



Australian Government  
Australian Sports Commission



# Children and Sport

full  
report



A RESEARCH REPORT BY THE  
UNIVERSITY OF SOUTH AUSTRALIA

# **Children and Sport**

**A report prepared for the Australian Sports Commission**

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## Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ANOVA	analysis of variance
ASC	Australian Sports Commission
BMI	body mass index
EBP	evidence-based practice
EE	energy expenditure
IQ	intelligence quotient
IQR	inter-quartile range
MARCA	Multimedia Activity Recall for Children and Adolescents
MET	metabolic unit
OSHC	out-of-school-hours care
PA	physical activity
PAL	physical activity level
PE	physical education
PLSD	protected least squares difference
RCT	randomised controlled trial
SA	South Australia
SCR	School Card Register
SEIFA	socio-economic indicators for areas
SES	socio-economic status
UniSA	University of South Australia

## Glossary

### critical window

The hours between the end of school and dinner time (typically 3 pm to 6 pm). There is evidence that activity choices in this time period are important for the overall activity pattern of children's lives.

### MET

Metabolic unit. A unit of power (rate of energy use).  $1 \text{ MET} = 1 \text{ ml O}_2 \cdot \text{kg}^{-1} \text{ body weight} \cdot \text{min}^{-1}$ . People use 1 MET at rest, and may use up to 15-20 METs when exercising as hard as possible.

### PAL

Physical activity level. The average rate of energy expenditure (in METs) over a given period of time. Over long periods (days and weeks), a person's energy expenditure may range from 1.1 to 3 METs.



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## Executive summary

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The Children and Sport study<sup>1</sup> draws its conclusions from three methodological approaches:

1. Literature review of Australian and international literature in order to summarise current knowledge on the relevant social and scientific contexts for Australian children in this age cohort.
2. Market segmentation analysis of data collected using the Multimedia Activity Recall for Children and Adolescents (MARCA), and case study interviews in South Australia
3. Use-of-time analysis of data collected using the MARCA to analyse how the children in South Australia use their time.

## **1.1 Young people's involvement in different kinds of physical activity**

Young people are involved in different levels and different kinds of physical activity, ranging from serious commitment to multiple organised sports, to a complete absence of interest in any form of activity.

### **1.1.1 Overall levels of involvement in sport and physical activity**

On any given day, about 55% of 11-13 year olds will play some kind of sport (5.3.2)<sup>2</sup>. Participation is higher for boys, younger children, and on school days. About 2-5% (32-69 min.) of children's daily time-budgets are devoted to sport, which contributes 12-19% of a child's total daily energy expenditure (5.4.1). In addition to sport, 3-4% of children's time (52-62 min.d<sup>-1</sup>) is devoted to free play and active locomotion, equating to 12-13% of their daily energy expenditure (EE).

### **1.1.2 Distribution of sport time**

The distribution of time devoted to sport is highly skewed (5.3.3). The median daily time devoted to sport is 35 min., but on one quarter of days, children do no sport at all. At the other end of the scale, children do 85 min. or more of sport on one quarter of days, and 185 min. or more on 5% of days. These figures reflect both variability in habitual activity between children, and day-to-day variability in the same child. Activity patterns tend to cluster in several distinct 'styles'. A cluster analysis has identified certain types of children ('sporties' and 'players') with high levels of engagement in sport and physical activity (4.3.3; 4.3.4). Boy 'sporties', for example, spend four times as much time each day involved in sport as children from other activity styles. Girl 'players' spend twice as much time playing as other girls. These activity styles are largely independent of major socio-demographic factors such as socio-economic status (SES) (4.3.5; 4.3.6).

### **1.1.3 Physical activity vs screen time**

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<sup>1</sup> It is important to note that the South Australian children do not differ from all Australian children upon certain characteristics, including age in height, weight, weight-for-height, place of residence, socio-economic status, and school sector.

<sup>2</sup> The numbers in parentheses relate to sections in this report.

The overwhelming competitor for physical activity is screen time – TV, video games, cinema and texting. Every extra hour of sport reduces screen time by 20-24 min. (5.5). During the ‘critical window’ period (between school and dinner), children are three to four times more likely to be in front of a screen than playing sport (5.5.1). While there is no evidence to suggest that children enjoy physical activity any less than previous generations, there is a wider choice on the modern leisure ‘menu’.

#### **1.1.4 Sport vs play**

Qualitative studies (MacDougall et al., 2003) have suggested that terms such as ‘sport’, ‘play’ and ‘physical activity’ have quite different resonances for children. ‘Sport’ suggests involvement in organised, rule-governed activities, particularly team events; ‘play’ is construed as free, unorganised and spontaneous. Play is much more common in girls and younger children; sport is preferred by boys and older children. The secular and age-related decline in physical activity is due in large part to declines in free play. Free, unsupervised play in the neighbourhood, once a dominant feature on the suburban Australian landscape, is severely curtailed by rising concerns for children’s safety, associated with crime and heavy traffic. The impact of modern street design, consumption of play space for further development, smaller home blocks, longer working hours of parents, and a general disintegration of neighbourhood social networks also contribute to reductions in children’s energy expenditure (3.2.2.5; 3.2.4.1).

#### **1.1.5 Which sports are the most popular?**

A recent survey of upper primary and lower secondary school age children identified soccer (21% of all sport minutes) as the most popular sport, followed by basketball (15%), Australian football (11%), cricket (9%) and netball (6%) (5.7). Together, these sports accounted for about two-thirds of all the time and energy children spend playing sport. When asked which sports they would like to do which they were not currently doing (5.10.3), the most popular choices were surfing (11% of mentions), soccer (8%), dancing (7%), basketball (7%) and cycling (6%).

#### **1.1.6 What attracts children to sport, or repels them?**

What features of organised sport do young people endorse and which do they view as deterrents to participation? The most commonly offered reason for not participating in (more) sport is lack of time or other time commitments such as homework and jobs (40% of all responses) (5.10.1). Focus groups raise other issues such as an emphasis on rigid rules, uniforms, training drills, competition and winning (3.2.3.1; 3.4.4.2.1.1). Fear of injury also emerges in focus groups as a deterrent. However, both of these issues rate very low (<5%) in terms of questionnaire responses. When asked what would facilitate their involvement in sport (5.10.2), the most common responses were the ability to play with friends and family (24% of all mentions), and various logistical issues, such as transport, facilities and cost (35%).

## **1.2 Types of young people active in sport**

The types of young people who are active, and why and how they get involved in physical activity, are determined by a complex mix of genetic, social and personal factors (3.2.1). At the personal level, physical and psychological attributes shape the individual's motivation to expend energy in play. The social and physical environments interact with these intrinsic factors through facilitatory and inhibitory influences, embedded within the home, neighbourhood and school. Genetic factors account for about 25-30% of the variability in sports participation (3.1.2.1). Presented with a child about whom we knew nothing, and asked to predict that child's activity patterns, we could make a very good estimate using just two pieces of information – gender and age.

### **1.2.1 Gender**

By far the best predictor of the amount and type of physical activity a child enjoys is gender. There is overwhelming evidence that boys are more active than girls at any age (3.2.2.3). Boys' daily physical activity levels (PALs) are about 5-10% greater than girls'. On average, boys spend about 68 min.d<sup>-1</sup> playing sport, compared to 36 min.d<sup>-1</sup> for girls (5.3.2). This equates to 19% of boys' total daily energy expenditure, but only 12% of girls' daily energy expenditure. Boys' play styles and preferred sports are also different. Boys occupy more space, and are more sensitive to restrictions in space (3.2.3.2). Sports dominated by boys include Australian football (7 boys for each girl), cricket (3 to 1) and soccer (2.5 to 1). Sports dominated by girls include netball (11 to 1) and dance (4 to 1) (5.7.1.1). Finally, boys have different motivations for sports participation: they tend to value extrinsic motivations (rewards and prizes) more than girls (3.4.4.2.2).

### **1.2.2 Age**

After gender, the next best predictor is age. Overall levels of physical activity decline with age, with sharp falls around puberty (3.1.7). This is a common pattern to a wide range of species (3.1.7.1), and may be related to changes in levels of the neurotransmitter dopamine and dopamine receptors. Puberty may represent an evolutionary 'tipping point' at which the benefits of play are outweighed by the risks (5.4.2). Declines in adolescence tend to be largely in non-organised physical activity rather than in organised sports (3.1.7.2), particularly amongst girls. When children are divided into 'activity clusters', girl 'screenies' (high levels of TV and videogames, low sport) tend to be older than other clusters (4.3.6).

The amount of time spent playing sport decreases at a rate of 7% per year of age in girls, and 3% in boys (5.3.5), while the percentage of daily energy expenditure devoted to sport is fairly constant (5.4.2). There are declines in participation in most sports with age, particularly in aerobics, swimming and dance (declines of 30-50% per year), and cricket, soccer and basketball (15-23% per year). Participation in Australian football and tennis are constant across the 10-14 year age-band, while table tennis becomes increasingly popular (5.7.1; 5.7.2). Finally, older children prefer less adult and family involvement in their play, prefer to mix with larger groups of friends (5.10.5), and are less influenced by high-profile athletes, coaches and other adults (5.10.4).

### **1.2.3 Socio-economic status (SES)**

Socio-economic status is a weak and inconsistent indicator of participation in physical activity (3.2.2.2). SES is not associated with the number of minutes Australian children devote to sport or play in their daily schedule (5.8.3), nor does SES differ among children from different activity clusters (2.3.3; 2.3.5). However, SES gradients do exist in children's attitudes towards physical activity, with children from lower SES groups being less likely to prefer active play with friends (5.8.3). The number of sports a child plays declines with SES (5.8.3), supporting claims that cost may exclude some families from certain types of organised sport (3.4.4.2.2).

#### **1.2.4 Family structure**

Aspects of family structure (single vs two parents; siblings vs no siblings) can overlap with SES. We divided families into four structural types: 1O for single-parent families with only one child (no siblings); 1S for single-parent families with more than one child; 2O for two-parent families with only one child; and 2S for two-parent families with more than one child. In both daily minutes of sports participation and overall physical activity level, boys from 2S families fared significantly better than boys from 1O families (5.8.1). Children from 1O families also had higher screen time. Children from 1O or 1S families reported playing less often with their families, were more likely to prefer quiet to active play, and less likely to consider active play to be fun. Some of these effects are probably due to the synergistic effect of siblings, and the reduction in average family size is of concern for future activity patterns (3.2.2.4).

#### **1.2.5 Parents as models**

Parents may affect the physical activity participation of children both directly (by serving as role models), and indirectly (by providing logistical support for sports, etc.). About one child in three cites parents as the main influence on their activity choices (5.10.4). The effect of direct modeling, however, appears to be small (3.2.2.3). Children, particularly older children, rank the influence of parents as motivators uniformly low (3.4.4.2.2). Children who reported that their Dads were involved in sport reported playing more sports themselves, and twice as many weekly sessions of play (5.10.4). There were no associations between reports of Mum's involvement and self-reported sports participation.

#### **1.2.6 The play environment**

Both the amount of play space available and its layout affect activity levels of children. In most developed countries there has been a trend away from wild, open, unstructured areas to suburbanised, closed, divided and structured cityscapes. The amount of physical activity equipment in the home (3.2.2.5) and the school (3.2.3.2) affects play behaviours, as does the available play space. This is particularly true for boys, whose games tend to be more wide-ranging. Smaller back yards reduce the amount of free play (3.2.2.5). The structure of neighbourhoods is also important: the presence of major arterial roads, poor lighting, cul-de-sac street layouts and the agglomeration of neighbourhood shops into shopping centres all discourage active transport (3.2.4.1).

### **1.3 ‘Good news’ stories about the benefits of sport**

Most recent findings about children and physical activity are negative. The background context is that children are getting fatter, aerobic fitness is declining, and physical activity decreasing. Nevertheless, sport and physical activity are still highly valued by both children and parents. A large minority of children maintain high levels of physical activity, in spite of living in an environment which is increasingly ‘toxic for exercise’. Furthermore, a substantial number of children combine high levels of physical activity with high levels of social activity.

#### **1.3.1 The background context: fitness, fatness and physical activity**

About 20-25% of Australian children are overweight or obese (3.1.1.2), and the proportion is increasing at an accelerating rate, particularly since the mid-1980s (3.1.1.1) – a trend which reflects international patterns (3.1.1.3). At the same time, the aerobic fitness of children has taken a sharp downward turn since 1970-1980 (3.1.2.1), trending downwards at about 0.4% per annum. This is again in line with international trends (3.1.2.2). Increasing fatness and decreasing fitness appear to be associated not with increased energy intake (3.1.4), but rather with declines in physical activity. There has been a fall in participation in organised club and school sports (3.1.5.2.1; 3.4.3); decreases in active transport; failure to reach physical education (PE) targets (3.2.3.1); and changes in the built environment, such as reduced open space, more arterial roads, and disintegration of community focal points, all of which have created an environment which is ‘toxic for exercise’ (3.2.4.1).

#### **1.3.2 Children and parents value sport and physical activity**

In spite of this context, sport has been consistently ranked in the top three preferred leisure-time activities for both Australian boys and girls over the last 50 years (3.4.2). Attitudes towards physical education, physical activity and school sport have been consistently positive since 1985 (3.4.2). Very few children (<6%) say that they ‘are not into sport’ (5.10.5), and a similar percentage avoid sport out of fear of injury (3.4.4.2.1). In response to a psychosocial questionnaire, only 19% of girls and 6% of boys said that they would prefer to use two hours of free time for ‘quiet’ as opposed to ‘active’ or ‘mixed’ activities (5.10.5).

Sport is generally perceived by young people as being a way of building and solidifying friendship networks, improving skills, and achieving physical fitness (3.4.4.2.2). A major motivating factor for girls was socialising. In interviews girls mentioned doing activities with friends and families, enjoying the sense of being part of a team. In rural areas in particular, attitudes towards sport are very positive, and sport is seen as a kind of ‘community cement’ (3.4.4.1.1).

The positive community attitudes towards sport are justified by research which finds physical activity to be associated with reductions in the risk of developing cardiovascular disease, diabetes, peripheral vascular disease, some forms of cancer, osteoporosis, and some mental disturbances (3.3.2; 3.3.5). Physical activity also improves quality of life, and is associated with reduced antisocial behaviour amongst young people (3.3.3). A range of economic analyses show that promotion of physical activity is 2-25 times more cost-

effective as either primary health care approaches to other behaviours (e.g. smoking), or secondary care approaches.

### **1.3.3 Some children maintain high levels of physical activity**

Young children have a natural drive to play, which is shared by other mammalian species. With the right permissive environment, children can achieve very high levels of physical activity. One quarter of boys spend more than 110 min.d<sup>-1</sup> on average playing sport. For girls, the figure is 65 min.d<sup>-1</sup> (5.3.3). This can represent 30-40% of a child's total daily energy expenditure. If such substantial minorities can achieve this level of physical activity, it would seem possible that other children can too. If we succeeded in raising the average amount of sport played to the current level played by the most active 25%, we would increase average daily energy expenditure by 10-22% (5.4), which equates to a relative loss of 6 kg of body weight each year.

### **1.3.4 Children can combine high levels of physical activity with social and academic activity**

There is no evidence of high levels of physical activity impairing academic performance. Interventions at Vanves in the 1950s, Trois-Rivières in the 1970s, and South Australia (SA) in the 1980s found that when large slices of the school day were taken away from academic subjects and devoted to physical education, academic performance was unchanged or improved. There is persuasive evidence that acute and chronic exposure to physical activity improves cognitive function in both normal and handicapped children, and there are positive correlations between levels of physical activity and academic performance (3.3.3).

Sport can also be successfully combined with a range of other leisure pursuits. About one third of boys fall into an activity cluster labeled ‘sporties’ or ‘techno-actives’ (4.3.1). These boys combine high levels of sports participation (118 min.d<sup>-1</sup> as opposed to 33 min.d<sup>-1</sup> for other boys) with above average levels of screen time. About one quarter of girls are labeled ‘players’, and combine very high levels of informal physical activity (140 vs 80 min.d<sup>-1</sup>) with large amounts of low-level social activity (chores, schoolwork, etc.) (4.3.4). In face-to-face interviews (8.3), it was striking how busy children were and how much they enjoyed being active.

## **1.4 Strategies to encourage involvement in sport and physical activity**

### **1.4.1 Child-based strategies:**

#### **Exploit the unique activity patterns of groups of children**

Recent studies have shown that different activity patterns exist within groups of children. These activity patterns should be acknowledged and utilised when designing interventions (4.3). For example, ‘techno-active’ children, who combine high levels of physical activity with large amounts of time in front of a screen, would benefit more from a screen reduction strategy than one aimed at physical activity promotion. On the other hand, screen time interventions would not be effective in inactive female socialisers, as they spend very little time in front of the screen to begin with. This group may respond well to an intervention which incorporates socialising and physical activity, such as a ‘walk and talk’ intervention. ‘Screenies’ who engage in high screen time but low physical activity, may respond well to an intervention which links multimedia technology with physical activity (4.4.5).

### **1.4.2 Home-based strategies**

#### *1.4.2.1 Reduce screen time*

The use of negotiated contracts, and various reward systems, for replacing screen time with active ‘backyard’ time, is a promising strategy (3.2.3.1).

#### *1.4.2.2 Remodel the home*

The provision of some yard space for play, along with simple, inexpensive play equipment is associated with greater play participation around the home. Dog ownership increases the likelihood of girls being physically active around the home (3.2.2.5). Parents can consciously create a culture of physical activity in the family.

### **1.4.3 School-based strategies**

#### *1.4.3.1 Remodel the school environment*

Optimise the use of playspace by staggering break-times. Recent research in SA schools confirms that play area, and more particularly, population density, impacts on willingness to play (3.2.3.2). At the same time, provide adequate equipment and staff supervision. Play areas with high levels of sports equipment and improvements (basketball hoops, tennis courts, etc.), coupled with high levels of adult supervision, are much more likely to have physically active boys and girls than areas deficient in both (3.2.3.2).

#### *1.4.3.2 Upskill teachers and provide specialist PE teachers*

Through in-servicing of classroom teachers, raise awareness of innovative approaches to PE delivery. Several studies have shown that the quality of primary school PE can be improved with improved curriculum and specific teacher training and in-servicing (3.2.3.1). Most success has been observed in those programs that emphasise high levels of aerobic activity, are well resourced, and are non-competitive. Reported enjoyment levels are higher in classes characterised by frequent encouragement and praise, where students do not select teams and where winning is de-emphasised.

#### *1.4.3.3 Integrate PE into homework policy*

Physical Education ‘homework’ is being trialed in schools in several countries. Innovative strategies to increase the quantity of active homework (e.g. through calendars with daily ‘fun’ activities) and the quality of movement skill (e.g. through checklists for mastery of specific skills) have been introduced with encouraging results (3.2.3.1).

#### *1.4.3.4 Maximise physical activity opportunities in out-of-school hours centres (OSHCs)*

The OSHC setting is particularly appropriate for physical activity interventions, not only because of the growing population it serves, but also because children attend OSHC at the time of the day which is the critical window of opportunity for children’s play (3.2.3.3). A recent trial in South Australian OSHC sites demonstrated that the provision of developmentally appropriate, fun-orientated, non-competitive activities reduced the number of children choosing sedentary indoor alternatives.

#### *1.4.3.5 Give students and parents a voice*

Listen to the opinions and preferences of children. Most schools encourage democratic decision making through student representative councils (SRCs). As recent surveys confirm that young people prefer to have some control over the development of their sporting activities (3.4.4.2.1.1), the SRC is an ideal opportunity for children to air their views on how opportunities to play can be maximised within the school environment. More autonomous governance in public schools provides parents with a real voice on management issues. Collectively, parents can advocate for ‘activity-friendly’ school environments in a powerful way.

#### **1.4.4 Community-based strategies**

##### *1.4.4.1 Establish neighbourhood networks*

Neighbourhood meetings to re-establish networks around children's sport and free play might focus on questions such as what interests children share, how transport and supervision can be collectivised, or how information could be shared regarding opportunities for organised sport or safe free play.

### **1.5 Further research needs**

While there has been a tremendous amount of research over the last decade or so on fitness, fatness and physical activity in children, there remain gaps in the literature and issues to be addressed, particularly in relation to effective interventions.

#### **1.5.1 Peer group influence**

Very little is known about the effect of the peer group on the amount and nature of physical activity in children (3.2.2.4). Recent studies in the psychological literature regarding personality and behavioural development in young people (Harris, 1999) have de-emphasised the impact of the family and stressed the importance of the friendship group. Consider the case of language, where children from families of non-English speaking background learn to speak accent-free, idiomatic English with ease in spite of the parents' poor English skills. Harris' partitioning of variability between genetic and environmental influences suggests that the home exerts only a very small influence on behaviour. Work remains to be done on whether the same applies to physical activity behaviour.

#### **1.5.2 Physical activity and academic performance**

Recent meta-analyses (Shephard 1997) have suggested that acute and chronic exposure to physical activity can significantly improve cognitive performance. Some intervention studies have been done in France, Canada and Australia where academic school time has been replaced by physical activity. While the results of these interventions were promising, each study had serious methodological flaws. This is a critical question, because PE is being squeezed out of a crowded curriculum (3.2.3.1), and fear of decrements in academic performance are driving some parents to discourage their children from 'too much' involvement in physical activity.

#### **1.5.3 Independent effects of screen time**

There is some evidence that sedentary behaviour (read: screen time) is an independent risk factor for pediatric fatness (3.1.4.1). This is an important question because high levels of physical activity may not compensate for high levels of screen time. There is a natural experimental group of interest: the so-called 'techno-actives' (4.3.3) who combine high screen time and high sports participation.

#### **1.5.4 Trickle down**

There is a powerful and appealing argument in political circles that increasing resources for elite level sport will eventually 'trickle down' to grass roots levels. This concept has led to interventions such as sponsoring sports stars to visit schools in the hope of boosting sports club membership, usually with poor results. One study (Hogan & Norton, 2000) has found no evidence for this hypothesis. Another (Olds, Tomkinson, Léger & Cazorla, submitted)

found no relationship between children's fitness and Olympic success across 37 countries. In the MARCA psychosocial questionnaire, fewer than 5% of students listed visits by high-profile athletes and coaches as major influences on their physical activity decisions (5.10.4). This is in spite of the fact that children will often list sports stars as their heroes (Appendix 8.3, case study 4). We need to know more about the trickle down effect to design rational and cost effective interventions.

### **1.5.5 Winding the clock forward**

Many studies have compared a relatively rosy picture of youth in the 1960s (lean, active, fit) to the situation in the 1990s (overweight, sedentary and unfit), and have produced a raft of suggestions designed essentially to 'turn the clock back' (get children walking to school again; increase membership of traditional sports clubs; return to old-style PE classes; redesign traditional neighbourhoods; reduce screen time). These suggestions fly in the face of large scale socio-economic and demographic trends, such as economic rationalism which is reshaping retail neighbourhoods; increasing suburbanisation which is increasing dependence on automobiles; technological energy-saving devices which are reducing the energy cost of work, consumption and daily life).

What has not been done is to brainstorm solutions for the world as it is likely to be in the future. Such solutions might include harnessing children's fascination with electronic technologies (4.4.5), fitting in with modern rhythms of work by expanding out-of-school-hours care (3.2.3.3) which also exploit the 'critical window' of activity (4.2.3; 5.5.1), creating new forms of physical activity exploiting mobile phones and the internet. In other words, we need lateral, futuristic solutions which adapt to the new social realities.

### **1.5.6 National uniform monitoring systems**

At the moment, there are no good data series on secular changes in physical activity (3.1.5.1), and no general agreement on desirable levels of physical activity. Systems should be set up allowing national uniform monitoring. These should include measures of overweight (BMI), physical activity (including sports participation), and energy intake. Such systems could be administered by specially trained teachers on a national basis. They could be delivered, and data collected, through the internet. Automatic analysis and feedback could be linked to curriculum modules. International agreement on simple instruments would facilitate comparisons with other countries. A significant weakness in most existing instruments is in psychosocial questionnaires regarding issues such as barriers and motivations. When children say they like physical activity because it is 'fun', or don't exercise because they have 'no time', the amount of information conveyed is virtually zero (5.10.1).

### **1.5.7 The watershed of puberty**

Pre-pubertal children have a natural drive to exercise, while post-pubertal children need to be coerced (5.4.2). There is a sudden drop-off in physical activity at puberty in both boys and girls (3.1.5.1; 3.1.7). Puberty may be an evolutionary 'tipping point'. Pre-pubertal children prefer unstructured play in small family and friendship groups; post-pubertal children prefer organised games with a wider circle of acquaintances (3.1.7.2). Research is needed on the social and physiological determinants of this change. An evolutionary psychology model may prove fruitful, as may neuropsychological approaches.



**The report**

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**Children and Sport**



# Introduction

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## **2.1 The questions this report addresses**

This report addresses five main questions:

- (a) How and why are young people involved in different kinds of physical activity?
- (b) Which types of young people are active, and how and why do they get involved in sport?
- (c) Are there ‘good news’ stories about the benefits of sport, and how young people can successfully combine their involvement in sport with other positive life pursuits, such as success at school?
- (d) What strategies are necessary to encourage and sustain lifelong involvement in sport and physical activity?
- (e) What further research is needed to reliably monitor, evaluate and investigate the efficacy of sport and physical activity programs designed for young people?

## **2.2 How we have approached these questions**

We have approached these questions from three different directions.

### **2.2.1 Literature reviews**

Firstly, we have conducted a series of reviews of the Australian and international literature in order to summarise current knowledge on the relevant social and scientific contexts. This includes the:

- medical background (the current fitness, fatness and physical activity of children, and future trends)
- social background (the roles of families, communities and governments in physical activity)
- economic background (the costs and benefits of activity)
- psychosocial background (children’s perceptions of sport and physical activity).

### **2.2.2 Market segmentation analysis**

Secondly, we conducted a market segmentation analysis of data collected using the Multimedia Activity Recall for Children and Adolescents (MARCA), and case study interviews. Market segmentation is a tool commonly used by companies selling products and services to identify different types of consumers based on demographic, attitudinal and behavioural characteristics. Until recently, market segmentation had mainly been applied in commercial contexts, but in this report, we have used cluster analysis to look at the ‘activity market’, based on several thousand very detailed use-of-time profiles completed by children. This part also contains interviews with children representative of the different ‘activity styles’.

### **2.2.3 Use-of-time analysis**

Thirdly, we used data collected using the MARCA to analyse how children use their time. This provided information on the amount of time children spend on physical activity, daily and seasonal patterns in time devoted to physical activity, and socio-demographic correlates of physical activity. The use-of-time analysis also allowed us to analyse individual sports in terms of age and gender profiles and relative popularity.

Approaching these questions from multiple points of view allowed us to ‘triangulate’ the questions, to examine them from different aspects and to compare and collate the results. For example, the literature review revealed weak and inconsistent relationships between socio-economic status (SES) and levels of physical activity. Our use-of-time analysis showed no relationship between SES and minutes devoted to sport or overall activity levels. Our clustering analysis also found no relationships between SES and different ‘activity styles’. It appears likely that the small effect of SES may be mediated by family structure.

## **2.3 Methodologies**

Detailed methodologies are provided in the body of the text, particularly in relation to the clustering MARCA use-of-time analyses. This section provides a brief overview.

### **2.3.1 Literature reviews**

Studies for the literature reviews were located by searching on-line databases (Sports Discus, Medline, AustROM, CINAHL, Digital Dissertations, Current Contents), using appropriate keywords. When published reports were obtained, all relevant references contained in the studies were followed up. We also occasionally used our own unpublished data, and data made available to us by colleagues. The literature reviews were not systematic reviews, and we did not follow the review process of identification and coding of studies, quality assessment, classification according to level of evidence, and qualitative or quantitative cumulation. However, the reviews do draw heavily on existing systematic reviews.

### **2.3.2 Market segmentation analysis**

The market segmentation analysis sought to identify clusters of activity styles and patterns of time use of children. It did this by identifying different categories of time use and seeing how children’s patterns fell into ‘clumps’. These clusters were formalised using well-established mathematical techniques (‘cluster analysis’). Children could then be classified according to how typical they were of each activity pattern, that is, how close they were to the cluster centre. Children close to each of the cluster centres were identified and earmarked for one-on-one interviews. We did this to try to get a concrete picture of the day-to-day lifestyles of children with different activity styles. The cluster analysis was based on a subset ( $n = 1129$ ) of all children who had completed MARCA profiles, and who had completed enough 24 hour recalls to provide sufficient data for analysis.

### 2.3.3 Use-of-time analysis

The use-of-time analyses were based on all available MARCA profiles (8261 24 hour recalls completed by 4661 children). The MARCA is a computerised instrument which asks children to recall everything they did in the last 24 hours in a minimum of five minute slices. These profiles contain enormous amounts of high-resolution data on how children spend their time, which can be analysed in many ways. Activity patterns can be correlated with socio-demographic characteristics.

## 2.4 The organisation of this report

This report contains the parts outlined below.

**Part 3** consist of a series of **literature reviews** of existing information relating to involvement in sport and physical activity by young people. Part 3 has four sections:

- 3.1 a summary of current information on the health status of young people and trends regarding involvement in sport and physical activity over the lifespan
- 3.2 a summary of findings regarding the role of parents, family, peers, schools, community groups and government in promoting involvement in sport and physical activity
- 3.3 a review of the costs of inactivity and the health, social and economic benefits attributable to sport and an active lifestyle
- 3.4 a review of findings on the perceived determinants and barriers to involvement in sport, activities young people appear interested in, and what they seek from involvement in sport

**Part 4** is the **market segmentation** analysis of data collected using the MARCA and some case study interviews.

**Part 5** of the report provides information relating to **the place of sport in children's 'time budgets'**. This analysis describes, among other aspects:

- how much time and energy children devote to sport
- the types of activities that compete for time with sport
- the place of sport in children's time budgets, including the amount of sport played in school versus outside of school
- the most popular sports, and the gender and age-distributions for individual sports
- key socio-demographic variables that influence participation in sport during school years (e.g. family structure)
- the effects of putative increases in sports participation
- psychosocial variables (facilitators and barriers to involvement in physical activity).

**Part 6** contains a general **discussion**, and a number of **recommendations**, addressing areas for future research, and suggesting policies for interventions designed to reinforce the place of sport in the community.



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## Literature review

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### Literature review, Section 3.1

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### Literature review, Section 3.2

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## 3.1 The health status of young people and trends in sport and physical activity involvement over the lifespan

### 3.1.1 Obesity and overweight

#### *3.1.1.1 Australian trends in overweight and obesity in children and adolescents*

There is growing evidence that the prevalence of overweight and obesity is dramatically increasing in Australian children and adolescents. **Note:** Children are characterised as pre-pubertal, while adolescents are between puberty and maturity. However, the identification of national trends in adiposity is limited by the lack of systematically collected anthropometric data. Due mostly to logistical difficulties and funding restrictions, most small surveys have been undertaken at a localised level using convenience samples which do not accurately represent the range of socio-economic, geographical and ethnic diversity of Australia and therefore cannot accurately reflect national trends.

For this reason, only large state-based surveys that have used random sampling techniques will be discussed below. Within these state-based surveys, the prevalence of overweight and obesity in groups with the greatest health needs are often under represented. Groups such as homeless, disabled and Indigenous children are often under sampled due to the survey's sample selection criteria. Children are most often recruited from mainstream schools, not speciality schools such as schools for disabled children or Indigenous schools. In addition, children from these high-risk groups may not fulfil common selection criteria, such as gaining written consent from a parent or care-giver.

The majority of studies rely on weight for height data (e.g. BMI) to indicate levels of overweight, rather than skinfold data. BMI measures are less accurate indicators of adiposity as changes in components of the fat-free mass cannot be distinguished from the fat mass. This is particularly relevant in children during growth and maturation, as it is conceivable that fatness can change while BMI remains constant, as ratios of lean to fat tissue change at different times and at different rates (Garn, Leonard, & Hawthorne, 1986). In contrast, skinfold assessment provides a more direct indication of adiposity, although may be subject to relatively large measurement error (Flegal, Harlan, & Landis, 1990). As the height and weight measures required to calculate BMI are technically simple to obtain, they are generally favoured in large sample surveys.

Secular trends in mass and height were studied by Olds et al (2001) in a review of 42 anthropometric reports collected on 5-16 year old Australian children between 1901 and 1997. The review involved a total of 62 datasets containing a total number of 517,203 subjects (52% boys). The review revealed disproportionate increases in mass relative to height. It was found that between 1937 and 1990 there had been a 10-15% increase in BMI in 13 year old boys and girls (Olds, Dollman, Norton, & Harten, 2001). Of particular

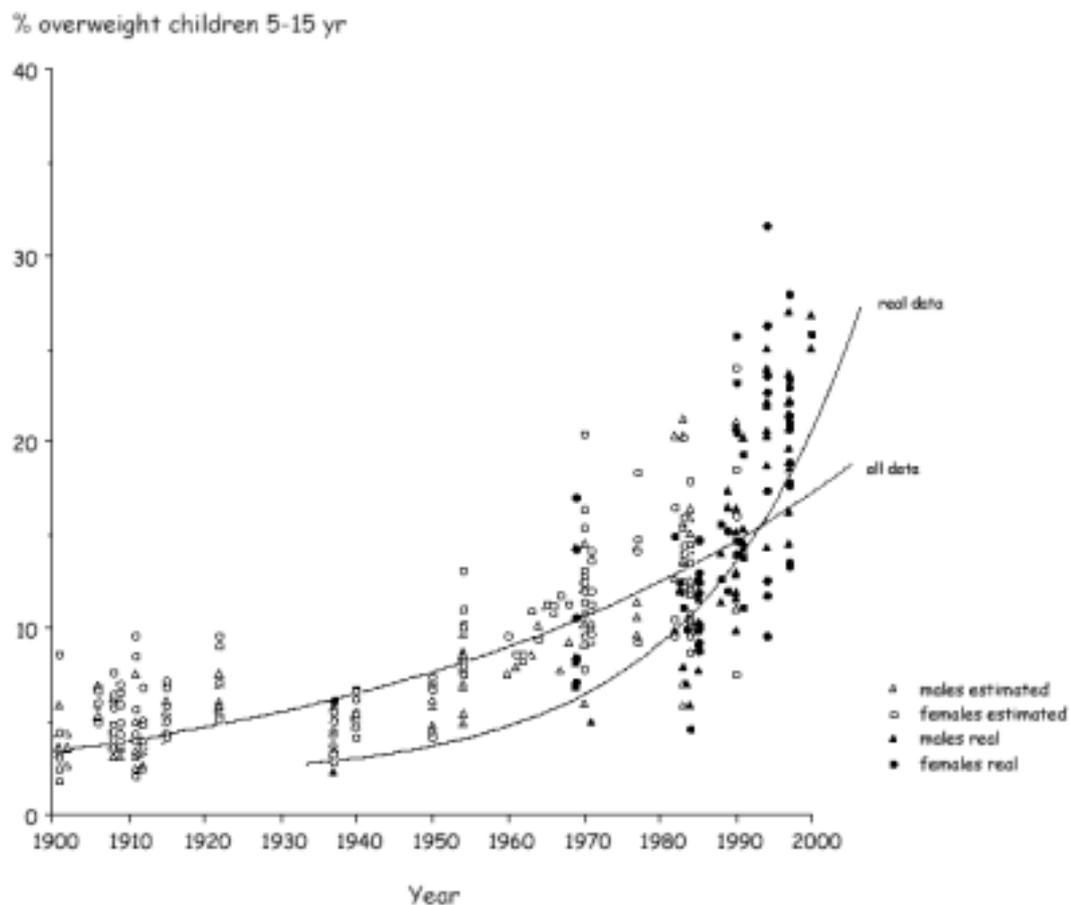
interest were the more marked differences in the higher percentiles (those children with the largest BMIs). The BMIs of the children in the 95<sup>th</sup> percentile increased two- to four-fold over the same period, indicating that the most overweight children are gaining weight at a greater rate compared to the remainder of the population (Olds et al., 2001).

In 2003, the authors of the Olds review from the School of Health Sciences, University of South Australia applied Cole's age- and sex-specific BMI cut-points (Cole, Bellizzi, Flegal, & Dietz, 2000) to approximately 220,000 estimated and 30,000 real datapoints pertaining to school age Australian youth. This is the most comprehensive summary of the Australian scene to date, presenting a picture of rapidly accelerating prevalence of overweight and obese youth. This trend is readily apparent in Figure 3.1. To span the 20th century as broadly as possible, surveys from which only descriptive data were reported have been included along with those from which raw data are available. In some cases, descriptive data of BMI are available, while most early studies (pre-1950) provide only mean heights and masses, from which BMI statistics were estimated. Where descriptive data were relied upon, estimates of overweight and obesity prevalence have been systematically derived. These methods are outlined elsewhere (Dollman, 2003).

Australia's largest state-wide surveys were investigated by Booth and colleagues (2003) in order to assess recent changes in prevalence of obesity and overweight among young Australians aged between 7 and 15 years. This study used Cole's BMI cut-points (Cole et al., 2000) to compare data collected in five independent population surveys undertaken from 1969 to 1997. The surveys analysed were:

- the Australian Youth Fitness Survey, 1969 (analysis performed on the data collected in SA only)
- the Australian Health and Fitness Survey, 1985 (Pyke, 1987)
- the South Australian Schools Fitness and Physical Activity Survey, 1997 (Dollman, Olds, Norton, & Stuart, 1999)
- the New South Wales School Fitness and Physical Activity Survey, 1997 (Booth, Macaskill, & McLellan, 1997)
- the Health of Young Victorians Study, 1997 (Lazarus, Wake, Hesketh, & Waters, 2000).

The three 1997 surveys were compared to the applicable state's dataset in the 1985 Australian Health and Fitness Survey. The 1985 and 1997 South Australian data were also compared to the South Australian data collected in the 1969 Australian Youth Fitness Survey. As absolute criteria for BMI were applied to each data set, it was possible to determine changes in the prevalence of overweight and obesity among Australian children and adolescents.



**Figure 3.1** The proportion of children (ages 5-15 yrs) who were overweight/obese (according to cut-offs by Cole et al, 2000) in Australian studies from 1901-2000. Two lines of best fit are shown, where (1) both raw and reported descriptive data are included, and (2) only raw data were used (1937-2000). (School of Health Sciences, University of South Australia, unpublished data, 2003)

The three states' surveys produced very similar findings. The prevalence of combined overweight and obesity doubled between 1985-1997. Prevalence of overweight increased by approximately 60-70%, while the prevalence of obesity trebled (Booth et al., 2003). Such dramatic increases in a short period (12 years) were not apparent in the analyses of the 1969-1985 period. The comparison of South Australian data from 1969 to 1985 found no significant changes in overweight/obesity prevalence in boys and girls combined, aged 13, 14 or 15 years. However, the prevalence for all boys combined increased by approximately 60% (Pyke, 1987). There was no increase in the prevalence of overweight and obesity among all girls over the same period. While the sample is restricted to South Australian adolescents, it appears that the changes in prevalence of overweight and obesity were far smaller during the period from 1969-1985 than the ensuing 12 year period. Therefore, the results represent a relatively new phenomenon and suggest obesity and overweight are not only increasing, but accelerating (Booth et al., 2003).

The South Australian (Dollman et al., 1999) and New South Wales (Booth et al., 1997) surveys also investigated changes in overweight by means of change in waist girths and skinfold measures. Both surveys found an increase of 5.2 mm in the mean sum of three skinfolds in boys. Waist girth among South Australian boys increased by 3.8 cm, compared to 0.8 cm in the New South Wales boys. The South Australian girls' skinfolds significantly increased by 6.6 mm and waist girths increased by 4.2 cm. Among the New South Wales girls neither mean waist girth nor mean sum of three skinfolds had changed over the 12 year period (Booth et al., 2003). The Victorian and South Australian surveys also demonstrated the marked differences in overweight trends at the highest percentiles highlighted in the Olds review (Dollman et al., 1999; Lazarus et al., 2000; Olds et al., 2001). It can therefore be deduced from the three state surveys that while the leanest children today are nearly as lean as their counterparts approximately 12 years ago, there are currently more overweight children and their level of overweight is greater.

#### *3.1.1.2 Prevalence of overweight/obesity in Australian children and adolescents*

The results from the Booth study suggest that approximately 19-24% of Australian children and adolescents in 1997 were overweight or obese (Booth et al., 2003). Although the data were only drawn from three Australian states, the three states' survey results were extremely consistent. In addition, the 1985 Australian Health and Fitness Survey (Pyke, 1987) found no systematic differences between any of the states or territories across the fitness measures (Pyke, 1987). As there seems to be no clear evidence to suggest the three states (NSW, VIC and SA) are different from the remainder of the country, it is likely that these trends reasonably accurately reflect the current national profile.

The National Nutrition Survey, undertaken in 1995, also included body mass index measurements in 2962 children and adolescents aged 2-18 years (Magarey, Daniels, & Boulton, 2001). Prevalence of overweight and obesity, determined by the Cole cut-points, in the National Nutrition Survey data provide support for figures reported in the Booth study. Combined prevalence of overweight and obesity was reported to be approximately 19.5% in boys and 21.1% in girls (Magarey et al., 2001).

#### *3.1.1.3 International trends in overweight and obesity in children and adolescents*

These trends of increasing prevalence of obesity and overweight in Australia are consistent with international data. It is difficult to make direct comparisons between the current prevalence of overweight and obesity in children from the United States to Australian children at present, as United States researchers have not always used Cole's international BMI cut-points (Cole et al., 2000). However, there is persuasive evidence of increased adiposity among United States children and adolescents during the last 30 years, with particularly dramatic increases from the 1970s onwards (Jolliffe, 2004; Troiano, Flegal, Kuczamrski, Campbell, & Johnson, 1995).

In addition, the *extent* of overweight (that is, the amount by which children exceed the overweight threshold) is increasing a rate that surpasses the rate at which *prevalence* (that is, the percentage of children who exceed the overweight threshold) is increasing. *Prevalence* of overweight increased by approximately 182% from 1971-2000, while the *extent* of overweight increased by 247%. Canadian data show similar trends with the prevalence of overweight more than doubling (from 11-33% in boys and 13-27% in girls) from 1981-1996 (Tremblay, M. S., Katzmarzyk, & Willms, 2002).

Increasing overweight is also being reported in Europe, particularly western and southern Europe (Chinn & Rona, 2001; Hughes, Li, Chinn, & Rona, 1997; Lobstein & Frelut, 2003). A comparison of data collected on British children in 1974, 1984 and 1994 found no change between 1974-1984, but an increase of 44-67% in overweight and a doubling of the prevalence of obesity between 1984-1994 (Chinn & Rona, 2001). Prevalence of overweight in 7-11 year olds, using Cole's BMI cut-points, is currently greater than 20% in the United Kingdom, Switzerland and Croatia, and greater than 30% in Spain, Italy and Greece (Lobstein & Frelut, 2003). While Asian countries still have a relatively low incidence of overweight, it is considered to be an emerging problem (Luo & Hu, 2002; Popkin, Richards, & Montiero, 1996).

### **3.1.2 Health-related fitness**

#### *3.1.2.1 Australian trends in health-related fitness in children and adolescents*

Comparison of data from health-related fitness tests can be difficult, due mainly to various tests being used to measure the same fitness construct and methodological differences within individual tests. The findings of some fitness tests may be spurious due to issues surrounding children's familiarity with test items and motivation to complete the tests (Dollman, 2003).

Mirroring trends in adiposity, the deterioration of children's aerobic fitness appears to be a relatively recent phenomenon, accelerating from about the mid-1980s to the present time. Australian studies of children's aerobic performance have used a variety of performance tests (600 m run, 1600 m walk/run, 20 m multistage, 10- and 12-min run), cover a wide range of ages (7-15 years), geographical areas and socio-economic strata, and have been conducted at national, regional and local levels. In spite of this, they paint a consistent picture. Analysis of data on 18,631 12-15 year old South Australians from the Talent Search program (conducted by the South Australian Institute of Sport) shows a decline of about 0.6% per year in 20 metre multistage shuttle run performance across all age and gender subgroups (Tomkinson, Olds, & Gulbin, 2003).

Again, the Australian Health and Fitness Survey, 1985 (Pyke, 1987) serves as a basis for comparison for state-wide surveys into health-related fitness. A Tasmanian survey found the performance of 7-10 year old Tasmanian children on the 1.6 k run/walk had declined

between 1985 and 1995, by approximately 0.2% per year (McNaughton, Morgan, Smith, & Hannan, 1996). South Australian data showed the median time on the 1.6-km run/walk increased by 38-45 seconds in 10-11 year old children (Dollman et al., 1999).

As was the case in the trends in overweight/obesity, it appears to be the least fit who are deteriorating fastest over time. In the Tasmanian study, this deterioration was concentrated at the 50th, 25th and 10th percentiles of completion time (those who took longer to complete the run) (McNaughton et al., 1996). In the South Australian survey, while the decrease in performance over 1.6 km affected all children, the decrease was exacerbated in poorer performers (Dollman et al., 1999).

There is little evidence of trends in other components of fitness among Australian children. McNaughton and colleagues' 1995 study of 7-10 year old Tasmanians (McNaughton et al., 1996) reported no overall declines in 50 m sprint performance since the national survey of 1985 (Pyke, 1987). In fact, faster times were recorded by 7 and 8 year olds in 1995. In contrast, the South Australian data revealed 0.5-2.0% decrements across both the fastest and slowest sprinters (Dollman et al., 1999). South Australian Talent Search data revealed no declines in vertical jump and basketball throw performances in 12-15 year olds between 1995 and 2000, while 40 m sprint performances had deteriorated (by approximately 0.3-0.6%) in 13-15 year old boys and girls (Tomkinson, Olds et al., 2003).

### *3.1.2.2 International trends in health-related fitness in children and adolescents*

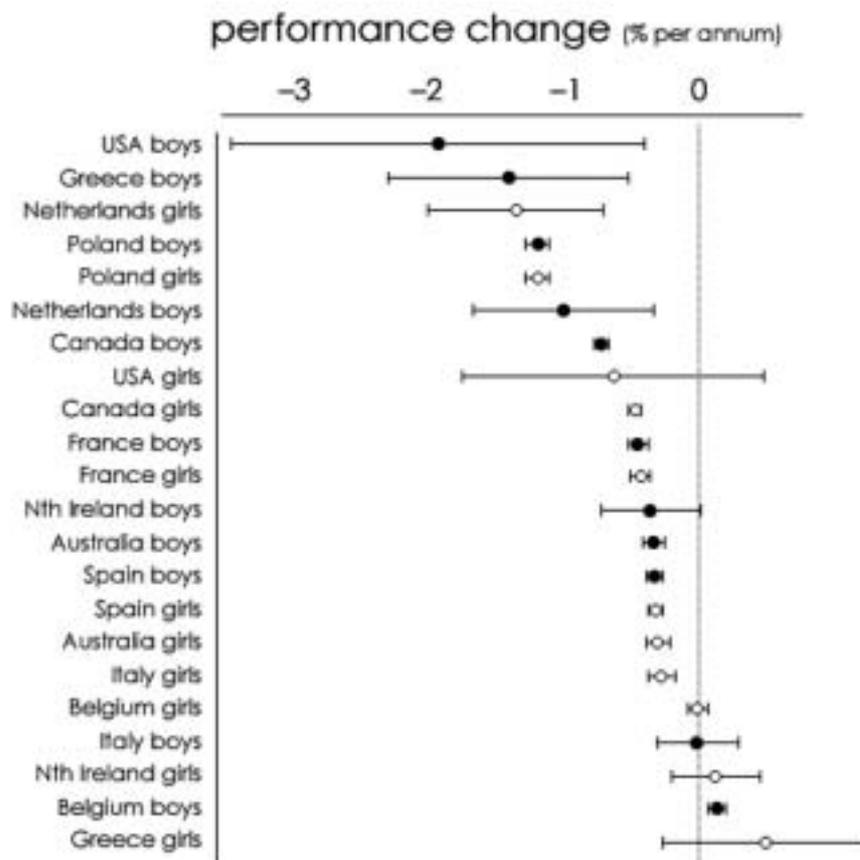
The declines in fitness dimensions across the world are not as clearly evident as the changes in overweight. As stated earlier, methodological discrepancies are largely responsible for a lack of comparable fitness data. Early comparisons in the United States ranging from 1934-1935 and 1985-1986 found fitness dimensions to be relatively stable and even some slight improvement in children and adolescents. Corbin and Pangrazi (1992) found little change in the data from the National School Population Fitness Surveys (NSPFS) between 1975 and 1985. Of the five fitness tests performed: 50 yd dash; standing broad jump; shuttle run; pull-ups for boys; and flexed arm hang for girls, performance declines were only found in the 50 yd dash for 11 year old boys and 10, 11, 14 and 16 year old girls (Corbin & Pangrazi, 1992).

In contrast, more recent surveys are reporting declines in the fitness levels of United States children. A study in 1989 using one-quarter to one mile (402-1609 m) runs reported an average decline of 1.1% per year in 6-17 year old American children and adolescents between 1980 and 1989 (Updyke & Willett, 1989).

Declines in performance in distance runs have also been reported in Italy and Poland with mean declines of 0.9% and 0.7% respectively in children and adolescents (Merni & Carbonaro, 1981; Przeweda & Trzesniowski, 1996). Large mass testing programs in Asia

also reveal decrements in distance run performance. A Japanese survey shows declines of 0.4% per year in 12-17 year old adolescents between 1985-1998 (Ministry of Education Science and Culture, 1999). In South Korea, two large surveys again reported declines in distance run performance in adolescents. The first survey tested 26,000 adolescents aged 10-17 years, from 1983-1985, while the second survey tested 11,636 adolescents aged 12-16 years between 1988-1998. Both surveys found mean declines of 1.1% per year (Ministry of Culture and Tourism, 1998; Ministry of Education, 1999).

However, the most comprehensive and damning evidence for international declines in aerobic performance comes from a review by Tomkinson and colleagues (2003). A meta-analysis was conducted on 55 reports of performance of children and adolescents (aged 6-19 years) in the 20 metre shuttle run test between 1981-2000. Rates of change were calculated for 11 countries representing a total of 129,882 children and adolescents in 151 groups according to age, gender and country. Of the 151 performance changes calculated, 106 were negative. The mean change was  $-0.43\%$  of mean running speed per year. The decline was most marked in the older age groups, and declines were similar for boys and girls (Tomkinson, Léger et al., 2003). The mean rates of change for boys and girls from the 11 different countries are shown in Figure 3.2.



**Figure 3.2** Sample-weighted mean rates of change in performance (% per year) for boys and girls from the 11 countries where rates of change were calculated. The error bars show the 95% confidence intervals. (Reprinted from Figure 3, Tomkinson et al., 2003)

### **3.1.3 Cardiovascular disease risk factors**

The trends of increased prevalence of childhood obesity and decreased physical activity are extremely disturbing as both are associated with a number of disorders, both medical and social. The most notable repercussion of childhood obesity is its relation to numerous cardiovascular disease (CVD) risk factors. Although the clinical manifestations of CVD generally do not appear until adulthood, it has been discovered that risk factors for CVD manifest before adulthood (Riddoch & Boreham, 1995). Studies in the United Kingdom and United States have indicated that greater than 69% of 12 year olds had at least one modifiable risk factor for CVD (Riddoch & Boreham, 1995).

CVD risk factors associated with childhood obesity include: hypertension; dyslipidaemia (raised levels of total, low and very low density lipoprotein cholesterol and reduced levels of high density lipoprotein cholesterol); hyperinsulinaemia (high levels of insulin); and insulin resistance (Bao, Srinivasan, Wattigney, & Berenson, 1994; Bar-Or & Baranowski, 1994; Baur, 1997). Insulin resistance is associated with Type 2 diabetes (non-insulin dependent diabetes), a condition traditionally limited to adults. However, rising levels of obesity and therefore increasing levels of insulin resistance have been attributed to rising incidence of Type 2 diabetes in children in the Western world (Kaufman, 2002).

Childhood obesity is also related to medical conditions such as respiratory disorders, orthopaedic problems, arthritis, hepatic complications, decreased release of growth hormone, gastroesophageal reflux and gastric emptying disturbances (Bar-Or & Baranowski, 1994; Baur, 1997). Social problems include decreased self image and self esteem, social problems in later life and a reduced desire to participate in physical activity (Baur, 1997; Hill & Silver, 1995; Moussa, Skaik, Selwanes, Yaghy, & Bin-Othman, 1994). This may lead to a complex interrelation between physical activity and obesity, where a sedentary life acts as both the cause and consequence of obesity (Moussa et al., 1994).

#### *3.1.3.1 Tracking into adulthood*

Preadolescents who are overweight are more likely to remain so into adolescence. Marshall and colleagues (1998) found adiposity (skinfolds and BMI) demonstrated a high degree of tracking over three years in children aged 8-10 years. In addition, a pertinent feature of CVD risk in childhood is the tendency to persist into adulthood. There is evidence that CVD risk factor status for dyslipidaemia, obesity, hypertension, plasma insulin levels and physical fitness track moderately from adolescence into adulthood (Malina, 1996). Persistence of obesity is more likely with an onset of obesity in late childhood or adolescence (Guo, Roche, Chumlea, Gardner, & Siervogel, 1994). Furthermore, individuals who were overweight in adolescence are shown to have significant association with long term morbidity, independent of their adult weight (Must, Jacques, Dallal, Bajema, & Dietz, 1992).

### 3.1.4 Gluttony or sloth?

Genetics, energy intake (diet) and energy expenditure are contributing factors in the development of obesity. While genetic factors are thought to account for approximately 25-40% of obesity cases in the general population (Bouchard, 1994), the rapid increase in the prevalence of obesity in the western communities has been attributed to changes in environment, rather than changes in the gene pool (Bouchard, 1994). In addition, despite a large body of evidence, there appears to be little change in the overall caloric intake in the general population despite increased levels of obesity. Prentice and Jebb (1995) reported that the mean energy intake of 14-15 year old British children had declined by about 20-30% between the 1930s and 1980s and there was a 20% reduction in the mean intake of United Kingdom residents between 1970 and 1990.

Data from three National Health and Nutrition Examination Surveys (NHANES), undertaken in the United States show that mean energy intakes across the three NHANES (from early 1970s to 1994) decreased slightly or remained stable for children aged 2-5 years and 6-11 years, but increased by approximately 400 kJ for adolescents aged 12-19 years (Troiano, Briefel, Carroll, & Bialostosky, 2000). In contrast, mean energy intakes as reported in the United States Department of Agriculture national food consumption surveys were slightly lower for adolescents in 1989-1991 than in 1977-1978 (Troiano et al., 2000).

When energy intake was further divided into its nutritional components, it was found that since the early 1970s United States children and adolescents have continued to reduce their intakes of fat and saturated fatty acids as a percentage of total energy. On average, fat intake has declined from 36-37% of total energy to 33-34% in the decade between surveys. The intake of saturated fatty acids has declined from 14% to 12% of total energy. Despite the lack of energy intake trend data in Australian children and adolescents, these findings suggest that increased intake over time is not the major contributor to the increased prevalence of overweight among youths. It is likely that physical inactivity has played a significant role in the increasing prevalence of overweight and obesity in children and adolescents.

#### *3.1.4.1 Relationship between habitual physical activity and body fat*

The relationship between habitual physical activity and body fat in children was investigated by Rowlands et al. (2000) in a meta-analysis of 50 studies. Of the 50 studies analysed, 78% showed an inverse relationship (that is, increased physical activity was related to decreased body fat), 18% found no relationship and 4% found a positive relationship. The mean effect size was small to moderate, but was largely dependent on the activity measure used (Rowlands, Ingledeu, & Eston, 2000).

Distinct forms of habitual leisure activity have also been found to influence levels of overweight. While the evidence is somewhat equivocal, sedentary activities (typically defined as time spent watching television and playing video games) have been implicated as a possible cause of rising levels of overweight. Numerous studies have suggested there may be a dose-response relationship between prevalence of overweight and hours of TV viewed. Data from the Healthy Young Victorian's survey found BMI was related to television in 2862 children aged 5-12 years (Wake, Hesketh, & Waters, 2003).

The South Australian Schools Fitness and Physical Activity Survey found time spent in television hours was a predictor of boys' body fat independent of physical activity level (Dollman, 2003). In the United States, Gortmaker (1996) found the odds ratio for being overweight was 4.6 times higher for youth (aged 10-15 years) watching five hours of television per day compared to those watching zero to two hours (Gortmaker et al., 1996). Investigation of NHANES III data found those children and adolescents (aged 8-16 years) who watched four hours of television had significantly greater body fat than those who watched greater than two hours per day (Anderson, Crespo, Bartlett, Cheskin, & Pratt, 1998). A Canadian study by Tremblay (2003) also supports a threshold of two hours of television viewing time per day in relation to overweight based on a study of 7-11 year old children. A threshold of three hours per day was found to be associated with obesity (Tremblay, M. & Willms, 2003). While significant, the correlations between fatness and TV watching are rather small, typically accounting for less than 1% of the variability in fatness. Mechanisms behind the relationship with television watching and body fat are unclear. While this sedentary activity may simply displace physical activity from daily life, other potential effects include a lowering of resting metabolism and influences on snacking frequency and choices while watching television (Dietz & Gortmaker, 1985).

Time spent in sport (both organised and unorganised) has also been found to be associated with prevalence of overweight. Tremblay's Canadian study found that participation in organised and unorganised sport and physical activity was negatively associated with being overweight and obese (Tremblay, M. & Willms, 2003). A study of 11,887 adolescent girls from the United States found that increasing total recreational physical activity over one year was associated with a relative BMI decline, taking into account normal BMI increases over time (Berkey, Rockett, Gillman, & Colditz, 2003). An Irish study found a reduction of 20% in sport participation was associated with a significantly higher probability of belonging to a high risk group for body fatness in 15 year old girls (Boreham, Twisk, Savage, Cran, & Strain, 1997). Salbe (Salbe et al., 2002) tracked 138 Native American children from 5 to 10 years old. At age 10 years, obesity was associated with decreased participation in sports and increased television viewing (Salbe et al., 2002).

It is important to note that causal relationships have not been established between levels of overweight and both sedentary behaviours and time spent in sports. It may be that overweight children may be more inclined to choose sedentary activities over active sports. Other factors such as parenting styles may also influence the relationship and will be discussed in Section 3.2 of this literature review.

#### *3.1.4.2 Habitual physical activity and health-related fitness*

Research on the relationship between physical activity and aerobic fitness in youth suggests a small to moderate association, despite a much clearer link in adults (Morrow & Freedson, 1994). Any true association is likely to be attenuated by methodological problems with measuring physical activity and defining aerobic fitness, as well as the relatively high levels of both among youth (Morrow & Freedson, 1994). Club sport participation in the South Australian Health and Fitness survey was strongly associated with cardiorespiratory fitness (1.6 km run/walk) among boys and girls (Dollman, 2003).

A physically active lifestyle has also been positively associated with physiological health in children and adolescents. In general, higher physical activity levels are associated with more favourable CVD risk factor profiles (Boreham et al., 1997). Specifically, physical activity has been demonstrated to be a significant predictor for favourable blood lipid profile levels (Suter & Hawes, 1993).

Regular physical activity has been found to influence physical fitness from childhood into adulthood, as habits and attitudes toward physical activity developed during childhood and adolescence are assumed to continue through adolescence to adulthood (Malina, 1996). Habitual physical activity in youth has also been associated with enhanced skeletal health (Bailey & Martin, 1994). The immediate consequences of physical activity for the psychological health of children and adolescents have received scant attention. The available evidence indicates a positive association with self-esteem and a negative association with stress and anxiety (Calfas & Taylor, 1994). Most studies of this phenomenon report that exercise is a more potent antidepressant than episodes of physical relaxation, or other activities which children and adolescents find 'enjoyable' (North, McCullagh, & Tran, 1990).

The measurement of physical activity in children is inhibited by the lack of a 'gold standard' method that accurately measures type, frequency, duration and intensity of activity. Children's physical activity is generally measured by: self-report questionnaires or diaries; proxy-reports, where another person, generally parent or teacher reports on the child's activity; observation; or objective measures, such as motion sensors and heart rate monitors. Each method has its own benefits and limitations (Sirard & Pate, 2001; Welk, Corbin, & Dale, 2000). Each method's measurement units are different, making comparison between studies very difficult. Due to convenience and cost, self-report measures are generally favoured in large-scale surveys of children and adolescents aged 10 years and above. The unsuitability of self-report measures for children aged less than 10 years means there are very little data on the physical activity levels of children in this age range.

### **3.1.5 Physical activity**

Recommendations for physical activity among young people were issued in a 'Health enhancing physical activity for young people' statement of the United Kingdom expert consensus conference in 2001 (Cavill, Biddle, & Sallis, 2001). The main recommendation states that 'all young people (aged 5-18 years) should participate in physical activity of at least moderate intensity (at least three metabolic units (3 METs) or equivalent to a brisk walk) for 60 mins per day' (Cavill et al., 2001, p. 18). **Note:** The MET is a rating of energy expenditure. One MET refers to resting metabolic rate and is equivalent to the energy required to sit quietly. An activity with a rating of 2 METs requires twice the energy expenditure of sitting quietly, and so on. The statement also caters for young people who are currently doing little activity, recommending that inactive young people 'should participate in physical activity of at least moderate intensity for at least half an hour per day' (Cavill et al., 2001, p. 18). In addition, a subsidiary recommendation states that 'at least twice a week, some of these activities should help to enhance muscular strength and flexibility, and bone health' (Cavill et al., 2001, p. 18).

### *3.1.5.1 Prevalence of Australian children and adolescents meeting guidelines*

There is a significant shortage of data on the physical activity levels of Australian children and adolescents. In particular, there are very few studies that have used large, randomly selected samples. In addition, there are even fewer studies whose chosen measurement tool allows for comparison with physical activity guidelines (that is, time spent in moderate to vigorous physical activity and strengthening activities).

A study of 165 South Australian children, aged 10-13 years, used the Multimedia Activity Recall for children and adolescents (MARCA) over three days to predict usual physical activity levels (Hill, 2002; Ridley, Olds, & Hill, 2002). Results indicate that 81.5% of boys and 47.6% of girls participated in at least 60 mins of moderate activity per day (Hill, 2002). However, this study used a higher activity cut-point of 5 METs, rather than the customary 3 MET cut-point and therefore is likely to be underestimating the proportion of children who met the current guideline.

Physical activity data were collected on 13-16 year old (school grades 8 and 10) adolescents in the 1997 NSW Health and Fitness Survey (Booth et al., 1997). The self-report questionnaire used (a frequency questionnaire referring to time spent in physical activity during a 'usual week') did not allow for direct comparison with the 60 min per day guideline, so the authors adapted the guideline to suit their data. Two categories were created – active and inactive. To be placed in the active category, students had to 'participate in at least 3.5 hours of moderate to vigorous activity (at least 3.5 METs) over at least five sessions in a normal week' (Booth et al., 1997, p. 25). During summer, 81% of the grade 8 boys and 86% of the grade 10 boys were classified as active, while 81% of grade 8 girls and 78% of grade 10 girls were active in summer. Fewer students were active in winter, with 76% and 84% of boys active in grade 8 and 10, respectively. Sixty nine percent (69%) of grade 8 girls, and 66% of grade 11 girls were active in winter.

A study of adolescent girls' activity was undertaken as part of the Central Queensland Physical Activity Nutrition Survey with a random sample of 240 13 year old girls and 244 16 year old girls (Schofield, Mummery, Schofield, & Walmsely, 2002). Physical activity was measured using the Previous Day Physical Activity Recall (PDPAR) self-report questionnaire (Trost, Ward, McGraw, & Pate, 1999). Girls were classified as active if they engaged in two 30 min blocks of activity of at least 3 METs during the after school period (that is, immediately after school to 11.30 pm). On the day surveyed, 56.5% of 13 year old girls and 47.7% of 16 year old girls were classified as active. Further investigation revealed that 17.3% of the 13 year old girls and 25.5% of 16 year old girls reported no organised sport or recreational activity (Schofield et al., 2002). This study was limited as the one-day recall was only administered on one occasion, so estimations of 'usual activity' are questionable.

Each of the three studies identified girls in early adolescence as targets for physical activity interventions (Booth et al., 1997; Hill, 2002; Schofield et al., 2002). The significance of early adolescence as a key period in the lifespan of physical activity behaviour is discussed further in the report.

### 3.1.5.2 *Secular trends in physical activity*

Again, the lack of data on children's physical activity levels inhibits the investigation of trends over time. The limited data focuses on changes in organised sport, activity choices and sedentary activity in children and adolescents.

#### 3.1.5.2.1 Organised club or school sport

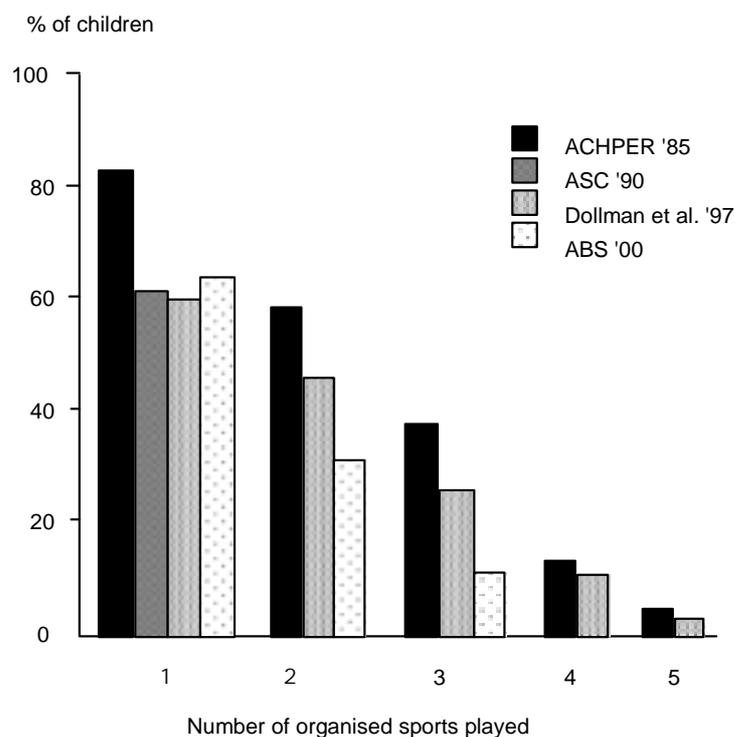
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Trends in organised sport have been investigated by Norton et al. (2001) in a study that compared four large scale surveys. Prevalence of participation in sports and recreational activities (both organised and non-organised) reported in the 1985 Australian Health and Fitness Survey (Pyke, 1987) was compared to data from the South Australian Schools Fitness and Physical Activity Survey (Dollman, 2003), and two recent surveys undertaken by the Australian Sports Commission (Australian Sports Commission, 1991) and the Australian Bureau of Statistics (Australian Bureau of Statistics, 2001b). Throughout the surveys, most children participated in one sport, with the number participating in two, three and four sports decreasing fairly linearly. Sport participation was high in the 1980s (82.5% of all children surveyed participated at some level). However, subsequent studies show the participation rate drop by approximately 60-64% (Norton et al, 2001). The most dramatic drop off was the percentage of children who were involved in more than two sports per year (see Figure 3.3). In 1985, 40% of children played three or more organised sports within a year. In 2000, only 11% of children reported playing three or more sports. The reasons behind these declines are yet to be established; however the roles of parents, family and peers in physical activity are likely to have an impact and are discussed in the Section 3.2 of the literature reviews.

#### 3.1.5.2.2 Activity choices

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The Norton study also gives some insight into activity and sport choice trends. The variety of club and school organised sports chosen in the South Australian 1997 study was considerably larger than in 1985. The number of sports listed increased from 28 to 33 in boys and from 18 to 33 in girls (Norton et al., 2001). As the variety of sports chosen increased, most sports experienced a decline in the percentage of children who reported participating. The biggest losses were in traditional organised sports (Norton et al., 2001). Cricket, tennis, soccer, hockey and Australian rules football experienced large declines in boys, while netball, softball and hockey declined in girls. Basketball in both boys and girls, and aerobics in girls were sports that showed increased levels of participation (Norton et al., 2001). These increased levels of participation may be the result of a large increase in the media profile of basketball (particularly from the National Basketball Association in the United States). The increase in participation in aerobics may be due to the introduction of competitive aerobics at both club and school level. The trend away from 'traditional' club and school organised sports may be simply the result of a larger activity market for children, demonstrated by the larger variety of sports listed in 1997. However, it may also represent a trend toward 'take-away' sports which require less time commitment (training and matchplay).



**Figure 3.3** Proportions of children (9-15 year old) playing organised sport (club and/or school) in four surveys across the period 1985-2000. (Reprinted from Norton et al., 2001)

### 3.1.6 Sedentary activity

Time spent by Australian children watching television has increased from 113 min per day in 1992 to 130 min per day in 1997 (Australian Bureau of Statistics, 1997). Importantly, 52% of children watch more than 20 hours of television or videos per week (Australian Bureau of Statistics, 2001a). This means that over half of all children aged 5-14 years are spending more time watching TV and videos than in the school classroom. One of the best predictors of weekly physical activity patterns in children is the two hour period immediately after school (Terre, Ghiselli, & Taloney, 1992). ACNielsen Surveys indicate that about half of all 5-12 year olds are watching television during this time (Nielsen, 2000).

Australian Bureau of Statistics (ABS) surveys (1995; 1999) indicate that between 1981 and 2000, television and VCR ownership increased from 92% to 100% (61% of homes have two or more) and from 3% to 86%, respectively. There has also been a threefold increase in Pay-TV in the past four years. About 50% of all homes have a computer, while Internet access has grown from 4% in 1996 to over 24% of residences in 2000, over half of which include children between 5-14 years. This increased accessibility to television and computers is likely to have resulted in increased levels of sedentary behaviour in children.

### 3.1.7 Trends in physical activity over the lifespan

There is substantial evidence of a decline in physical activity over the lifespan. A number of international tracking studies have identified adolescence, typically between 13-18 years, as the period of greatest decline in physical activity in both males and females over the lifespan (Caspersen, Pereira, & Curran, 2000; Kimm et al., 2000; Telama & Yang, 2000; Van Mechelen, Twisk, Post, Snel, & Kemper, 2000). However, as there is a lack of data on

physical activity levels of children less than 10 years old, trends within childhood are unclear. It is possible that substantial declines in physical activity in childhood may also be apparent.

While female adolescents are generally less active than males, most notably inactive in vigorous and strengthening activities (Hill, 2002; Hoos, Gerver, Kester, & Westerterp, 2003; Mota & Esculcas, 2002; Van Mechelen et al., 2000), the differences in rate of decline between genders is unclear. A review of studies found an average decline of approximately 7.4% per year in girls, compared to 2.7% in boys (Sallis, 1993). Although many studies report rates of decline to be larger in females, a number of studies report significantly greater declines in males. Three recent studies of boys in the United States, Finland and Amsterdam found declines of approximately 1.8-3.7% in boys, compared to 1.2-1.3 % in girls (Caspersen et al., 2000; Telama & Yang, 2000; Van Mechelen et al., 2000).

Physical activity continues to decline in adulthood, most significantly between the ages of 65-74 years (4% decline) and 75 years and over (10% decline) (Caspersen et al., 2000). During the age range of 30-44 years and 45-64 years, the percentages of males and females participating in sustained physical activity are relatively similar. However there is a widening gap at retirement, with males actually increasing their physical activity by approximately 9%, while female activity levels remain unchanged (Caspersen et al., 2000). It is likely that the typical leisure activities of men in retirement, such as golf and gardening are more active than the retirement activities chosen by women.

#### *3.1.7.1 Declining physical activity throughout the lifespan: biological phenomenon?*

There is some evidence to suggest the decline in physical activity levels has a biological basis. Studies of a variety of animal species, such as insects, rodents and monkeys, show a decline in physical activity levels over the lifespan (Ingram, 2000). While some animal surveys show a linear decline, others find a greater decline at young ages, similar to human studies (Ingram, 2000). These studies suggest that decline in physical activity over the lifespan is at least partially a biological phenomenon. However, there is substantial evidence which points to a large, adaptable behavioural component. Numerous studies have shown that psychology, social and physical environments are related to physical activity (Sallis, Prochaska, & Taylor, 2000). In essence, while a decline in physical activity over the human lifespan is somewhat inevitable, the degree or slope of decline can be altered by intervention.

#### *3.1.7.2 Trends in activity choice throughout adolescence*

Declines in physical activity in adolescence are predominantly in vigorous activities and non-organised sports (Bradley, McMurray, Harrell, & Deng, 2000; Caspersen et al., 2000; Van Mechelen et al., 2000). The decline in non-organised sports is evident by the reduced numbers of adolescents found playing playground games or sports and games in local parks. As participation in non-organised sports decreases, participation in organised sports becomes even more important to overall activity level. As behavioural patterns with regard to organised sport are established early (Engstom, 1991), it is important that involvement in organised sports begin in pre-adolescence. This is particularly important for girls as girls' team sports, which are common in middle school, tend to drop off in high

school (Bradley et al., 2000). In a study into the activity choices of 656 girls and boys tracked from ages 9-15 years in the United States, girls reported more social and sedentary activities with age. Girls aged 12–15 years reported mostly sedentary activities, with talking becoming the girls' primary leisure activity at 12 years of age (Bradley et al., 2000). In boys, there was a sharp increase in sedentary behaviour at ages 12-15 years, however more than 50% of boys still reported more vigorous activities than sedentary (Bradley et al., 2000).

While there are very little data on the mechanisms behind the dramatic decline in physical activity in adolescence, adolescence represents a time of increased study commitments and assimilation into adult work and family roles. These issues may act as barriers and will be discussed in Section 3.4 of the literature review.

### **3.1.8 Conclusion**

Increases in the prevalence of overweight and obesity and declines in physical fitness among children and adolescents have occurred in the Western world over the last few decades (Jolliffe, 2004; Tomkinson, Léger et al., 2003; Troiano et al, 1995). While the identification of Australian trends is restricted by a lack of systematically collected data in nationwide surveys, it appears that Australian children are no exception and are also becoming more overweight and less fit (Booth et al., 2003; Dollman et al., 1999; Tomkinson, Olds et al., 2003). In particular, it appears to be the most overweight and least fit children who are exhibiting the greatest deterioration (Dollman et al., 1999). Disturbingly, these trends of increasing overweight and declining fitness are accelerating (Booth et al., 2003). These trends are not only affecting the health status of children in the short-term, but as both obesity and physical fitness have been linked to a number of cardiovascular disease risk factors, it is likely their health status in adulthood will be seriously affected (Bar-Or & Baranowski, 1994; Riddoch & Boreham, 1995).

Physical inactivity has been identified as a major cause of overweight and decreased physical fitness (Prentice & Jebb, 1995). While data are very scarce, there appear to be declines in the amount of physical activity being performed by Australian children. Self-reported declines in club or school organised sport have been demonstrated over a 12 year period (Norton et al., 2001). In particular 'traditional' Australian club and school sports, such as cricket, tennis, netball and softball are experiencing the largest drop-off in participation. In addition, children are spending increasingly more time in sedentary activities, such as watching television (Australian Bureau of Statistics, 1998). These declines in physical activity and increases in sedentary activity appear to be most apparent in adolescence and most pronounced in girls (Booth et al., 1997; Bradley et al., 2000). While there is some evidence that declines in physical activity are a biological expectation and therefore somewhat inevitable, the degree of decline can be altered (Sallis, 2000). It is essential that the mechanisms behind the increases in overweight and obesity and declines in physical fitness and physical activity are further investigated, with a particular focus on those groups of children and adolescents who are experiencing the greatest declines.

## **3.2 The roles of parents, family, peers, schools, community groups and government in promoting involvement in sport and physical activity**

### **3.2.1 Introduction**

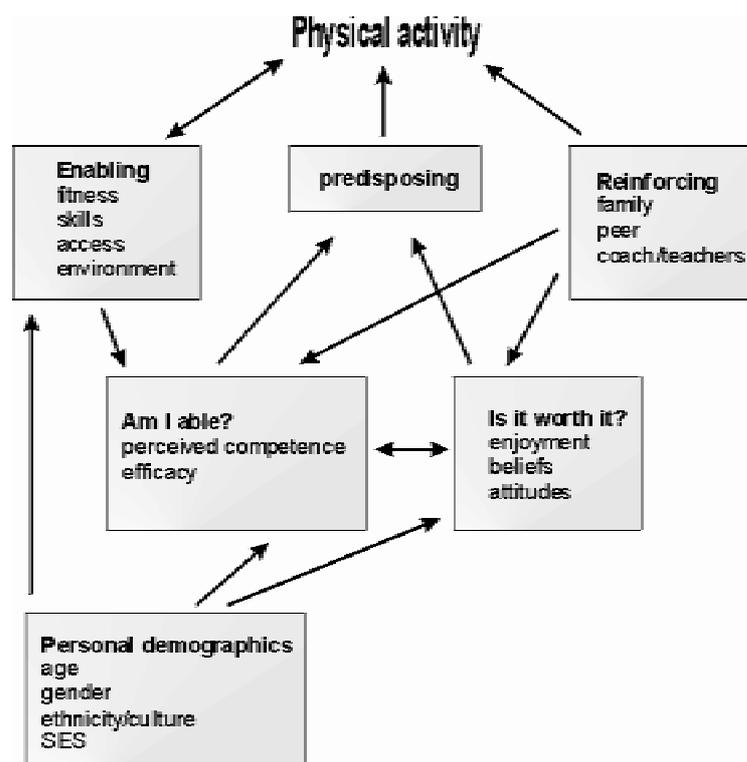
A range of theories and models have been proposed and tested for the capacity to explain physical activity behaviours in children. The numerous studies in this area differ widely in aspects of research design, measurement techniques, physical activity contexts (e.g. unstructured play, physical education and organised sport) and populations studied. It is not surprising that the literature presents a confusing picture of ‘predictors’ of physical activity, and that intervention design is limited accordingly. Most studies have been cross-sectional in design, thus restricting findings to ‘correlates’ rather than determinants of behaviour. A higher quality of evidence is required to confirm true determinants, that is, a causal pathway from hypothesised intrinsic and extrinsic factors to habitual physical activity (Bauman et al., 2002). Unfortunately there is a dearth of such evidence in the literature.

Correlates of physical activity consistently demonstrated in cross-sectional studies have led to useful hypotheses regarding determinants of physical activity. However, the nature of the association is obscured by such research designs. For example, it is likely that reciprocal determinism operates between some psychosocial influences and the behavioural ‘outcome’ (Bauman et al., 2002). ‘Intention to be active’ is a psychological attribute consistently reported as associated with youth physical activity (Sallis. et al.), and yet it is likely that an individual’s intention to be physically active will be higher if an active behaviour pattern is already established. Similarly, it is easier for parents to provide encouragement and support for their child’s physical activity if the child is already engaged in regular activity, in part explaining the consistently reported association of parental influences on children’s physical activity.

The context within which physical activity takes place can also moderate the associations of psychosocial factors and children’s physical activity. A recent study of South Australian youth examined parental influences of children’s sport participation and accumulated moderate-to-vigorous physical activity (MVPA) in the entire representative sample, and separately in urban and rural sub-samples. Representations of parent support and parent activity were unrelated to MVPA and sport participation in rural children, but were consistently positively associated among urban boys and girls (Dollman, 2003). As urban and rural children did not differ in the overall levels of MVPA and sport participation, it is possible that urban children are more highly dependent on parental influences to be active, perhaps due to barriers to access in the urban milieu, such as cost, safety and availability of suitable play spaces.

Within the same child, different sets of predictors may operate on play at school (such as at lunch and recess times) compared with play in or near the home (Dollman, 2002). Influences on unstructured play may differ from factors affecting sport participation, and these influences may be moderated by gender and age. A recent study of metropolitan South Australians identified that, among girls, ‘lack of potential playmates’ was the only correlate of total MVPA, while among boys, peer support and self-efficacy were strongly associated with MVPA (Dollman, 2002). Different predictors applied to MVPA performed at school (peer support among girls, with no predictors for boys), and out-of-school (peer support and self-efficacy for boys, with no predictors for girls).

It is clear that physical activity behaviour in young people is the outcome of a complex causal web, involving multiple levels of factors where effects are mediated and moderated by a wide range of influences. Models of behavioural theory used to explain adult physical activity are likely to be inadequate for youth. There have been recent attempts to configure models of youth physical activity that take account of the complex network of hypothesised influences, according to a social-ecological framework. The Youth Physical Activity Promotion Model proposed by Welk (1999) includes multiple levels of environmental influences (e.g. social, cultural, physical, institutional), both direct and indirect, on physical activity behaviour (see Figure 3.4).



**Figure 3.4** A conceptual diagram of the Youth Physical Activity Promotion Model (YPAP).  
Adapted from Welk (2000)

### 3.2.2 Home and family influences on youth physical activity

The social and physical aspects of a child's home environment that influence physical activity are represented at multiple sites in the YPAP (see Figure 2.0). Cultural and socio-economic circumstances of parents link with issues of access to opportunities as well as physical resources such as space, equipment and sedentary alternatives. Parents may directly influence their child's behaviour through genetic transmission, as well as through the forces of socialisation. Family structure and sibling activity behaviours may also impact on levels of habitual activity.

#### *3.2.2.1 Genetic influence*

While many studies have looked at the impact of parents' physical activity and their children, it is difficult to isolate cultural and environmental factors that are shared by the family from direct genetic transmission. Studies of monozygotic and dizygotic twins are able to separate the genetic factors from the cultural and familial environment factors. A study by (Beunen & Thomis, 1999) looked at the heritable factors of physical activity and sports participation using twin and family data. The heritability coefficient for sports participation ranged from 0.35-0.83 (12-69% of variance) while for daily physical activity it ranged from 0.29-0.62 (8-38% of variance). In a comprehensive study of 1610 individuals from 375 Canadian families (Pérusse et al., 1989), associations of activity behaviours were studied for parent-child, foster parent-child, grandparent-child, cousin-child, unrelated sibling-child, related sibling-child, and twin pairings. Generally speaking, the relationship between the relatives physical activity increased the closer the familial link, with monozygotic twins having a coefficient of 0.72. Using a path model analysis, the authors concluded that the genetic factors explained about 29% while environmental factors explained the remainder of the variance in physical activity (Pérusse et al., 1989).

The manipulable environmental factors affecting physical activity are clearly of greatest epidemiological interest. Socioeconomic status (SES), in its various representations (e.g. family income, parent occupation and education) is one of the more extensively studied influence on physical activity behaviour of children and adults.

#### *3.2.2.2 Socioeconomic status*

Overseas studies of the association of SES and physical activity fail to deliver a consistent pattern. McMurray and colleagues investigated the association of self-reported physical activity and SES, indicated by parental education and family income, in 2207 children aged 8-11 years from North Carolina (McMurray et al., 1995). Physical activity was not predicted by SES, either as income or education, in boys and girls. Data from the National Health Interview Survey-Youth Risk Behaviour Survey (NHIS-YRBS, 1992) on US youth aged 14-19 years were assessed for the relationship between self-reported physical activity and household income (Caspersen & Zack, 1997). Prevalence of 'adequate' levels of vigorous physical activity decreased from 60% of youth in households reporting an income of \$50,000 or greater, to approximately 47% for households reporting less than \$10,000. Thompson (1996) surveyed 496 males aged 14-19 years, reporting no association of SES and exercise frequency, despite those from high SES having better attitudes to healthy diet and exercise.

Lindquist, Reynolds and Goran (1999) investigated 107 children aged 6-13 years in Alabama for associations of SES, represented by a composite index of parental occupation and education, and the following components of physical activity: TV viewing; daily energy expenditure; vigorous physical activity of greater than 20 min duration; active time in Physical Education classes; and sport participation. There were no predictive effects of SES on any of the dimensions of activity, after controlling for ethnicity, number of parents and pubertal status. The most consistent independent predictor of activity was number of parents, with those from single-parent families watching more television and, somewhat surprisingly, engaging in more regular vigorous activity. Similarly, Sallis and colleagues found no association of parental education and physical activity, both objectively measured by Caltrac motion sensors and self-reported by 297 Californian children aged 9 years (Sallis et al., 1992). In accord with the study of Lindquist, Reynolds and Goran (1999), single parent status was positively associated with boys' physical activity, determined by Caltrac accelerometry (Sallis et al., 1992).

Shropshire and Carroll (1997) measured physical activity by seven day recall and regular sport participation in 924 children aged 10 and 11 years in Manchester, England. The SES of each child was indicated by eligibility or non-eligibility for free school meals. There were no associations of SES with any of the activity indicators, the authors speculating that economic circumstances may impact more on the activity of older children, who play more formal sport and who are too old for concessional entry to community facilities such as swimming pools.

Father's education was positively related to activity levels, reported through interview, of 13 year old Swedish girls (n = 174), but not boys (n = 171) (Sunnegardt, Bratteby & Sjodin 1985). Consistent with the observations of Shropshire and Carroll (1997), no sociodemographic gradients were noted for the 8 year olds in this study. Yang, Telama and Laakso (1996) evaluated data from the longitudinal Cardiovascular Risk in Young Finns Study (n = 4326, ages 9, 12 and 15 years), relating parental occupation and father's education to a physical activity composite of leisure-time activity and sport participation. Girls between 9 and 12 years whose fathers belonged to the highest social status groups, were more likely to continue in regular vigorous activity than girls in other groups. There were no associations of social class and physical activity of boys. Notably, children from single parent families were more active than those from two parent families in which the father was passive. Overall, the authors concluded that father's activity level exerted a more powerful influence on children's activity than SES.

There is scant evidence of the impact of families' economic circumstances on Australian children's physical activity. The 1997 NSW Schools Fitness and Physical Activity Survey (Booth 1997) found no association of SES by residential postcode with the proportion of boys aged 9-15 years engaging in adequate regular physical activity, defined as 30 minutes or more on most days per week. Among girls, there was a non-significant trend towards greater participation in summer months among the highest SES tertile, while the same trend reached statistical significance for winter activity.

A recent South Australian survey reported a positive association between SES, represented by postcode, and physical activity of 7 year old boys, but not girls, objectively measured using Caltrac accelerometers (Dollman, 2003). Among 11 year olds in the same study, SES, represented by postcode of residence and parent education, was unrelated to MVPA (measured using a computer-based questionnaire; Ridley et al., 2001) and organised sport participation, but was strongly and negatively associated with television viewing hours, particularly among girls (Dollman, 2002).

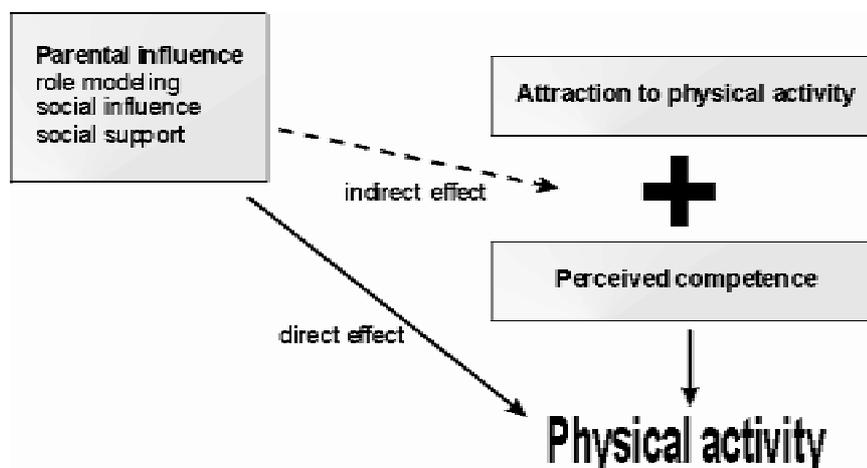
### 3.2.2.3 *Socialising influences of parents*

According to Social Cognitive Theory (Bandura, 1987), parents influence the behaviour of children in a range of possible ways. Mechanisms relating to role modeling, social influence and social support have been studied, with largely mixed findings (Sallis et al., 2000; Welk, Wood, & Morss, 2003). Part of the confusion in the literature is likely to relate to the inherent difficulties of measuring physical activity in children, and the considerable overlap between social-cognitive based constructs. However, there is growing consensus that parent influences on children's physical activity operate through direct means (e.g. provision of finances and transport, role modeling) and through indirect processes such as support and encouragement affecting mediators such as perceived competency and enjoyment (Welk, Wood, & Morss, 2003). Welk and colleagues (2003) have postulated a framework of parental influence based on the YPAP model (see Figure 2). Kimiciek, Horn and Shurin (1996), in proposing a similar explanatory framework, argue that the influence of parents may change, and perhaps weaken, as parents and children grow older.

In testing their mediational model of parent influence (Figure 3.5), Welk, Wood and Morss (2003) identified that measures of parent facilitation (an indicator of social support) and overt encouragement (a measure of social influence) were consistent and strong contributors to statistical models of children's physical activity. This study reported that boys perceived stronger parental facilitation (operationalised as provision of equipment, access and opportunities to be active) than girls, which is consistent with the overwhelming evidence that boys are more active than girls across all ages (Welk, 2003).

Interestingly, the study of Welk, Wood and Morss (2003) reported that representations of direct role modeling were weak predictors of children's physical activity. There is recent evidence that social changes affecting family structure and function may be attenuating the relationships between parent and child physical activity behaviours. A study of South Australian children (Martin, Dollman, Norton, & Robertson, in press) examined the associations of child-reported parent activity and children's sport participation in two surveys, separated by 12-14 years. Using identically structured questions, information was collected from 10-13 year old children in 1985 (n = 2463) and then again in 1997-99 (n = 1469), about their sports participation and their perceptions of parents' exercise habits. Interactions between parents' and children's sport participation were examined using chi-square analysis techniques. Results showed gender specific relationships in the 1985 sample, such that active fathers were associated with increased participation in sports by

boys, and inactive mothers were associated with less participation in sports by girls. However these associations were no longer evident in the later survey, suggesting that parental influences need to be better understood in the context of the social milieu in which families currently function.



**Figure 3.5** Conceptual model of parental influence on children's physical activity.  
(Adapted from Welk, Wood, & Morss [2003])

#### 3.2.2.4 Siblings and peers

The number of persons per Australian household has fallen linearly from 4.5 in 1911, to 3.3 in 1971, and then to 2.6 in 1996, largely due to lower fertility rates (ABS, 2001a). The result is that children have fewer siblings as play partners. This is concerning given the demonstrated aggregation of physical activity among siblings (Sallis et al., 1988). The impact of sibling behaviour may be moderated by ethnic background; in one study of North American children, African Americans identified their brothers as most influential on habitual physical activity, while white children nominated their father (Greendorfer, & Ewing, 1981). Very few studies have explored the influence of peers on physical activity in depth, but it would appear that the positive impact among friendship groups becomes stronger in adolescence, with younger children more likely to model parent behaviour (Sallis et al., 2000).

#### 3.2.2.5 Physical home environment

The physical characteristics of the home and immediate surroundings have continued to evolve in recent decades. The trend is towards larger homes being built on smaller land blocks or multiple townhouses replacing traditional family homes – the so-called 'in-fill' phenomenon (Australian Bureau of Statistics, 1999). Coupled with increasing concerns for safety, this effectively reduces the available play space for children particularly outdoors (Norton, Dollman & Norton, 2003). This is important because the characteristics of the playspace impact on children's inclination to play and the types of activity they engage in. For example, there is consistent evidence that children are more likely to engage in creative physical activity if the play area is complex, manipulable and comprising high levels of vegetation (Moore, 1980; Taylor et al., 1998). Also, time spent outdoors is strongly related to energy expended by children in physical activity (Pate et al., 1997; Sallis et al., 2000).

A recent study in Melbourne examined the impact of the home environment on children's physical activity objectively measured using accelerometry (Salmon, 2003). The physical activity equipment in the home was positively associated with children's physical activity levels. The study also found that children who live in a home with a large yard (larger than a standard house block) spent approximately 18 min more per day being active compared to children who live in a house or flat with no or limited yard space. Dog ownership was related to girls' physical activity. Young girls whose family owned a dog spent 30 min.d<sup>-1</sup> more in physical activity compared to non-dog owners. With housing 'footprints' becoming larger, children's opportunities to be active may be diminishing.

### **3.2.3 School environment**

#### *3.2.3.1 The curriculum*

Physical Education in schools is in serious decline in Australia (Ross, Hargreaves, & Cowley, 1995) and overseas (Pratt, Macera, & Blanton, 1999). There is a pervasive argument for more time to be committed to the 'core academic' learning areas, such as literacy, numeracy and information technology (Sibley, 2003). Physical Education has been marginalised in many schools to accommodate the demands of these other learning areas. A recent survey of South Australian schools (Brown et al., 1999) found that approximately 40% of primary schools fail to provide the 100 minutes per week of structured physical activity recommended by the Department of Children and Human Services (Brown et al., 1999) at Years 2 and 3, while approximately 25% similarly fall short at Years 5, 6 and 7. The same survey reported that in about 20% of primary schools, Physical Education was not compulsory at any of the year levels. Of the primary school principals interviewed, 86% expressed the view that overcrowding in the curriculum made implementation of the 100 minutes recommendation difficult in their schools. Accordingly, PE was afforded a lower priority in schools. As one teacher put it: 'How many parents complain in your parent-teacher interviews that their kids aren't doing well at fitness?' (Brown, p. 36).

While PE has been in decline in recent times, a number of studies have examined the efficacy of school-based interventions (Sallis, & Owen, 1999). This is an important leverage point given the potential for PE to reach a wide audience. Debate continues on the desired goals of school PE, with arguments presented for an emphasis on cognitive, motor, social emotional, sport and health related outcomes. Another challenge facing PE specialists is the low level of activity engaged in by typical participants in classes. Extensive observations of classes conducted by trained specialists in the United States reveal that children were vigorously active for only about 10% of the time (Simons-Morton et al., 1994).

Several studies have shown that the quality of primary school PE can be improved with improved curriculum and specific teacher training and in-servicing. Most success has been observed in those programs that emphasise high levels of aerobic activity, are well resourced, and are non-competitive (Sallis, & Owen, 1999). Reported enjoyment levels are

higher in classes characterised by frequent encouragement and praise, where students do not select teams and where winning is de-emphasised.

Recent North American studies have examined the impact of teacher training on the quality of PE programs. The Go for Health Study, in Texas, focused on teacher training and promotion of their own physical activity levels. Active engagement by children in intervention classes represented 40% of class time after two years of the program, compared with 10% in control schools (Simons-Morton et al., 1991).

The SPARK (Sports, Play and Active Recreation for Kids) program in Southern California compared the impact of PE specialists and trained classroom teachers on active time in class and use of 'quality' teaching methods, such as demonstration skills (Sallis et al., 1997). Trained classroom teachers greatly increased their children's active time compared with untrained classroom teacher controls, but the best results were seen in classes conducted by PE specialists. A 1.5 year follow-up of the SPARK initiative showed that only in those schools where trained classroom teachers received ongoing on-site support were changes in quantity and quality of PE classes sustained (McKenzie et al., 1997). Similar findings emerged from the comprehensive, four state CATCH (Child and Adolescent Trial for Cardiovascular Health) intervention (Luepker et al., 1997).

Relatively few studies have focussed on school-based promotion of physical activity among adolescents. The Class of 1989 Study involved a peer-led program combined with a 10 lesson health education module among 8th and 10th grade North Americans (Kelder et al., 1993). At seven year follow-up, intervention girls were more active than girls in the control community, while no differences were observed for boys.

One of the more dramatic success stories emerged from a recent school-based trial in Singapore (Toh, 2002). This highly aggressive and far-reaching strategy operates across all years of schooling and comprises aspects of nutrition education, control of food and beverages in school canteens, access to clean water coolers and structured physical fitness classes (Sahota et al., 2001a; 2001b). Schools operate on a system of rewards and penalties depending on the success of the program in each setting. Specific counselling of students and parents and intensive follow-up with doctors and dietitians are likely for those not meeting targets for body fat levels. Between 1992 and 2000, obesity levels among 11-12 year olds have declined from 16.6% to 14.6% in response to the program. The decline in obesity prevalence among older children (15-16 year olds) has been from 15.5% to 13.1%.

Some school-based interventions have attempted to influence physical activity outside of school, consistent with the notion that lifelong activity should be a goal of school PE. While some studies have shown that classroom curricula can stimulate out of school activity among North American primary schoolers (McKenzie et al., 1996), other studies have shown no effects (Sallis et al., 1997). One recent Australian study (The Switch Off and Play Study) has reported promising links between behavioural modification classes in school and reduction in television viewing in the home (Salmon, 2003). Process evaluation of this ongoing initiative confirms a high level of acceptability among children and parents.

Physical Education 'homework' has been the focus of recent interventions to extend the influence of the school into the home. While some strategies have focused on the cognitive domain, the use of active homework is being increasingly reported in the literature (Smith & Claxton, 2003). Innovative strategies to increase the quantity of active homework (e.g. through calendars with daily 'fun' activities) and the quality of movement skill (e.g. through checklists for mastery of specific skills) have been introduced and trialled.

### 3.2.3.2 *The play environment in schools*

The type of area available to children and its effects on physical activity have rarely been investigated. (Sallis et al., 2001) examined the association in the school environment and PA before school, during lunch and after school in 24 public middle schools in the United States. Results showed that boys and girls tended to be more active in court spaces followed by fields and least active in indoor play areas, and more active in supervised areas with high levels of equipment (Sallis et al., 2001). Areas with high levels of sports equipment and improvements (basketball hoops, tennis courts etc), coupled with high levels of adult supervision, were 4-5 times more likely to have physically active boys and girls than areas deficient in both (Sallis et al., 2001).

A study of South Australian children (Harten, Olds, & Dollman, 2002) investigated the play behaviours of children in areas of various sizes. In a single co-educational non-government school, available play space was deliberately manipulated on different days, to represent 100%, 75% and 50% of the usual area. It emerged that boys were influenced by reduced amounts of space, but not girls. This is consistent with previous reports that boys tend to occupy most space under free play. In high amounts of play space, there was no association of motor skills and physical activity. However, in reduced play space there was a moderate to strong positive relationship between motor skills and physical activity among boys, but not girls. This suggests that boys who have high motor skills are still able to be relatively active but those with a low ability find it much harder to be active.

### 3.2.3.3 *Out-of-School-Hours Care (OSHC) environment*

Changing family structures and work patterns mean that increasing numbers of children routinely attend out-of-school hours care during the time between end of school and evening mealtime. Research has shown that this time is a critical predictor of children's overall physical activity behaviour (Sallis et al., 2000). For these reasons, an activity promotion strategy (Get Active Out of School Hours, or GOSH) was conducted by the University of South Australia in OSHC centres located in low SES suburbs of Adelaide, South Australia (Norton et al., 2003). The OSHC setting is particularly appropriate for this type of intervention, not only because of the growing population it serves, but also due to proximity to school grounds and access to appropriate facilities and equipment. In the GOSH intervention, senior Human Movement students led developmentally appropriate games and activities in eight intervention sites, twice a week for eight weeks. During this time, children still had free access to all other choices in the centre including sedentary activities such as TV and computer games. Compared with control sites, the intervention resulted in a reduction in the numbers of children seated inside, and an increase in overall

moderate to vigorous activity. The second phase of this project, the development of a training resource for OSHC staff, has just been completed. The effectiveness of the resource as a means of skilling OSHC staff to replicate the effectiveness of the activity leaders in Phase One of the intervention will be evaluated throughout 2004.

### **3.2.4 Community-based interventions**

Community-based promotion of youth activity is less frequently reported in the literature than school-based programs, presumably due to the relative convenience of the school as the organisational setting. Baranowski and colleagues (Baranowski et al., 1990) trialled a 14 week program targeted at African American families, involving weekly fitness and education classes in a popular community facility. Families exercised together to music, and the education classes provided behaviour change skills. Largely due to low attendance and adherence rates, the program had no effect of physical activity or fitness, compared with controls. Process evaluation revealed conflicts between attendance and the demands of work and school on participants. A similar year long intervention with Mexican American and European American families, using exercise and education components, resulted in some favourable shifts in primary risk factors for the parents, but no effects on fitness or physical activity of children or their parents (Nader et al., 1989). Similarly, large and long-lasting community-based interventions such as the Minnesota Heart Health Program Study (2376 participants followed over seven years) resulted in small and largely non-significant effects on physical activity (Kelder et al., 1993).

One recent comprehensive study in South Carolina examined the influence of after-school and summer physical activity programs on total physical activity among public school 5th graders (Pate et al., 2003). The multi-level strategy comprised home, school and community components and took place over an 18 month period. After school activity was self-reported by participants prior to, during and after the intervention. Hypothesised psychosocial and environmental determinants of physical activity were also measured. The intervention failed to influence physical activity and had a minor influence on potential determinants. A process evaluation revealed considerable difficulties with the implementation of home, school and community components of the program.

#### *3.2.4.1 The role of governments: designing neighbourhoods*

The immediate surroundings of the home should ideally present limitless opportunities for children to play freely. In reality, this environment has become increasingly 'hostile' to unsupervised play, particularly in economically disadvantaged, urban communities (Dollman, unpublished thesis, 2003). The current generation of parents are much more concerned for children's safety, particularly in relation to traffic and abduction than ever before (Dollman, 2003). A recent Victorian study reported that parents are extremely concerned about their child's safety, and fear that their children are at risk of harm from strangers and from traffic (Salmon, 2003). These concerns have been shown to be a significant negative correlate of physical activity patterns of children (Salmon, 2003; Sallis et al., 2000). In the Melbourne study, 10-12 year old children were less likely to cycle

or walk at least three times per week if: parents believed there were no lights or crossings nearby; there were no parks or sports grounds nearby; parents believed several roads had to be crossed to reach neighbourhood play areas; and public transport was limited (Salmon, 2003). Cities have been redesigned to facilitate motor transport, with a shift from a grid pattern to cul-de-sacs linked to major arterial roads (Frank & Engelke, 2001). This conformation discourages pedestrian and bicycle traffic. A recent study has found that traditional (pre-1950) street patterns featuring grid designs, mixed land use (retail/residential/light industry) and buildings which do not allow out-front parking are associated with much greater levels of walking than modern patterns featuring disconnected street networks, single-purpose land use, and parking areas (Shriver, 1997).

Recent trends in family structure are such that it is less likely for a parent to be home during the day. In Australia between 1983 and 1992, there was a 50% increase in the number of one-parent families with that parent in full-time employment (ABS, 1998). Of all couples with dependent children, 40.3% were both in full employment in 1983. By 1997, this had risen to 56.3% (ABS, 1998). These changes to family functioning must limit the capacity of parents to overcome environmental deterrents through direct supervision of children's outdoor play.

Atrophying of the traditional neighbourhood network compounds the problem, with children less likely to form large and active friendship groups. Agglomeration of local businesses into retail chains means that the local corner shop no longer serves as a meeting point for people, who now tend to drive to shopping complexes. Altered employment patterns have led to a more rapid turnover of jobs and more frequent relocation of families, further weakening local community links.

Gaster (1991) investigated whether the use of public spaces by children had changed over three generations in a New York City neighbourhood. He interviewed adults who were children during the 1920s and during the 1940s and those who were children between the 1970-80s. He found that the average age at which children were first allowed outside alone had increased from five-and-a-half-years in the 1920s to seven-and-a-half-years in the 1970s and 1980s. Over this period obstacles and barriers to play in the neighbourhood increased. In the 1920s relatively few barriers existed and most were natural barriers (rivers edges and thick woodland). However, by the 1970s most barriers imposed were by adults such as strict rules in housing developments not to play or cycle within the grounds, and fencing around buildings.

Tandy (1999) conducted a similar study comparing the use of their neighbourhood in a group of 421 children from Newcastle, New South Wales, Australia to their parents. She found that although the potential to be more mobile within their neighbourhood was evident in terms of bicycle ownership, children of today were more restricted than their parents in the use of their neighbourhood. Only 3.1% of today's children were allowed to play wherever they wanted so long as they told their parents. Thirty-three percent (33%) of their parents had been allowed to do this when they were children. Further, 24.6% of today's children are allowed to play in the neighbourhood unsupervised, compared with 82.7% of children in the generation preceding them.

Responses to where children would prefer to play differ between the generations. Fifty-nine percent of today's children would prefer to play at home or at a friend's home and 0.9% in the bush or creek. This compares to 34% of yesterday's children who preferred to play at home and 26% in the bush or creek. These results suggest that today's children are denied the opportunity to explore and investigate their environment and are probably content playing at home with sedentary technologies such as TV and computer games. However, when asked what they would choose to do on a sunny day, 50% chose outdoor activities such as going to the beach, fishing, and going on a picnic, while only 7.3% chose home-based activities.

A common finding in the literature is that children, when playing outdoors prefer to play in wild and natural environments rather than structured environments like playgrounds (Berg & Medrich, 1980; Cunningham & Jones, 1991; Ferreira-Molero, 1981; Freeman, 1995; Taylor, Wiley, Kuo, & Sullivan, 1998). Taylor and colleagues found that even in inner city housing developments, twice as many children played in areas that contained trees and grass compared to barren spaces such as concrete and asphalt.

#### *3.2.4.2 The role of governments: media campaigns*

Very few media campaigns have specifically targeted physical activity in children. The Be Active Campaign, an initiative of the South Australian Department of Human Services, has as its centerpiece a television advertisement promoting physical activity in all of its contexts. The advertisement is currently being run, and its impact is being assessed through the use of pedometers and self-report using the Multimedia Activity Recall for Children and Adolescents (MARCA; Ridley & Olds, 2002). The results of the evaluation, conducted by the University of South Australia, will be available by mid-2004.

#### **3.2.5 Summary**

Most researchers currently agree that physical activity among children is the outcome of a complex causal web of influences. Recent data from South Australian youth (Dollman, 2003) suggest that children enjoy sport, physical education and play no less today than they have in previous generations. If this is true, it follows that the social and physical environment of today's youth is suppressing energy expenditure in ways that we need to better understand. While it is unreasonable to propose a return to the social and physical milieu of previous generations, researchers and policy makers must search for innovative strategies that are synergistic with modern youth, with respect to the ways they think and within the context of their daily lives.

### **3.3 The costs of inactivity and the health, social and economic benefits attributable to sport and an active lifestyle**

#### **3.3.1 Introduction**

Australia has long enjoyed a reputation for sporting prowess and the Australian image exported to the world is of the toned, bronzed lifesaver. However recent studies have shown that the proportion of the adult populous who are overweight is just over 50% and that almost 50% of people are not sufficiently active to achieve health benefits (Active Australia Survey, 1997). This compares to data from 1989-90 when only 40% of adults were overweight (AIHW, 2003). While Australia's continued success in sport at an elite level perpetuates our reputation as a fit and sporting nation the truth is that the general population is becoming progressively less active and fatter – in fact we are the fourth most obese nation after only the US, UK and Mexico (AIHW, 2003). Our fit and healthy image is becoming a lie.

For centuries people have recognised the potential of physical activity to contribute positively to health and general well being. However, it is only in approximately the last 30 years that epidemiologists have started to recognise relationships between activity levels and prevalence of disease. In 1996 the US Surgeon General published its landmark report into physical activity. This report recognised that there is almost certainly a causal relationship between physical inactivity and incidence of cardiovascular disease, diabetes and colon cancer, and that higher levels of activity are associated with lower mortality rates for both older and younger adults (US Surgeon General, 1996). Every year since this report was published new and stronger evidence emerges of the positive health benefits of physical activity and this trend can be expected to continue. The purpose of this section is to summarise the present knowledge of the benefits of physical activity including the potential economic benefits available through reduced rates of disease.

#### **3.3.2 Long term health benefits**

The largest health effect of physical activity is likely to be in the reduction of CVD since this is one of the leading causes of death in western society. Epidemiological evidence suggests that the risk of an event or mortality from CVD is roughly halved by regular physical activity (US Surgeon General, 1996). Physical inactivity is recognised as a risk factor in its own right but the large beneficial effect of activity is partly because of its positive effect on other risk factors such as hypertension, obesity, total cholesterol and high density lipoprotein (HDL) levels (Bauman, 1990).

Diabetes is a massive health care problem in Australia with an estimated one million sufferers (Dunstan et al., 2002). The incidence of Type 2 diabetes is highly correlated with physical activity level and it has been estimated that between one third and half of all new cases of Type 2 diabetes could be prevented with the adoption of a moderate activity program (Helmrich, 1994).

Physical activity is emerging as having a significant preventative effect on the development of some cancers with the most compelling evidence at this time for reduced incidence of colon cancer (Slattery, 1997; Neugut, 1996; Colditz, 1997). More research in this area is presently being conducted with several studies showing promising results in the prevention of breast cancer (Coogan, 1997; Thune, 1997).

A number of studies have recently shown lower rates of stroke in sections of the population that are at least moderately active. This is believed to occur either through a reduction in blood clotting or by reducing hypertension (Fagard, 1994).

Physical activity is associated with higher rates of bone mineral deposition during adolescence and with increased maintenance of bone density during later life. The likelihood of development of osteoporosis is affected by both peak bone mass and the rate of loss of bone tissue in later life so physical activity represents a useful preventative factor (Drinkwater, 1994). Physical activity in later life is also associated with better maintenance of muscle strength and control along with balance, all of which are important factors in prevention of falls and potential injuries such as fractures that are a significant cause of morbidity in the elderly (Lord, 1995).

The beneficial effects of physical activity are not completely confined to purely physical health factors. Mental health is also believed to be improved by physical activity with the US Surgeon General's Report (1996) suggesting that physical activity is effective in relieving the symptoms of depression and anxiety, and that it may reduce the risk of developing depression.

The above conditions represent those for which strong epidemiological evidence already exists for the positive role of physical activity. It should also be noted that it is well known that physical activity plays a positive role in the reduction of other factors such as hypertension, obesity and total cholesterol (US Surgeon General's Report, 1996). Whilst these conditions are not included above as specific diseases they do represent significant risk factors for most of the conditions listed and some others. Any increase in physical activity is therefore likely to have magnified effects due to the concurrent reduction of these risks. Furthermore it is likely that physical activity has positive effects on other conditions not listed but at this time these effects are difficult to divorce from associated reductions in other risk factors (Stephenson et al., 2000).

### **3.3.3 Social/environmental effects**

In addition to the health benefits attributable to physical activity there are also a range of other desirable effects. From a social perspective physical activity increases confidence and self esteem, improves social skills and reduces feelings of isolation and loneliness by encouraging social networks and family/community connections. It reduces absenteeism at work, creates employment, and reduces crime rates. At a personal level physical activity has been shown to improve sleep patterns, enhance motor skills, improve concentration, memory and learning and generally increase quality of life (National Physical Activity

Guidelines, 1999). Physical activity has also been found to reduce antisocial behaviour in youth through factors such as reducing boredom and the amount of unsupervised leisure time (Morris et al., 2003).

At an environmental level physical activity has positive effects through reduced traffic congestion by people commuting to work on foot or by bike. This reduces air/noise pollution and greenhouse emissions and also has the tendency to create safer public spaces through the increased number of people using them (National Physical Activity Guidelines, 1999).

#### **3.3.4 Economic costs of inactivity**

A number of recent studies in Australia, North America and Europe have attempted to estimate the economic costs that are attributable to physical inactivity. These studies have generally found that physical inactivity represents a significant burden to health services through increased prevalence of certain diseases. The general approach of these studies has been to relate known levels of inactivity in society to the prevalence of these diseases whose incidence is increased by physical inactivity. Diseases included are usually ones for which strong epidemiological evidence exists to support a relationship between incidence and activity level such as coronary heart disease (CHD), colon cancer, breast cancer, stroke and depression. Measures are then applied to estimate the proportion of the incidence of each disease attributable to physical inactivity and therefore the proportion of the overall health expenditure on that disease which can be attributed to physical inactivity. This type of health cost is known as a direct cost since it occurs as a direct result of the illness. Most studies have confined themselves to estimating the direct health costs whilst others have attempted the more difficult task of estimating secondary costs such as increased absenteeism and reduced productivity at work. Still other studies have attempted to elucidate further intangible costs such as the reduced quality of life associated with factors such as pain, disability and bereavement. All studies required certain assumptions but the following represents a summary of the largest and most credible findings.

A study conducted by Katzmarky et al. (2000) in Canada examined the direct health care costs associated with coronary heart disease, Type 2 diabetes, colon cancer, breast cancer, stroke and osteoporosis. They estimated that \$150 million would be saved annually for a 10% increase in the number of people who achieved adequate levels of physical activity. An Australian study by Roberts et al. (1987) focussing on cardiovascular disease estimated that \$274 million per annum could be saved by increasing the proportion of people active enough to gain protective effects from the current level of 10-20% to 50%.

A major study in the US was conducted recently by Colditz et al. (1999). Using US health statistics this study looked at physical inactivity and obesity and their effect on incidence rates of coronary heart disease, colon and breast cancer, hypertension, osteoporosis and diabetes. It was estimated that \$24 billion or 2.4% of the US health budget was due to direct costs attributable to physical inactivity through increased incidence of these diseases. When combined obesity and physical inactivity were estimated to account for 9.4% of US health expenditure.

The studies listed above have focussed on estimating health care costs attributable to physical inactivity. The other approach that has been used is to project the savings that might be achieved by various interventions to increase physical activity. This process allows assessment of the cost effectiveness of programs and allows decisions to be made on allocation of money to programs. Further it allows comparison between the expected benefits of programs focussing on physical activity with those aimed at other health risk factors such as smoking.

Munro et al. (1997) studied the costs of physical activity interventions in the UK and compared them with other strategies. They estimated that a physical activity intervention would cost £332 per life year saved compared with antismoking advice from a doctor (£700/life year saved), cholesterol screening (£3700/life year saved) or treating hypertension (£8500/life year saved). Obviously the physical activity intervention compares favourably in this light.

Another study by Hatziaandreu et al (1988) in the US modelled the health benefits that could be expected in a hypothetical group of 1000 middle aged men who participated in a physical activity intervention compared with a group who remained sedentary. They included costs such as direct health care costs, exercise equipment, time spent in exercise and medical costs of injuries. The projected benefits were measured in terms of reductions in the incidence of CHD, increased life expectancy and gains in quality adjusted life years (QALYs). The study suggested there would be 78.1 fewer CHD cases in the active group, saving 1138 QALYs. The direct and indirect costs of the intervention would total \$6 million equating to \$11313 per QALY gained and \$76760 per CHD event avoided. These estimates suggest the physical activity intervention would be cost effective compared with other interventions such as treating hypertension which costs over \$25000 per QALY gained.

### **3.3.5 The Australian perspective**

The most important study from an Australian perspective was conducted by Stephenson et al. (2000). This study used morbidity and mortality data from 1996 along with health costs data from 1993-1994. They focussed on six main conditions for which strong evidence exists for a relationship between incidence or mortality and physical inactivity. These diseases were CHD, Type 2 diabetes, colon cancer, breast cancer, depression and stroke. The study used data from the 1997 Active Australia survey which estimated that 44% of Australians aged over 18 were insufficiently active to achieve significant health benefits (Active Australia Survey, 1997). Multiple studies relating to each disease were used to calculate the incidence of each disease that could be attributed to physical inactivity. It was estimated that the following proportions of the diseases studied were due to physical inactivity: 18% of CHD, 16% of stroke, 13% for Type 2 diabetes, 19% for colon cancer, 9% for breast cancer and 10% for symptoms of depression. The study also estimated that 18% of all cause mortality was attributable to physical inactivity.

Once the proportion of disease attributable to physical inactivity had been estimated the next step was to translate this information into estimates for mortality and morbidity and then compute economic costs. It was estimated that physical inactivity was responsible for 6400 deaths through CHD, colon cancer and diabetes, and a further 2200 through other

conditions including stroke and breast cancer (Stephenson et al., 2000). Approximately 1500 of these deaths would occur in people aged under 70 years leading to the projection that around 77,000 lost years of life and are attributable to inactivity and could potentially be regained by increasing activity levels. These estimates were combined with the health cost data to calculate that direct health care costs attributable to physical inactivity are about \$377 million per annum. The costs for the diseases studied were \$161 million for CHD, \$28 million for Type 2 diabetes, \$16 million for colon cancer, \$101 million for stroke, \$16 million for breast cancer and \$56 million for depressive disorders.

The Stephenson report (2000) then went on to conduct a sensitivity analysis where they projected the direct health cost savings that could be expected if the proportion of physically active people was increased. They computed the potential savings for a 5% increase in the proportion of physically active people, a 10% increase and finally the savings if the whole population became sufficiently physically active. From this analysis it was suggested that every 1% increase in the proportion of physically active people could be expected to save 122 lives lost through CHD, colon cancer and Type 2 diabetes. One quarter of these deaths would have occurred in people aged under 70 years leading to a projection of 1764 life years gained and \$3.6 million saved in direct health care costs.

It was suggested that further work was needed on assessing the cost effectiveness of strategies to increase the proportion of physically active people. On the basis of the figures calculated in the study it could be suggested that to be cost effective any intervention would have to cost less than \$3.6 million for every 1% increase in physically active people it produced – so an intervention which produced a 10% increase should cost less than \$36 million (Stephenson et al., 2000). It seems unlikely that an increase as large as this could be achieved by an intervention with this small a budget. However, the Stephenson report emphasised throughout that conservative methods were used in calculations and that the direct health costs attributable to inactivity could actually be much higher than reported.

Further, indirect costs to society such as reduced absenteeism and lost productivity were not included and would be likely to substantially increase the costs attributable to inactivity. Another factor to be addressed in costing of interventions is the durability of the changes they induce. For example, if a one off intervention costing \$10 million produced a 1% increase in the proportion of physically active people it would save \$3.6 million in direct costs in the first year after the intervention. If the effects of the intervention were only maintained for one year then it would not be worthwhile; however, if the effects of the intervention were maintained for five years then the health costs saved would increase to \$18 million making it far more attractive. In reality the situation would more likely consist of a large upfront cost and smaller ongoing costs but the intervention is still more likely to be cost effective if it can produce an enduring change.

### **3.3.6 Conclusions**

Physical inactivity is a significant problem in Australia leading to negative outcomes in terms of physical, mental and social well being, and incurring significant economic costs to society through health care expenditure. The deleterious health effects of physical inactivity have been discovered relatively recently compared with those of; for example, tobacco. Much less money is spent on strategies to increase physical activity than is spent on strategies to reduce smoking or promote safe sex. However, recent economic studies suggest that strategies aimed at increasing rates of physical activity are likely to be cost effective in terms of the benefits they achieve compared with strategies aimed at other health risk factors. If the aim of these health promotion strategies is to achieve the greatest health gains per dollar spent then it would appear that at present physical activity promotion is an under-funded area. Therefore more research is needed to further prove the case of physical activity as a cost effective measure followed by cost benefit analyses of various physical activity interventions, allowing decisions to be made on the most effective allocation of funds.

### **3.4 Perceived determinants and barriers to involvement in sport, activities young people appear interested in, and what they seek from involvement in sport**

#### **3.4.1 Changing leisure preferences of Australian youth**

Recent surveys of Australian children's favourite activities show some interesting patterns of changing preferences. A series of surveys since 1957 have asked respondents to list their favourite ways of using leisure time, using similar question structures (Connell, 1957; Wheeler, 1961; Youth Say Project, 1974; Robertson, 2003). As seen in Tables 3.1 and 3.2, playing sport has remained a popular choice since the earliest survey, encouraging considerable optimism for those responsible for 'activating' modern youth. Some of the activities that have changed are the rise and rise of television from 13<sup>th</sup> for boys in 1974 to number 4 in 2000, and 10<sup>th</sup> for girls in 1974 to 2<sup>nd</sup> in 2000. Making a strong appearance is high-tech entertainment for both boys (2<sup>nd</sup>) and girls (3<sup>rd</sup>) in 2000. Somewhat disturbingly, eating and sleeping are now ranked in the top 10 preferred activities. There is an obvious overall trend towards less active leisure pursuits. In 1957, it could be argued that seven of the top 10 activities for boys and girls were 'active' pursuits, while this has reduced to two or three for boys and three or four for girls in 1994 and 2000. Of further concern is the trend towards less social and more isolated activities among modern day youth (see Tables D1 and D2). This may further reflect the changing nature of the home and neighbourhood such that groups of children meet less freely, particularly in urban environments (see Chapter 1.2).

#### **3.4.2 Attitudes towards sport, PE and play**

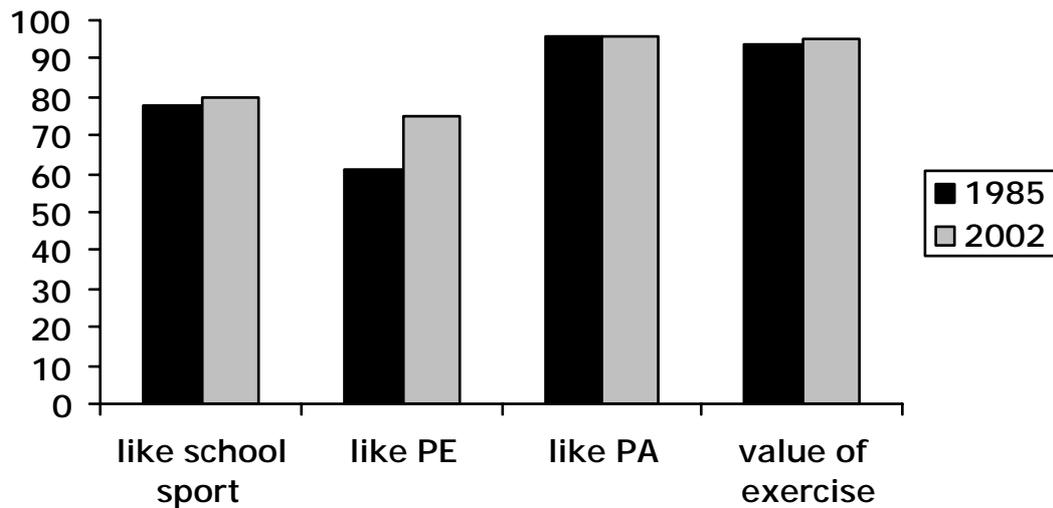
Tables 3.1 and 3.2 summarise youth attitudes when respondents were asked to rank leisure pursuits relative to others. Is there any evidence of how children's absolute level of approval for physical activity constructs has changed over time? In the national ACHPER Survey of 1985 (Pyke, 1997), respondents (11-12 years old) were asked to indicate their affinity for sport, PE and 'physical activity' on a five point Likert scale. A survey of 11-12 year old South Australian children in 2002, conducted by the University of South Australia (Dollman, 2003), replicated these questions. Interestingly, today's youth report similar affinity for organised and non-organised dimensions of physical activity (see Figure 3.6), and also report a high appreciation of the value of exercise in their personal lives.

**Table 3.1 Girls' favourite leisure pursuits**

Preference order	1957 Connell Sydney, 13 y	1961 Wheeler Perth, 13 y	1974 Youth Say Sydney, 12-14y	1994 Robertson Adelaide, 13 y	2000 Robertson Adelaide, 13 y
1	play sport	pictures	water sports	play sport	play sport
2	pictures	play sport	cultural	TV	TV
3	watch sport	swimming	play sport	educational	high-tech entertainments
4	tennis	picnics	social	pets	outdoor activities
5	youth group	walk/hiking	indiv. sports	music	music
6	swimming	playing	outdoor activity	hobbies	pets
7	hiking	visiting	personal	outdoor activity	sleep/eating
8	dancing	parties	sexual	sleeping/eating	home activities
9	Lunar Park	dancing	hobbies	home activities	hobbies
10	milk bar	watching sport	TV	youth groups	youth groups

**Table 3.2 Boys' favourite leisure pursuits**

Preference order	1957 Connell Sydney, 13 y	1961 Wheeler Perth, 13 y	1974 Youth Say Sydney, 12-14y	1994 Robertson Adelaide, 13 y	2000 Robertson Adelaide, 13 y
1	play sport	play sport	play sport	play sport	play sport
2	pictures	pictures	aquatics	TV	high-tech entertainment
3	watch sport	swimming	indiv. sports	educational	outdoor activities
4	church/youth gp	cycling	outdoor activities	outdoor activities	TV
5	swimming	walking/hiking	social	hobbies	music
6	hiking	playing	cultural	sleeping/eating	sleeping/eating
7	tennis	picnics	personal	music	hobbies
8	speedway	watch sport	hobbies	pets	home activities
9	Lunar Park	visiting	work/study	home activities	pets
10	milk bar	parties	bush activities	work	anti-social

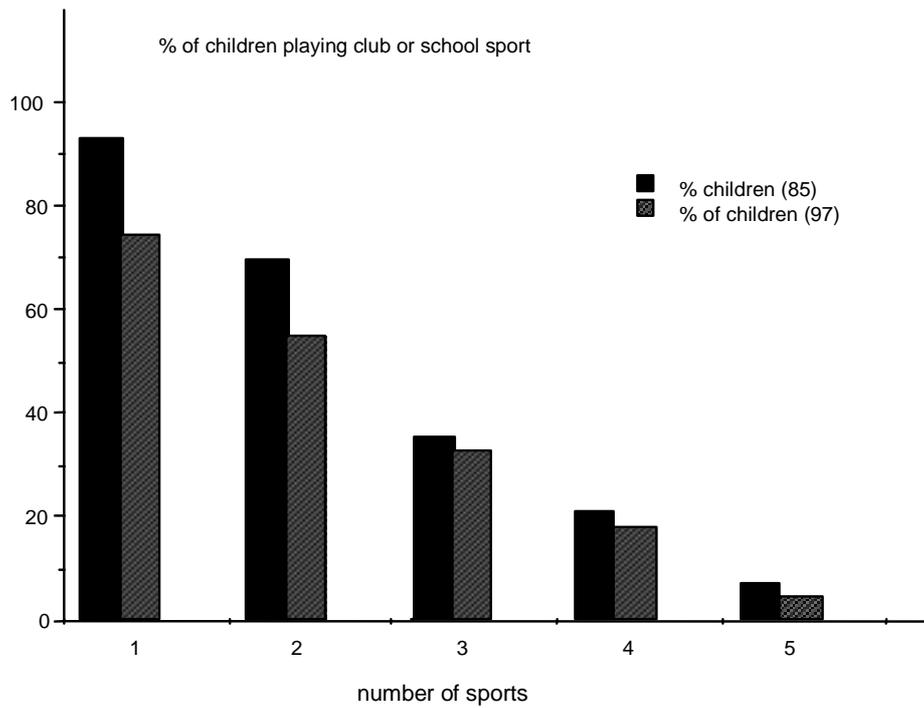


**Figure 3.6** Percentages of children indicating a positive attitude to school sport, physical education (PE), physical activity (PA), and the value of exercise

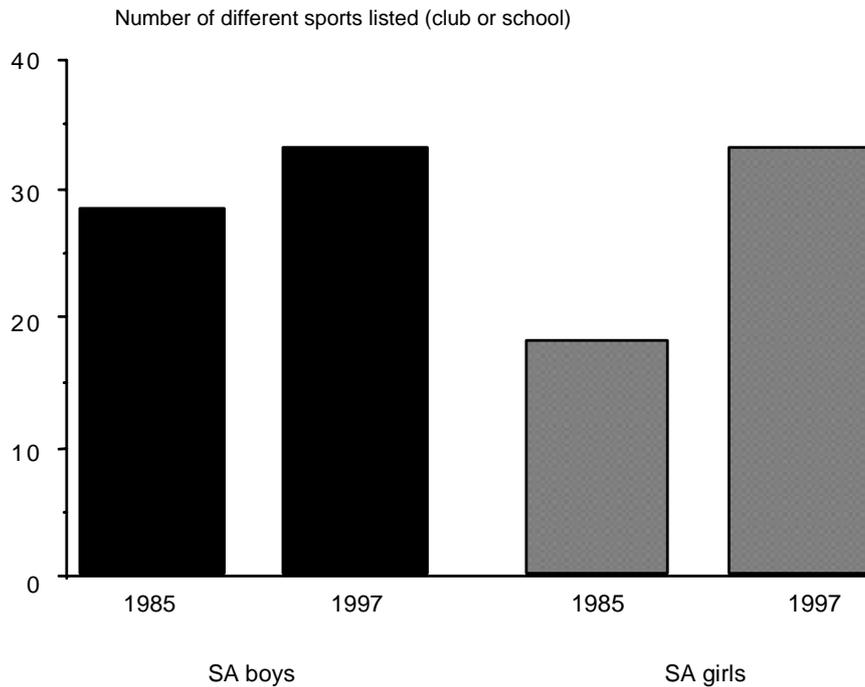
Taken together, it can be concluded that modern youth are positively disposed towards sport and physical activities in general, but are presented with a wider choice from the modern leisure ‘menu’. Promotion of organised and non-organised physical activity among this demographic group must involve enhancing the attractiveness of the product (*‘will I do it?’*) and also its accessibility (*‘can I do it?’*).

### 3.4.3 Choices in youth sport

A survey of South Australian children in 1997 (Dollman et al., 1999) asked respondents to indicate the sports played in the previous 12 months, using the same question from the questionnaire in the 1985 National Health and Fitness Survey (Pyke, 1987). In 1997, boys and girls reported overall participation in a wider variety of organised sports (see Figure 3.8). However, by 1997 the proportion of children engaged in club or school sport had declined (see Figure 3.7). In 1985, boys reported playing a median of 2 (interquartile range 2-4) sports. By 1997, this had declined to a median of 1 (IQ range 0-3) sport. The trends were similar in girls. In 1985, girls reported a median of 2 (IQ range 1-3) sports. By 1997, the median was 0 (IQ range 0-2) sports.



**Figure 3.7** Percentages of children (boys and girls combined) from 1985 and 1997 playing 1-5 sports (club or school).



**Figure 3.8** Number of different sports listed by South Australian boys and girls in 1985 and 1997 surveys.

### **3.4.4 Barriers and motivation for organised sport participation among youth**

#### *3.4.4.1 Environmental factors*

##### *3.4.4.1.1 Urban vs rural residence*

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There is recent evidence that broad ecological factors impact on patterns of organised sport participation by Australian youth. A South Australian survey (Dollman et al., 2002) of 10-11 year olds assessed school and club sport participation among urban and rural residents. The rural setting increased the likelihood of participation in club sport by approximately 61% in boys and 44% in girls. In contrast, children from urban schools were more likely to play school sport, by approximately 22% in boys and 35% in girls.

It is feasible that community sport is more firmly 'embedded' in Australian rural community life. A recent survey of voluntary support for junior sport in Australia (ABS, 2001a) revealed that adult males (13.7%) and females (10.1%) in non-metropolitan areas are more involved in support roles than their metropolitan counterparts (9.2% and 6.9%, respectively).

Sporting clubs in rural towns tend to be sustained by strong volunteer support and contributions from local businesses, thus reducing the cost of participation. While not directly comparing costs of children's sport participation in urban and rural communities, another ABS survey (2000b) indicated that rural families spend less on recreation (\$75.50 per week) compared with families in capital cities (\$95.88 per week), and that there are more children per rural family. If rural children are more involved in club sport, these data suggest that participation is more affordable in rural settings.

There is evidence that the sport-centred rural lifestyle is under threat. Community organisations in country townships, including sporting clubs, have been traditional sources of 'social capital', defined by Townsend, Moore and Mahoney as 'the level of connectedness or civic engagement within a community, the trust members feel towards others, and the security they feel living within the community' (Townsend, Moore, & Mahoney, 2002). With regionalisation and rationalisation of rural services and facilities leading to a loss of personnel to larger cities, there is evidence that many community organisations are becoming moribund, with the pool of potential volunteers in sharp decline (Gerritsen 2000).

Mahoney's study of two small Victorian rural communities found that while other organisational sources of 'social capital' were eroding (e.g. Lions, Apex), sporting clubs remained a focus of identity and communalism (Mahoney, Townsend, Nesbitt, & Hallebone, 1998), as they provide a common bond within the community (Dempsey 1990). Importantly, the bonds formed by sporting clubs in rural townships have been found to transcend factors such as age, length of residence and socio-economic status (Townsend, Moore, & Mahoney, 2002). However, a more recent study of rural Victoria reports declining involvement in club sport, affecting players, spectators and administrators (Townsend, Moore, & Mahoney 2002). This has been attributed to the lack of employment

opportunities for youth in small townships and a lack of confidence and expertise among those who remain to take on leadership roles, imposing a greater burden on fewer and fewer people (Townsend, Moore & Mahoney 2002). Rural communities need to create solutions that preserve the tradition of organised sport as sources of community cohesion and physical activity for youth and adults.

#### 3.4.4.1.2 Socio-economic status

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The impact of the family's economic circumstances on physical activity in a range of contexts has been discussed earlier in this report. There is a paucity of evidence of the link between SES and organised sport participation by Australian youth. Kirk and colleagues investigated the impact of parent occupation on junior sport participation in 226 families from Victoria and Queensland (Kirk et al., 1997). Parents were surveyed on the costs associated with their child/children's participation in organised sport, such as uniforms, equipment, coaching and fees. A subset of 27 families was interviewed to determine the extent to which such costs represented a significant barrier to participation. The study determined that parents of junior sport participants were predominantly in 'white collar' occupations. In particular, the data suggested that the direct and indirect costs favour children from high income families with a flexible daily routine, or one parent at home full- or part-time to provide transport and other means of practical support. As the authors concluded: 'There can be no question, on the basis of the findings of this study, that there remain substantial socio-economic barriers to children's participation in club and representative sport.' (Kirk et al., 1997, p.32)

#### 3.4.4.2 Personal factors

##### 3.4.4.2.1 Perceived barriers

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A computer assisted telephone survey (CATI) of 791 South Australian parents of 4-18 year olds was conducted in 2001 (Gill et al, 2003). The CATI was followed up with focus groups of children in low SES schools in Adelaide. While less than 6% of parents cited 'fear of injury' as a barrier to their child's participation in sport, this theme emerged much more strongly in the focus groups, along with 'put-downs' and bullying. Parents indicated factors such as cost, self-consciousness, poor sport skills, embarrassment and health reasons as relatively strong deterrents of sport participation. This study brings into sharp focus the discrepancies in parents' and children's perceptions of barriers to sport participation, a situation which can only serve to attenuate the potential of parents to positively influence the behaviour of children.

The 2002-2003 Youth Sport Issues Forums, 'Getting the Goss', were conducted through the Australian Sports Commission to identify factors which influence youth sport participation (ASC, 2003). Over 500 young people from across Australia participated, with particular emphasis on those from remote and rural communities, and on those who had little or no interest in sport. A wide range of issues were raised in these discussions, some which were specific to urban vs rural residence.

3.4.4.2.1.1 *2002-2003 Youth Sport Issues Forums.* The emphasis on competition and winning, often reflecting adult rather than youth values, was highlighted as the biggest deterrent to participation from the 2002-2003 Youth Sport Issues Forums (ASC, 2003). Fun and socialising with friends were preferred by children as a focus of sport. Rigid rules, compulsory uniform and over-emphasis on skill training were also seen as negative aspects of sport. Junior sport was also viewed as somewhat elitist, with resources and attention directed more to those with higher skill. This criticism was more strongly expressed by adolescents and young adults. Participants also expressed the desire to have more control over the development and organisation of their own sporting experiences. They spoke of the 'sterile' environment in which sport is typically offered, particularly the indoor setting.

Older participants in the 2002-2003 Youth Sport Issues Forums expressed their unease at taking up sport in late adolescence, due to the embarrassment of participating alongside more established and highly skilled performers. Where social competitions were available, they felt that there was limited access to appropriate coaching in these settings. Rural and remote participants sensed that metropolitan youth had better access to state-of-the-art facilities and more up-to-date coaching methods. There was also reference to a narrower range of choice of sports in remote and rural communities, with girls in particular complaining of the reluctance of 'traditional' sport communities to allow them to participate in sports regarded as male domains.

The difficulties of juggling time for sport with other commitments in their lives, such as homework and part-time work, were also raised by forum participants. This further highlights the need to listen to the voice of youth and involve them in the development of more flexibly delivered sport options.

#### 3.4.4.2.2 Perceived positive motivations

An early study by Longhurst and Spink (1987) examined the participation motivation of a sample of Australian children already involved in a number of sports, and compared these attributes with a similar North American study. Participants (n=404) in Little Athletics, swimming, cricket, netball and Australian Rules responded to a questionnaire based upon an equivalent instrument administered earlier to North American children (Gill et al., 1983). Analysis of the data ranked 27 possible motives, in the overall sample and separately by sport. The most important reason for participating in sport was 'to improve my skills', for both boys and girls. The next highest rated motives were 'physical fitness', 'competition', learning new skills', and 'challenge', with boys and girls differing somewhat in the order in which these factors were ranked. The least important reasons overall were 'be popular', 'get rid of energy', 'have a uniform and good equipment', 'parents and friends want me to' and 'rewards and prizes'. The most obvious sex difference for the least common factors was that boys valued rewards and prizes more highly than girls.

It is interesting to note that the influence of parents and peers were ranked uniformly low among boys and girls, given the consistent appearance of these factors in the literature as correlates of physical activity (see Chapter 1.2). Most studies of social influences involve samples with wide ranging levels of participation, and tend to focus on physical activity in

general. Motivating influences may be different among those with an established pattern of organised sport participation, and if the questions specifically refer to that sport, rather than to all forms of physical activity.

Among the five sports represented in the study of Longhurst and Spink (1987), different sets of motivators were identified. Participants in Little Athletics, netball, cricket and Australian rules rated factors associated with 'action' more highly than swimmers. Little athletes, cricketers and netballers rated 'fun' and 'be with friends' as more important motives than did swimmers. Little athletes and netballers rated 'excitement' as more important than swimmers. The lesser ratings of 'fun' and 'action' by swimmers is consistent with an earlier survey of junior coach attitudes (Longhurst, 1985), which found that swim coaches were much less 'fun-orientated' than coaches in other sports.

Cross-cultural comparisons revealed that Australian children endorsed similar motives to those reported in North American studies (Longhurst & Spink, 1987). The only major difference related to 'fun', in that North American children rated 'like to have fun' as the most important motivator in sport participation, whereas the Australian children ranked this factor 9<sup>th</sup> in importance. The reason for this is unclear; the authors suggest the concept of 'fun' may be subsumed by respondents under some other category such as 'excitement' or 'challenge', but why this should be unique to the Australian sample is unclear. Further study of the role of 'fun' as a prompt for sport participation among Australian youth is warranted, given the consistency with which this attribute predicts physical activity in studies ranging widely in sample age and cultural background (Sallis et al., 2000).

*3.4.4.2.2.1 2002-2003 Youth Sport Issues Forums.* Enjoying established social links and forming new friendships were overwhelmingly strong benefits of sport, as perceived by participants in the 2002-2003 Youth Sport Issues Forums (ASC, 2003). The challenge of sport, and the associated discipline and determination it fosters, were seen as positive outcomes. Improved health and stress release were also viewed as benefits of participation.

Remote and rural residence acknowledged the importance of sport as a community focus. Interestingly, this was seen by some as a potentially divisive influence, in that children who were not good at sport could be isolated from their peers and stigmatised by their disinterest in the main source of 'social capital' in the community.

### **3.4.5 Summary**

Patterns of children's leisure time use have changed in recent times, coinciding particularly with the emergence of technology as a source of entertainment. The socio-demographic milieu (e.g. urban vs rural residence, socio-economic status) conspires to shape opportunity and choice of activity behaviours, in ways which are not clearly understood. Yet there is no evidence to suggest that children enjoy physical activity any less than previous generations, offering some hope for interventions designed within a social ecological framework. The challenge is to more fully explicate the motivations and barriers that relate to physical activity in its distinct contexts, from unstructured play to organised sport. Seeking the opinions and attitudes of youth through comprehensive consultation is likely to provide researchers with a sound basis for further action.

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# Activity markets: A clustering analysis of activity styles among South Australian children

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## 4.1 Introduction

Recent rapid increases in children's level of fatness (Booth et al., 2003; Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995; World Health Organisation, 1998) and decreases in fitness (Tomkinson, Léger, Olds, & Cazorla, 2003) have focussed attention on the activity levels of young people. There have been many community-based and clinical interventions designed to promote physical activity (Stone, McKenzie, Welk, & Booth, 1998). These have usually treated the target population as an homogeneous entity, applying the same intervention for all children and generally have had limited success (Campbell, Waters, O'Meara, Kelly, & Summerbell, 2002).

Many interventions have focused on reducing television viewing, due to the notion that time spent in sedentary activities displaces time spent in physical activity. There are some data to support this suggestion and some interventions that have targeted television viewing have been successful (Gortmaker et al., 1996; Janz & Mahoney, 1997; Robinson, 1999; Robinson et al., 1993). However, recent research has suggested that those children who watch significant amounts of television are not necessarily inactive. These so called 'techno-active' children watch a large amount of television as well as spending a lot of time being active (Marshall, Biddle, Sallis, McKenzie, & Conway, 2002). On the other hand, there appears to be a group of girls who are very inactive, yet don't spend excessive amounts of time in front of the screen (Caspersen, Pereira, & Curran, 2000). Therefore homogeneous television viewing interventions may not be effective in these groups. To design more effective interventions it is important that we understand what activities children do and how they use their time. In addition, we need to know how their activities interact and how common activities vary across groups of children.

Market segmentation is a technique which has long been used in business to identify customer clusters based on consumer behaviours. The market for a product area is rarely undifferentiated, but rather tends to segregate into clusters with different preferences and behaviours, each with its own specific drivers. An example would be an automobile manufacturer who is aware that young females, safety-conscious mothers, single men, and retired couples will be looking for cars with very different styling, colours, performance and durability. Armed with market segmentation information, companies can tailor their products and advertising to address different types of consumers.

Children can also be seen as players in an 'activity market', consuming different forms of activity and inactivity from a range of available options. Just as with other consumers, their behaviours are differentiated into various 'activity styles', which may be distinguished by market segmentation techniques. Coupled with socio-demographic profiling of clusters (that is, analysis of how clusters differ by age, socio-economic status, weight status, and geographical location), and with qualitative data from interviews, the identification of activity styles among children has the potential to result in better tailoring of interventions and activity promotion messages.

Segmentation techniques have rarely been applied to healthy lifestyle issues (Slater & Flora, 1991). Marshall, et al. (2002) recently used market segmentation to study 11-15 year olds from the United States and the United Kingdom, identifying distinct clusters based on inactivity and activity patterns. They distinguished ‘uninvolved inactives’, reporting low levels of both sedentarism and physical activity; ‘non-socialising actives’, who had high levels of physical activity but spent little time socialising; ‘techno-active’ boys, who coupled high levels of physical activity with high video game and TV use; and ‘sociable active’ girls. However, one weakness of this innovative study was that, due to the use of activity checklists, the stratification of young people into activity clusters may have reflected tendencies to systematically under- or over-report all activities, rather than real differences in time budgets. The authors admitted that the clustering procedure might have been affected by ‘a response-set to under-report all behaviours’ (Marshall, 2002, p. 413). Use-of-time recalls, where children are required to account for all the minutes of their day, circumvent this problem.

The aims of this study were to apply market segmentation techniques – that is, cluster analysis – to use-of-time and demographic data collected on a large sample of 9-15 year old South Australian children, with a view to differentiating children according to their physical activity and inactivity time-budgets. This age group is of particular interest because a number of cross-sectional studies (Kimm et al., 2000; Telama & Yang, 2000; Van Mechelen, Twisk, Post, Snel, & Kemper, 2000) have identified rapid declines in physical activity and increases in sedentary behaviours in children in the peri-pubertal years. Identification of children typical of each cluster would then allow us to gather qualitative information on their lifestyles and family contexts and consequently inform future interventions.

## **4.2 Methods**

### **4.2.1 Participants**

The cluster analysis component involved 1429 children aged 9-15 years (mean age = 11.9 ± 0.8) from randomly selected schools in **South Australia**. Parents and children consented to being involved in the study via information sheets and consent forms approved by the University of South Australia’s Human Research Ethics Committee. Children’s socio-economic status was calculated using the Socio-Economic Indicators for Areas (SEIFAs). SEIFAs are a series of indexes of socio-economic status devised by the Australian Bureau of Statistics using a basket of indicators such as educational and employment status. The index used was the Index of Relative Disadvantage at the residential postal area level. Children were also classified as living in metropolitan or non-metropolitan regions based on their residential postcode. The children in the sample did not differ from the South Australian population in terms of SES. However, a lower proportion of children in the sample than in the population attended non-government schools (15.4% vs 26.0%,  $p < 0.0001$ ) and a lower proportion lived in non-metropolitan areas (19.5% vs 27.0%,  $p < 0.0001$ ).

It is important to note, that this component of the study explores the reported behaviour of children in **South Australia only**. The findings of this component therefore may not necessarily be representative of all Australian children.

#### **4.2.2 Measurements**

On two to five occasions between April 2001 and September 2003, children completed the Multimedia Activity Recall for Children and Adolescents (MARCA). The MARCA is a computerised activity recall linked to a compendium of energy expenditures. The MARCA asks children to recall their previous day's activities in blocks as small as five minutes using a segmented day format. Children may choose from lists of more than 200 activities, grouped into seven categories. Some physical activities, such as play and sport, require children to indicate whether their activity was light, medium or hard, assisted by text and video cues. The listed activities and MET values were based on the Ainsworth compendium (Ainsworth et al., 2000) and a comprehensive search of the literature on the energy cost of children's activities (Ridley, Olds & Hill, 2002). The MARCA compendium currently consists of approximately 70% adult values.

If two activities were being performed at the same time, children were asked to choose their main activity. The MARCA has shown validity comparable to similar instruments such as the ActivityGram (Welk, Dziewaltowski, Ryan, Sepulveda-Jowers, & Hill, 2001), with a coefficient ( $r^s$ ) of 0.51. Test-retest reliability was high with coefficients of  $r_s = 0.84, 0.83$  and  $0.84$  for physical activity level (PAL), minutes of moderate-to-vigorous physical activity (MVPA) and minutes of screen time (that is, television, computer use and video games) (Ridley, Olds, & Hill, 2002) respectively.

Every child completed the MARCA on at least two days, at least one of which recalled a full day at school, and at least one a non-school day (weekend, holiday or day off). When more than one school day or non-school day was recalled, values were averaged. The mean of the school day and non-school day averages has been used in analysis. School days were not weighted because children spend approximately one day in two at school over the course of a year.

The MARCA also asked children to fill in socio-demographic details, including date of birth, residential postcode and family structure. The family structure question was used to determine whether the child was part of: a single parent family with no siblings (1O); a single parent family with one or more siblings (1S); a two-parent family with no siblings (2O); a two-parent family with one or more siblings (2S); or any *other* family structure (e.g. living with grandparents). On the first MARCA administration, children's height and mass were measured using the standards outlined by the International Society for the Advancement of Kinanthropometry (2001).

#### **4.2.3 Data analysis**

The MARCA's analytical module was used to determine an overall daily physical activity level in METs, minutes of MVPA, and minutes devoted to various activity subsets. The number of minutes spent in the following subsets was calculated:

- sleep
- screen time (time spent watching television or videos and time spent playing computer or video games)
- inactive socialising (e.g., sitting and talking, talking on the phone, playing board games, etc.)
- low-level activities (self-care, household chores, school work, studying, etc.)
- loco-play (time spent in active locomotion and unorganised play, such as playground games, etc.)
- sport (physical activities with recognised rules, governing associations and typically taking place in specialised spaces, such as ovals, courts, etc.). **Note:** There was no indication whether sports were participated in as organised activities (such as a school game of football) or non-organised activities (such as playing with friends in the backyard).

Cluster analysis identifies ‘clumps’ of cases in multi-dimensional space. A two-step clustering technique was chosen (Pung & Stewart, 1983). Analyses were performed for boys and girls separately using *SPSS version 11* (2002). The details of the data treatment prior to analysis and a description of the complex two-stage clustering technique can be found in the Appendix 8.2.

Once clusters had been identified, descriptive statistics (median and inter-quartile range) were performed on all variables. In addition, to give an indication of overall activity level, median PAL and MVPA during 3:30–6:00 pm were calculated. MVPA 3:30-6:00 pm was included due to research suggesting that this time period, immediately after school until bedtime, is a ‘critical window’ for youth physical activity as it relates strongly to total daily physical activity and influences relationships with obesity and overweight (Colchico, Zybert, & Basch, 2000; Robinson et al., 1993; Sallis, Taylor, Dowda, Freedson, & Pate, 2002).

We tested whether clusters varied significantly according to age, socio-economic status (SEIFA), body mass index (BMI), geographical location (metropolitan vs non-metropolitan), school sector (government vs private) and family structure (single parent family with no siblings vs single parent family with siblings vs two-parent family with no siblings vs two-parent family with siblings).

### 4.3 Results

The demographic characteristics of the participants are shown in Table 4.1. Using the Cole BMI classifications (Cole, Bellizzi, Flegal, & Dietz, 2000), 73.5% of subjects were classified normal weight, 19.6% classified overweight and 6.9% obese. As not all subjects completed each demographic measure, the sample size (n) is reported under the results of each variable that did not contain the entire sample. There were no differences between boys and girls ( $p > 0.05$ ) on any of the variables.

**Table 4.1 Demographic characteristics of the participants in this study**

variable n	boys 700	girls 729	all 1429
age (years)	11.9 (0.8)	11.9 (0.8)	11.9 (0.8)
mass (kg), $n^a$	44.7 (11.3), 556	45.2 (11.3), 572	45.0 (11.3), 1128
stature (cm), $n$	149.9 (8.4), 558	150.8 (8.1), 573	150.3 (8.3), 1131
BMI (kg.m <sup>-2</sup> ) <sup>b</sup> , $n$	18.9 (4.6), 553	19.0 (4.1), 571	18.9 (4.3), 1124
SEIFA <sup>c</sup> , $n$	990.4 (98), 674	981.0 (100), 729	985.5 (99), 1394
non-metropolitan (%) <sup>d</sup> , $n$	20.0, 690	19.0, 729	19.5, 1419
non-govt schools <sup>e</sup> , $n$	15.4, 700	15.4, 729	15.4, 1429

<sup>a</sup> sample size is reported where the variable analyses did not contain the entire sample.  
<sup>b</sup> BMIs are reported as medians (IQ range) due to highly skewed values.  
<sup>c</sup> SEIFAs (socio-Economic Indicators For Areas) are a series of indexes of socio-economic status devised by the Australian Bureau of Statistics using a basket of indicators such as educational and employment status. The index used here is the Index of Relative Disadvantage at the postal area level. The national average is 1000 and the SD is 100, and the average for the whole state is 982. Higher values indicate more advantaged areas.  
<sup>d</sup> 27% of South Australians live in non-metropolitan areas.  
<sup>e</sup> Across the whole state, 26% of primary school aged children attend non-government schools.

### 4.3.1 Cluster identification

A three cluster solution for the boys and a four cluster solution for girls were found to be efficient. Both solutions were also found to have acceptable reliability (see Appendix for details). Mean z-scores were investigated to determine the distinctive activity characteristics of each cluster. Transforming data into z-scores is a statistical technique which standardises each of the variables. This standardisation ensures each variable has equal weighting when entered into the clustering analysis. If this standardisation did not occur, activities such as sleeping would have a greater impact on the cluster analysis, compared to sport, for instance, due to the larger time spent in sleep during the day. The z-score represents how far each individual's score sits away from the mean score, that is, how many standard deviations a score is from the mean. Each cluster's mean z-score for a variable gives an indication of how long a typical child from that cluster spends performing the activity variable compared to the entire sample. If a cluster displays a high mean z-score for the activity variable, its members spend more time in that activity than the entire sample. Alternatively, if a cluster shows a low mean z-score, on average its members spend less time in that activity compared to the entire sample.

### 4.3.2 Boys' cluster solution

Three distinct clusters were found for boys. Cluster 1 consisted of 35.7% of the sample and its members were named 'sporties' due to their large amounts of time spent playing sport (z-score = +0.91; median min.d<sup>1</sup> = 117.5). Cluster 2 members (32.2% of sample) were named 'screenies' due to their high levels of screen time per day (z-score = +0.90; median

min.d<sup>-1</sup> = 372.1). The third cluster also consisted of 32.2% of the entire sample and its members were named ‘autonomes’ due to their tendency to participate in activities they could create and participate in by themselves without the need for external organisation or stimulation. Autonomes spent a lot of time in inactive socialising (z-score = +0.61; median min.d<sup>-1</sup> = 85.0) and locomotion and play (z-score = +0.50; median min.d<sup>-1</sup> = 105.0). Figure 4.1 shows the mean z-scores for all variables in each of the boys’ clusters. Table 4.2 shows the descriptive data for PAL, MVPA 3:30-6:00 pm and each of the activity variables for each of the boys’ clusters.

#### **4.3.3 Boys’ between-cluster differences**

There were no significant differences across the boys’ clusters in age, BMI and SES (ANOVA results shown in Table 4.4). There did appear to be a trend in SES with the screenie boys coming from lower SES backgrounds, but the difference did not reach significance (p = 0.09). However, results from the contingency table analyses (Table 4.5) showed significant differences across the clusters in geographical location, school sector and family structure. A larger proportion of screenie boys live in non-metropolitan areas and a larger proportion of screenie boys attend government schools compared to rest of the sample (p<0.005). Screenie boys were also different in terms of family structure. A larger proportion of screenie boys came from single parent families (both in single parent families with or without siblings; p<0.005).

#### **4.3.4 Girls’ cluster solutions**

A four cluster solution was found for the girls. Cluster 1 consisted of 26.9% of the sample and its members were named ‘players’ due to their high levels of play time (z-score = +0.93; median min.d<sup>-1</sup> = 140.4). Cluster 2 (26.2% of sample) was characterised by high levels of screen time (z-score = +0.91 ; median min.d<sup>-1</sup> = 280.0) and its members labelled ‘screenies’. Cluster 3 (25.8% of sample) contained girls who spent large amounts of time in sport (z-score = +0.79; median min.d<sup>-1</sup> = 58.8) and were therefore named ‘sporties’. Members of the 4<sup>th</sup> cluster (21.1% of sample) were named ‘socialisers’ due to their high levels of inactive socialising (z-score = +0.61; median min.d<sup>-1</sup> = 122.5). Figure 4.2 shows the mean z-scores for all variables in each of the girls’ clusters. Table 4.3 shows the descriptive data for PAL, MVPA 3:30-6:00 pm and each of the activity variables for each of the girls’ clusters.

#### **4.3.5 Girls’ between-cluster differences**

Table 6 shows the results of the ANOVA comparing cluster for differences in age, BMI and SES (SEIFA). The screenie girls were the eldest cluster group and were significantly older than the socialisers and the players. The sporties were also significantly older than the youngest players. Significant differences were also found in BMI between clusters. The screenie girls had significantly higher BMIs than any of the other clusters. No significant differences in SES (SEIFA) were found across the clusters. However, as with the boys’ clusters, there was a trend (p=0.08) for the screenie girls to come from lower SES backgrounds. There were also no significant differences in proportions across the clusters in geographical location, school sector, or family structure (see Table 4.5).

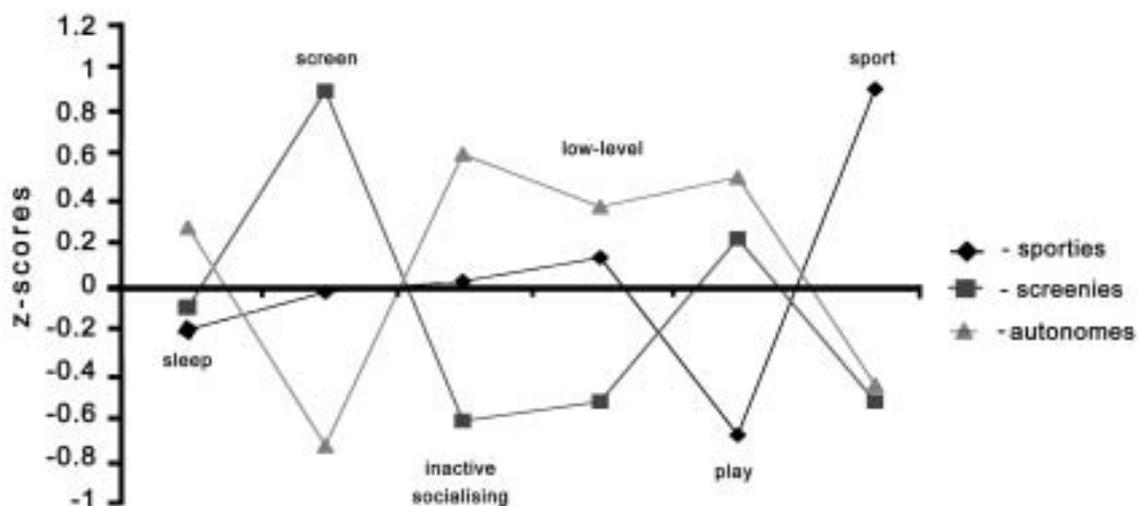


Figure 4.1 Mean z-scores of all activity variables for each of the boys' clusters

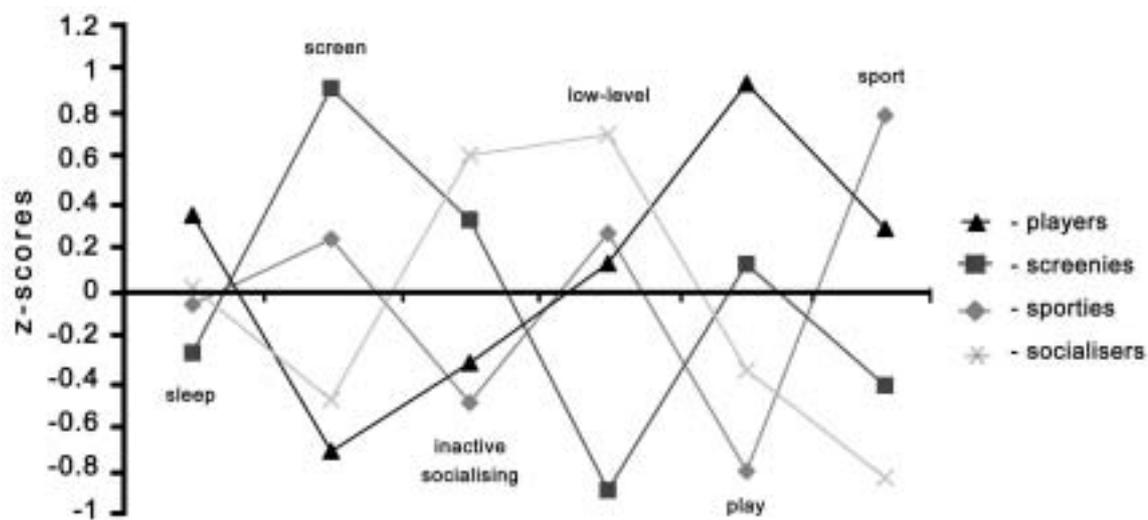


Figure 4.2 Mean z-scores of all activity variables for each of the girls' clusters

**Table 4.2 Median values (upper figure) and inter-quartile range (lower figure) for PAL, MVPA 3:30-6:00 pm and activity variables for each of the boys' clusters.**

**PAL = physical activity level; MVPA = moderate-to-vigorous physical activity**

	Cluster		
	1 'sporties'	2 'screenies'	3 'autonomes'
<i>% of sample</i>	35.7	32.2	32.2
<b>PAL (METs)</b>	1.89 0.38	1.69 0.33	1.74 0.46
<b>MVPA (min.d<sup>-1</sup>)</b> 3:30-6:00 pm	33.8 65.0	15.0 53.0	28.3 65.0
<b>sleep (min.d<sup>-1</sup>)</b>	584.6 70.0	591.3 70.2	612.5 75.3
<b>screen (min.d<sup>-1</sup>)</b>	265.0 101.9	372.1 115.9	191.3 95.6
<b>inactive socialising (min.d<sup>-1</sup>)</b>	55.8 60.0	23.8 45.3	85.0 72.2
<b>low-level (min.d<sup>-1</sup>)</b>	202.5 83.8	152.5 80.0	213.8 116.7
<b>loco/play (min.d<sup>-1</sup>)</b>	41.3 42.5	90.0 77.5	105.0 96.9
<b>sport (min.d<sup>-1</sup>)</b>	117.5 68.8	32.5 48.1	33.3 46.9

**Table 4.3 Median values (upper figure) and inter-quartile range (lower figure) for PAL, MVPA 3:30-6:00 pm and activity variables for each of the girls' clusters.**

**PAL = physical activity level; MVPA = moderate-to-vigorous physical activity**

	Cluster			
	1 'players'	2 'screenies'	3 'sporties'	4 'socialisers'
<i>% of sample</i>	26.9	26.2	25.8	21.1
<b>PAL (METs)</b>	1.84 0.28	1.59 0.22	1.66 0.25	1.57 0.22
<b>MVPA (min.d<sup>-1</sup>)</b> 3:30-6:00 pm	40.0 55.0	20.0 46.9	15.9 45.0	7.9 32.5
<b>sleep (min.d<sup>-1</sup>)</b>	628.7 65.4	597.5 68.4	605.5 65.6	610.6 77.5
<b>screen (min.d<sup>-1</sup>)</b>	139.4 80.0	280.0 110.0	222.5 92.0	164.6 92.5
<b>inactive socialising (min.d<sup>-1</sup>)</b>	62.5 55.6	102.5 84.8	53.8 52.5	122.5 85.0
<b>low-level (min.d<sup>-1</sup>)</b>	255.0 94.8	187.5 64.1	270.0 96.3	306.3 107.5
<b>loco-play (min.d<sup>-1</sup>)</b>	140.4 62.1	91.2 68.6	40 42.5	63.3 50.0
<b>sport (min.d<sup>-1</sup>)</b>	35.6 36.3	16.3 25.0	58.8 51.3	7.9 18.3

**Table 4.4 Results from one-factor ANOVA comparing age, body mass index (BMI) and socio-economic status (measured by SEIFA) across the boys' clusters. Mean values (upper figure), standard deviation (middle figure) and sample size (lower figure) are shown.**

	Cluster		
	1 'sporties'	2 'screenies'	3 'autonomes'
<b>age</b>	11.9	11.9	11.9
<i>SD</i>	0.8	0.7	0.9
<i>n</i>	250	225	225
<i>ns<sup>a</sup></i>			
<b>BMI<sup>b</sup></b>	18.9	18.7	18.9
<i>IQR</i>	4.1	5.2	4.6
<i>n</i>	184	177	192
<i>ns<sup>a</sup></i>			
<b>SES (SEIFA)<sup>c</sup></b>	995.0	978.6	996.8
<i>SD</i>	98.2	97.1	97.9
<i>n</i>	237	218	219
<i>ns<sup>a</sup></i>			

<sup>a</sup>ns= non significant  
<sup>b</sup>BMI's are reported as medians (IQ range) due to highly skewed values. BMI was Box-Cox transformed ( $\lambda=-2$ ) for ANOVA  
<sup>c</sup>SES = socio-economic status; SEIFA = socio-economic indicators for areas

**Table 4.5 Contingency table analyses for geographical location, school sector and family structure across the boys' clusters**

	Cluster		
	1 'sporties'	2 'screenies'	3 'autonomes'
<b>Geographical location</b>			
metro	82.1%	74.3%	82.5%
non-metro	17.9%	25.7%	17.5%
<i>n</i>	246	221	223
$\chi^2=6.097^*$			
<b>School sector</b>			
government	81.2%	89.3%	83.6%
private	18.8%	10.7%	16.4%
<i>n</i>	250	225	225
$\chi^2=6.266^*$			
<b>Family structure</b>			
1-0	4.7%	9.1%	1.6%
1-S	10.9%	34.5%	14.3%
2-0	4.7%	7.3%	11.1%
2-S <sup>a</sup>	79.7%	49.1%	73.0%
<i>n</i>	64	55	63
$\chi^2=19.288^*$			

\* = p < 0.05; \*\* = p < 0.005  
<sup>a</sup> – 1-0 = one parent family with no siblings; 1-S = one parent family with sibling(s); 2-0 = two parent family with no sibling(s); 2-S = two parent family with sibling(s).

**Table 4.6 Results from one-factor ANOVA comparing age, body mass index (BMI) and socio-economic status (measured by SEIFA) across the girls' clusters. Mean values (upper figure), standard deviation (middle figure) and sample size (lower figure) are shown.**

	Cluster			
	1 'players'	2 'screenies'	3 'sporties'	4 'socialisers'
<b>age</b>	11.8	12.1	11.9	11.9
<i>SD</i>	0.8	0.8	0.8	0.8
<i>n</i>	196	191	188	154
<i>F=4.937**</i>				
<b>BMI<sup>b</sup></b>	18.6	19.8	18.6	18.7
<i>IQR</i>	3.4	4.9	4.3	3.7
<i>n</i>	164	156	126	126
<i>F=4.594**</i>				
<b>SES (SEIFA)<sup>c</sup></b>	992.8	966.3	980.8	984.2
<i>SD</i>	98.0	95.8	102.6	103.7
<i>n</i>	195	187	186	152
<i>ns<sup>a</sup></i>				
<p><sup>a</sup>= non significant; * = p &lt; 0.05; ** = p &lt; 0.005            Fisher's PLSD – age: screenies&gt;players; screenies&gt;socialisers; sporties&gt;players, p&lt;0.05            Fisher's PLSD – BMI: screenies&gt;players, screenies&gt;sporties; screenies&gt;socialisers, p&lt;0.05  <sup>b</sup>BMI's are reported as medians (IQ range) due to highly skewed values. BMI was Box-Cox transformed (<math>\lambda=-2</math>) for ANOVA  <sup>c</sup>SES = socio-economic status; SEIFA = socio-economic indicators for areas</p>				

**Table 4.7 Contingency table analyses for geographical location, school sector and family structure across the girls' clusters**

	Cluster			
	1 'players'	2 'screenies'	3 'sporties'	4 'socialisers'
<b>Geographical location</b>				
metro	77.0%	78.5%	85.1%	83.8%
non-metro	33.0%	21.5%	14.9%	16.2%
<i>n</i>	196	191	188	154
<i>ns</i>				
<b>School sector</b>				
government	85.7%	86.9%	80.3%	85.7%
private	14.3%	13.1%	19.7%	14.3%
<i>n</i>	196	191	188	154
<i>ns</i>				
<b>Family structure</b>				
1-0	7.0%	6.0%	6.6%	5.4%
1-S	30.2%	27.4%	18.0%	23.2%
2-0	11.6%	3.6%	3.3%	3.6%
2-S <sup>a</sup>	51.2%	63.0%	72.1%	67.9%
<i>n</i>	43	84	61	56
<i>ns</i>				
<p>ns = non-significant; * = p &lt; 0.05; ** = p &lt; 0.005  <sup>a</sup> 1-0 = one parent family with no siblings; 1-S = one parent family with sibling(s); 2-0 = two parent family with no sibling(s); 2-S = two parent family with sibling(s).</p>				

## **4.4 Discussion**

### **4.4.1 Physical activity levels across boys' clusters**

The cluster analyses found distinct and stable clusters for both boys and girls. Comparison within both the boys' and girls' clusters showed substantial differences in the activity levels of each cluster. The sporty boys were the most active boys' cluster. In particular, they spent a substantially greater amount of time in MVPA during the critical window after school period. It would appear that the sporty boys prefer to participate in organised sports rather than unstructured play. While remaining active, the sporty boys still manage to spend a substantial amount of time in front of the screen (mean = 265 min.d<sup>-1</sup>). These boys appear to be similar to the 'techno-active' boys that Marshall et al. (2002) discovered, who spend large amounts of time in both sedentary and physical activity.

The second most active cluster of boys was the autonomes. As stated earlier, the members of the autonomes' cluster seem to be able to initiate activity for themselves without relying on external stimuli or organisation such as television, computer games or organised sport to direct their activity. They spent a lot of time in inactive socialising and play, but less time in front of a screen or playing sport.

Screenies were the least active cluster and spent an extraordinary amount of time in front of a screen, on average, greater than six hours per day. They spent very little time engaged in sport and, in particular, spent very little time in MVPA during the critical after school window.

We can use previously reported PAL classifications to compare the clusters. Using Torun's PAL classifications for 6-13 year old boys, PALs of 1.55, 1.75 and 1.95 correspond to light, moderate and heavy habitual physical activity (Torun et al., 1996). The sporty boys would be classified as participating in moderate to heavy physical activity. The autonomes' activity would be classified as moderate and the screenies' activity as light-moderate.

### **4.4.2 Characteristics of the boys' clusters**

Despite recent findings that have suggested television viewing may be a predictor of body weight and of physical activity (Hernandez et al., 1999; Proctor et al., 2003; Salmon, Bauman, Crawford, Timperio, & Owen, 2000), there were no significant differences in BMI across the boys' clusters. The screenie boys, who could be classified as 'extreme' screen users, appear to support the theory that screen time displaces physical activity, but as yet they had not developed higher levels of overweight compared to other boys of the same age. However, the sporty boys do not conform to the displacement theory as they still manage to accrue fairly significant periods of screen time. This suggests there may be a screen time cut-point where screen time and physical activity no longer remain independent constructs and screen time begins to invade into physical activity time. This concept of a screen time cut-point warrants further investigation, as it may inform future recommendations and television and video game playing time guidelines. While both the sporty boys and autonome boys reached at least moderate levels of physical activity, the sporty boys spent more time in screen time than the autonomes.

Both the sporty boys and the autonomes do not appear to have any distinguishing characteristics in terms of age, BMI, SES, geographical location, school sector or family structure. However, the screenie boys appear to have strong characteristics which may contribute to their high levels of screen time. A higher proportion of screenie boys were found to live in non-metropolitan areas. This is somewhat surprising given recent South Australian findings suggesting that rural children are aerobically fitter than metropolitan children (Dollman, Norton, & Tucker, 2002). Screenie boys were also more likely to attend government schools. This may be partially explained by SES as, while not significant, there was a trend for screenie boys to come from lower SES backgrounds. Screenie boys were also much more likely to come from single parent families. 44% of sportie boys came from 1O or 1S families compared to only 16% of sporties and autonomes. We can speculate as to why living in a single parent family may impact on screen time in children. The television or computer may act as a babysitter while the single parent attends to household duties that would ordinarily be shared amongst two adults. Children from single parent families may also be home alone with no parental supervision more often than children from two-parent families. This could impact screen time and opportunity for physical activity in a number of ways: children may not be allowed to leave the home while their parents are out; parents are not able to transport the child to organised sport; or parents are not able to enforce screen time restrictions while out of the house. As these reasons are only speculative, further investigation into the determinants of screen time behaviour is recommended.

#### **4.4.3 Physical activity levels across girls' clusters**

As expected, the sporty boys were the most active cluster of boys. However, it is the players in the girls who are more active than any other group. The players' girls are substantially more active than any other cluster in the after school period, spending 50% more time in MVPA during the critical after school window than any other cluster.

The sporty girls are the next most active cluster of girls and appear to be distinguished from the players in terms of screen time. The players exhibit very low levels of screen time, while the sporty girls could possibly be labelled as 'techno-active' as they are the second highest participants in screen time across the clusters.

Surprisingly, it is not the screenie girls who are least active. The socialisers are less active than any other cluster and appear to regularly choose socialising activities such as sitting and chatting or talking over the phone over organised sports. Torun's PAL classifications for girls aged 6-13 years are 1.50, 1.70 and 1.90 for light, moderate and heavy habitual physical activity respectively (Torun et al., 1996). These classifications would rank the players' physical activity as moderate to heavy, the sporties would be approaching moderate physical activity and the screenies and socialisers would be classified only slightly above light activity.

#### **4.4.4 Characteristics of the girls' clusters**

The girls' clusters differed significantly in terms of age, although the absolute differences were small – only 0.3 years. The screenies were the eldest girls, while the players were the youngest. This increased free play behaviour and increased sedentary behaviour in older children, resulting in lower physical activity levels with age has been found in longitudinal surveys of children (Bradley, McMurray, Harrell, & Deng, 2000; Caspersen et al., 2000; Van Mechelen et al., 2000). However, it was somewhat surprising that the socialisers were the second youngest cluster, significantly younger than the screenies. Given that the socialisers were the least active cluster, participation in inactive social activities increase in girls with age (Bradley et al., 2000) and physical activity levels decline steeply in adolescent girls (Van Mechelen et al., 2000), it is disturbing that the socialisers in this study are so young. Further investigation into these girls' activity choices is important.

BMI analyses also revealed interesting findings. While the socialisers were the least active cluster of girls, the screenie girls were found to have significantly greater BMIs than the other clusters. Unlike the boys' findings, this supports the notion that television has a relationship with overweight, independent of physical activity level. While causality is yet to be determined, the mechanisms behind this relationship have been suggested to be related to snacking practices in front of the television, exposure to advertising of high fat foods and even possibly a decreased metabolic rate while watching television (Gortmaker et al., 1996; Klesges, Shelton, & Klesges, 1993). It is important to note that these mechanisms only affect television viewing, while our data combines both television viewing and computer and video game playing. As with the boys' clusters there was a non-significant trend toward the screenie girls coming from low SES backgrounds. Unlike the boys' clusters there were no differences in geographical location, school sector or family structure across the clusters.

#### **4.4.5 Implications for physical activity interventions**

The diverse activity patterns across the boys' and girls' clusters have implications for the development of future physical activity interventions. These findings suggest the 'blanket' intervention approach where one intervention is applied to all children independent of their activity patterns and choices may not be as effective as tailored interventions. It is important we understand the unique activity patterns existing in groups of children and that we consider these patterns and activity choices when designing an intervention. A good example is the socialising cluster of girls. The socialising girls were the least active group of girls; however, an intervention that purely targets television may be ineffective in addressing the inactivity of our least active group of girls, as the socialisers don't spend large amounts of time in front of the screen to begin with.

The least active group of boys was the screenies. The screenie boy may respond well to a traditional intervention designed to decrease screen time by restricting television watching via curfews, rations of television viewing hours, etc. However, perhaps we need to think 'outside the square' and acknowledge that these children are obviously attracted to technology. It may be beneficial to encourage the development of technologies such as

computer games which require large body movements and moderate physical activity throughout the course of the game. In addition, we need to acknowledge the demographic characteristics of a screenie boy when designing an intervention. The intervention needs to be appropriate to the needs of a single parent family. It therefore should not rely on parental transport if the intervention is based out of the home, in which case supervised, safe transport could be incorporated. The intervention may need to be tailored to the home environment, incorporating activities that require limited supervision.

The least active group of girls was the socialisers. A successful intervention for the socialisers may need to exploit their social nature. Therefore, interventions that involve partner or group activities with an opportunity to socialise may be appropriate. This may take the form of a 'Walk and Talk' intervention where girls meet together to combine socialising and physical activity.

#### **4.4.6 Conclusion**

Along with other evidence outlined in this document, the cluster analysis exercise clearly demonstrates that different activity patterns exist within groups (or clusters) and each activity pattern's relationship with variables such as PAL and BMI are quite different. We have also supported the notion that activity and inactivity may not always act as competitors for time and are in fact different constructs, with some children able to spend large amounts of time in both activity and inactivity. This information can help us tailor physical activity interventions as we need to not only understand but *utilise* the unique activity patterns of each group to our advantage.

A number of areas were highlighted for future investigation in this study. The main questions which require further investigation are:

- Do screen time cut-points exist where screen time begins to impact on physical activity levels?
- Does a relationship exist between screen time and overweight independent of physical activity?
- What are the determinants of screen time (in particular, the relationship between one parent families and screen time)?
- What are the determinants of inactive social behaviour in girls?

In order to investigate the determinants of activity behaviour, children closest to each cluster centre were targeted for in-depth qualitative interviews (see Section 8).

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## Sport and children's time budgets

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## 5.1 Characteristics of the children

**Summary:** 4661 10-15 year old children from 144 randomly selected schools from around South Australia were surveyed. The South Australian children do not differ from all Australian children upon certain characteristics, including age and height, weight, weight-for-height, place of residence, socio-economic status, and school sector. There were few differences between boys and girls.

This section of the report presents data on 8261 profiles from 4661 children from schools in South Australia. A *profile* is a record of one child for one 24 h period, so that most children recorded more than one profile (range 1 to 7). Use-of-time analyses were performed at the level of the profile, but in this section we will present data at the level of the child, so as to provide a picture of the kind of children we interviewed.

**Table 5.1 Characteristics of the children interviewed. The value shown are means (standard deviations)**

characteristic	boys	Girls	all children	boys vs girls
sample size	2364	2297	4661	
age	12.6 (1.2)	12.6 (1.2)	12.6 (1.2)	NS
mass (kg)	49.1 (12.7)	48.5 (12.1)	48.8 (12.4)	NS
height (cm)	154.7 (12.8)	153.7 (9.8)	154.2 (11.5)	NS
BMI (kg.m <sup>-2</sup> )	20.4 (3.9)	20.5 (4.3)	20.5 (4.1)	NS
SEIFA	992 (90)	989 (93)	991 (92)	NS
% non-metro	21.8	17.4	19.6	p < 0.0001
% govt schools	77.5	76.0	76.8	NS

BMI = body mass index

SEIFA = Socio-economic indicators for areas

% non-metro = percentage of children living outside the metropolitan area

% govt schools = percentage of children attending government schools

NS = not significant

### 5.1.1 Characteristics of the children surveyed

Table 5.1 shows the characteristics of these children. Almost all were aged between 10 and 15 years. They were drawn from 144 randomly selected schools around South Australia, the only exception being that very remote schools were not visited.

#### *Height, mass, BMI*

They were of average mass (48.8 kg), height (154.2 cm) and BMI (20.5 kg.m<sup>-2</sup>) for their age when compared to children from other recent South Australian surveys. While data from random national samples of children of this age are not available, previous national surveys have shown no differences between the heights, masses and BMIs of South Australian and national children of this age.

### *Socio-economic status*

As indicated previously, Socio-Economic Indicators for Areas (SEIFAs) are a series of indexes of SES devised by the Australian Bureau of Statistics using a basket of indicators such as educational and employment status. The index used here to quantify SES is the Index of Relative Disadvantage at the postcode level. The national average is 1000 and the standard deviation is 100. Higher values indicate more advantaged areas. In our sample, the mean (SD) SEIFA was 991 (92), which is higher than the average for South Australia (982), and lower than the national average (1000). However, these differences, while statistically significant, are quantitatively very small (<1%).

### *Geographical distribution*

About 20% of the children interviewed were from non-metropolitan areas, which is almost identical to the total percentage of Australians living in population centres of less than 500,000 people (21%). Over three-quarters of the children (76.8%) attended government schools, compared to the national average of 73%. The children were therefore quite typical of the population of Australian schoolchildren.

### *Boys vs girls*

There were no differences between boys and girls in height, mass and BMI, which is typical at this age. There were also no differences in age, SEIFA, and percentage attending government schools. Slightly more boys than girls lived in non-metropolitan areas, mainly because some large non-metropolitan boys' schools were sampled.

## **5.2 Characteristics of the profiles**

**Summary:** 70% of all profiles reported school days, and 30% non-school days. Over 80% of the profiles were reported by children aged 11-13 years.

Analysis of children's use-of-time and the place of sport in children's time budgets was conducted at the profile level. Any profile which indicated an improbably low activity level (PAL < 1.1) or an improbably high activity level (PAL > 3) was culled, as were profiles which recorded fewer than 10 activities over the course of a day. It was felt that for these profiles children were not making a genuine effort to recall their activities.

As explained earlier in the report, profiles were collected using a computerised activity diary linked to a compendium of energy expenditures, the Multimedia Activity Recall for Children and Adolescents (MARCA). The children were asked to recall their previous day's activities in blocks of at least a 5 min duration. Children chose from lists of more than 200 activities grouped into seven main categories. When they were doing two or more activities at the same time, they were asked to choose their main activity. The reliability and validity of the MARCA have been shown to be as good as the best pencil-and-paper recall instruments. Children completed the MARCA in school computer laboratories, and recalled either full days at school or non-school days (weekends, holidays or days off). Children also filled in socio-demographic details, including date of birth and residential postcode. Children's stature and mass were measured by trained anthropometrists.

Seventy percent of all profiles recorded school days, and 30% non-school days. These proportions were the same for both boys and girls. Because approximately one day in two over the course of a year is a school day, time allocations have been reweighted on a 1:1 basis when overall time use patterns have been analysed. The age breakdown of profiles is shown in Table 5.2. The most heavily represented age-group was the peri-pubertal zone (11-13 years). This age group is of particular interest because a number of cross-sectional studies have shown rapid declines in physical activity levels at this age, perhaps reflecting the transition from primary to secondary school (e.g. van Mechelen, Twisk, Bertheke Post, Snel, & Kemper, 2000).

**Table 5.2 Breakdown of profiles by age**

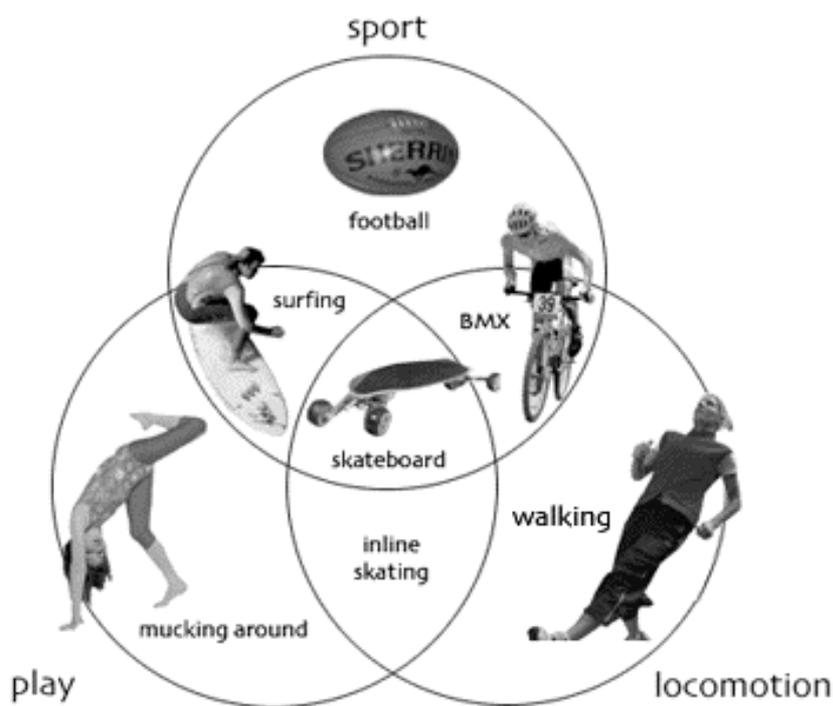
age at last birthday	% of all profiles
<11	8
11	35
12	32
13	14
>13	10

### 5.3 The contribution of sport to the time budgets of children

**Summary:** The major components of children’s time budgets are sleep and screen time, which together make up 55-65% of a child’s day. Moderate-to-vigorous physical activity (MVPA) makes up 10-12% of the day, of which about 40% is sport and 40% play. The distribution of minutes of sport is highly skewed: relatively few children engage in high amounts of sport, while large numbers do very little. Boys play sport more than girls (5% vs 2.5% of total time). The amount of time devoted to sport decreases by about 5% with each year of age, the decline being greater on school days than on non-school days, and greater for girls than for boys. This reflects a trend towards lower levels of MVPA overall.

#### 5.3.1 What counts as sport?

It is not easy to define sport (Suits, 1989), because there is considerable overlap with areas such as play and locomotion (Figure 5.1), and unfortunately there is no internationally agreed classification system. While football, for example, is unequivocally a sport, surfing may count either as a sport or as a kind of play. Hopscotch is unquestionably play, but inline skating may be seen either as play or locomotion. While walking is almost always locomotion, bicycle riding may be either locomotion (i.e. getting from one place to another) or a sport. Activities such as skateboarding may be sport, play or locomotion, depending on the circumstances. Fortunately, there is little doubt about the major sports: the various forms of football, basketball and netball, tennis, swimming, etc. Important areas which we have *not* classified as sport are using bicycles, skateboards, skates and scooters (classified under locomotion), and various forms of play such as playing in water (e.g. at the beach). These decisions are somewhat arbitrary, but reflect some of the categories used in the Ainsworth compendium for adults (Ainsworth, et al., 2000).



**Figure 5.1** The overlap between sport, play and locomotion

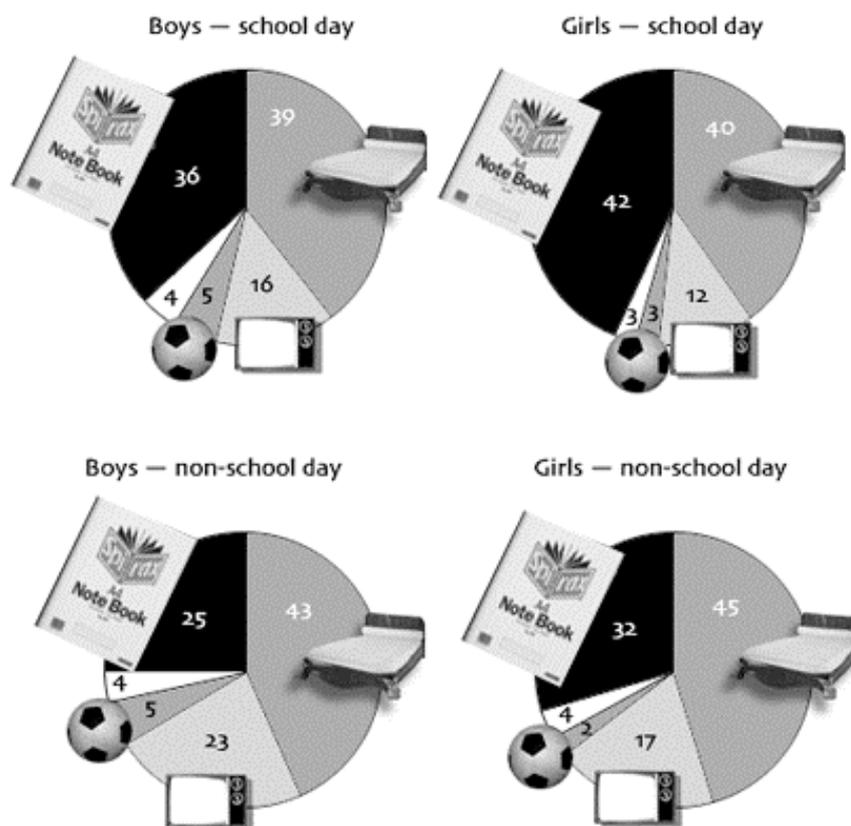
### 5.3.2 Time devoted to sport

On any given day, about 55% of children will play some kind of sport. The percentage is considerably higher for boys (63%) than for girls (46%), and higher on school days (65%) than on non-school days (45%). Participation rates decline with age at the rate of about 3% per year of age, from 58% for 10 year olds, down to 47% for 14 year olds. Table 5.3 and Figure 5.2 show the various components of the time budgets of children. Children of this age spend about 40% of their time sleeping on school days, and considerably more – about 45% – on non-school days.

The second major component in their time budget is a miscellaneous category including mainly schoolwork on school days, but also self-care, non-screen inactivity (e.g. listening to music) and small amounts of time devoted to chores and homework. The third component is ‘screen time’ (i.e. the time spent watching TV or videos, using the computer, playing video-games or at the cinema). This component constitutes a greater proportion for boys (16-23%) than for girls (12-17%), and a greater proportion on non-school days (20%) than on school days (14%).

Sport and play/locomotion take up a relatively small percentage of a child’s day. Boys spend about 5% of their day playing sport, and girls 2-3%. The percentage for play and locomotion is about 3-4%. Together these constitute about three-quarters of all the moderate-to-vigorous physical activity (MVPA) that children of this age experience. The rest is made up of chores and some of the more vigorous activities of daily living.

The remaining time (varying between 25% and 42% of the time budget) is devoted to self-care (bathing, eating), other forms of inactivity (phone, listening to music), inactive socialising, chores and of course school. This component is larger on school days (39%) than on non-school days (28%), because school takes up a large part of the day. It is also larger for girls (32-42%) than for boys (25-36%), because boys' behaviours tend to be more polarised between vigorous activity and sedentarism. For boys, 64-75% of the day is spent either asleep, in front of a screen or at sport and play. For girls, the corresponding figure is 58-68%.



**Figure 5.2** Percentage of time devoted to sleeping, screen time, sport, play and locomotion (white area) and other activities (black area; this rubric includes schoolwork, non-screen inactivity, self-care and chores) on school and non-school days for boys and girls

**Table 5.3 Mean amounts of time spent per day in various activities (expressed as minutes – upper figure, and as a percentage of total time – lower figure) by boys and girls on school and non-school days**

	boys		girls		all
	school day	non-school	school day	non-school	
<b>sleep</b>	561 39%	611 43%	565 40%	641 45%	582 41%
<b>screen</b>	227 16%	333 23%	170 12%	242 17%	225 16%
<b>sport</b>	69 5%	67 5%	41 3%	32 2%	53 4%
<b>play/locomotion</b>	52 4%	61 4%	49 3%	62 4%	54 4%
<b>other</b>	515 36%	354 25%	605 42%	452 32%	514 36%

### 5.3.3 Distribution of time allocated to sport

Mean values do not give us an idea of how much time individuals devote to sport. A high mean value may be the result of almost everyone doing quite a bit of sport, or a few people doing a lot and most people doing very little. Table 5.4 shows the percentiles for sport time in boys and girls on school and non-school days. It is clear that sport time is highly positively skewed: that is, a relatively small number of children do a very large amount of sport, while most do very little. This is particularly true in girls, and on non-school days. On non-school days, for example, over 50% of girls do no sport at all, while 5% spend almost 2.5 h playing sport. Again, school has an equalising function: it tends to involve more people in sport, and ‘spreads the sport out’ more evenly. Attention to distributions tells us that while we should try to increase the average amount of sport played, we should also attend to those groups who play very little sport. That is, we should not only aim to increase the overall level of ‘sport wealth’, we should also aim to equalise the distribution of that wealth.

**Table 5.4 Minutes of sport for boys and girls on school and non-school days at different percentiles**

	Minutes of sport per day				
	bottom 5%	bottom 25%	average	top 25%	top 5%
<b>all children</b>	0	0	35	85	185
<b>all boys</b>	0	0	55	110	210
<b>all girls</b>	0	0	0	65	145
<b>boys – school days</b>	0	10	60	108	195
<b>girls – school days</b>	0	0	20	70	145
<b>boys – non-school days</b>	0	0	25	112	255
<b>girls – non-school days</b>	0	0	0	45	147

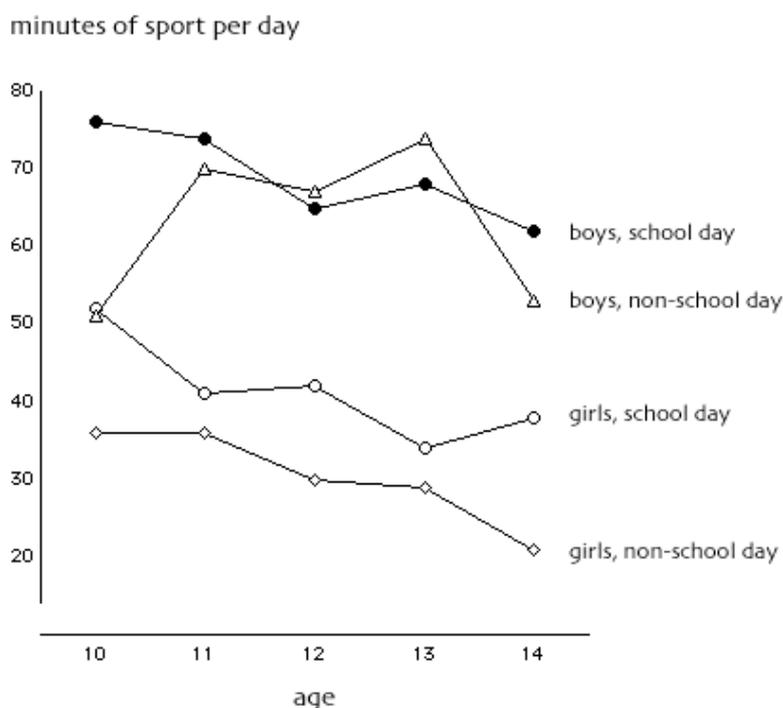
### 5.3.4 School days vs non-school days

The mean amount of time boys spend playing sport is similar on both non-school days (67 min per day) and school days (69 min per day). However, girls spend less time playing sport on non-school days (32 min) than on school days (41 min). The regimen of school tends to equalise sports participation, as well as overall levels of physical activity, between the genders. This is a strong argument for the use of school-based sport.

### 5.3.5 Age-related changes

As children get older, their sleep time decreases rapidly on school days, by about 16 min per day or 3% of mean values per year of age. Interestingly, sleep on non-school days remains unchanged. Screen time, on the other hand, increases at a rate of about 8 min per year of age, at least until the age of 13. The amount of time spent in MVPA generally decreases in this age-range by about 11 min per day or 7% of mean values for each year of age.

The amount of time spent playing sport decreases at a similar rate (2.5 min or 5% of mean values) per year of age (Figure 5.3). The decline is much more rapid for girls (7% per year of age) than for boys (3% per year of age), and more rapid on school days (7%) than on non-school days (3%). Although these data are cross-sectional, it is very likely that they represent true age-related changes rather than secular trends. When expressed as a percentage of MVPA, time spent playing sport is fairly constant. Sport constitutes 40-45% of all MVPA time for boys on school days, and 35-45% on non-school days. For girls, sport constitutes 30-35% of MVPA time on school days, and 20-25% on non-school days. These figures do not change across the age range. So the decline in sports participation reflects a general decline in physical activity. Figure 5.3 shows the minutes of sports participation across the age span for boys and girls on school and non-school days.



**Figure 5.3** Mean minutes of sports participation across the age span for boys and girls on school and non-school days

## 5.4 The contribution of sport to the daily energy expenditures of children

**Summary:** Sport contributes about 19% of boys' total daily energy expenditure (EE), and 12% of girls' daily energy expenditure. These figures are similar for school and non-school days. As children get older, there is only a small decline in sport's contribution, although there is a rapid decline in energy expenditure associated with play, which leads to a decline in overall energy expenditure by about 2% for each year of age.

Time budgets do not always give a good idea of how children partition their energy expenditure\* and trends and differences in time use may not reflect trends and differences in energy expenditure. For example, children may participate in more or less vigorous sports, or play the same sports more or less vigorously. Boys report being more vigorous in their sport (average = 7.8 METs) than girls (6.6 METs), and sport is slightly more vigorous on non-school days (7.4 METs) than on school days (7.0 METs). Play, on the other hand, is more vigorous on school days (6.6 METs) than on non-school days (5.3 METs).

### 5.4.1 Energy devoted to sport

Table 5.5 shows the various components of the daily energy expenditures (EEs) of children. Children of this age spend about 20% of their energy while sleeping. This figure is a little higher on non-school days (22-25%) than on school days (19-21%), because children sleep longer on non-school days. Screen time constitutes a greater proportion of energy expenditure for boys (12-19%) than for girls (10-15%), and a greater proportion on non-school days (17%) than on school days (11%). These two components together therefore constitute a much greater part of energy expenditure on non-school days (40%) than on school days (31%).

Sport and play/locomotion, although they consume a fairly small amount of time, make a major contribution to daily energy expenditure. Boys spend about 19% of their energy expenditure playing sport, and girls 12%. The percentage for play and locomotion is 12-13%. Together these constitute over one quarter of total daily energy expenditure.

The remaining energy expenditure (varying between 27% and 46% of total energy expenditure) is devoted to self-care (bathing, eating), other forms of inactivity (phone, listening to music), inactive socialising, chores, and of course school work. This component is larger on school days (42%) than on non-school days (31%), because school takes up a large part of the day. It is also larger for girls (35-46%) than for boys (27-38%). Notice

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\* **A handy reminder.** The rate at which we expend energy is expressed in METs. A MET (metabolic unit) is a rate at which we consume oxygen, which is used to generate energy for activity. 1 MET is equivalent to  $3.5 \text{ ml O}_2 \cdot \text{kg}^{-1} \text{ body weight} \cdot \text{min}^{-1}$ , which is the amount of oxygen we consume when we are at rest. Over short periods (minutes and hours), a fit person can maintain rates of energy expenditure of 10-15 METs, but over longer periods (days), an average energy expenditure of 3 METs would be very high. The amount of energy we use (as opposed to the rate at which we use energy) is expressed in MET.min: 1 MET.min is the amount of energy a person expends in one minute when at rest.

again that boys tend to be either ‘on’ or ‘off’. For boys, 62-73% of energy expenditure is spent either sleeping, in screen time or in sport and play. The corresponding figure for girls is 54-65%.

**Table 5.5 Mean amounts of energy expended per day in various activities (expressed as MET.min – upper figure, and as a percentage of total energy expenditure – lower figure) by boys and girls on school and non-school days**

	boys		girls		all
	school day	non-school	school day	non-school	
<b>sleep</b>	505 19%	550 22%	509 21%	576 25%	524 21%
<b>screen</b>	324 12%	474 19%	244 10%	344 15%	321 13%
<b>sport</b>	468 18%	481 19%	262 11%	281 12%	369 15%
<b>play/locomotion</b>	329 12%	334 13%	314 13%	307 13%	321 13%
<b>other</b>	1007 38%	675 27%	1143 46%	809 35%	975 39%

As with time devoted to sport, sport energy expenditure is positively skewed, especially in the case of girls, and on non-school days. The percentage of the ‘energy budget’ boys and girls spend playing sport is similar on both non-school days and school days (18-19% of total energy expenditure for boys; 11-12% of total energy expenditure for girls).

#### **5.4.2 Age-related changes**

As children get older, there are consistent changes in energy expenditure. Overall energy expenditure declines by about 1.5% with each year of age for boys and 2.5% for girls. There are small declines in the energy expenditure of sleep (as children sleep less on school days), and small increases in the energy expenditure associated with screen time. The energy expenditure due to sport is fairly stable on school days, despite falls in the number of minutes devoted to sport (this is probably due to the choice of more vigorous sports), but declines somewhat on non-school days. However, the major changes occur in play and locomotion, where there are dramatic falls. On school days, children over 13 spend only about one quarter as much energy on play as those younger than 11 on school days, and about half as much on non-school days. The decline in play is a phenomenon found in all mammals at adolescence, and probably reflects an evolutionary tipping point where the decreasing benefits of play (exploration of the environment, development of skills) are outweighed by the benefits of energy conservation. There is a strong argument that puberty is an important watershed in physical activity. Pre-pubertal children play naturally, and the main function of intervention is permissive: to create the environment where children can play. Post-pubertal children, like adults, are inclined to sloth. Here, interventions need to have an element of coercion and regimentation.

Similar trends appear when we look at the percentage of energy expenditure associated with different activities, rather than the absolute amount. Sleep continues to use 19-23% of daily energy expenditure on school days, the exception being an increase in non-school days for girls, from 24% at 10 years to 27% at 14 years. Screen time uses 9-13% of energy expenditure on school days, and on non-school days 18-19% for boys and 13-18% for girls. The percentage of energy expenditure associated with sport is relatively stable across the age range with boys (17-23%) and girls (10-14%).

## 5.5 What competes for time with sport?

**Summary:** Cross-sectionally, every extra hour of sport is associated with a reduction of 20-24 min in screen time, 7-12 min in play/locomotion, and 1-9 min in sleep. The ‘critical window’ period (3.30 pm - 6.30 pm on school days) is a period where sports participation increases by 50% relative to the rest of the waking day. The greater the percentage of their total sport children acquire in this period, the more sport they do overall. During this period, screen time is the overwhelming competitor: every extra hour of sport is associated with a reduction of 24-32 min in screen time.

Time devoted to sport has to be ‘plundered’ from elsewhere in the child’s time budget, and conversely when sport time is reduced, the extra time flows to other components of time use. By regressing minutes of various activities against minutes of sport, we can get an idea of how these time shifts are likely to occur. Table 5.6 shows the reduction in time devoted to other activities with every extra hour of sport time. Each extra hour of sport is associated with a reduction of 20-24 minutes in screen time, indicating that screen time is the main ‘competitor’ with sport. Each extra hour of sport is associated with a 6-9 min reduction in sleep on non-school days, but with only very small reductions on school days (1-2 minutes). Each extra hour of sport is associated with a reduction of 7-12 minutes in play and locomotion, this figure being somewhat greater in boys (9-12 minutes) than in girls (7 minutes). The remaining time (21-31 minutes) is associated with reduction in other activities.

**Table 5.6 Reduction (min) in other activities associated with each extra hour of sport time, for boys and girls on school and non-school days**

	boys		girls	
	school day	non-school day	school day	non-school day
sleep	1	9	2	6
screen	24	21	20	21
play/locomotion	12	9	7	7
other	23	21	31	25

It is important to understand that these data are cross-sectional. They describe different time-use patterns among children with higher and lower amounts of time devoted to sport. There is therefore no guarantee that if children actually increase or reduce their sport time, the same relationships will hold. Simultaneous performance of different activities allows a

degree of compressibility and extensibility when time budgets are restructured. For example, children may increase sport time by eating their dinner in front of the television. When displacement does occur, it may be selective. When something is added to the time budget, it may displace structurally or functionally cognate activities (for example, sport may displace locomotion – to play sport for a longer time, a child may get a ride in a car to the sports venue, where she would normally ride a bicycle), or activities which are ‘elastic’ (in the sense in which economists talk about the elasticity or responsiveness of prices, i.e. they can easily be stretched out or compressed, such as screen time), or activities which tend to occur at the same time of day as the new activity.

There are some strange constants in time use. For example, the ‘law of constant travel time and trip rates’ states that people will make four or five trips a day and travel for 60-80 minutes, regardless of the transport options available to them. This pattern has been found to apply in a wide range of societies, and also applies to the children in this study, who made an average of four trips a day averaging 62 minutes of travel time.

### **5.5.1 The ‘critical window’**

It has often been suggested that there is a ‘critical window’ for sports participation in children, namely the hours between 3.30 pm and 6.30 pm on school days. It has been suggested that children perform a disproportionate amount of sport in this period (relative to the amount of time available), and that children with high overall sport participation achieve disproportionately large amounts of sport time in the critical window period. If the critical window hypothesis is correct, the after-school period would provide an excellent point of leverage for interventions to increase participation (Terre, Ghiselli, & Taloney, 1992).

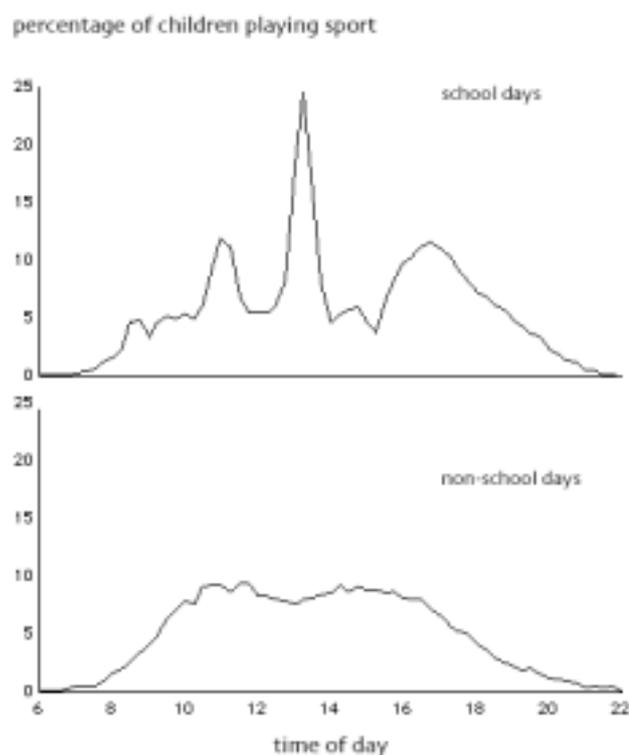
Our data provide moderate support for these hypotheses. The critical window period constitutes 20% of non-sleeping time, but 29% of all sport is performed in that time. Therefore, sport participation in this period is 50% higher than at other times of the day. There is also a significant relationship between the percentage of sport children perform during the critical window period and their total minutes of sport (boys:  $r = 0.32$ ,  $p < 0.0001$ ; girls:  $r = 0.22$ ,  $p < 0.0001$ ). Every extra minute of sport performed in the critical window equates to an extra 0.2 min of sport elsewhere during the school day.

The major competitor for sport time during the critical window period is screen time. Children are 3.5 times more likely to be found in front of a screen at this time than playing sport, and 1.5 times more likely to be in front of a screen than either playing, moving about or playing sport. Every extra hour of sport in this period is associated with a 32 min reduction in screen time in boys, and a 24 min reduction in girls. Sport also competes with play, but to a lesser extent: every extra hour of sport reduces play time by 12 min for both boys and girls. The remaining time (16-24 min) is drawn from other activities, such as self-care and chores.

## 5.6 When do children play sport?

**Summary:** On school days, sport participation peaks at lunch (25% of all profiles), recess (12%) and after school (12%). On non-school days, participation rises slowly to plateau at about 8-10% from about 10 am until 5 pm. Children are more likely to play sport on school days than on non-school days, and about half of all sport on school days occurs in school hours. Sport participation is highest in summer, and lowest in winter.

Figure 5.4 shows the percentage of children playing sport as the day progresses. On the school day, there are peaks at recess, lunch, and a slowly accumulating peak after school finishes. About 5% of children are playing sport at any one time during the school day, which is in rough agreement with recent estimates that about 3% of school time is devoted to sport. It is of interest that even at the lunch time peak (1.15 pm), only 25% of children are playing sport. This is in part due to the fact that schools in South Australia have different lunch times, but also reflects the fact that many children will either play or do nothing active at lunch time. However, even after school, in the critical window period, less than 12% of children are playing sport at any one time. After school, participation rises slowly to peak at 4.45 pm (11.7%), and then declines rapidly.



**Figure 5.4** Percentage of children playing sport at different times during the school and non-school days

School time appears to offer many opportunities to increase sport participation, either through encouraging children to be more active during lunch and recess, including more structured sport in school time (e.g. more frequent sport breaks between lessons), or through introducing structured sport after school. A number of studies which have introduced large amounts of structured physical activity replacing classroom activities in primary school have generally showed no detrimental impact on academic performance (e.g. Dwyer, Coonan, Leitch, Hetzel & Baghurst, 1983), while systematic reviews have shown that acute exercise consistently results in improved cognitive function in young people (Tomprowski, 2003).

On non-school days, the peaks are absent, largely because there is no school regimen to synchronise behaviours. Participation rises slowly (starting somewhat later than on school days, as children get up later) to plateau at about 8-10%. It remains at that level until about 5 pm with a slight dip for lunch, after which there is a slow decline. It should be noted that the non-school day recalled was generally a Sunday (recalled on a Monday), so the expected peak on Saturday morning is not evident. These weekend participation levels are relatively low.

### **5.6.1 In-school vs out-of-school sport**

On average, children perform 52% of their school day sport time in school hours, and the remainder outside school hours. In-school sport averages 29 min each day, and includes both dedicated PE time, organised school sports in school time, and sports played at recess and lunch. Assuming children spend about one day in two at school over the course of a year (40 weeks X 5 days = 200 days, or about 180-190 days with absences for illness, etc.), in-school sport amounts to 27% of total sport time. The percentages are similar for boys and girls, although girls have much lower overall sport participation.

About 43% of children reported that they preferred to do something active after school. Less than one child in five (17%) specifically identified sports as their preferred after-school activity. The most popular choices were soccer (4%), basketball (2.9%), swimming (2.2%), football (2.1%), netball (1.7%) and tennis (1.2%). In addition, bike riding (5.9%), 'mucking around' (5.7%), playing with pets (5.4%) and 'running around' (2.9%) were popular non-sport physical activities. Nevertheless, over half of all children preferred inactive pursuits: television (14.5%), video games (12.6%) and socialising (13.7%).

### **5.6.2 Seasonal variation**

The allocation of time to various components of children's time budgets changes with the seasons. Sport, play and MVPA are highest in summer and decline until winter, before they start to rise again in spring. Given this, one would expect that children's overall energy expenditure would peak in summer, but this is not so. Energy expenditure in winter is much higher than energy expenditure in other seasons (PAL = 1.79 vs 1.69-1.70,  $p < 0.0001$ ). The reason for this is that children also sleep more in summer (595 min vs 570-585 min,  $p < 0.0001$ ), with the amount of sleep declining steadily until spring. Children also have much higher screen time in summer (223 min vs 193-210 min,  $p = 0.002$ ). Because these numbers refer to both school and non-school days, this does not reflect summer holiday free time.

Perhaps, ironically, it is related to televised night-time sport. Screen time is lowest in autumn (193 min). Table 5.7 shows seasonal patterns in children's time budgets.

**Table 5.7 The median number of minutes devoted to various components of children's time budgets according to season. Also shown is the overall average EE (PAL, in METs)**

	autumn	winter	spring	summer
sleep	585	580	570	595
screen	193	205	210	223
sport	40	30	35	45
play/locomotion	40	30	35	48
PAL	1.70	1.79	1.69	1.69

## 5.7 Which sports are the most popular?

**Summary:** Soccer is the most popular sport of children in this age group, followed by basketball, Australian football, cricket and netball. Together, these sports account for about two-thirds of all the time and energy children spend playing sport. The sports most dominated by boys are Australian football, cricket and soccer, while netball, gymnastics and dance are dominated by girls.

Determining which sports are the most commonly played is not entirely straightforward. The amount a sport is played can be quantified as the number of minutes devoted to it, the percentage of total energy expenditure derived from playing it, the percentage of children who report playing it, or the number of bouts of play. In this analysis we use the total number of minutes committed to each sport as the yardstick of the amount it is played.

Table 5.8 shows the total reported minutes of activity and total energy expenditure (EE, MET.min) for each sport children reported playing. It also shows these values as a percentage of the total number of minutes, and as a percentage of the total energy expenditure, associated with all sports participation. The top five sports – soccer, basketball, Australian football, cricket and netball – account for about two-thirds of all the time and all the energy expenditure associated with sport. On average, children reported 1.2 bouts of sport each day, lasting an average of 44 minutes in total.

Traditional sports continue to dominate. Data on the frequency of individual sports are available from Pyke's 1985 national survey, and Dollman's 1997 South Australian survey (Norton, Dollman, Klanarong, & Robertson, 2001). The popularity of soccer continues to rise. Basketball, which gained popularity between the mid-1980s and mid-1990s, is still popular with both boys and girls. Sports which appear to have increased in popularity since surveys in 1997 are dance, aerobics (mainly due to the introduction of 'health hustles' in schools) and martial arts. 'Extreme' sports (like rock climbing), 'slide' sports (like surfing), and 'take-away' sports (like beach volleyball) are making very little impact in this age group. Note, however, that skateboarding and the like have been classified under 'locomotion', and that the survey was conducted in school time, not during mid-summer. Nevertheless, the total time spent riding scooters, skateboards, inline skates and roller skates amounts to less than that spent playing table tennis. If bicycling was counted as a sport, it would come in fourth, behind Australian football.

**Table 5.8 All sports mentioned by children listed in order of the number of minutes of total participation. The table also shows the estimated energy expenditure (EE, MET.min) for each sport, and the time and energy expenditure expressed as a percentage of total sport time and total sport energy expenditure. The 'av. METs' column shows the average estimated rate of energy expenditure for each sport, while the 'session' column shows the average reported session duration in minutes.**

<b>sport</b>	<b>min</b>	<b>EE</b>	<b>av. METs</b>	<b>% of min</b>	<b>% of EE</b>	<b>session</b>
soccer	94495	696930	7.4	21.2	22.6	40.6
basketball	68105	403700	5.9	15.3	13.1	39.3
Australian football	49860	521620	10.5	11.2	16.9	41.2
cricket	38130	175480	4.6	8.6	5.7	54.4
netball	28630	229810	8.0	6.4	7.5	48.5
tennis	19660	152540	7.8	4.4	5.0	53.6
table tennis	15700	57555	3.7	3.5	1.9	41.9
aerobics/health hustle	13070	89760	6.9	2.9	2.9	34.5
swimming laps	11495	113825	7.9	2.6	3.7	35.5
tap dancing/ballet	10035	45483	4.5	2.3	1.5	52.5
martial arts	9090	94380	10.4	2.0	3.1	72.1
hockey	8285	74950	9.0	1.9	2.4	48.5
softball/T-ball	8205	48500	5.9	1.8	1.6	43.0
gymnastics	6400	33975	5.3	1.4	1.1	56.1
pool/snooker etc.	5750	14375	2.5	1.3	0.5	55.8
golf	5175	18248	3.5	1.2	0.6	72.9
horseback riding	4810	20058	4.2	1.1	0.7	98.2
volleyball (court)	4680	17115	3.7	1.1	0.6	41.4
badminton	4370	19820	4.5	1.0	0.6	57.5
rugby league	4100	41620	10.2	0.9	1.4	35.7
darts	3735	9338	2.5	0.8	0.3	45.5
baseball	3570	23690	6.6	0.8	0.8	48.9
rugby union	3195	33820	10.6	0.7	1.1	34.0
athletics: throwing	3070	11510	3.7	0.7	0.4	36.5
touch football	2655	20990	7.9	0.6	0.7	49.2
tenpin bowling	2305	6915	3.0	0.5	0.2	92.2
lacrosse	2115	18050	8.5	0.5	0.6	54.2
surfing	2055	8585	4.2	0.5	0.3	89.3
lifting weights	1810	8865	4.9	0.4	0.3	39.3
athletics: jumping	1720	8530	5.0	0.4	0.3	38.2
race walking	1670	10225	6.1	0.4	0.3	26.9
squash	1240	12710	10.3	0.3	0.4	51.7
athletics: hurdles	1175	11860	10.1	0.3	0.4	34.6
water skiing	955	5730	6.0	0.2	0.2	136.4
sailing/boating	835	2715	3.3	0.2	0.1	92.8
volleyball (beach)	720	4905	6.8	0.2	0.2	36.0
canoeing/rowing	690	4830	7.0	0.2	0.2	115.0
archery	565	1978	3.5	0.1	0.1	56.5
ice hockey	275	2750	10.0	0.1	0.1	68.8
lawn bowls	220	660	3.0	0.0	0.0	36.7
curling	170	680	4.0	0.0	0.0	85.0

There are clear gender differences in the most popular sports. Australian football has almost no female participants, while netball is practised by almost no boys. Sports which are popular with both boys and girls include soccer, basketball, tennis and table tennis. Table 5.9 shows the ten most popular sports for boys and girls, and the percentage they contribute to the total time each gender commits to sport. For boys, soccer, Australian football, basketball and cricket account for over two-thirds of all time devoted to sport. Girls' sporting preferences are more distributed: the top four (netball, basketball, soccer and tennis) make up only 50% of all sports time.

**Table 5.9 The ten most popular sports for boys and girls, and the percentage they contribute to the total time each gender devotes to sport**

ranking	boys		girls	
	sport	% of time	sport	% of time
1	soccer	26.0	netball	21.2
2	Aust. football	16.0	basketball	15.3
3	basketball	15.6	soccer	13.0
4	cricket	10.9	tennis	5.4
5	tennis	3.8	ærobics	4.9
6	table tennis	3.4	dancing	4.7
7	martial arts	2.3	cricket	4.6
8	swimming	1.9	table tennis	3.8
9	hockey	1.8	swimming	3.7
10	ærobics	1.8	gymnastics	3.1

### 5.7.1 Participation characteristics of the most popular sports

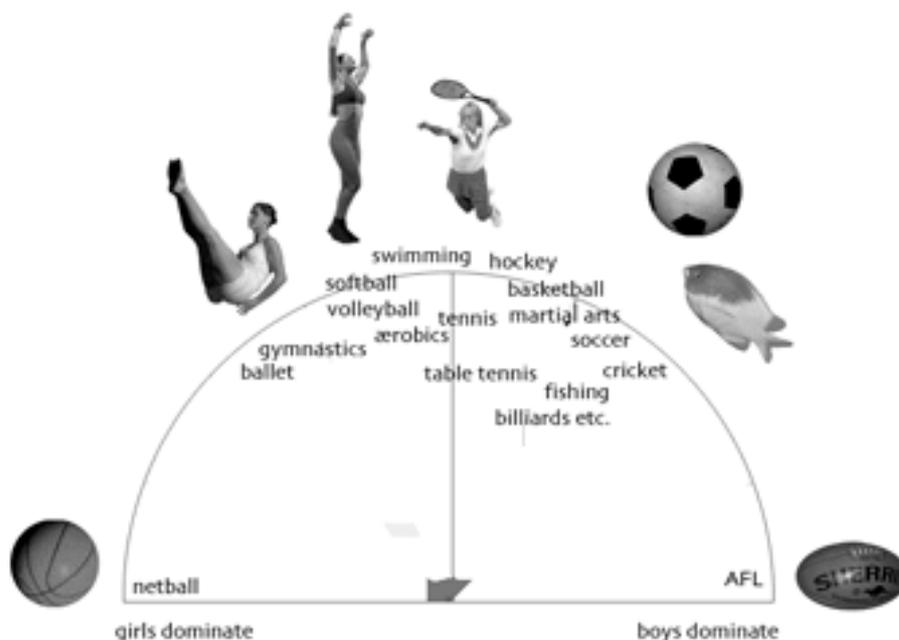
Table 5.10 shows the percentage of profiles which report participation in the ten most popular sports, broken down by gender, day type (school/non-school) and age. The most popular sports (soccer, basketball, Australian football, cricket and netball for girls) are each practised by about 10-25% of children each day. However, even the sixth most popular sport, tennis, is reported in <5% of profiles. Table 5.10 indicates that some sports are dominated by boys, and others by girls (see Figure 5.5).

**Table 5.10** Percentage of profiles which report participation in the ten most popular sports, broken down by gender, day type (school/non-school), and age

sport	gender		day type		age				
	boys	girls	school	non-school	<11	11	12	13	>13
soccer	25.8	10.1	21.1	10.1	26.2	20.5	18.2	14.7	9.6
basketball	16.9	12.4	16.7	9.7	18.7	16.4	14.5	13.2	7.5
Aust. football	16.5	2.5	10.5	6.8	11.9	8.7	8.8	9.4	11.6
cricket	9.6	3.2	6.5	6.1	6.4	8.0	6.7	4.7	1.8
netball	0.9	10.0	6.7	2.6	10.5	5.4	4.7	5.0	5.6
tennis	3.8	3.2	3.0	4.7	1.4	4.5	3.7	2.5	2.6
table tennis	4.2	2.6	3.2	3.8	2.7	3.3	2.9	3.3	5.7
aerobics	3.7	4.9	5.8	0.8	16.8	4.5	2.7	2.5	2.4
swimming	1.6	2.0	1.8	1.8	3.8	2.0	1.8	0.6	1.2
dancing	0.7	3.0	2.0	1.6	4.1	2.2	1.6	1.4	1.1

### 5.7.1.1 Gender ratios

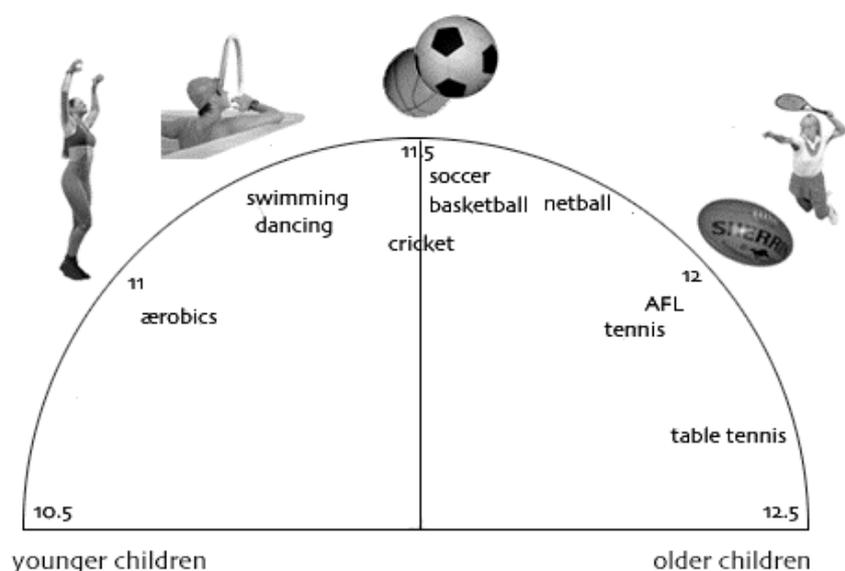
Figure 5.5 shows the gender ratio (the ratio of the average number of minutes played by boys to the average number of minutes played by girls) for the most common sports. The most ‘masculinised’ sports are Australian football (ratio = 9.4), cricket (4.0) and soccer (3.4), while netball (>10), gymnastics (3.3) and ballet (3.3) are heavily feminised. In table tennis, tennis, swimming and softball, boys and girls participate equally.



**Figure 5.5** Sex ratio (the ratio of the average number of minutes played by boys to the average number of minutes played by girls) for some of the most common sports. Sports appearing towards the right of the graph tend to be played by boys, while those towards the left of the graph tend to be played by girls. Sports close to the middle vertical involve boys and girls evenly.

### 5.7.1.2 Age profiles

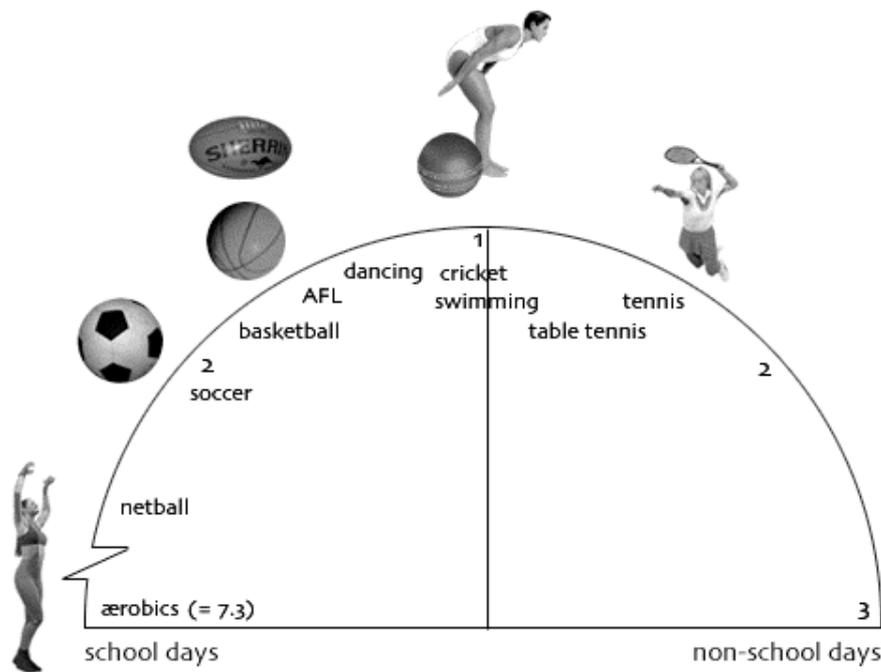
Table 5.10 shows that there is generally a decline in sport participation with age, particularly as children move from primary to secondary school (i.e. at age >13). The smaller sample sizes among the ‘fringe’ age groups will not bias these estimates. Different sports are also popular with different age groups. The average age of participants in different sports has been calculated using the average of participants in each age band, without sample weighting. The ‘youngest’ sport was aerobics (mean age = 10.9 years). Swimming and dancing (11.3) were also favourites of younger children. The ‘oldest’ sport was table tennis (12.3 years). Tennis and Australian football (12.0 years) were at the upper end of the age scale. Figure 5.6 shows age differences for the ten most popular sports. Many of the ‘younger’ sports (swimming, dancing, aerobics) are also dominated by girls, perhaps reflecting the rapid age-related drop-out of girls from sport.



**Figure 5.6** Age profile of the ten most popular sports. The average age of participants has been calculated using unweighted age bands. The sports on the left of the figure are those which attract younger children (< 11.5 years), while those on the right hand side are those which tend to attract older children (>11.5 years).

### 5.7.1.3 School vs non-school days

In general, more sport is played on school days than on non-school days. However, some sports tend to be predominantly played on school days, and others on non-school days. We calculated a ‘day ratio’, which is the ratio of profiles involving a particular sport on school and non-school days. The data for the top ten sports are shown in Figure 5.7. By far the most school-dominated sport is aerobics, which is 7.3 times more likely to be performed on school days. Netball (2.6) and soccer (2.1) also tend to be played on school days. On the other hand, tennis (1.6) and dancing (1.3) are predominantly non-school day activities. Once again, it must be remembered that most non-school day profiles recorded a Sunday during school term, so that Saturdays and holidays were under-represented.



**Figure 5.7** Profiles of the ten most popular sports according to the type of day when they are most practised. The sports on the left of the figure are those which are mainly practised on school days, while those on the right hand side are those which tend to be practised on non-school days. The figures indicate the 'day ratio' – a figure of 2 on the left, for example, indicates that the sport is played twice as often on school days as on non-school days.

## 5.8 What kind of children play sport?

**Summary:** Boys without siblings have lower sport participation than boys with siblings. The trend in girls is somewhat weaker. Socio-economic status, place of residence (metropolitan vs non-metropolitan), and school sector are not related to sport participation.

While our cluster analysis has identified a typical sporting 'activity profile' in children, it is worthwhile also to consider what socio-demographic characteristics are associated with sports participation. In this section we consider the importance of family structures (single parent vs two-parent families; number of siblings; birth order), socio-economic status and geographical area.

### 5.8.1 Family structure

Children were asked to indicate who they lived with at home: just Mum or just Dad, or two parents, and whether they lived with siblings. They were then categorised into four groups:

- (1) two-parent families with siblings (2S) – 69% of all profiles
- (2) two-parent families without siblings (2O) – 7% of all profiles
- (3) single parent families with siblings (1S) – 19% of all profiles
- (4) single parent families without siblings (1O) – 5% of all profiles

In this sample, the number of children from single parent families was slightly greater (24%) than the national average for parents with dependent children (20%). Sports participation between the groups was then statistically compared between boys and girls using the Kruskal-Wallis test.

There were significant differences in the average amount of sport participation between the groups for boys ( $p = 0.008$ ), but not for girls. Boys from 2S families had the highest participation (a median of 50 min per day), followed by boys from 1S families (45 min), and then boys from 2O and 1O families (30 min). This pattern suggests that the presence of siblings is important for sports participation among boys. When boys with siblings were compared with boys without siblings, the boys with siblings had significantly higher levels of sports participation ( $p = 0.002$ ; median for boys with sibs = 50 min, median for boys without siblings = 30 min). There was no similar pattern for girls.

When we looked more closely at contrasting activity patterns across different family structures, we found that overall activity levels (PALs) were about 7% lower for boys from 1O families (mean = 1.71) than for boys from 2S, 1S or 2O families (1.83-1.88;  $p = 0.04$ ). Girls from 1O families were also slightly (but not significantly) less active (1.65 vs 1.68-1.70). One factor which might explain these differences in overall activity levels were differing amounts of screen time. Boys and girls from 1O families had 23-29% more screen time than boys and girls from 2S families. Boys and girls from 1S families also had 13-23% more screen time. This shows that children from single parent families were more likely to spend time in front of a screen, perhaps because there were often no parents to supervise them doing other activities. There were no differences in screen time for boys and girls from 2S and 2O families.

One interpretation of these patterns is that in single parent (1O and 1S) families, screens are more likely to act as ‘baby-sitters’, while in only child (1O and 2O) families the absence of siblings means a child is less likely to be ‘dragged’ into sport. Parents may feel it is more ‘worth their while’ to take two children to sport (e.g. swimming lessons) rather than one. Older children may be able to look after younger children as they play sport, or initiate younger children into sport. Children from 1O families may therefore be likely to spend more time in front of the screen, and less time playing sport. An extreme case is girls from 1O families on non-school days, who spend only 13 minutes each day participating in sport.

These conclusions were supported by the results of the psychosocial questionnaire (Section 5.10). Children from 1O or 1S families also reported playing with their families less ( $p = 0.048$ ; 47% of 1O and 1S children reported playing ‘rarely’ or ‘never’, compared to 36% from 2O or 2S families). Children from 1O families were less likely to prefer ‘active’ as opposed to ‘quiet’ or ‘mixed’ play ( $p = 0.03$ ), and children from 1S and 2S families were more likely to consider physical activity fun than children without siblings ( $p = 0.017$ ).

### **5.8.2 Birth order**

Children were divided according to their birth order: eldest child, middle child, youngest child or only child. Boys and girls were then compared according to their level of sport participation, using the Kruskal-Wallis test. With boys, there were significant differences ( $p < 0.0001$ ). Middle children and youngest children experienced a median of 60 min sport each day, slightly ahead of eldest children (55 min). This does not reflect an age difference, as the average age of eldest, middle and youngest children was the same in this sample. However, only children without siblings experienced a median of only 35 min per day of sport. The pattern with girls was similar but weaker ( $p = 0.053$ ). Eldest girls experienced 25 min a day, youngest girls 20 min, and middle girls 10 min, while the median for girls who were only children was 0 min. This pattern confirms the data from the family structure analysis: the presence of siblings increases the amount of sport being played.

This is an important finding, because the size of families is decreasing fairly rapidly – from about 4.5 in 1911 to close to 2.5 today (Australian Bureau of Statistics, 2001). In Australia as in many developed countries, the number of children per woman is falling. It was over three in the 1960s, while today it is barely 1.7. There are a number of reasons why siblings might be associated with greater levels of sport. Children may of course play with their siblings. Parents with more than one child may be more inclined to take all their children to organised sport – for example, it may seem more ‘worth one’s while’ to a parent to take all the children along to, say, martial arts classes. Older children may also be able to oversee younger children as they play sport. A larger number of children extends families’ social networks, facilitating integration into organised sport.

### **5.8.3 Socio-economic status**

Sport participation is not associated with socio-economic status, as quantified by SEIFA or the School Card Register (SCR – the percentage of children within each school receiving government assistance with school fees, which correlates strongly with SEIFA). This is in spite of the fact that screen time decreases as SES increases (by about 6-12 min for each SD of SEIFA) (cf. Dollman, Olds & Norton, 2000), and PAL tends to increase as SES increases.

However, attitudinal differences towards sport and play became apparent when analysing the results of the psychosocial questionnaire (Section 5.10). Table 5.11 summarises these results. Kids from high-SCR (i.e. low SES) families are more likely not to see physical activity as fun, prefer quiet play and screen time to active play, and prefer to play alone rather than with companions. In addition, there are SCR gradients related to the reported number of sports played ( $r = 0.10$ ,  $p < 0.0001$ ). The reported number of sports played declines by about 0.15 with every 10% increase in SCR. Finally, children from high-SCR families are less likely to report that their Dad plays sports, often because they do not live with their Dad. It should be noted that these data are somewhat confounded by distinct SCR associations with family type: the mean SCR of 1O families is 38.3, as compared to 37.3 for 1S families, 35.7 for 2O families, and 30.9 for 2S families.

**Table 5.11 Mean School Card Register (SCR) values for children with various responses to questions regarding their attitude towards active play, preferred play mode, preferred type of play, and preferred companions.**  
**Note that the higher the SCR, the lower the SES.**

active play is ... (p < 0.0001)		preferred play mode (p < 0.0001)		preferred type of play (P < 0.0001)		companions (p = 0.006)	
response	SCR	response	SCR	response	SCR	response	SCR
no fun	44.6	TV/video game	36.9	quiet	42.4	self	38.6
OK	33.5	quiet play	34.1	mix	31.3	family	33.3
fun	31.6	sport	32.4	active	32.0	few friends	31.0
		play	30.0			lots of friends	32.6

#### 5.8.4 Metropolitan vs non-metropolitan children

Place of residence (metropolitan vs non-metropolitan) had no effect on sport participation. Children from non-metropolitan areas had slightly higher median daily sport participation (55 min for boys and 10 min for girls) than children from metropolitan areas (50 min and 0 min respectively), but the difference was not statistically significant.

#### 5.8.5 School sector

School sector (government, independent, Catholic) was unrelated to sports participation. Similarly, there were no differences in energy expenditure according to school sector. There were, however, distinct differences between school sectors in screen time for both boys and girls (p < 0.0001), with independent school children experiencing lower screen time (215 min for boys and 152 min for girls) than children from other school sectors (250-263 min for boys and 179-199 min for girls). This reflects differences in SES.

### 5.9 The effects of increases in sports participation

**Summary:** Increasing the amount of sport participation from the current average to the current 75th percentile would increase daily energy expenditure by 10-22%.

The effects of changes in children's activity patterns on energy expenditure can be modelled if we know how much time and energy children currently devote to various components of the time budget, and likely shifts in other components as one component increases or decreases. Using the data provided in Section 5.5 – 'What competes for time with sport?' – we can estimate where extra time would be taken from if participation in sport were to increase. From there, we can calculate how this would impact on energy expenditure. In this section, we model the effect of increasing sport participation from the current 50th percentile levels (0-60 min.d<sup>-1</sup>) to the current 75th percentile (45-112 minutes per day).

**Table 5.12** Effect on mean baseline PAL (METs, or multiples of 3.5 ml O<sub>2</sub>.kg<sup>-1</sup> body weight.min<sup>-1</sup>) of a putative increase in sport participation from the current 50th percentile level to the current 75th percentile levels for boys and girls on school and non-school days. The table shows the new mean PAL and the percentage increase over baseline.

	boys		girls	
	school day	non-school day	school day	non-school day
baseline PAL	1.84	1.76	1.73	1.62
new PAL	2.03	2.15	1.90	1.80
% increase	10	22	10	11

Table 5.12 shows the putative effect of such increases on boys and girls on school and non-school days. The average daily rate of energy expenditure is measured as physical activity level (PAL), for which the units are METs. An increase in sport participation from the current 50th percentile to the current 75th percentile would increase mean PAL values by 11-22%. The biggest increase (22%) would be for boys on non-school days, largely because the distribution of sport participation is very skewed: 50th percentile values are very low (25 min) and 75th percentile values are very high (112 min). The new estimated PALs would be equivalent to the current 70-80th percentile values.

The effects are therefore very large. Using the model of Westerterp (1995), these changes in energy expenditure, uncompensated by changes in energy intake, would equate to relative reductions of about 6 kg in body mass per year. Whether it is logistically possible to increase sport participation to this extent is problematical. However, by definition one quarter of children manage to maintain sport participation at the 75th percentile level, so it is clearly feasible at the moment for some families.

## 5.10 Psychosocial barriers and facilitators

**Summary:** The main barriers children see to participation in sport are lack of time and logistical issues such as transport. Few children express a general lack of interest in sport. Improving logistics would, in their view, enhance participation in sport, as would greater peer participation. When asked which sports they would like to do, which they were not currently doing, the most popular choice was surfing. Other ‘take-away’ sports also rated highly. Children felt that they made up their own minds about participation, but that family members had an influence. There were distinct age- and gender-related differences in preferred play modes.

For this section, data have been based on a questionnaire on sports participation completed by a subset of 399 children (171 boys and 228 girls) who also completed the MARCA. They were slightly older ( $13.2 \pm 1.0$  years) than the larger group ( $12.6 \pm 1.2$  years), but were of similar SES (SEIFA =  $990 \pm 92$ ).

### 5.10.1 What do children consider to be the barriers to participation?

Children were asked to indicate what they perceived to be barriers to sports participation. They could choose multiple responses from an extensive list, or enter their own concerns. Of the 399 children, 256 (64%) identified at least one barrier. Children listed a total of 595 barriers. Table 5.13 shows the most common choices, expressed as a percentage of all choices.

Perceived lack of time emerged as the major barrier. Interestingly, however, those who indicated that time was a barrier had just as much screen time (median = 200 min) as those who indicated time was not a barrier (193 min), and played the same amount of sport (median = 30 min). Lack of time, too much homework and part-time jobs accounted for over 40% of all the responses. Logistical difficulties (transport, cost, injury, lack of parental support, no coach) accounted for 32% of responses. General lack of interest in or suitability for sport (not into sport, too embarrassed, too competitive, unfit) accounted for 12.5% of all responses, and lack of peer group involvement accounted for a further 11%.

**Table 5.13 Responses of children regarding perceived barriers to sport participation**

barrier	no. of responses	% of responses
no time	133	22.0
too much homework	93	15.4
friends not involved	69	11.4
transport	68	11.2
too expensive	45	7.4
health or injury problems	41	6.8
not into sport	35	5.8
parents not supportive	20	3.3
no coach	19	3.1
part-time job	19	3.1
unfit	15	2.5
too embarrassed	15	2.5
too competitive	10	1.7
other	23	3.8

These results support the idea that in this age group, interventions to increase sport participation should be largely permissive. It is not that children in general don't want to play sport. They do, however, need to be provided with the means and the encouragement, including time, infrastructure and peer group involvement. Interestingly, the more active children were, the more likely they were to perceive barriers to participation. Kids who were not involved tended not to see barriers, while older children were more likely to see barriers ( $p < 0.0001$ ; this is perhaps a function of maturity and reflection, and perhaps reflects their greater involvement in sports).

Responses to the ‘barriers’ and ‘facilitators’ questions may reflect the ‘salience’ of life-importance of sport, rather than real difficulties or desires. Where children play a lot of sport, and sport is seen as a priority in their lives, children tend to see more barriers than facilitators. They don’t see a need to promote it, but do see frustrating impediments. Adults would probably respond in a similar way to items of specific personal interest: people who take public transport to work are likely to be more vocal about the need for better bus and train services than people who drive their cars.

### 5.10.2 What do children think would make them more physically active?

Children were asked to indicate what they thought would help to make them more physically active. They could choose multiple responses from an extensive list, or enter their own suggestions. There were 692 responses (children could select multiple responses), which are ranked in order of frequency in Table 5.14. Being able to play with friends ranked first (20% of responses). Various logistical factors (cost, availability of coaches, transport, facilities) totalled 43% of all responses. These perceived facilitators mirrored the perceived barriers. Suggestions of planned activities in recess and lunch or after school were not enthusiastically welcomed (11%). Children also showed little interest in reducing competitiveness (5%) or increasing family involvement (4%). Unlike barriers, children who were more active were less likely to nominate facilitators of involvement – presumably because they are already involved.

**Table 5.14 Responses of children regarding perceived facilitators of sport participation**

facilitator	no. of responses	% of responses
play with friends	136	19.7
lower cost or free	102	14.7
better transport	79	11.4
greater variety	71	10.3
better facilities	62	9.0
more information	55	7.9
activities at lunch/recess	45	6.5
after school activities	39	5.6
less competitive	34	4.9
if family did it with me	31	4.5
other	25	3.6

### 5.10.3 What sports would children like to play?

Children were asked to list the sports which they would like to play, but currently were not playing. The results are shown in Table 5.15.

The results are somewhat surprising. The sports which are commonly practised – soccer, basketball, Australian football, cricket and netball – rate reasonably well (26% of all responses), as would be expected. Surfing easily ranks top, dancing third, and cycling fifth (a total of 23% of all responses), indicating a clear preference for sports other than ‘traditional’ organised sports. Riding scooters, skateboards and rollerblades together make up another 9% of responses.

**Table 5.15 Children’s indications of sports and activities they would like to be involved in, but are not currently doing**

<b>sport</b>	<b>no. of responses</b>	<b>% of responses</b>
surfing	125	10.9
soccer	94	8.2
dancing	76	6.6
basketball	75	6.5
cycling	67	5.8
Australian football	62	5.4
swimming	58	5.1
gymnastics	54	4.7
tennis	52	4.5
baseball/softball	50	4.4
skateboard	48	4.2
jogging/running	43	3.7
rollerblading	41	3.6
table tennis	39	3.4
trampoline	37	3.2
cricket	32	2.8
netball	31	2.7
aerobics	24	2.1
walking	23	2.0
PE classes	22	1.9
playground games	22	1.9
playing with pets	18	1.6
callisthenics	15	1.3
scooter	10	0.9
other	29	2.5

#### **5.10.4 Who do children consider influence activity patterns?**

Children were asked to indicate who had the greatest influence on their decisions regarding participation in sport and physical activity. Table 5.16 shows the results. Over one-third (38%) of children indicated that they made up their own minds. The only other major figures were adult family members (30%) and friends (19%). Siblings, sportspeople and others (such as coaches) were rarely mentioned.

**Table 5.16 Children’s responses to the question asking about who has the greatest influence on their physical activity decisions**

	<b>no. of responses</b>	<b>% of responses</b>
myself	149	38.2
adult family	118	30.3
friends	72	18.5
brothers and sisters	23	5.9
sportspeople	17	4.4
other	11	2.8

There were distinct age gradients in perceived influences ( $p < 0.0001$ ): the average age of those designating the coach as a source of influence was 11.2 years; for athletes it was 11.4; for friends 11.9 years; for parents 12.0 years, and for non-one (i.e. the child themselves) 12.2 years. This suggests that strategies such as sending well-known coaches and athletes to schools might work best with younger children. As children grow older, the ‘locus of perceived influence’ retracts to the circle of friends, family and the self.

It was also possible to correlate the children’s reports of parental sports involvement with their own. Kids who reported that their Dads were involved in sport also reported playing more sports themselves (2.11 for families where Dad was involved vs 1.09 for others;  $p < 0.0001$ ). They also report more sessions of play (6.4 vs 3.3 per week;  $p < 0.0001$ ). There were no associations between reports of Mum’s involvement and self-reported sporting activity.

### 5.10.5 What kind of activities do children prefer?

There were distinct age gradients in the nature and context of children’s self-reported play and sport preferences. Older children were more likely to prefer active play (average age for preference for TV/video games = 9.9 years vs preference for play/sport = 10.6 years;  $p < 0.0001$ ). Older children prefer less active adult involvement, and prefer to play with larger groups of friends as opposed to playing alone or with the family ( $p < 0.0001$ ). Older children report playing with their families less often than younger children ( $p < 0.0001$ ; Table 5.17). This is likely to be due to the natural drift towards independence and identity-construction that accompanies adolescence.

**Table 5.17** Average age of children reporting that they play with their families every day, nearly every day, 2-3 times per week, rarely or never

frequency of reported play with family	average age
every day	11.41
nearly every day	11.82
2-3 times per week	11.87
rarely	11.94
never	12.13

As expected, there were also differences by gender. Girls preferred ‘quiet’ play much more than boys (19% vs 6%), and also preferred ‘play’ (43% vs 29%) to ‘sport’ (19% vs 25%). However, girls were much less likely to opt for TV/video games in their spare time (13% vs 36%). Girls were less likely to play actively with their families than boys (rarely or never – girls 43%, boys 36%; every day – girls 9%, boys 21%). All differences were significant at the  $p < 0.0001$  level. Girls were also more likely to prefer to play with small groups of friends (52%) than boys were (42%;  $p = 0.002$ ). Girls were more likely to see any barriers than boys (27% vs 18%) and less likely to see facilitators (41% vs 58%). Finally, girls were less likely to be influenced by athletes or coaches (3% vs 13%;  $p = 0.002$ ).

Summarising these age- and gender-related differences in activity preferences, we can say that older children prefer more active play and sport, prefer the company of their friends to that of their parents (no surprises there), and make their own decisions. Girls are simply less interested in sport: they tend to prefer quiet play with a small group of friends.

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## Discussion and recommendations

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## 6.1 The context

Increases in adiposity and decreases in aerobic fitness have been consistently reported in Australia and throughout the developed world. Lifestyle factors, such as diet and physical activity behaviours, would appear to be at the core of these phenomena. Among Australian children there is evidence of declining participation in organised sport (Norton et al., 2002) and fewer who regularly walk or ride to school (Harten & Olds, 2004). More time is spent watching television than ever before (ABS 2001b) and viewing time is concentrated in the hours between school and the evening meal (Nielsen 2000), when the opportunities to be physically active are otherwise at an optimum (Sallis et al, 2002; Terre, Ghiselli & Taloney 1992). It is likely that environmental barriers, such as safety of unsupervised play and access to neighbourhood play space, conspire to restrict children's play range beyond the home.

Calls for action to address issues of falling physical activity levels and rising overweight were heard as far back as the early 1970s. One of the earliest Australian reports on the growing problem of overweight children was in 1973. In a Commonwealth report on sport and recreation in Australia, it was stated:

There is no doubt that Australians are facing unprecedented physical problems as a result of this physical inactivity. The number of very obese people, often quite young, whom one sees in Australia, is an indication in itself of the poor state of the nation's health. – Bloomfield (1973)

In an editorial in *The Lancet* in 1974 a warning was made in relation to overweight 'in affluent countries of the world'. The article stated that 'on balance the evidence suggests that we need to be more vigilant in preventing obesity throughout childhood.' Since these recommendations almost 30 years ago there have been numerous inquiries at state, national and international level in relation to the problems of overweight and obesity. Table 6.1 summarises the conclusions from key Australian inquiries of recent times. These reports resonate with calls for improved lifestyle behaviours, and yet the problem has grown unabated. For example, consistent recommendations have been made for school-based physical education, adequate community facilities and play spaces, safe walkways, reduced sedentary behaviours, and less advertising of fast food and high sugar foods during children's television time.

**Table 6.1 Summary of recent government reports on obesity trends among Australians**

Report	Major findings
South Australian Ministerial Report – Physical Fitness in the Community (1978). South Australian Department of Tourism, Recreation and Sport.	We recommend that the Government accepts these assertions (that regular physical activity is required to achieve and maintain physical fitness and reduce the risk of heart disease) and adopts a policy of encouragement of physical fitness throughout the community.
South Australian Minister of Recreation and Sport – Fitness Green Paper, Policies and Recommendations (1982).	It is recommended that the Government adopt an overall policy of fitness promotion and that this policy is recognised and supported by all government departments.  ...recommended that the Recreation and Sport Division, the Education Department and the S.A. Health Commission plan together to formulate a consolidated approach to fitness promotion and the provision of programs and activities for adolescents of school leaving age.
Senator Crowley Report – Report on Physical and Sport Education (1992). Senate Standing Committee on Environment, Recreation and the Arts.	The inquiry resulted in physical education being put back on the national curriculum as a core learning area with recommendations for 100 minutes of activity each week (Crowley, 1992).  A later survey in South Australia (Brown, Lewis, Murtagh, Thorpe, & Collins, 2000) showed less than half of all schools were actually delivering this level of physical activity in primary schools and only about one third in secondary schools.
National Health and Medical Research Council – Release of ‘Acting on Australia’s Weight’ (1997).	Recommendation 3.1: Incorporate daily physical activity into schools programs.
Shaping Up – A Review of Commonwealth Involvement in Sport and Recreation in Australia (1999). Commonwealth Department of Industry, Science and Resources.	The task force is concerned that such an important and vital aspect of life learning skills (school sport and teaching children physical skills) and the development of healthy habits which will serve children into adult years, is no longer being given the same emphasis in the school curriculum.

The area of overweight and obesity (and the impact of activity/inactivity) is under-represented in health care policy. In part this is because the extent of the problem is relatively new and policy makers have only recently stopped asking ‘is there a problem?’ and are now asking ‘is there a solution?’ As the NSW obesity summit recently concluded: ‘this is not a problem with a single cause or an easy fix or a single solution’ (NSW Childhood Obesity Summit Communiqué 2002, p.2). However, we are all part of both the causes and consequences of the overweight problem. This is encapsulated by Battle and Bronwell (1996) who wrote of North American society: ‘it is hard to envision an environment more effective than ours for producing obesity’.

## **6.2 Intervention strategies**

### **6.2.1 Winding the clock forward**

How can health promotion respond to this epidemic? Why have previous attempts failed? Before 1970, Australian children were lean and fit; now they are fat and unfit. It is naturally tempting to try to wind the clock back, to try to recreate the social, economic and demographic circumstances of Australia in the late 1960s. This is not a viable approach. It is not possible to recreate the environmental conditions characteristic of the pre-1970s, when playing and riding bicycles in urban parks and streets were commonplace, and at least one parent was likely to be free during daylight hours to supervise or share free play.

Fertility rates are falling, leading to a lower ‘critical mass’ of children. Cities are becoming increasingly suburbanised, increasing reliance on automobiles. Technological advances in telecommunications and automation are reducing the energy required for daily living. Greater job, marriage and home turnover are fragmenting communities. Competition policy and economic deregulation are changing consumer behaviour. Changing work patterns have led to chronic under- or over-employment, and in particular to a rapid increase in the number of working mothers. All of these large-scale economic, social and demographic changes are impacting on children’s physical activity – and we are not going to reverse them.

Rather we must think in terms of winding the clock forward: how can physical activity be maximised in the new world which is being created, a world in which both parents work, shops and schools are too far away to walk to, everyday life is automated, physical activity and sport are subject to the laws of the market, and communities are transient?

#### *6.2.1.1 Play in the school of the future*

Play space is often restricted in schools, particularly in inner cities. This trend is likely to continue as more independent schools are set up in city areas, close to where professional parents work. There will also be pressure on government schools to sell off play spaces as ‘small government’ reduces funding to schools. This can seriously reduce the types of games that children can play, and the number of children who can confidently and safely participate. The density of the play population can be reduced to a manageable level by ‘staggering’ recess and lunch breaks, to separate the older and younger children. Simple, relatively inexpensive improvements to play space, such as line markings and basketball hoops, stimulate active play, at least in younger children. The presence of adult supervision in the playground increases the proportion of children engaged in active play. However, it is unlikely that schools will be able to afford extra teachers for these tasks, or to recruit from a diminishing pool of volunteer parents. Efforts could be made to recruit retired people, particularly as retirement age diminishes, but also to systematically use students training in PE or human movement courses through agreements regarding clinical placements.

### 6.2.1.2 *Increasing school-based PE*

Given current and likely future work patterns for families (increasing numbers of single-parent families and families where both parents work; increasing casualisation with less flexibility about working hours; 'labour on demand' in a range of service industries), school would appear to offer the best option for increasing children's physical activity.

One of the main reasons offered for declining levels of physical activity is the squeezing of PE from the school curriculum, largely by the pressure of parents concerned about the academic advancement of their children. It appears logical that increased amounts of PE will reduce the amount of time devoted to 'vocational' subjects such as IT and basic skills.

The evidence, however, paints quite a different picture. Cross-sectional and quasi-experimental studies provide strong evidence that physical activity will enhance cognitive function, including IQ and academic ability. Significant correlations have consistently been reported between academic performance and time spent in physical activity or its surrogates. However, these correlations are substantially attenuated when allowance is made for confounding factors such as SES. Other studies have compared groups with standard and enhanced school-based PE, with consistent findings that the enhanced PE groups perform as well if not better than groups with standard PE.

There have been a number of intervention studies where increased amounts of PE have displaced time devoted to traditional academic activities. In Vanves, France, in 1950, children in the treatment group (8 h PE per week, vitamin supplements, naps) performed better than controls in a study which has been described as 'almost legendary'. In 1954, Rogers and Palmer (1954) introduced enhanced PE at Nathaniel Hawthorne Junior High School, in Yonkers, New York. Improvement in the Physical Fitness Index was significantly correlated with academic performance (Clarke & Harrison, 1955). The Trois-Rivières study in Canada in the mid-1970s (Shephard, et al., 1980) found that the enhanced PE group performed significantly better at school work than the control group. In South Australia, the SHAPE program in 1978 found no evidence of decline in academic performance despite the loss of 45-60 min per day of formal academic teaching (Dwyer, et al., 1983; Dwyer, 1996). In the US, the SPARK program (Sallis, et al., 1999) found no declines in academic performance despite increased PE time (65-80 vs 38 min per week).

While all of these intervention studies had methodological flaws, the overall picture which emerged is quite persuasive: larger amounts of in-school physical activity do not impede, and probably enhance, academic performance. The mechanisms are unclear. They may be psychological (e.g. relief from boredom), physiological (e.g. increased cerebral blood flow), or functional (e.g. reduced absenteeism from illness).

Whatever the mechanisms, the evidence is sufficiently persuasive for a controlled study to be mounted in a series of trial schools, which avoids some of the methodological problems of previous studies (cross-contamination, small sample sizes, lack of follow-up, Hawthorne effect). A number of structures are possible, including extra physical activity periods in the after-school period, extra in-school breaks, or embedding physical activity in traditional subject areas (for example, learning fluid dynamics through air and water resistance encountered during running or swimming).

### *6.2.1.3 The effects of socio-economic and demographic trends*

Over the last 20-30 years, Australian society has been characterised by a sustained high divorce rate and plummeting marriage rate, increasing proportions of single-parent families, and diminishing numbers of children per family. Family ‘turnover’, like turnover in jobs and places of residence, is becoming faster. We are committed to the same job, partners and homes for ever shorter periods. These trends are likely to continue, given current dominant economic rationalist policies, globalisation and reduction of tariff barriers, rationalisation of smaller enterprises, competition policy, privatisation and corporatisation of government instrumentalities. Certainly Australia’s current fertility rate – about 1.7 – looks likely to be heading south towards values as low as 1.1, which we see in a number of European countries.

At the same time, the distribution of household wealth is becoming increasingly unequal. The Gini Index is a measure of inequality of income distribution, and ranges from 0 for perfect equality to 1 for perfect inequality (ABS, 2001a). Recent data (Saunders, 2001) confirm that economic maldistribution is a growing issue in countries such as Australia, the United Kingdom and the United States. Countries with low Gini Indexes tend to have lower levels of pediatric obesity and superior levels of aerobic fitness. The 2002 European Health Report (WHO, 2002) argues that economic and social divides are the main drivers of growing differences in the health status of all people.

These trends appear to be reflected in the distribution of children’s health-related fitness and fatness, which are becoming increasingly skewed. There is evidence of a socio-economic rift in Australian children’s health-related fitness that has widened in recent times. Body fatness measures collected prior to 1980 (Dwyer et al. 1980) were relatively homogeneous across the SES gradient, whereas more recent surveys (Booth et al., 1999; 2001) have demonstrated an SES gradient with at least some measures of fatness and fat distribution, particularly among girls. There is also convincing evidence that the spread of fitness scores is becoming wider, with a ‘drop-out’ phenomenon at the bottom end, and an ‘elite’ phenomenon at the top end. In many areas, there is simply not a sufficient ‘critical mass’ of children available to make up local teams. Global declines in the number of children have affected the viability of sport structures.

In such a social environment, we may ask how health and fitness may be ‘socialised’. We know that the variability in physical activity between boys and girls, and between the most and least active children, is reduced on school (as opposed to non-school) days. The school environment imposes a uniform regimen on students. This suggests that increasing school-based physical activity may be an effective way of socialising physical activity.

## 6.2.2 A multiplicity of interventions

‘One size fits all’ interventions to increase sports participation are unlikely to be successful, because children ‘consume’ sport differently. There are systematic differences by age (older children play less sport), gender (girls), type of day (non-school days), family structure (single-parent and single-child families), SES (low SES) and activity style (screenies). Table 6.1 shows the average minutes of sport played by the best-case group (young, high-SES boys with two parents and siblings, on school days). We then systematically change the parameters, showing the effect on sports participation.

**Table 6.2 Mean daily minutes of sport for children with different socio-demographic characteristics**

gender	day type	SES	parents	sibs	min of sport	sport in critical window
boys	school day	high	two	yes	69.6	21.2
girls	school day	high	two	yes	38.1	12.1
	non-school day	high	two	yes	29.1	9.1
		low	two	yes	26.5	6.4
			single	yes	26.3	5.5
				no	7.9	0

The inferences are obvious: sports participation is not evenly distributed, and specific, definable groups are ‘sport poor’. We therefore need to ask ourselves what types of strategies will attract these various subsets. Can socialising be woven into the sports experience to attract girls? Can structured sport be offered, perhaps through schools, on non-school days? Can there be subsidised school-based activity clubs much like the youth clubs in Europe which see millions of children being physically active each evening and over the summer holidays on organised tours?

### 6.2.2.1 Interventions tailored to activity styles

We have identified ‘activity styles’ which largely cut across standard socio-demographic categories. These are different ways in which children ‘consume’ activity. ‘Sporties’ or ‘techno-actives’ combine high levels of sport with moderately high levels of screen time. In such a group, it would be pointless promoting physical activity, as physical activity is already an embedded behaviour. These children would benefit from interventions aimed at reducing screen time, as this would seem to be the harmful ingredient of their lifestyle. ‘Socialiser’ girls are the least active group of girls. As their screen use is quite low, strategies to reduce television viewing will have little impact on this group. Encouraging ‘Walk and Talk’ networks in the school playground, or while commuting to and from school, could increase energy expenditure while satisfying the desire to socialise with friends.

The least active group of boys was the screenies. The screenie boy may respond well to a traditional intervention designed to decrease screen time by restricting television watching via curfews, rations of television viewing hours, etc. However, perhaps we need to think

‘outside the square’ and acknowledge that these children are obviously attracted to technology. It may be beneficial to encourage the development of technologies such as computer games that require large body movements and moderate physical activity throughout the course of the game. In addition, we need to acknowledge the demographic characteristics of a screenie boy when designing an intervention. The intervention needs to be appropriate to the needs of a single-parent family. It therefore should not rely on parental transport if the intervention is based out of the home, in which case supervised, safe transport could be incorporated. The intervention may need to be tailored to the home environment incorporating activities that require limited supervision.

#### *6.2.2.2 Different interventions for pre- and post-pubertal children*

Puberty appears to be a watershed. Pre-pubertal children can be coaxed into activity; post-pubertal children need to be coerced. Their activity styles are quite different. Younger children prefer unstructured play in small family and friendship groups; older children opt for structured sport with large groups, eschewing adult participation. Younger children are more susceptible to the influence of coaches and athletes; older children see themselves as making their own decisions. Sport is likely to have a very different psychosocial role in older children: it is at least in part an instrument of identity construction, and a means of ‘tribal integration’. It appears that strategies based on structure, organisation and quasi-compulsion are likely to be more effective with older children.

### **6.3 Research imperatives**

There is a great push nowadays in medicine, allied health areas, and social sciences for evidence-based practice (EBP). EBP identifies several levels of evidence, ranging from descriptive accounts, to cross-sectional, cohort and case-control studies, through to non-randomised and ultimately randomised controlled trials (RCTs). In terms of interventions to increase physical activity, and ultimately to reduce paediatric overweight, there have been virtually no RCTs. There have been a few non-randomised controlled trials, but in many cases the controls have been inadequate (e.g. they have lacked a sham intervention). So most of the data we have to inform our decisions regarding interventions rely on mechanistic speculations, cross-sectional studies (e.g. looking at the relationship between physical activity and BMI in the community), and some case-control (retrospective) studies. The over-arching need is therefore for higher-quality evidence-based research. Given the need for EBP, there are a number of promising avenues for research.

#### **6.3.1 Out-of-school hours care (OSHC)**

Increasing numbers of school age Australians are attending out-of-school hours care on a regular basis. In these settings, children can typically choose between a range of sedentary and energetic alternatives. A recent intervention trial in South Australian OSHC centres found that physical activity presented as fun, non-competitive and developmentally appropriate can significantly reduce the number of children opting for indoor inactivity.

OSHC fits in with the work rhythms of modern families, and is therefore an attractive option for single-parent families, and for families where both parents work. It also focuses on what appears to be an important discriminator between active and inactive children – the critical window between the end of school and dinner time. In the critical window period, every extra hour of sport is associated with a 24-32 min reduction in screen time. A RCT based on OSHC should therefore be a research priority, perhaps comparing groups with active and sedentary OSHC interventions, and a group with no OSHC.

### **6.3.2 Teenage girls**

This is not the first report to argue for physical activity promotion targeted at high school age girls. How entrenched is this tendency for female adolescents to ‘drop out’? Previous attempts to motivate this group have operated within a largely outmoded sport framework. If there is widespread rejection of a restricted, ‘traditional’ sport culture, perhaps the current redefining of youth sport to legitimise the so-called ‘takeaway’ alternatives may warrant a more optimistic outlook. In particular, an emphasis on socialising while participating is likely to be more compatible with the personal preferences of adolescent girls. Interventions might use sports identified as those which girls would like to try but haven’t as ‘leverage sports’. Aerobics/dance was the third most commonly chosen of those sports.

### **6.3.3 The independent effects of screen time**

There is some evidence that screen time has deleterious effects on body composition, independently of how it may displace physical activity. ‘Sporties’ or ‘techno-actives’ are children who combine relatively high levels of screen time with high levels of physical activity in their daily lives. A recent study of bone health in preschool children in the United States found independent effects of vigorous physical activity and television viewing on bone mineral density (Janz et al., 2001). Similar observations have been made on circumpubertal children (Bailey et al., 1994). Some of the proposed mechanisms are greater exposure to advertisements for high-energy, low-nutrient foods, and reduced metabolic rate while watching television. These groups of boys and girls need to be researched further to assess whether the benefits of physical activity are derived despite the high amounts of sedentary behaviour. If it is found that ‘techno-active’ children have a lower health status from their high levels of sedentary behaviour, then there is a need to intervene.

### **6.3.4 PE homework**

While physical education is identified as one of the key learning areas in most school curricula, it has not previously been part of the homework policy in schools. Recent studies that have trialled PE homework have concluded that it is generally accepted by children. Most school-based interventions have produced quite modest outcomes for children’s physical activity. A trial testing the benefits of PE homework would be worthwhile. At the same time, any school-based intervention must involve leadership by PE specialists, and/or intensive, sustained in-servicing for classroom teachers. The amount of class time committed to regular physical activity and games can vary widely in the same school, and is strongly influenced by the skill and confidence of the teacher. The incorporation of basic PE delivery skills into all teacher training courses would address current shortcomings in the primary and secondary sectors.

### **6.3.5 Uniform national monitoring systems**

At the moment, there are no good data series on secular changes in physical activity, and no general agreement on desirable levels of physical activity. Even where guidelines exist, whether they are met or not depends heavily on the instrument used to quantify and monitor physical activity. Systems should be set up allowing national uniform monitoring systems. These should include measures of overweight (BMI), physical activity (including sports participation) and energy intake. Such systems could be administered by specially trained teachers on a national basis. They could be delivered, and data collected, through the internet. Automatic analysis and feedback could be linked to curriculum modules. International agreement on simple instruments would facilitate comparisons with other countries.

A significant weakness in most existing instruments is in psychosocial questionnaires regarding issues such as barriers and motivations. When children say they like physical activity because it is 'fun', or don't exercise because they have 'no time', the amount of information conveyed is virtually zero. Those who explain that time is a barrier to sports participation in fact have as much screen time as those who do not cite time problems, and children who are more engaged in sport actually cite more barriers than those less engaged.

While it is important to give children a voice in physical activity decisions, perhaps through mechanisms such as Student Representative Councils, so that policies are clearly visible as shared outcomes, children's perceptions about physical activity are often objectively quite wrong. In a recent questionnaire of 1290 8-13 year old Australian schoolchildren (Tim Olds, unpublished data), 72% felt that screen time did not compete with active play. It may be interesting that children feel this way, but it is definitely not true. Almost all studies report significant negative correlations between screen time and MVPA.

### **6.3.6 Peer group influence**

Very little is known about the effect of the peer group on the amount and nature of physical activity in children. Recent studies in the psychological literature regarding personality and behavioural development in young people (Harris, 1999) have de-emphasised the impact of the family and stressed the importance of the friendship group. An example is language, where children rapidly adopt the language of their peers and not of their parents. Harris' partitioning of variability between genetic and environmental influences suggests that the home exerts only a very small influence on behaviour. Work remains to be done on whether the same applies to physical activity behaviour. There are a number of research approaches. One is to look at clustering of physical activity patterns within friendship groups. Qualitative work remains to be done on the physical activity culture of friendship groups.

### **6.3.7 Trickle down**

There is a powerful and appealing argument in political circles that increasing resources for elite level sport will eventually 'trickle down' to grass roots levels. This concept has led to interventions such as sponsoring sports stars to visit schools in the hope of boosting sports club membership, usually with poor results. One study (Hogan & Norton, 2000) has found

no evidence for this hypothesis. Another (Olds, Tomkinson, Léger, & Cazorla, submitted) found no relationship between children's fitness and Olympic success across 37 countries. The authors constructed an 'Olympic Index' for Olympic performance. There was only a weak relationship between the Performance Index and the Olympic Index. Countries with a high Olympic Index could have very fit children (e.g. Finland), or relatively unfit children (e.g. Australia). Similarly, countries which perform only moderately at the Olympics (e.g. Estonia) may have children of well above average fitness. This relationship may reflect the growing schism between grassroots physical activity and high performance sport, the latter being driven largely by GDP. In the MARCA psychosocial questionnaire, fewer than 5% of students listed visits by high profile athletes and coaches as major influences on their physical activity decisions. This is in spite of the fact that children will often list sports stars as their heroes. We need to know more about the trickle down effect to design rational and cost effective interventions.

## **6.4 Conclusion**

This report provides quite a comprehensive snapshot of the role of sport and physical activity in the lives of children, both from an objective use-of-time perspective and from subjective (cognitive and affective) perspectives. It contains few surprises. It documents the now commonplace increases in overweight, and somewhat more controversial decreases in aerobic fitness. It summarises growing evidence for declines in physical activity, and chronicles the various official reports and interventions. It points to broad-brush social, economic and demographic changes that are probably driving these trends.

In so far as we can recommend programmatic changes to policies surrounding children's physical activity, we would emphasise:

- (1) the need for genuine evidence-based research on intervention strategies, adequately funded, with large sample sizes, and using well-designed control groups
- (2) the need to avoid 'nostalgic' solutions based on a 'back to the sixties' mindset. No intervention is going to reverse the massive socio-demographic changes which are driving the current crisis. We need to think how new sports structures are going to operate in a new society.

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## Appendices

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## **Appendix 8.1      A descriptive study into time usage of children with typical activity profiles, aged 10 – 13 years in Adelaide, South Australia.**

### **EXECUTIVE SUMMARY**

This component of the study aimed at providing qualitative information on the factors involved in the time usage of children. Semi-structured interviews were conducted with nine children and their parents. By exploring the meaning that children attach to activities, furthers our understanding of the determinants that influence children's activity patterns. In turn, this can lead to the introduction of appropriate strategies in promoting active lifestyles in children.

This study has identified findings that support other published studies: the complexity of factors relating to an interplay between individual and environmental factors, the influence of personality factors, parents, peers and experience of competition on activity participation. In addition, it has provided findings which have not been researched extensively before: the seemingly spontaneous tendency of children to seek out engagement in activities and doing so in a balanced manner with both physically demanding and less demanding activities incorporated, and the influence of the experience of skill development and sense of achievement that influences activity participation. Recommendations to effectively facilitate physical activity participation in children are provided based on these findings, which include:

- incorporating physical activities into the daily lives of children that provide both group and individual experiences;
- incorporating self-directed and individually based goal setting strategies for children in activities;
- introducing challenging activities to all children which provide opportunities for skill development;
- fostering parent involvement, interest and support in their children's activities;
- facilitating and supporting parents to be able to provide children with the practical arrangements for engagement in activities and lastly,
- viewing children's participation in activities within a complex interrelation of environmental and individual factors.

## **INTRODUCTION**

Given the dramatic rise in overweight prevalence amongst youth overseas (Troiano & Flegal, 1998) and in Australia (Booth, Chey, Wake, Norton, Hesketh, Dollman, & Robertson, 2002; Dollman, Olds, Norton & Stuart, 1999), as well as decreases in fitness (Tomlinson, Leger, Olds & Cazorla, 2003), investigating children's activity patterns are very relevant. Reasons for these unhealthy patterns may be attributed to reduced energy expenditure (Ebbeling, Pawlak & Ludwig, 2002) in light of temptations which exist for children to spend more time on sedentary activities. The promotion of physical and social health by means of participation in physical activity is recognized (Biddle, Sallis & Cavill, 1998) and is a very current debate in the move towards health promotion. The age group of 10 – 13 year olds is of particular interest due to the rapid decline noted in physical activity of children in this age group (Van Mechelen, Twisk, Bertheke Post, Snel, & Kemper, 2000).

Studies that widely explore the determinants for patterns in activity are recommended by Gordon-Larsen, McMurray and Popkin (2000). From the outset, this current study aimed at extending knowledge in regards to these aspects, from the child's viewpoint. Only a few studies have included the children themselves as informants (Curtin, 2001), and in addition, a limited number of studies have provided qualitative data on this topic. A plethora of studies have been found that describe demographic and practical determinants of physical activity, mostly all of which were quantitative studies. Bowden (1995) recommends obtaining qualitative information from children regarding their engagement in occupation in order to increase the knowledgebase of children's preferences in engagement in occupation.

## **METHODOLOGY**

This study employed descriptive naturalistic methodology, with elements of phenomenology. Phenomenology aims at understanding the meaning that individuals attach to a phenomenon. In utilising aspects of phenomenology, this study aimed at understanding what meaning children attach to activity participation. In doing so, the study aimed more specifically at obtaining descriptive information regarding the determinants which influence children's use of time. In addition, it aimed at gathering information related to the lifestyles of children with typical activity profiles. In providing rich descriptive information of this nature, a better understanding of the determinants of children's activities will be formulated, which in turn may inform future strategies to enhance children's participation levels.

## **Sampling**

The study was conducted as part of a larger study, namely “Children and Sport”. This larger study utilised clustering analysis (a market segmentation technique) of data collected using the Multimedia Activity Recall for Children and Adolescents (MARCA). 1429 children across South Australia participated in completing the MARCA. The MARCA is a computerised instrument which asks children to recall their activities in the past 24 hours.

Data obtained from the MARCA provided information on how children use their time. Cluster analysis was used to group subjects into distinct clusters using use-of-time profiles. Seven clusters were identified, four clusters for girls (sporties, screenies, players and socialisers) and three for boys (sporties, screenies and autonomes). “Sporties” were identified as spending large amounts of time playing sport. “Screenies” spend large amounts of time watching television or playing video games. “Players” spend considerable time in unorganised play activities, while “Autonomes” participate in activities they can create and participate in by themselves without the need for external organisation or stimulation (such as inactive socialising, locomotion and play). Finally “Socialisers” spend a large amount of their leisure time participating in inactive socialising. Those participants closest to the cluster centroids were targeted for qualitative interviews as these children were most typical of the global activity pattern for the cluster. These potential participants were sent letters inviting them to participate in the interviews, after ethics approval had been obtained from the University of South Australia’s Human Research Ethics Committee.

## **Participants**

Nine children in total along with their parents were interviewed including, seven girls and two boys from suburban areas in Adelaide to obtain an understanding of why children choose to spend time on their preferred activities. The following indicates the activity profiles of the cluster from which each of these children belong, as well as the activity that they spent a high amount of time on: formal sports – three participants; socialising – three participants, informal play – two participants, screen time – one participant. The children’s ages ranged from 12 years to 14 years, with one child being 14 years, three were 13 years and five were 12 years of age.

## **Interviews**

Face-to-face, semi-structured interviews were conducted with the children and their parents. Interview questions are included in appendix 8.1.1 and 8.1.2. Interviews occurred at the homes of participants. Interview questions have been developed in line with current literature on the determinants of activity levels of children, as well as literature guidelines on how to conduct interviews with children (Bowden, 1995; Lewis, 2002; Curtin, 2001; Garbarino & Stott, 1990; Goodwin & Goodwin, Minkes, Robinson & Weston, 1994; 1996; Rich, 1968). Aspects such as triangulation of questions and techniques within the interview, accommodation of children's communication styles, externalizing parts of the discussion and balancing direct and indirect questions, have been incorporated to ensure validity of questions asked. These aspects were important given the complexities of interviewing children and obtaining reliable information (Bowden, 1995; Lewis, 2002; Curtin, 2001).

Methods to ensure scientific rigour included co-coder procedures for data analysis, pilot testing the interviews, interviewer training and uniform interview procedures. Three interviewers conducted the interviews, which each lasted around 1.5 hours.

## **Data analysis**

The data obtained from the interviews were transcribed and compiled into case studies (see attached to this Appendix). The case studies attempt to provide holistic and context sensitive descriptions of each child, as recommended by Patton (2002). During the case-studies, the information from both the child and parent interviews was combined into a description of the child's activity patterns and the determinants of these patterns.

In addition to the case studies, a content analysis was undertaken to identify common themes across all case studies. These themes are provided below.

## **FINDINGS**

The case studies illustrate the complexity of determinants involved in children's activity patterns. All of the children interviewed enjoyed and sought out participation in activities. Of interest is that children seem to naturally seek a balance in their activity patterns (both physically demanding and less physically demanding activities) and that both child specific (such as personality traits) and environmental factors (such as access to facilities, time limitations) influence children's engagement in activities. The following two overarching themes provide insight into the engagement of children in activities:

### **Engagement, balance and extensive range of activities**

From the case studies, it is evident how busy all of the children are and how much they enjoy being involved in activities. These children are either involved in formally organised activities or informal play activities organised by themselves with friends or family members.

From the case studies, it can be seen that the nine children have no lack of opportunities to be involved in activities and that they spontaneously choose to be involved in activities of their choice. Activities range from competitive sport, informally organised games, music, drama and socialising with friends while doing an activity such as shopping or with family during family activities. Activities are offered at school, outside of school or at local community centres and facilities.

Another point worth highlighting, is the balanced nature of these children's engagement: for those who are engaged in less physically demanding activities, all, except one, also indicated engagement in activities that require physical demands such as Scouts, basketball, bowling, water-skiing, informal games of soccer, tennis and games in the swimming pool. Of the more active children, all indicated a balance between physically demanding activities and less active activities such as music, reading and board games.

### **Engagement in less physical activities**

Activities such as reading, drama, music, crafts, singing in the choir, playing board games, chatting with friends on the internet, playing computer games and watching game shows on television while engaging with competitiveness regarding the game show with family members, were mentioned by three children who indicated engagement in less physically demanding activities. Albeit being less physically active in these activities, their lifestyles testify of engagement and skill development.

In addition, sub themes were developed from these nine case studies. From these one can conclude that these children indicated self determination in selecting their activities, with influence from the environment. The following themes were identified and provide a description of the type of determinants which influence activity patterns: Personality characteristics, competition, sense of achievement, self development and socialisation are major determinants for these children as well as family considerations.

## **Personality Factors**

Personality factors are one of the common motivating factors among the nine children underpinning their decisions regarding which activities to participate in. During the interviews, personality characteristics of all nine children stood out clearly as a determinant of their activity choices: the children and/or their parents indicated that they enjoy being involved in activities, four children being creative; which resulted in participation in drama or music, another two are described as individualistic; resulting in enjoying it to be different than others and seven expressed their preference for being busy and avoiding boring, passive activities. One child, who is less physically active and does not incorporate physical activities in their lifestyle, indicated that they “do not like the feeling of having to go and do something”.

## **Competing against others**

For the six children, all of whom engage in physical demanding activities, competition against others is a common factor. This aspect was evident for both engagement in physically demanding and less demanding activities. The children talked about the enjoyment of competing. Some children indicated competitiveness both in physically demanding activities, such as basketball and less physically demanding activities, such as board games. Another child indicated competition and socialising as both being important in less formally organised activities, such as bowling with a friend.

## **Value attached to self development and sense of achievement**

Eight children indicated that skill development, challenging themselves and getting a sense of achievement were important to them when they engage in activities. This also applies to the one child who engages solely in less physically demanding activities. The parent of this child mentioned their enjoyment of musical activities since it is a form of self expression and is something they could excel in.

## **Socialising**

A motivating factor for the seven socialising participants is – they mentioned doing activities with friends and families, the team spirit and collaboration as aspects which they enjoy about being involved in certain activities.

## **Family considerations**

Of significance, is the prevalence of the influence of family involvement and support for all these children. Parent involvement and interest in the same activities, such as coaching the team, socialising and musical interests, seems to be a significant driver behind children's involvement in activities. It seems that parents would become involved after the children have chosen the activities that they wish to participate in or that children would become participants in activities which their parents are involved in. Parental values on what constitute constructive use of free time play a large role – although most of these children seem to select their own activities, parents have an influence on guiding children in what they believe their free time should consist of. The support of parents in encouraging their children to participate in activities and in ensuring that practical arrangements are made to make participation possible, were evident in all the children.

Factors which resulted in limitations of activity participation include limited parental time, parents' health, the child's health, limited access to transport and concerns regarding safety of children. The one child, identified with an activity pattern indicating more time usage related to screen time, has family considerations which have had an influence on their activity patterns. Limitations have included restricted parental time with both parents having work commitments outside of traditional business hours and the mother's ill health. For another child's parent, safety is an issue, as well as the child's health and these considerations restrict their activities. A third child's mother does not drive, which limits their activities to facilities close to home.

## **DISCUSSION AND CONCLUSION**

This study has provided some valuable descriptive information on the meaning that these nine children attach to activities. It has extended our knowledge-base of determinants from children's and parents' viewpoints and has provided unique insights into some aspects of these determinants. In summary, it highlights: the interactive influence of child specific and environmental factors on activity patterns, and the seemingly spontaneous tendency of children to seek out engagement in activities and doing so in a balanced manner, incorporating both physically demanding and physically less demanding activities. In supporting previous studies related to personality characteristics, and specifically to this study's finding in regards to children's preference for being busy, Sallis, Prochaska & Taylor (2000) found a positive association between "intention to be active" with adolescents' and children's physical activity. Viewing activity performance within a framework which recognises the complexity of influencing factors, both

individual and environmental, have been documented by Poulsen and Ziviani (2004) and Sallis, Prochaska & Taylor (2000).

Specific common determinants have been highlighted which further support other documented evidence and the subsequent introduction of strategies such as:

**Recognition of the influence of parents on activity participation**

- Recognition needs to be given to the significant influence that parents have on activity patterns and incorporating strategies to facilitate the involvement and support of parents in activities of children. Similar results have been obtained by Thompson, Davis, Gittelsohn, Going, Becenti, Metcalfe, Stone, Harnack & Ring (2001), Singleton and Harvey (1995), Neumark-Sztainer (2003) and Brustad (1993) in regards to the impact of parents as determinant of engagement in physical activity. In addition, it is recommended that strategies are implemented to support parents in being able to provide children with the practical arrangements for engagement in activities.

**Recognition of the influence of peers in involvement in activities**

- Recognition of the importance of peers in involvement of activities and incorporating strategies to involve children within groups in activities such as Physical Education activities at school. Thompson, Davis, Gittelsohn, Going, Becenti, Metcalfe, Stone, Harnack & Ring (2001) and Allison (1996) reported similar results related to the influence of peers on participation in physical activity. Csikszentmihalyi and Larsa (1984) found that adolescents reported more experiences of happiness and motivation when they are with friends. It would therefore increase the chances of involving adolescents in physical activities, in increasing their motivation to participate and their enjoyment, if their peers were involved too.

**Recognition of the influence of competition on activity participation**

- The experience of competing against others seems an important driver behind engagement in physical activities. In introducing group activities, wherein healthy competition can be incorporated, would seem to tap into this motivating factor for children.

### **Recognition of the influence of the experience of skill development and sense of achievement during activity participation**

- In addition, the result related to the value that children attach to the experience of skill development and sense of achievement, while engaged in activities, is worth highlighting. Few studies have focussed on this aspect as determinant of activity participation. Persson, Erlandsson, Eklund and Iwarson (2001, p. 10) provides a theoretical framework for understanding human occupation, which supports the incorporation of an “above average challenge to the doer and a challenge that matches his or her skills”. This finding links further with Csikszentmihalyi (1993, p. 41) in regards to the experience of flow in activities and providing “high challenges commensurate to (their) skills” which will facilitate enjoyment of activities.

Studies that have explored the concept of flow (high challenge, high skill experience) include Bidwell, Csikszentmihalyi, Hedges and Schneider (1997) who found that US adolescents experience more flow during physically demanding leisure time activities, than during more passive activities such as listening to the radio or television watching. Hektner (in Csikszentmihalyi, 1997) found that adolescents who had many experiences of flow in their earlier lives, reported many flow experiences later as well, while those who reported less earlier, also had less experiences of this nature later. This finding supports the concept of building flow experiences into physical activities, which will in turn impact on the child’s life later as well, and in other situations. Hektner (in Csikszentmihalyi, 1997) also found that adolescents who experienced flow had higher levels of concentration, self esteem, enjoyment and interest, with less time spent in passive leisure, than those who had less experiences of flow. Adlai-Gail (in Csikszentmihalyi, 1997) talks of “autotelic” personalities who are individuals who do things for the experience of it, and not for external goals. This researcher found that “autotelic” adolescents spent more time on studying, on hobbies and sport than “non autotelic” adolescents. In another study Hektner (in Csikszentmihalyi, 1997) found that “autotelic” adolescents concentrate more, have higher self esteems and see the importance of current activities such as part time work and studies as of importance to future goals and had higher levels of family interaction than other adolescents.

In exploring the concept of skill development and sense of achievement, Sallis, Prochaska & Taylor (2000) found a positive association between perceived activity competence and adolescents’ physical activity, as well as a positive association between achievement orientation and physical activity. Brustad (1993) found that perceived physical competence influence children’s attraction to physical activity. Adolescent skill

has also been found to be related to adult participation in physical activity by Taylor, Blair, Cummings, Wun & Malina (1999).

It therefore seems logical to incorporate opportunities of skill development and experiences of achievement for all children during participation in physical activities. In addition, adding strategies to incorporate individual goal setting, and fostering an approach of individual achievement orientation and self-directedness, would facilitate children's positive experience of physical activities.

Having highlighted some of these strategies, it is important to view these within the context of each child's individual personality traits, as well as family specific considerations such as health of family members, transport and time limitations.

### **LIMITATIONS AND FURTHER RECOMMENDATIONS FOR RESEARCH**

The findings of this research needs to be seen in light of a number of limitations: firstly, difficulties in recruitment resulted in a skewed representation of the original activity profiles and gender balance of children. Only one child who spends a high amount of time on screen time and only two boys were included. It would be recommended that a further extension of this project would endeavour to provide a more representative sample to capture all these profiles and both genders sufficiently in order to reach a level of saturation of data. In addition, the current case studies reflect the information of mostly children who engage in physically demanding activities. In using the sampling and recruitment strategy as described above, it seems as though a degree of self selection in regards to the population type has occurred, where mostly the active children volunteered themselves for participation, while the more inactive children, due to the nature of their activity patterns, did not volunteer. Difficulties in contacting parents via the participating schools in the MARCA study, and the time lapse between the two studies have resulted in difficulties with recruitment.

While this study did not attempt to provide findings that are generalisable to all Australian children, the findings need to be viewed in light of the afore mentioned limitations and the context of each individual case study.

Given the emergence of the findings related to the influence of the experience of skill development and achievement from this study, it is recommended that a future research project focuses on expanding the exploration of this aspect more to assist in understanding this driving factor in children's activity participation.

## **Acknowledgement**

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## Case Study 1: High Socialiser

### Sarah

Sarah is 12 years of age. She lives with her mother and her brother in a suburban house in the north of Adelaide. Sarah describes herself as happy and active, enjoying it to be busy and being with her family and friends. Her mother has the same perception of her – that Sarah is an active girl, engaging mostly with informal and outdoor play and enjoying spending time with people, which may include chatting with her friends and being with family members. Sarah enjoys sports, but prefers participating within supportive environments such as with friends and within informally structured games.

*Socialising and spending time with the dogs:* Sarah describes highlights of her school day as chatting with friends before school, during breaks and after school. She has a group of three friends, two girls and a boy. They would either sit in a group and chat or they would engage in an informal activity such as playing ball. Sarah spends a lot of her time in the evenings chatting to friends on the phone. They would either have a three way conversation or she would be talking to only one friend. They would talk about things that have happened at school and things that they may not be able to discuss during the school day. Sarah is very aware of going to high school next year and that she may not have so much time to spend with her current friends in the future. In talking about future jobs, Sarah mentions being a hairdresser as a possibility and says she would enjoy doing other people's hair. This may allude to the social aspects involved in being a hairdresser.

After school, Sarah chooses to spend time on walking the family's dogs which she usually does with her mother or brother in the afternoon after school. She also enjoys playing with the dogs.

*Socialising, informal games and competition:* On Saturdays, Sarah enjoys going bowling with a friend. She describes enjoying it because of the competition involved: "... we try to get better scores than each other...its fun". Competition and socialising are also aspects which she considers when talking about future jobs: being a lawyer is one of the jobs that Sarah sees herself doing in the future. She likes debating in a team and winning.

On some Saturdays, Sarah may go out for the day, water-skiing with her mother's partner and with Sarah's brother. Sarah also describes being at the river with her friends as her ideal holiday – playing soccer, volleyball and swimming with them all day. On a

weekend day, the family would usually have lunch together with the extended family. Sarah enjoys spending time with her cousins, kicking the football, going to the park, riding their bikes or playing games. Her mother would usually organise for Sarah's group of friends to join them a few times during the holidays for an outing.

*Interest in formal sport, health considerations:* Sarah has an interest in formal sport – she names football and soccer players (David Beckham) as her heroes. She mentions enjoying watching football on television and going to football games. She admires football players' skill with the ball. Sarah mentions being a dancer as a potential job of hers in the future.

Sarah usually participates in informal games like non-competitive basketball, swimming, soccer and tennis which gets organised when she is with friends or family. Sarah describes her interest by talking about how they informally organise the teams, about being with others, being active and competing for best scores. She has participated in formal netball before but has broken her arm last year and on the doctor's recommendation has not taken up formal sport again. Her mother talked about her health and that they are taking precautions due to the probability that Sarah may have a bone related illness. Her mother indicated that Sarah is short for her age and that Sarah is sensitive about her ability to play netball due to her height. Her mother also mentions the competitive nature of the sport and that Sarah tends to get embarrassed and upset when she makes a mistake.

*Being active versus watching television and utilising the computer:* Sarah does not spend a lot of her time on watching television or utilising the computer. She watches about 30 minutes of television in the evenings and an hour on Saturday and Sunday mornings. Sarah describes watching television as an "in-between" activity which she engages in between chores and active playing or before going to bed. She enjoys watching "Neighbours" and "Home and Away" because it is about people's life stories. Sarah also enjoys movies with action and comedy in them. She seldom spends time on the computer but may play a game on it once in a while when her brother is on the computer. She says that computer games get boring and that she does not like sitting down for too long.

*Family considerations:* Sarah and her brother are allowed to make their own choices in regards to how they spend their free time, but within limits. The family has had experience with crime in the past, where a family member was murdered - this amongst other things, have emphasised the importance of safety and supervised activities as considerations. The mother's belief in supervision for this age group when they are in

community facilities drives related decisions about time usage. Sarah's health is another consideration and has led to her withdrawal from formal sports and emphasis on bowling currently. The family prioritises family time on weekends and expects the children to participate mostly in family activities on weekends. Sarah's mother has a strong belief in children being active and encourages both children to spend more time outside than inside the house. Their house and garden is well equipped and spacious and does not limit the children's activities, according to Sarah's mother. The following quote describes the reasons behind Sarah's activity choices, from her mother's viewpoint: "It's just Sarah. I just see it as Sarah. It's more of her personality. She makes most of the choices."

## **Case Study 2: High sport**

### **Anna**

Anna lives with her mother, her mother's partner and brother in a suburban house, in the north of Adelaide and is 13 years old. She leads an active lifestyle, which include chosen activities such as playing in an orchestra, playing netball competitively at school, reading and watching a bit of television in the evenings, chatting with friends on the phone, visiting friends and family and water-skiing with the family. Her mother describes her as a dedicated, committed person who is "exceptionally busy", competitive and someone who enjoys self development and challenging herself. Her weekly routine consists of a busy and structured week, with a less formal weekend.

*Competition, sense of achievement and individualism:* Anna mentions that she enjoys sports because of the competition and being good at it: "I don't think if I wasn't as good at it (that) I would have enjoyed it as much". She would also love to meet the Thunderbirds netball team and famous tennis players. Anna spends a lot of her time on practicing music and being in an orchestra. She mentions Australian Idol as her favourite television show, indicating that she is a bit jealous of their talent and she enjoys the competitive nature of it. She enjoys the challenge that being in the orchestra provides, stating that some parts are really hard and that "Not everyone can do it". Her mother describes her as someone who competes against herself. Anna also values being an individualist. She noted that she does activities such as playing in the orchestra, with children who are outside of her usual circle of friends – she likes this and also likes being different from her friends.

Anna's mother mentions her self determinism to achieve. Her mother believes that Anna will look for challenges herself, no matter what her situation may be. Anna mentioned

being a paediatrician as a possible career choice for her one day, finding medicine an interesting field, but also wanting to spend time with sick children and helping them.

*Socialising:* Anna describes herself as someone who has lots of friends and who enjoys being with friends and family. One of the reasons why she enjoys netball is because of the teamwork involved. Similarly, she states that she has friends in the orchestra and that she enjoys their company. Anna likes spending time with her mother, the family and extended family. Mealtimes with the extended family is a favourite time of hers. Chatting over the phone is an activity which Anna says she spends quite a bit of time on after school and during the evenings, more so than watching television. She says that they usually talk about things that you are not able to talk about at school. She has a group of 4 friends at school. She states that they are “really good friends”. Anna’s perfect day would include going shopping and water-skiing with friends and having a sleep-over. Anna talks about enjoying shopping with friends because of the socialising involved and not having parents around.

*Family considerations:* Anna’s mother states that although there are family considerations in terms of the choices that the children have, that Anna has the freedom to make her own choices and that she is very self-determined in this aspect. Anna’s mother works from home and she sees this is a facilitating factor since it is her perception that parents have the responsibility these days in regards to extra-mural activities and activities which are not available at school. Her mother believes in a balanced and active lifestyle and encourages this in her children. She describes herself as a busy person, preferring to keep active – which may impact on Anna’s lifestyle choices as well. Her mother also coaches Anna’s netball team. Anna’s mother mentioned public schools’ financial resources and that costs play a part in determining some of the scope of Anna’s participation.

When Anna was asked about designing her favourite holiday, she mentioned being at a swimming pool or beach with her friends and with a lot of free time and time to relax. There would be no rules and they would be able to do what they want. They would have the options of playing tennis, netball, swimming, relaxing and chatting.

### Case Study 3: High informal play

## Larry

Larry is 12 years of age. He lives with his mother and father and younger brother in a suburban house in the eastern suburbs of Adelaide. Larry describes himself as a happy and creative child and enjoying school. He says he likes to think. He plays club tennis at the weekend, stating that he is not competitive when he plays. He enjoys acting in drama performances, reading, playing the saxophone and going to scouts. He said that he is a loyal friend but that it's not that important to him to be with other kids. His mother confirms this in her description:

“Essentially...he's a creative, artistic sort of kid, rather than a real physical, competitive kid. He likes doing things that don't require beating someone else.” His mother also confirmed that he is an active child who likes to be involved in various activities.

*Individualism, imagination, creativity:* Larry belongs to a theatre group and enjoys rehearsing and performing in plays. Despite enjoying playing characters in drama performances and reading, Larry found it hard to identify any heroes, saying that “I guess I feel there's no point in me trying to be like someone else because it's better to be who I am. I don't really have anyone I want to be like.”

He was able to identify actors that he would like to meet or work with, namely Hugh Grant (“Love Actually”) and Orlando Bloom (“Lord of the Rings”). He seems to admire their skills as actors.

He took up the saxophone when a friend began and continued to learn when his friend gave up. Larry enjoys experimenting with different styles when playing the saxophone. He says that he enjoys reading because it allows him to use his imagination and enter the fantasy world of the characters. He would like to write his own stories one day and teach English to high school students. Larry enjoys computer games that involve creating a city or a family and fantasy games like Lord of the Rings.

*Enjoying the experience, informal games and active play, humour:* Larry plays competition tennis on Saturday morning and has training and private coaching during the week. He goes for walks with his parents and the dog in the evenings and enjoys playing cards and board games, when they “often have a good laugh”. He attends Scouts regularly as a way of keeping fit and active. His choice of holiday also reflects an interest in family with Larry planning an ideal holiday to England in the countryside where he could meet his parents' friends and experience the cosiness of reading in bed

while it's snowing outside. He also seems to have an appreciation of experiencing different lifestyles. Larry says he enjoys watching "The Simpsons" on television because Homer's behaviour is so bad it sends a message of how to behave in a funny way.

*Outside environment:* Larry emphasised getting "out and about" in his conversation. His mother pointed out that with a small backyard, they tend to utilise nearby parks, tennis courts, etc for informal play (eg cricket) and walks. This seems to be an aspect that Larry values.

*Family considerations:* Larry's parents' values and interests have an influence in his activity patterns. His mother says that if there is something that Larry or his brother want to do then they try to find a way to make it happen, although there is a family limit of no more than two school activities on any one day – it is up to Larry to make choices if there are more than two activities. Larry's television time is limited to 5 hours non-educational screen time a week during the school term.

Larry seems to have a close knit family where his parents tend to become involved with the children's chosen activities such as managing Larry's tennis team. Larry's mother emphasised the role of cooperation in their family interactions and activities with neither she nor her husband playing competitive sport. This is illustrated in the following quote: "Probably his lack of competitiveness would come from us. You don't have to beat someone to prove anything. We tend to work more cooperatively and work in with people. And helping people is better than beating them."

It can also be illustrated in Larry's participation in the Battle of the Minds every year at Flinders University. This is a problem-solving event where children have to work together in teams to solve a problem and present a solution.

#### **Case Study 4: High sport**

### **John**

John is 11 years of age. He lives with his mother and father and younger brother in a suburban house in the eastern suburbs of Adelaide. John describes himself as active, enjoying having some organised sport or activity everyday. He also enjoys reading and having non-organised time playing screen games, backyard cricket and hanging out with his friends. John's mother emphasises the importance of organised sport in John's life, the skill and social aspects together with the values and life skills that she sees organised

sport as providing. She and her husband actively participate in running the school sports and Little Athletics. John enjoys informal play both active and inactive (with his brother and friends) and solo leisure especially reading. When asked to plan his favourite holiday, John combined visiting the NBA with a cruise incorporating his favourite sport with “carefree” time.

*Sport and skill development:* John enjoys the opportunities he has to develop and demonstrate his skill in organised sport. He names basket ball as his favourite sport and identifies players from the NBA as his heroes, especially Magic Johnson. Every afternoon after school there is an organised sport that John attends, usually with his mother providing transport and sometimes coaching. He plays school sport and has team practice during the week and then engages in competition sport at the weekend. He plays summer hockey on Friday nights and then club basketball on Saturday mornings. Sometimes, his grandmother will take him to these matches, depending where his younger brother has a match. Some Saturday afternoons, he attends Surf Lifesaving at a beach club and then Sunday morning and into the early afternoon, he attends Little Athletics, where he enjoys shot-put and 200 and 400 metre sprints. His mother and father organise this event every week, so it means an early start.

Sometimes, he feels tired and doesn't always want to go to swimming classes, however, he loves playing basketball and dreams of playing in the NBA when he is older:

“I dream of playing for the NBA when I grow up. When I watch and look at some of the guys they're just really super tough and funny and they pass balls to the audience. And if you can play you get loads of money for doing something you really enjoy.”

*Socialising, valuing free time, informal games and active play:* John describes the highlights of his school day as playing with his friends at recess and lunch times. This includes informal games of cricket, chasey, basketball and handball. John enjoys free time with friends, surfing and boogie boarding with his dad, relaxing and reading, and sometimes board games. John's mother emphasised the importance of sport and team games to the family but said that she doesn't mind John having 'down-time' because he spends so much time being active and involved in structured activity. She said that she knows things will change this year as John prepares himself for high school.

In free time, he enjoys playing Nintendo games like Super Mario, Legend of Zelda and Basketball games and on Friday nights, he sleeps in his brother's room and they watch

videos and movies. He says he “loves” reading at night. He watches more television and plays more Nintendo in the holidays when he has more unstructured time.

*Family considerations:* John’s parents values, interests and participation in activities have an influence in his activity patterns. The following quote emphasises the family commitment to sport when John’s mother is discussing her part-time employment:

“[We] made the decision that I would be available to do all those activities with the kids because otherwise they’d miss out.”

John’s mother said that she knew John would sometimes like to give up swimming lessons, but she believes he should keep at them as a safety measure for the surfing he likes to do with his dad. John’s father works Tuesday to Saturday and so it is John’s mother and grandmother who provide transport to sport through the week and on Saturday. John said he likes the informal play he does with his dad – surfing and backyard cricket.

Although John’s mother provides opportunities and encourages John and his brother in structured team sports, she believes that free choice in unstructured time is also important and allows the boys to choose their own activities, be they active or inactive when they don’t have other commitments.

### **Case study 5: Socialiser**

## **Casey**

Casey is a 12 year old girl who lives in a northern suburb of Adelaide. She lives with her parents, brother and sister. Casey describes herself as a happy child, who gets along well with her family and who has lots of friends. She is very active, being involved in competitive gymnastics, which she does three times per week for 3 hours each, and doing scouts, music as well as girls’ soccer. More informally she prefers to spend her time on reading, writing in her diary, talking on the phone with friends, going shopping and hanging out with friends. Casey’s mother describes her as extremely independent and self determined, in that she will become involved in activities herself without any input from her parents.

*Passion for gymnastics, competition, sense of self achievement, peer recognition and socialisation:* Casey has been involved in gymnastics since first starting with school. She spends the majority of her free time during the week practicing gymnastics and does so at a local community facility. Casey describes her involvement in gymnastics passionately.

She indicates hard work, as sense of personal achievement, peer recognition and competition when talking about gymnastics: “It is the thrill of... its working up to something and then finally getting to show what you do best... and then working hard again for the next competition...”. Casey also participates in soccer. She described how her team lost every game in the beginning, but worked hard and won the league in the end. Her mother mentions that her height is a consideration since she is short for her age and that she is not held back by her height when participating in soccer.

In describing her ideal day, Casey mentions wanting to invite her school friends with to gymnastics so that she could show them what she works hard at after school. She mentions the gymnast, Nadia Comaneci as her hero, because she admires her ability to perform well under pressure and becoming number one. Casey also mentions that she has friends at gymnastics which are outside of her school circle of friends. She mentions spending time with them on weekends as well.

Casey talked about hurting her ankle a while ago and that she could not participate in sport for a while. Her mother confirms this incident and says that it limited her physical activity for a period.

*Socialising, personality characteristics:* Casey describes herself as a people - person, “...it makes me happy being with someone else...I hate being on my own.” She describes having friends at gymnastics, at school and values the team spirit when participating in soccer. She describes playing a bit of computer games over weekends, but mostly with her brother and sister, laughing and talking with them, otherwise it would be boring. She spends about an hour each week day on the phone with friends. She mentions talking about boys, gossiping and talking about what they will be doing over weekends. Casey mentions that talking over the phone helps her to be with others when she is alone at home. Casey talks about shopping with her friends on her ideal holiday and mentions that she needs to be with someone when shopping – they would talk about fashion and boys.

*Family considerations:* There are few considerations that Casey’s family need to keep in mind when she makes decisions regarding how she spends her time. Travel is one of these, since her mother does not drive and she is limited to those activities which she can attend by walking there or bicycling. Her mother does however think that Casey has access to adequate facilities. Casey’s mother also mentions safety as an aspect, for example, that she would not allow Casey to travel to and go into the city by herself. Except for these two considerations, her mother mentions that Casey mostly makes up

her own mind about which activities she wants to participate in - "...she knows what she wants to do and goes for it."

### **Case Study 6: High informal play**

## **Melissa**

Melissa, aged 12 ½ years, lives with her mother, father and sister in a suburban house in the eastern suburbs of Adelaide. She describes herself as an energetic person with lots of friends who is seldom bored. Melissa leads an extremely busy life: she plays competitive netball on weekends, soccer for the school on weekends, learns the piano and flute, and enjoys chatting with her friends on the telephone and on the internet. Her mother confirms that Melissa is a very social girl who does indeed live an active life, playing sport and learning music.

*Physical fitness and keeping active:* Melissa discusses her love of sport as being because she likes the high energy level and enjoys keeping fit. She generally describes herself as watching television for only half an hour at a time because she does not like sitting down for too long, and prefers more active pursuits. Melissa's mother confirms that, if she does watch TV, she needs to be doing something else at the same time such as craft, making cards or writing letters. She also confirms that Melissa's physical fitness facilitates her many sporting interests.

*Enjoying a challenge, sense of achievement:* Melissa describes herself as being good at netball and that this adds to her enjoyment of the sport. Her mother reports that Melissa loves a challenge and the sense of fulfilment she gets from improving her skills, and that her confidence and good self esteem both help her in her sporting pursuits. Melissa's mother also reports that the whole family enjoy a challenge, evident through the board games they play etc.

*Socialising:* Melissa mentions how much she enjoys the social aspect of sport, particularly at her weekend netball, because all the girls on the team like to chatter and gossip. At school Melissa has a large group of friends (about 12 or 13) with whom she plays social sport (netball, basketball, soccer, football) – these friends seem to be focused on the sport aspect and not so much on chatter. Melissa discusses that she enjoys playing on one particular weekend sporting team because her best friend also does. However, she feels that she would still probably play the sport even if her friend was not on the team. While Melissa likes music and practising her instruments, she mentions that she does not

like practising on weekends because she'd rather be playing with her friends. Melissa describes the enjoyment she gets from hanging out with her friends, chatting with them on the telephone and spending hours talking to them on the internet. Melissa considers that she enjoys chatting to her friends because they are good friends and she enjoys spending time with them. Melissa's mother considers that keeping in touch with her friends on the internet is 'cool' and a little motivated by peer pressure. Her mother confirms that Melissa loves socialising, loves going shopping and to the cinema with her friends on school holidays, and that she misses the company of her friends when they go to the family beach house.

*Creativity:* Melissa also enjoys some solitary pursuits, such as craft activities, playing with her dogs in the mornings before school, and playing music (apart from practising her instruments every day, Melissa does enjoy playing around on her instruments during school holidays). Melissa comments that she "feels happy playing music by myself in my room".

#### *Family considerations*

Melissa's family are all very involved with sport, music and socialising with friends, all areas of great interest for Melissa. Her parents role model time spent with family or friends. The family as a whole do not watch much television, but instead spend their time making music or reading. However, Melissa's mother is quite happy for Melissa to spend some time watching TV so that she is not ostracised by her peers (i.e. is aware of the latest shows). Melissa's family are extremely social, and often have visitors popping into the house. Melissa's parents are active members of the community, with a large circle of friends and also mixing in sporting and music clubs. Melissa's mother feels that their social values have had a large impact on Melissa's social choices and use of free time. Melissa's parents are very committed to ensuring that their children have access to their extracurricular activities. While they both work full-time, they have organised their shifts to ensure that one of them is home every afternoon to transport them to activities. They also consider that money is no object to their children's participation in activities. Therefore, family commitment to extracurricular activity is very high.

#### **Case Study 7: High sport**

### **Charlotte**

Charlotte is 12 years old and lives with her mother, father, sister and brother in a suburban house in the north eastern suburbs of Adelaide. She describes herself as a competitive person who loves the tactical elements of sports or games, has lots of friends

and is always on the go. Charlotte has an extremely hectic life in terms of organised activities. On Saturdays she coaches basketball, plays for two different basketball teams, and takes two dance lessons (jazz and tap dancing). Her mother confirms that Charlotte is a ‘gregarious girl who needs the approval of her friends’, ‘has a lot of energy to burn’, is competitive by nature (seeking out goals to strive for), and enjoys sport immensely but also likes to “veg out” in front of the television after so much physically demanding activity. Her mother reports that Charlotte also enjoys some creative pursuits such as creative writing.

*Competitive (‘joy of winning’), fun, keeping fit:* Charlotte discusses her love of the competitive aspect of her interests, such as playing sport or playing cards with friends. When discussing basketball, Charlotte comments that she loves the challenge and loves the tactical nature of the game (the interplay between playing offence and defence) and the different moves that can be used. She also refers to basketball as fun, great because it keeps you fit and that she loves the ‘joy of winning’. Her mother also mentions the ‘high’ that Charlotte seems to get from playing, and the sense of satisfaction she gets from using her strong physique to achieve. When discussing having recently been moved up to play in a higher division, Charlotte mentions her love of a challenge and that it is not fun if her team wins too easily. The higher division gives her this challenge, even though she misses some of her friends. However, Charlotte is very clear that, although she loves playing with her friends, she would not sacrifice getting into a higher division to stay with them. One of Charlotte’s heroes is actually one of her coaches because of her sense of humour and because ‘she keeps you disciplined’. One of Charlotte’s career aspirations is to be a professional basketballer, so no doubt discipline in her sport is very important to her. When discussing dancing, Charlotte says that she enjoys the competitions and putting on the end of year concert, though sometimes practising for an exam or competition gets a bit hectic or tiring.

*Socialising:* Charlotte mentions how much she enjoys going on sleep-overs to friends if she is not too tired after all her sport. She likes staying up late with her friends talking or watching a movie. Charlotte also enjoys the social aspect of her dancing classes as some of her friends do it, and she enjoys talking with the other girls there. Playing cards at school is also another social activity she enjoys.

*Relaxation:* Charlotte reports how much she likes mucking around with her dogs (walking or playing with them), and finds this to be a bit of a ‘cool down’ and good relaxation. When she is on holidays, Charlotte’s mother confirms that she likes to take the dogs for long walks, and also loves doing this as a family. Charlotte also mentions

enjoying television or movies because of the fantasy aspect. Her mother confirms that Charlotte enjoys a good laugh on TV and really appreciates a good movie. Charlotte sometimes reads in bed at night, reporting how much she enjoys learning new words and different ways of expressing them, but also enjoying reading because it gets her mind off other things and she can be in another world.

*Creativity:* Charlotte also enjoys some of her own space, such as when she is doing creative writing, walking or playing with her dogs (though this is also sometimes done with her mother or sister). Creative writing is obviously important to Charlotte, because being a journalist is one of her preferred career options when she is an adult. Her mother reports that she also enjoys visiting historical places when on holidays, such as the migration museum, and that this seems to be some of her inspiration for her story writing.

#### *Family considerations*

Charlotte's parents are very dedicated to ensuring that their children can pursue their sporting interests. In fact, Charlotte's mother gave up work because the transport to and from activities became too difficult to maintain. Therefore, ensuring the children are able to access their interests and pursue their goals is definitely a family priority. Charlotte's parents value the pursuit of sport because of the health, enjoyment, social and friendship benefits, and also because of the importance of having an interest to take pride in. Other factors that influence Charlotte's time use include time and the cost of activities, because she is one of three children. While Charlotte pursues much organised activity, there are also family rules regarding chores and household responsibilities before she can spend some free time.

### **Case Study 8: Socialiser**

## **Ashleigh**

Ashleigh is 11 ½ years old and lives with her father and brother in a suburban house in the near southern suburbs of Adelaide. Ashleigh describes herself as an avid reader who loves to hang out and chat with her friends. Her free time at school is usually spent walking around the school and chatting, doing activities in the library or going on the swings. Out of school hours Ashleigh spends time practising in a choir or participating in church activities. She also enjoys talking with her friend on the telephone sometimes, and doing crafty activities such as working with beads, drawing or cutting. Ashleigh also prides herself on being a collector of soft toys and dolls. Ashleigh values the expressive aspect of doing craft activity and the imaginative aspect of reading. While she enjoys

watching television sometimes, she says that she prefers to read because she likes to create her own pictures of the story in her head. Ashleigh's father confirms that she is not a sporting type of child, preferring interests that revolve around music, reading and being with her friends.

*Socialising:* Most of Ashleigh's free time at school is spent socialising. At lunchtime she walks around the school chatting to her friends, and mentions 'Me and my friends are not all that energetic'. She explains that she does not enjoy sport because she gets puffed out so easily and it stresses her out. Ashleigh says being with her friends is fun because you really get to know your friends well. Sometimes she goes on the swings or to the library with her friends. As well as reading in the library, Ashleigh does puzzles with her friends, looks through dog books together, or dog advertisements in the paper. Ashleigh has one particular friend who consistently rings her at home. Ashleigh describes chatting with her friends as 'sort of like playing, but it's talking', she enjoys having close friends and chatting to them. Ashleigh describes being with friends as being a nice change from reading. Her family is very involved with church on Sundays, and she mentions that she likes the social aspect of church – she has nice friends there. Her father confirms that she is a social girl, and that this seems to be a good balance for her avid reading which is obviously a solitary pursuit.

*Self expression, Imagination & Creativity:* Ashleigh enjoys reading so much that she was unable to say how long she read for of an evening, saying "I never tell the time". She becomes very focused on her reading, describing how she usually finishes a book in a night. Ashleigh explains that 'When you're reading you can imagine absolutely everything, you can imagine what the characters look like'. Ashleigh participates in the South Australian Primary Schools Choir, but in addition to this organised activity, enjoys practising singing in her room. Her father confirms that she loves music, singing in both the school and the state choir, and also playing the piano. He also feels that Ashleigh is drawn to musical activities because she is so good at them and that they are a form of expression for her. Ashleigh's father feels that her strength in music compensates for her lack of sporting prowess (perhaps due to her poor vision) – it is something she can excel in. Ashleigh likes doing craft activities such as making things with beads, cutting and drawing, but mentions that she does not have a long concentration span when it comes to craft activities. Drawing is one particular activity that she enjoys doing with her grandfather – they like to draw faces together. Ashleigh explains that she likes doing craft activities because they are 'an expression of yourself. Nobody can tell you what to do'. Ashleigh indicated in her survey that she sometimes feels sad and unhappy.

*Relaxation:* Ashleigh mainly uses reading to relax, however, does enjoy watching some television with her brother, and likes being able to ‘veg out’. Ashleigh also enjoys sleeping in on Saturdays because she does not like that feeling of having to go and do something. She also likes to collect soft toys because ‘they are cute and cuddly and you never know when something might be useful’.

#### *Family considerations*

*Church Community:* Ashleigh’s father describes their church as being different from most people’s view of church, with a strong sense of community and village life. Consequently, many of Ashleigh’s social activities are provided within the church community, such as camping and kayaking with the church, going to church concerts etc. Ashleigh’s father also considers that the church emphasis on music could be partly attributable to her interest in music, although both parents are also musical. As a family, great value is placed on music, with Ashleigh, her father and brother often singing 3 part harmony in the car. The family interest in music, socialising and the church community play a large role in guiding Ashleigh’s interests.

Ashleigh’s grandparents are very supportive in helping her to pursue her interests. For example, they transport her to choir practice and also pay for her singing lessons. The facilities provided at home facilitate musical involvement e.g. piano, musical software on the computer.

#### **Case Study 9: High screen time**

### **Susan**

Susan is 12 years old and lives with her mother, father, sister and brother in a suburban house in the outer southern suburbs of Adelaide. She describes herself as enjoying hanging around at school and chatting to her friends, teaching the junior primary children to jump rope, sometimes playing chasey. Susan enjoys playing a leadership role at school, and has enjoyed the responsibility of teaching the junior primary children to learn ‘jump rope for heart’. Apart from the jump rope activity, the younger children do sometimes seek her out to play with. This is consistent with Susan’s career aspiration of being a teacher. After school Susan likes to ride her bike, watch television or use the computer. Susan participates in one organised weekend activity – playing basketball, and mentions that she likes the action in basketball.

*Socialising:* Susan describes how she enjoys the social aspect of her bike riding, that is, she can ride to friends' houses and visit them. Susan's computer use is largely social, often chatting with friends on the internet. While she does play computer games on her own, she often plays computer games jointly with her friends at their houses. Susan also plays board games with her family on some weekends. Her mother confirms that Susan enjoys the companionship of her friends.

*Physical activity, the challenge, competitiveness:* Susan mentions that she enjoys physical activity, enjoying the action in basketball. Her mother also confirms that Susan likes to keep moving, likes the exercise she gets from activities such as playing chasey, and enjoying the challenge of catching someone or trying not to get caught. Susan's mother also mentions that she likes to exercise and keep fit, and that jump rope is a good way to do this because she does not play a great lot of sport. Her mother also feels that Susan's competitiveness is not only evident through sport, but the family also compete against each other when watching game shows on television. The family also compete against each other in board games such as Cluedo and Monopoly. Susan's mother considers that Susan's interest in computer games is largely because of her competitive nature.

*Relaxation:* Susan enjoys the relaxation she gets from watching television. Her mother confirms that she seems to like not having to think when she watches television. However, she also feels that Susan does sometimes like to watch more in-depth shows for the social comment (i.e. she likes movies that are based on true stories).

#### *Family considerations*

It is worth noting that Susan has only recently had her bike and her mother reports that this has impacted greatly on decreasing her television and computer time. Susan also mentions that she still enjoys television and computer use, but is probably doing those activities less than when she completed the computer survey because she now has a bike and can visit her friends in person. Family time together is considered an important priority for Susan's parents, therefore family social activities such as playing board games are greatly encouraged. Socialising with extended family is also an important family value. Susan's parents enjoy socialising and have never been overly sporting people, therefore, Susan's mother considers that this has probably impacted upon Susan's limited involvement in sporting pursuits.

Parental time is a major factor in not being able to transport Susan to more than one leisure pursuit on weekends, with both having work commitments that are largely out of traditional business hours. Cost of involvement and time are major considerations with 3

children in the family. Facilities at home have been very much a factor of influence, as discussed above with the change that access to the pushbike has facilitated. Susan's mother's health has also impacted on informal active tasks such as walking to school – she has a chronic back injury which has meant they can no longer walk to school which is one activity they used to do on a regular basis.

### Appendix 8.1.1 Interview Schedule - Children

Questions:	Procedures
	<p><b>Equipment needs: 2 audiorecorders, 2 tapes (90 minutes each); butchers paper, pens , 2 sets of pictures</b></p>
<p>Interviewer states</p> <ul style="list-style-type: none"> <li>• Tape recording</li> <li>• reason for the interview: refer back to entering of daily activities on computers at school. We would like to get more information about how you choose to spend your time.</li> <li>• No right or wrong answers – all children we interview may give us different answers and that is what we want.</li> </ul>	
<p><b>Game 1:</b> Think of an ordinary school day and build your day for me with these pictures from the beginning when you get up to when you go to bed at night. The pictures have been chosen to represent your activities during the day but they do not include all the activities that you could possibly think of – therefore, you may need to choose one that is not entirely the same, but we will write underneath the pictures if they are not exactly the activity that you are looking for. <i>(Take child through them.)</i></p> <p>Interviewer builds discussion around the finished routine – focus on activities done by choice and in free/ unstructured time.</p> <p>Prompts: Tell me more about:</p> <ul style="list-style-type: none"> <li>• What time do you usually do this activity?</li> <li>• Where do you do this?</li> <li>• Who do you do this with? Tell me a bit about your friends. How often do you get together. What would you do when you get together?</li> <li>• How long do you do this?</li> </ul>	<ul style="list-style-type: none"> <li>• Use pictures of activities which represent a typical school day</li> <li>• Build on butchers paper, write extra headings where required, write name on and take a photo.</li> </ul> <p><b>Guidelines for questioning:</b></p> <ul style="list-style-type: none"> <li>• Simplify your language when child does not respond</li> <li>• Repeat question in a slightly different way when child does not respond</li> <li>• Clarify child’s response by repeating child’s words/ using synonyms or categorising</li> <li>• Do not ask leading questions</li> <li>• Summarise child’s response at end by saying <ul style="list-style-type: none"> <li>○ So, am I right in saying...</li> <li>○ So, your day usually goes like this....</li> <li>○ Then give them time to verify or add</li> <li>○ Give yourself time to check whether you have asked all possible questions</li> </ul> </li> <li>• Maintain a neutral stance- no acknowledgement of answers</li> <li>• Look for themes emerging in various questions and take the opportunity to verify the themes</li> <li>• With more than one answer, try to focus on one option only and</li> </ul>

<ul style="list-style-type: none"> <li>• Do you like/ dislike doing this?</li> <li>• How do you do this?</li> <li>• Why do you do this?</li> </ul>	<p>prompt further</p> <p><b>Guidelines for prompting:</b></p> <ul style="list-style-type: none"> <li>• Do not ask guiding questions</li> <li>• Use the child's own language to clarify or expand</li> <li>• Use synonyms of the child's words</li> <li>• Categorising the child's activities is fine</li> <li>• "Its fun" – what is fun about/ what makes it fun?</li> <li>• "I like.." - What is it about... that you like?</li> <li>• What would it be...</li> <li>• What else...</li> </ul> <p>Eg " what do you like about animals/ horseriding?"</p>
<p><b>Game 2:</b> Think of a weekend day and build your day for me with these pictures from the beginning when you get up to when you go to bed at night.</p> <p>Interviewer builds discussion around the finished routine – focus on activities done by choice and in free/ unstructured time.</p> <p>Prompts: Tell me more about:</p> <ul style="list-style-type: none"> <li>• What time do you usually do this activity?</li> <li>• Where do you do this?</li> <li>• Who do you do this with? Who do you do this with? Tell me a bit about your friends. How often do you get together? What would you do when you get together?</li> <li>• How long do you do this?</li> <li>• Do you like/ dislike doing this?</li> <li>• How do you do this?</li> <li>• Why do you do this?</li> </ul>	<ul style="list-style-type: none"> <li>• Use pictures of activities which represent a typical school day</li> <li>• Build on butchers paper, write extra headings where required, write name on and take a photo.</li> </ul> <p>Look for themes and use opportunity to prompt more/ verify themes</p> <p>End by summarising, giving child opportunity to verify/ add and for interviewer to check whether all questions have been asked</p>
<p>If you could design your perfect day, tell me about what it would look like</p>	<p>Children can make it as unrealistic/ realistic as they want to</p>

<ul style="list-style-type: none"> <li>• Why do you like spending time on.....?</li> <li>• What would you do during the day</li> <li>• What would you do during night time</li> <li>• Who would you do it with?</li> <li>• Where would you do this?</li> <li>• Why do you do this?</li> </ul>	<p><i>Depends on the amount of detail obtained above, select prompts accordingly</i></p> <p>Look for themes and use opportunity to prompt more / verify themes</p>
<p>Do you remember the activities that you had to choose from and enter into the computer at school? We have taken all of the information and put it together. From there, we could see that you spend a lot of time on.....</p> <ul style="list-style-type: none"> <li>• Can you tell me why you do this activity so often?</li> <li>• Do you like this activity? What is it that you like about.....?</li> <li>• Who do you do it with?</li> <li>• Where do you do it?</li> <li>• What time of day do you do it?</li> <li>• What makes you feel good about doing this?</li> <li>• How good are you at doing this?</li> </ul>	<p><i>Depends on the amount of detail obtained above, select prompts accordingly</i></p> <p>Look for themes and use opportunity to prompt more / verify themes</p>
<p>From the information that you have put into the computer, we could see that you do not spend a lot of time on.....</p> <ul style="list-style-type: none"> <li>• Why don't you spend a lot of time on .....</li> <li>• Do you like this activity? What is it that you like/ don't like about.....</li> <li>• Who do you do this with?</li> <li>• When do you do this?</li> <li>• Where do you do this?</li> </ul>	<p><i>Depends on the amount of detail obtained above, select prompts accordingly</i></p> <p>Look for themes and use opportunity to prompt more / verify themes</p>

<ul style="list-style-type: none"> <li>• What time of day do you do it?</li> <li>• How good are you at doing this?</li> </ul>	
<p>Do you have any heroes or people that you really like, for example movie stars, musicians sport heroes?</p> <ul style="list-style-type: none"> <li>• Can you tell me about one? (<i>prompt for 3</i>)</li> <li>• Why do you like.....?</li> <li>• What is it about.... That you like?</li> <li>• Can you tell me more...</li> <li>• Anyone else that you can think of as a hero?</li> </ul>	<p>Prompt for 3 if possible</p> <p>If they give more than one, keep focussed on only one and prompt further</p> <p>Look for themes and try to verify themes</p>
<p>Tell me a bit about your favourite tv show or movie.</p> <ul style="list-style-type: none"> <li>• Why do you like.....?</li> <li>• What is it about.... That you like?</li> <li>• Can you tell me more...</li> </ul>	<p>Prompt for 3 if possible</p> <p>If they give more than one, keep focussed on only one and prompt further</p> <p>Look for themes and try to verify themes</p>
<p>If you could design your own holiday what would it be?</p> <ul style="list-style-type: none"> <li>• What do you like about that holiday?</li> <li>• What do you like about...</li> <li>• Can you tell me more...</li> <li>• What would you do during the day</li> <li>• What would you do during the night time</li> <li>• Who would be there with you</li> <li>• Where would you live?</li> </ul>	<p>Children can make it as unrealistic/ realistic as they want to</p> <p>Look for themes</p>
<p>Tell me about what job you would like to do when you have finished school</p>	

Thank participant and ask him/ her to complete the survey.

Interviewer's field notes of observations/ impressions during interview:

## Appendix 8.1.2: Interview Schedule – Parents

### Interview: Parents

Questions	Procedures
	<b>Equipment needs: 2 audiorecorders, 2 tapes (90 minutes each)</b>
<p>Interviewer states:</p> <ul style="list-style-type: none"> <li>• reason for the interview: refer back to entering of daily activities on computers at school. We would like to get more information about how and why your child chooses to spend his/her time on specific activities</li> <li>• takes about 30 – 45 minutes</li> <li>• tape recording</li> </ul>	
<p><b>Please describe a typical school day (i.e. weekday) for your child:</b></p> <ul style="list-style-type: none"> <li>• time (duration) eg 7 – 7:45</li> <li>• activity eg wake up, get ready for school</li> <li>• further description</li> </ul> <p>Focus on the activities done by choice and in child’s free time, ask:</p> <ul style="list-style-type: none"> <li>• where does he/ she do this?</li> <li>• Who does he/ she do it with.</li> <li>• Tell me a bit about his/ her friends. How often do they get together. What would they do when you get together?</li> <li>• Family’s involvement in community?</li> <li>• Neighbourhood events?</li> <li>• Extended family?</li> <li>• Does he/ she like doing it?</li> <li>• How does he/ she do it?</li> <li>• Why does he/ she do this?</li> </ul>	<ul style="list-style-type: none"> <li>• Interviewer prompts time and activity; also family’s involvement in community events/ neighbourhood, extended family</li> <li>• Focus on themes of determinants not actual activities</li> <li>• Summarise main aspects to verify description</li> <li>• Look for themes emerging in various questions related to determinants of behaviour</li> <li>• Take time to verify themes emerging</li> <li>• With more than one answer, try to focus on one option at a time and prompt further</li> </ul>
<p><b>Please describe a typical weekend day for your child:</b></p> <ul style="list-style-type: none"> <li>• time (duration) eg 7 – 7:45</li> </ul>	<ul style="list-style-type: none"> <li>• As above</li> </ul>

<ul style="list-style-type: none"> <li>• activity eg wake up, get ready for school</li> <li>• further description</li> </ul> <p>Focus on the activities done by choice and in child's free time, ask:</p> <ul style="list-style-type: none"> <li>• where does he/ she do this?</li> <li>• Who does he/ she do it with.</li> <li>• Tell me a bit about his/ her friends. How often do they get together. What would they do when you get together?</li> <li>• Family's involvement in community?</li> <li>• Neighbourhood events?</li> <li>• Extended family?</li> <li>• Does he/ she like doing it?</li> <li>• How does he/ she do it?</li> <li>• Why does he/ she do this?</li> </ul>	
<p>Can you describe the activities which your child would typically be doing during school holidays?</p> <ul style="list-style-type: none"> <li>• where does he/ she do this?</li> <li>• Who does he/ she do it with.</li> <li>• Family's involvement in community?</li> <li>• Neighbourhood events?</li> <li>• Extended family?</li> <li>• Does he/ she like doing it?</li> <li>• How does he/ she do it?</li> <li>• Why does he/ she do this?</li> </ul>	<ul style="list-style-type: none"> <li>• As above</li> </ul>
<p>Can you give me an idea of what your child loves spending his/her time on? What do you think the reasons are for his/her interest in this activity/ these activities?</p>	<ul style="list-style-type: none"> <li>• As above</li> </ul>
<p>From the survey, your child has been identified as a typical child with .....(name of profile), what do you think are the reasons for this</p>	<p>Interviewer selects questions depending on the level of detail obtained in previous questions</p>

<p>activity pattern occurring with your child?</p> <ul style="list-style-type: none"> <li>• where does he/ she do this?</li> <li>• Who does he/ she do it with.</li> <li>• Family's involvement in community?</li> <li>• Neighbourhood events?</li> <li>• Extended family?</li> <li>• Does he/ she like doing it?</li> <li>• How does he/ she do it?</li> <li>• Why does he/ she do this?</li> </ul> <p>And/ Or</p> <p>Can you tell me more about why does he/she <b>not spend a lot of time on</b>  .....</p> <ul style="list-style-type: none"> <li>• where does he/ she do this?</li> <li>• Who does he/ she do it with.</li> <li>• Family's involvement in community?</li> <li>• Neighbourhood events?</li> <li>• Extended family?</li> <li>• Does he/ she like doing it?</li> <li>• How does he/ she do it?</li> <li>• Why does he/ she do this?</li> </ul>	
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Tell me about the sorts of things within your family which you feel may influence your child's use of time:	Interviewer notes the activities below which parents mention spontaneously, then asks about the others which they have not mentioned – are they considerations as well for the family?
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<b>Activity:</b>	<b>Tick</b>	<b>Please describe</b>
Transport to and from activities		
Costs of involvement in activities		
Time considerations for child		
Time considerations for family		
Facilities at home, e.g. garden, swimming pool		
Access to playgrounds, parks or other community facilities		
Safety of my child while doing activities		
Family member/s' interest and/or participation in activities		
Family rules regarding the use of leisure		
Parent/s' attitude to screen time e.g. watching tv, playing video/ computer games		
Other children available to do activities with		
Weather conditions		
Amount of physical activity time at		

school		
School resources, e.g. sport facilities, PE teachers available		
Ethnic/ cultural background		
Other:		
Family values/beliefs		
Parent's own routine		
Family's health issues		

Anything to add which we may not have covered and which may give us a better understanding of the activity patterns of your child?

Thank participant.

Interviewer's field notes of observations/ impressions during interview.

### 8.1.3 References

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## Appendix 8.2 – Clustering data analysis

### Data treatment prior to clustering analyses

Most time-use variables were highly skewed. Box-Cox transformation was used to normalise all time-use variables, which resulted in normal distributions for all, using d'Agostino's test (d'Agostino & Pearson, 1973). All variables were then standardised (using z-scores) relative to cases of the same sex prior to cluster analysis.

### Multicollinearity

In clustering analyses, it is important to ensure the variables do not exhibit multicollinearity (the extent to which one variable can be explained by the other variables in the analysis; (Hair, Anderson, Tatham, & Black, 1998). A polychoric correlation matrix of all activity variables was calculated and variance inflation factors were calculated to assess multicollinearity (Kutner, Nachtschiem, Wasserman, & Neter, 1996). As the MARCA requires children to account for their entire waking day, negative correlations are expected between most variables (i.e., if you spend a lot of time in one activity variable, you automatically spend less time in the remaining variables). The table below shows the polychoric correlation matrix for the five activity variables. Most correlations between the variables were low, with the correlations between inactive socialising and sport ( $r = -0.494$ ) and screen time and low-level activity ( $r = -0.470$ ) being the highest negative correlations. Variance inflation factors range from 1 to infinity, with 10 representing very high multicollinearity (Kutner et al., 1996). All VIFs calculated on our variables were  $< 2.13$  (mean = 1.64), therefore multicollinearity of variables did not impact the clustering analysis.

**Table 1 Polychoric correlation matrix for all activity variables used in the clustering analyses**

Activity variable	Screen	Inactive socialising	Low-level	Loco-play	Sport
sport					1.000
sleep	-0.260	-0.077	+0.059	+0.025	-0.158
screen	1.000	-0.237	-0.470	-0.340	+0.058
low-level			1.000	+0.282	-0.494
loco-play				1.000	-0.358
inactive socialising		1.000	-0.082	-0.079	-0.030

### **Two-step clustering technique**

Clustering attempts to minimise the variance within clusters, while maximising the difference between cluster centroids. There are a number of different methods of cluster analysis (Pung & Stewart, 1983). A two-step clustering technique was chosen. The first step involved using a hierarchical clustering technique to identify the number of clusters for each gender and to identify the initial cluster centroids to base the second stage of the clustering analysis on. Squared Euclidean distances were used to create the similarity matrix between clusters and Ward's method algorithm was used to form the clusters. The second step involved a K-means, non-hierarchical clustering method to refine the clusters into the selected number of final clusters. The K-means method is the most suitable for large datasets, and a number of empirical studies (Mezzich, 1978; Milligan, 1980) have found that K-means performed best when compared to other methods. Other cluster methods were not as suitable for this dataset. Analyses were performed for boys and girls separately using *SPSS version 11(2002)*. Each case was assigned to one cluster, and the Euclidean distance between it and its cluster centroid was calculated.

### **Reliability of the cluster solution**

The reliability of the cluster solution was assessed by a 'holdback' technique where both the girls' and boys' samples are split in half and a cluster analysis performed on each half. The cluster centroids from one half are used to classify the remaining half into clusters. The two cluster solutions are then compared using Cohen's kappa and percentage agreement. While F-ratios do not quantify the validity of the clusters themselves, because the clustering process is designed to maximise those F-ratios, one-factor ANOVA was used to assess the efficiency of the solution (Hair, et al., 1998). The relative size of the F-ratios quantifies the relative contribution of each variable to cluster separation and reflects the efficiency of the solution.

### **Profiling the clusters**

We tested whether clusters varied significantly according to age, socio-economic status (SEIFA), body mass index (BMI), geographical location (metropolitan vs non-metropolitan), school sector (government vs private) and family structure (single parent family with no siblings vs single parent family with siblings vs two-parent family with no siblings vs two-parent family with siblings). Box-Cox transformations were applied to skewed BMI values and resulted in normal distributions (d'Agostino & Pearson, 1973). These analyses were done using factorial ANOVA and Fisher PLSD post-hoc analyses for the continuous variables, and contingency tables for categorical variables.