the children could play, as well as undercover pergolas and hall space.

Phase 2.
At the completion of the first phase of the study 6 schools will be invited to participate in an in-depth study. This will involve a short interview with the principal, 4-6 consenting teachers and 12 friendship pair interviews with students from Years 4, 5 and 6. Interviews will be recorded on audiocassette.

When will the study be conducted?
Phase 1
The study will be conducted during weeks 2-10 of terms 1, 2 and 3 in 2005. The date for the research will be negotiated with each school and we will do our best to accommodate the first preference of the school.

Phase 2
Will be conducted during weeks 4-10 of term 3 of 2005. The date for interviews of 6 schools will be negotiated with each school and we will do our best to accommodate the first preference of the school.

What is required of schools?
Phase 1.
The school will be required to distribute and collect the information notes and consent forms to parents.

Phase 2.
The school will be required to distribute and collect the information notes and consent forms to parents.
The Principal, 3 Primary teachers and 12 (with 12 friends) students will be asked to volunteer 15 –20 mins to participate in a recorded interview, consent will be obtained prior to the commencement of the interview.

A room will be required to conduct the interviews. Access to a power source would be helpful but is not essential. The school will be asked to help by allowing the students who will be participating in friendship pair interviews release from class time to participate.

Professional development for schools
The results of both phases of this research will be distributed to all Illawarra schools involved in the research.

Confidentiality
Only the researchers/supervisors involved in this study will have access to any questionnaires and cassette recordings. The results will be published so that no individual school, teacher or student can be identified.

Well-being of the students
Every effort will be made to protect the privacy and self esteem of students.

If you have any questions regarding the study please call Anne-Maree Parrish on 42214438 or 0418 657359.

If you wish to make a complaint about the conduct of the research in your school you may contact:

University of Wollongong Ethics Committee
Telephone:

School participation confirmation sheet

To: _____ From: _____
Attention: _____
Date: _____
Fax Number: _____ Phone: _____
Number of pages including this one ____ Fax No: _____

Subject: University of Wollongong Playground Physical Activity Research

Dear

Thank you for agreeing to participate in this research. I will be coming to your school to determine the best areas to observe the children, to collect information about your school equipment and to video and photograph your empty playground, hall and undercover play areas.
It is my intention to ring you by the end of this week, or if it is more convenient you could ring me on _____.

Appendix L: Parent information sheet

UNIVERSITY OF WOLLONGONG

Parent information sheet

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

Background
In the world obesity summit of 2000 it was noted with concern that physical activity levels in children are declining. The purpose of the study is to obtain more detailed information about children's playground physical activity. Your school is being approached as it was selected on the basis of a random sampling procedure of all Illawarra schools.

The study
A research student from the University of Wollongong is conducting the study. In the first phase of the study, 25-30 Illawarra primary schools from the public sector will be invited to participate.

Purpose
The purpose of the study is to obtain more detailed information about children's playground physical activity. The results of the survey will be used to inform the schools and parents of positive ways to approach physical activity in the playground.

Study benefits
The study will provide valuable information about physical activity in our primary aged children. It will provide a historical reference for future research into playground activity. It will contribute to our understanding of the factors, which influence physical activity participation.

Observation
Three researchers from the University of Wollongong will be present in the school playground at recess and lunch on _____(date) this term. They will be be observing at the children as they play.

If you have any further questions please direct your inquiries to
Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)

Appendix M: Final confirmation of site visit for physical activity and questionnaire data collection

UNIVERSITY OF WOLLONGONG

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

Final confirmation of arrangements for site visit

School: _____
Contact teacher: _____
Date of scheduled visit: _____
Time of scheduled visit: _____

Confirmation date: _____

Appendix N: Final confirmation of site visit for interview data Collection

UNIVERSITY OF WOLLONGONG
Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

Final confirmation of arrangements for interview site visit

School: _____
Contact teacher: _____
Date of scheduled visit: _____
Time of scheduled visit: _____

Confirmation date: _____

Year 4 friendship pairs	**Time:**	**Location:**
Name	**Class**	**Teacher**

Year 5 friendship pairs	**Time:**	**Location:**
Name	**Class**	**Teacher**

Year 6 friendship pairs	Time:	Location:
Name	**Class**	**Teacher**

Teacher/Principal interviews	Time:	Location:
Name	**Class**	

Important Information

A. Time requirements

- The time required for each friendship pair interview will be 10-15 minutes

B. Space requirements

- A room which can seat 3 people.

C. Student requirements

- Students wanting to participate in the friendship pair interviews must have returned their signed permission notes prior to the researcher visiting the school to permit participation in the study.

D. Staff

- Staff will be invited to participate. Participation is completely voluntary. The aim is to have a primary teacher from each year to participate in the teacher

interviews. Consent will be needed before the commencement of each interview.

- Interviews will be conducted at recess, lunch, prior to or after school to minimise classroom disruption.
- Please ensure that a convenient time to interview the principal is arranged.

Should you have any further question or issues, please contact Anne-Maree Parrish

Appendix O: Principal and teacher consent forms

UNIVERSITY OF WOLLONGONG

Principal/Teacher consent

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman (02 4221 3463) and Professor Don Iverson (02 4221 4208)
Department: Graduate School of Public Health

University of Wollongong School Playground Research 2005

I have been given information about the proposed study and discussed the research project with Anne-Maree Parrish who is conducting this research as part of a Doctor of Philosophy in the Graduate School of Public Health at the University of Wollongong.

I understand if I consent to be involved in this research I will be asked to participate in a recorded interview. I have been told that anything I say will be kept in strict confidence. Audiocassettes will be securely stored and only accessed by the researcher. I have been advised of the potential risks and burdens associated with this research, mainly that it will take approximately 15-20 minutes of my time, and that interviews will be kept in strict confidence. I will be given the opportunity to ask Anne-Maree Parrish any questions I may have about the research and my participation.

I understand that my participation in this research is voluntary; this means that I am free to refuse to participate and I am free to withdraw from the research at any time. My refusal to participate or withdrawal of consent will not affect my treatment in any way.

I am aware that if I have any inquiries about the research, I can contact Anne-Maree Parrish, Dr Heather Yeatman and Dr Don Iverson (details above). If I have any concerns or complaints regarding the way that research is or has been conducted, I can contact the Complaints Officer, Human Research Ethics Committee, at the University of Wollongong on 02 4221 4457.

By signing below I am indicating my consent to participate in the research conducted by Anne-Maree Parrish as it has been described to me in the information sheet and in discussion with me. I understand that the data collected from my participation will be used for purpose of a thesis and journal publication, and I consent for it to be used in that manner.

I hereby consent to participate in the University of Wollongong Playground Physical Activity Research Interviews.

_____ Date: _____

Signature of Principal or Teacher

Name: _____ Class: _____

Appendix P: Parent information and consent for Kindergarten to Year 3 Questionnaire

UNIVERSITY OF WOLLONGONG

Parent information and consent for Kindergarten to Year 3 Questionnaire

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

University of Wollongong School Playground Research 2005 Kindergarten to Year 3

Dear Parent,

During this term students in Kindergarten to Year 3 from 25-30 schools in the Illawarra will be invited to participate in a short picture questionnaire about what they like to play at recess and lunch. This questionnaire should take no more than 10-15 minutes of their time and will be completed during school time.

The study will provide valuable information about physical activity in our primary aged children.

Your child's class has been selected to take part in this questionnaire. It will take place on: _____. It will allow your child with the opportunity to provide valuable information about playground physical activity in their school.
All aspects of your child's questionnaire will remain confidential. The research will not report on any details of an individual student. The questionnaires involving the children will be conducted at the school. Any child may decline to participate for any reason. All information pertaining to the questionnaires will be securely stored at the University of Wollongong.

Any child may refuse to participate at anytime for any reason. Their refusal to participate or withdrawal of consent will not affect their treatment in any way. All information regarding this research is kept confidential and will only be accessed by the researcher/s and supervisors.

This project is an exciting step in helping us improve the health and physical activity of our students. I encourage you to support your child's involvement.

Please complete the details below and return to _____by _____.

_____

Researchers Signature

UNIVERSITY OF WOLLONGONG

Parent consent for Kindergarten to Year 3 questionnaire

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman (02 4221 3463) and Professor Don Iverson (02 4221 4208)
Department: Graduate School of Public Health

University of Wollongong School Playground Research Kindergarten to Year 3 2005

I have been given information about the proposed study of Anne-Maree Parrish who is conducting this research as part of a Doctor of Philosophy in the Graduate School of Public Health and Nutrition at the University of Wollongong.

I understand if I give consent for my child to be involved in this research he/she will be asked to complete a questionnaire. I have been advised of the potential risks and burdens associated with this research, mainly that it will involve my child completing a short questionnaire which takes 10-15 minutes of their school time.

I understand that my child's participation in this research is voluntary; this means that he/she is free to refuse to participate and is free to withdraw from the research at any time. His/Her refusal to participate or withdrawal of consent will not affect his/her treatment in any way.

I am aware that if I have any inquiries about the research, I can contact Anne-Maree Parrish, Dr Heather Yeatman and Dr Don Iverson (details above). If I have any concerns or complaints regarding the way that research is or has been conducted, I can contact the Complaints Officer, Human Research Ethics Committee, at the University of Wollongong on 02 4221 4457.

I have discussed this research with my child and he/she is willing to participate in this research. By signing below I am indicating my consent for my child _____ to participate in the research conducted by Anne-Maree Parrish as it has been described to me in the information sheet.

I understand that the data collected from my child's participation will be used for purpose of a thesis and journal publication, and I consent for it to be used in that manner. I understand that any individual data about my child will not be published.

I hereby consent to my child _____ participating in the University of Wollongong Playground Physical Activity Questionnaire.

_____ Date: _____
Signature of Parent

Name: _____ Class: _____
(Please Print)

Appendix Q: Parent information and consent for Kindergarten to Year 3 Accelerometer (Pilot Study)

UNIVERSITY OF WOLLONGONG

Parent information and consent for Kindergarten to Year 3 Accelerometer (Pilot Study)

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

University of Wollongong School Playground Research 2005 Kindergarten to Year 3

Dear Parent,

During this term students in Kindergarten to Year 3 from 25-30 schools in the Illawarra will be invited to participate in a measuring their physical activity during recess and lunch. This research will be conducted over 4 days.

Physical activity will be measured using accelerometers. Children who have parental consent to participate will be asked to wear an accelerometer during recess and lunch. This device is slightly larger than a matchbox and is attached to a belt around their waist.

Your child's class has been selected to take part in this research. It will take place on: _____. It will allow your child with the opportunity to provide valuable information about playground physical activity in their school.
All aspects of your child's results will remain confidential. The research will not report on any details of an individual student. All accelerometer measures will be conducted at the school by trained staff. Any child may decline to participate for any reason. All information pertaining to the measures will be securely stored at the University of Wollongong.

Any child may refuse to participate at anytime for any reason. Their refusal to participate or withdrawal of consent will not affect their treatment in any way. All information regarding this research is kept confidential and will only be accessed by the researcher/s and supervisors.

The study will provide valuable information about physical activity in our primary aged children. This project is an exciting step in helping us improve the health and physical activity of our students. I encourage you to support your child's involvement.

Please complete the details below and return to _____by _____.

_____

Researcher's Signature.

UNIVERSITY OF WOLLONGONG

Parent consent Kindergarten to Year 3 Accelerometer

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman (02 4221 3463) and Professor Don Iverson (02 4221 4208)
Department: Graduate School of Public Health

University of Wollongong School Playground Research Kindergarten to Year 3, 2005

I have been given information about the proposed study of Anne-Maree Parrish who is conducting this research as part of a Doctor of Philosophy in the Graduate School of Public Health and Nutrition at the University of Wollongong.

I understand if I give consent for my child to be involved in this research, he/she will be will be fitted with an accelerometer at recess and lunch for 4 days. I have been advised of the potential risks and burdens associated with this research, mainly that it will involve the child wearing an accelerometer device during recess and lunch over a 4 day period.

I understand that my child's participation in this research is voluntary; this means that he/she is free to refuse to participate and is free to withdraw from the research at any time. His/Her refusal to participate or withdrawal of consent will not affect his/her treatment in any way.

I am aware that if I have any inquiries about the research, I can contact Anne-Maree Parrish, Dr Heather Yeatman and Dr Don Iverson (details above). If I have any concerns or complaints regarding the way that research is or has been conducted, I can contact the Complaints Officer, Human Research Ethics Committee, at the University of Wollongong on 02 4221 4457.

I have discussed this research with my child and he/she is willing to participate in this research project. By signing below I am indicating my consent for my child _____ to participate in the research conducted by Anne-Maree Parrish as it has been described to me in the information sheet.

I understand that the data collected from my child's participation will be used for purpose of a thesis and journal publication, and I consent for it to be used in that manner. I understand that any individual data about my child will not be published.

I hereby consent to my child _____ participating in the University of Wollongong Playground Physical Activity Accelerometer participation.

_____ Date: _____
Signature of Parent

Name: _____ Class: _____

Appendix R: Parent information and consent for Years 4, 5 and 6 questionnaire

UNIVERSITY OF WOLLONGONG

Parent information and consent for Years 4, 5 and 6 Questionnaire

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

University of Wollongong School Playground Research 2005 Years 4, 5 and 6 Questionnaire

Dear Parent,

During this term Years 4,5 and 6 students from 25-30 schools in the Illawarra will be invited to participate in a questionnaire about physical activity. This questionnaire should take no more than 10-15 minutes of their time.

The study will provide valuable information about physical activity in our primary aged children.

Your child's class has been selected to take part in this questionnaire. It will take place on: _____. It will provide your child with the opportunity to give their opinion about playground physical activity in their school.
All aspects of your child's questionnaire will remain confidential. The research will not report on any details of an individual student. The questionnaires involving the children will be conducted at the school. Any child may decline to participate for any reason. All information pertaining to the questionnaires will be securely stored at the University of Wollongong until the completion of the research project.

Please complete the details below and return to _____by _____.

_____
Researcher's Signature

UNIVERSITY OF WOLLONGONG

Parent consent Year 4,5 and 6 questionnaire

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman (02 4221 3463) and Professor Don Iverson (02 4221 4208)
Department: Graduate School of Public Health

University of Wollongong School Playground Research Year 4, 5 and 6, 2005

I have been given information about the proposed study of Anne-Maree Parrish who is conducting this research as part of a Doctor of Philosophy in the Graduate School of Public Health and Nutrition at the University of Wollongong.

I understand if I give consent for my child to be involved in this research, he/she will complete a questionnaire that addresses school playground physical activity. I have been told that anything he/she says will be kept in strict confidence. Questionnaires will be securely stored and only accessed by the researchers/supervisors. I have been advised of the potential risks and burdens associated with this research, mainly that it will take 15-20 minutes of his/her time.

I understand that my child's participation in this research is voluntary; this means that he/she is free to refuse to participate and is free to withdraw from the research at any time. His/Her refusal to participate or withdrawal of consent will not affect his/her treatment in any way.

I am aware that if I have any inquiries about the research, I can contact Anne-Maree Parrish, Dr Heather Yeatman and Dr Don Iverson (details above). If I have any concerns or complaints regarding the way that research is or has been conducted, I can contact the Complaints Officer, Human Research Ethics Committee, at the University of Wollongong on 02 4221 4457.

I have discussed this research with my child and he/she is willing to participate in this research project. By signing below I am indicating my consent for my child _____ to participate in the research conducted by Anne-Maree Parrish as it has been described to me in the information sheet.

I understand that the data collected from my child's participation will be used for purpose of a thesis and journal publication, and I consent for it to be used in that manner. I understand that any individual data about my child will not be published.

I hereby consent to my child _____ participating in the University of Wollongong Playground Physical Activity Research Interviews.

_____ Date: _____
Signature of Parent

Name: _____ Class: _____

Appendix S: Parent information and consent for Years 4, 5 and 6 interviews

UNIVERSITY OF WOLLONGONG

Parent information and consent for Year 4, 5 and 6 Interviews

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman and Professor Don Iverson
Department: Graduate School of Public Health

University of Wollongong School Playground Research 2005 Years 4, 5 and 6

Dear Parent,

During this term Years 4,5 and 6 students from 6 schools in the Illawarra will be invited to participate in interviews involving children in groups of 2 to talk about physical activity.

The study will provide valuable information about physical activity of our primary aged children.

Your child's class has been selected to take part in this survey. It will take place on: _____. The interviews will take between 15 and 20 minutes, and will provide your child with the opportunity to give their opinion about physical activity in their school. Your child will participate in the interview with one of their friends who have also consented to be part of this research. A research student from the University of Wollongong will conduct the interviews. The research student is a mother of primary school aged children and is experienced in talking with children.

The interviews will be recorded on audiocassette for analysis at a later date. All aspects of your child's interview will remain confidential. The interviews will not report on any details of an individual student. The interviews with the children will be conducted at the school. Any child may leave the interview at anytime for any reason. All information pertaining to the interviews will be securely stored at the University of Wollongong until the completion of the research project, at which time they will be destroyed.

Please complete the details below and return to _____by _____.

_____

Researchers Signature

UNIVERSITY OF WOLLONGONG

Parent consent Year 4,5 and 6 Interviews

Researcher: Anne-Maree Parrish (Ph: 02 4221 4438; e-mail: amp17@uow.edu.au)
Supervisors: Associate Professor Heather Yeatman (02 4221 3463) and Professor Don Iverson (02 4221 4208)
Department: Graduate School of Public Health

University of Wollongong School Playground Research Year 4,5 and 6, 2005

I have been given information about the proposed study of Anne-Maree Parrish who is conducting this research as part of a Doctor of Philosophy in the Graduate School of Public Health and Nutrition at the University of Wollongong.

I understand if I give consent for my child to be involved in this research, he/she will participate in a recorded interview. I have been told that anything he/she says will be kept in strict confidence. Audiocassettes will be securely stored and only accessed by the researcher. I have been advised of the potential risks and burdens associated with this research, mainly that it will take 15-20 minutes of his/her time, and that interviews will be kept in strict confidence.

I understand that my child's participation in this research is voluntary; this means that he/she is free to refuse to participate and is free to withdraw from the research at any time. His/Her refusal to participate or withdrawal of consent will not affect his/her treatment in any way.

I am aware that if I have any inquiries about the research, I can contact Anne-Maree Parrish, Dr Heather Yeatman and Dr Don Iverson (details above). If I have any concerns or complaints regarding the way that research is or has been conducted, I can contact the Complaints Officer, Human Research Ethics Committee, at the University of Wollongong on 02 4221 4457.

I have discussed this research with my child and he/she is willing to participate in this research project. By signing below I am indicating my consent for my child _____ to participate in the research conducted by Anne-Maree Parrish as it has been described to me in the information sheet.

I understand that the data collected from my child's participation will be used for purpose of a thesis and journal publication, and I consent for it to be used in that manner. I understand that any individual data about my child will not be published.

I hereby consent to my child _____ participating in the University of Wollongong Playground Physical Activity Research Interviews.

_____ Date: _____
Signature of Parent
Name: _____ Class: _____