



Australian Government
Australian Sports Commission



Children and Sport

an overview



A RESEARCH REPORT BY THE
UNIVERSITY OF SOUTH AUSTRALIA

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A copy of the full report can be found on the Australian Sports Commission web site at www.ausport.gov.au/research/youthandsport04.asp.

If you require further information regarding this research, please contact:

The Manager
Corporate Planning and Research
Australian Sports Commission
Tel: (02) 6214 1531

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The Manager
Business Development
Australian Sports Commission
PO Box 176
BELCONNEN ACT 2616
Email: copyright@ausport.gov.au

For general enquiries regarding the Australian Sports Commission:

Tel: (02) 6214 1111
Fax: (02) 6251 2680
Email: asc@ausport.gov.au
Web site: www.ausport.gov.au

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Introduction

In December 2003, the Australian Sports Commission engaged the University of South Australia (School of Health Sciences) to conduct research to provide an understanding of the factors influencing young peoples' involvement in sport and physical activity, and the promotion of the positive benefits of lifelong involvement in organised sport. It was envisaged that the results of the research would contribute to the development of effective strategies to address the growing problem of childhood obesity and increasing sedentary behaviour.

Between 20 per cent and 25 per cent of Australian children are overweight or obese, with the proportion increasing at an accelerating rate (National Obesity Taskforce 2003).

About the Australian Sports Commission and overview of the research

The Australian Sports Commission is the Australian Government body responsible for coordinating the Government's commitment to the sporting industry. Its role is to provide national leadership in all facets of sport development from the elite level, through national sporting organisations (national governing bodies for sport and their affiliated associations, clubs and individuals), to the government and private sectors, schools and the wider sporting community.

Research objectives

The overall aims of this research were to provide a better understanding of the factors influencing young peoples' involvement in sport and physical activity, and through tackling issues such as obesity, verify the positive benefits of lifelong involvement in organised sport.

The study addressed five main questions:

- 1 How and why are young people involved in different kinds of physical activity?
- 2 Which types of young people are active, and how and why do they get involved in sport?
- 3 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?
- 4 What strategies are necessary to encourage and sustain lifelong involvement in sport and physical activity?
- 5 What further research is needed to reliably monitor, evaluate and investigate the effectiveness of sport and physical activity programs designed for young people?

Research methodology

The research program used three methodological approaches to collect different types of data, which provided the insights to answer the five research questions posed. These were literature reviews, market segmentation analysis and use-of-time analysis.

Literature reviews

A series of reviews of Australian and international literature were conducted to summarise current knowledge on the social and scientific contexts relevant to Australian children and policymakers. This included 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).

Market segmentation analysis

The study applied market segmentation techniques — that is, cluster analysis — to use-of-time and demographic data collected on a large sample of 9–15-year-old¹ South Australian children² with a view to differentiating children according to their physical activity and inactivity time budgets. Identification of children typical of each cluster enabled qualitative information on their lifestyles and family contexts and, consequently, better informed recommendations for future intervention strategies. Until recently, market segmentation, which identifies different types of consumers based on demographic, attitudinal and behavioural characteristics, had mainly been applied in commercial contexts, but in this study, it was used as part of a cluster-analysis process to look at the 'activity market', based on several thousand very detailed use-of-time profiles completed by children.

Overall, 4661 children aged 9–15 years (the mean age was 11.9 ± 0.8) were randomly selected from schools in South Australia and completed the use-of-time Multimedia Activity Recall for Children and Adolescents diaries. All of these were analysed; however, for the purposes of this study, only a sub-set (1129) was used for the cluster analysis. 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. On two to five occasions between April 2001 and September 2003, children completed the Multimedia Activity Recall for Children and Adolescents. The Multimedia Activity Recall for Children and Adolescents is a computerised activity recall linked to a compendium of energy expenditures. It asks children to recall their previous day's activities in blocks as small as five minutes using a segmented-day format. Children choose from lists of more than 200 activities, grouped into seven categories. 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 analysis also included interviews with children representative of the different activity styles. 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.

Use-of-time analysis

Data were collected using the Multimedia Activity Recall for Children and Adolescents to recall everything the child did in their last 24 hours (in a minimum of five-minute slices) to effectively analyse how they used their time. It provided information on the amount of time children spent

1 This age group is of particular interest because a number of cross-sectional studies have identified rapid declines in physical activity and increases in sedentary behaviours in children in the peri-pubertal years (Kimm et al. 2000, Telama and Yang 2000, van Mechelen et al. 2000).

2 It is important to note that this study draws from international literature and the reported behaviour of children in South Australia only. The findings of the Multimedia Activity Recall for Children and Adolescents and use-of-time analysis components of this research therefore may not necessarily be representative of all Australian children.

on physical activity, daily and seasonal patterns in time devoted to physical activity, as well as socio-demographic correlates of physical activity. The use-of-time analysis also allowed the analysis of individual sports in terms of age and gender profiles and relative popularity.

Approaching the research questions from multiple points of view allowed the study to examine the questions from different aspects and to compare and collate the results. For example, the literature review revealed weak and inconsistent relationships between socio-economic status and levels of physical activity. The use-of-time analysis showed no relationship between socio-economic status and minutes devoted to sport or overall activity levels. The clustering analysis also found no relationships between socio-economic status and different activity styles. The findings appeared to indicate that the small effect of socio-economic status may be mediated by family structure.

Category/cluster identification — a description of the groups

A three-cluster solution for boys and a four-cluster solution for girls were found to be efficient and had acceptable reliability.

Boys' cluster solutions

Three distinct clusters were found for boys. Cluster 1 consisted of 35.7 per cent of the sample and its members were named 'sporties' due to the large amounts of time they spent playing sport. Cluster 2 members consisted of 32.2 per cent of the sample and were named 'screenies' due to their high levels of screen time per day. The third cluster also consisted of 32.2 per cent 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.

Girls' cluster solutions

A four-cluster solution was found for girls. Cluster 1 consisted of 26.9 per cent of the sample and its members were named 'players' due to their high levels of play time. Cluster 2 consisted of 26.2 per cent of the sample and was characterised by high levels of screen time. Its members were labelled 'screenies'. Cluster 3 consisted of 25.8 per cent of the sample and consisted of girls who spent large amounts of time playing sport and were therefore named 'sporties'. The fourth cluster (21.1 per cent of the sample) was named 'socialisers' due to their high levels of inactive socialising.

Findings

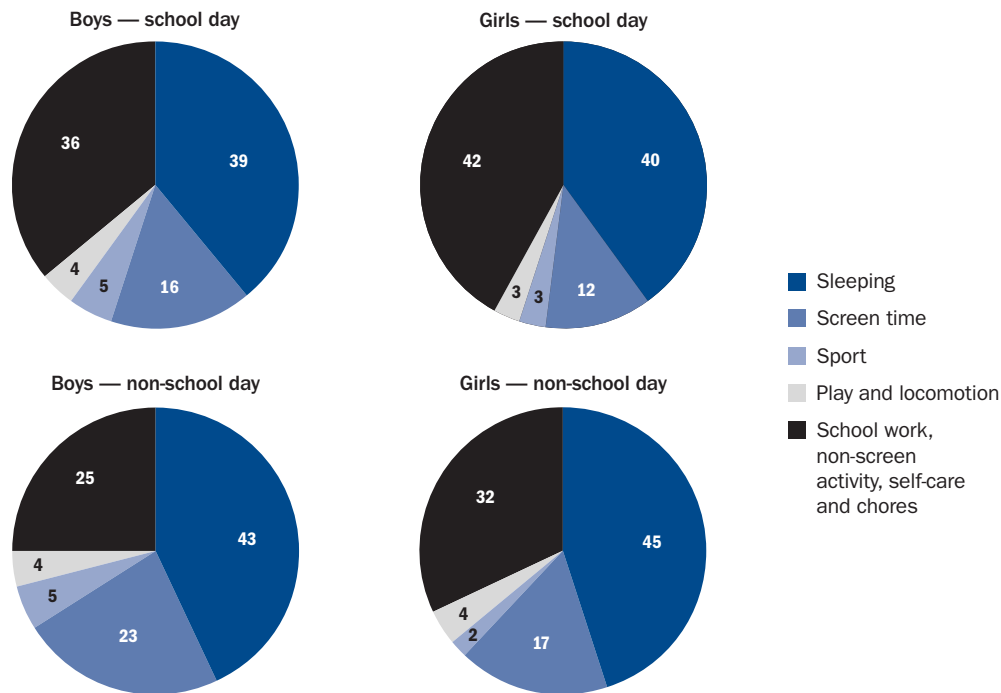
Young people's involvement in different kinds of physical activity

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

Overall levels of involvement in sport and physical activity

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

Figure 1 Percentage of time devoted to sleeping, screen time, sport, play, locomotion and other activities including school work, non-screen inactivity, self-care and chores, on school and non-school days for boys and girls



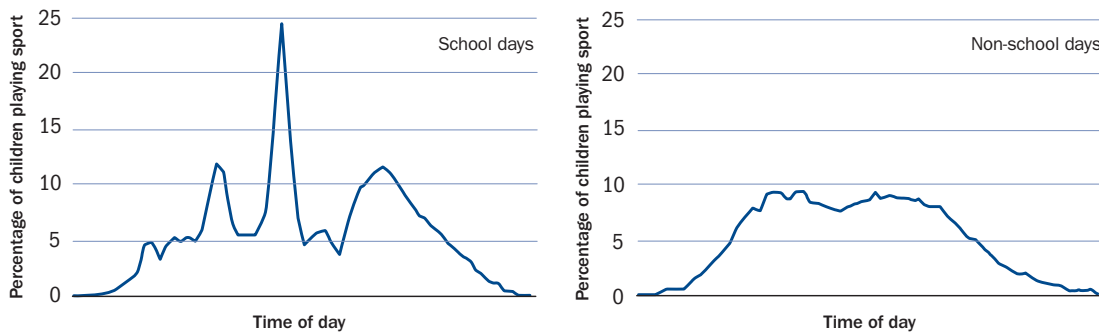
Distribution of sport time

The distribution of time devoted to sport is highly skewed. The median daily time devoted to sport is 35 minutes, but on one quarter of days, children do no sport at all. At the other end of the scale, children do 85 minutes or more of sport on one quarter of days, and 185 minutes or more on 5 per cent of days. These figures reflect both variability in habitual activity among 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. Boy 'sporties', for example, spend four times the amount of 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.

When children play sport

On school days, sport participation peaks at lunchtime (25 per cent of all profiles), recess (12 per cent) and after school (12 per cent). On non-school days, participation rises slowly to plateau at about 8–10 per cent from about 10.00am until 5.00pm. 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 2 shows the percentage of children playing sport as the day progresses. On school days, there are peaks at recess and lunch, and a slowly accumulating peak after school finishes. About 5 per cent of children are playing sport at any one time during the school day, which roughly agrees with recent estimates that about 3 per cent of school time is devoted to sport. It is of interest that even at the lunchtime peak (1.15pm), only 25 per cent of children are playing sport. This is in part due to the fact that schools in South Australia have different lunchtimes, but also reflects the fact that many school children will either play or do nothing active at lunchtime. However, even after school, in the critical window period (between after school and the evening meal), less than 12 per cent of children are playing sport at any one time. After school, participation rises slowly to peak at 4.45pm (11.7 per cent), and then declines rapidly.

Figure 2 Percentage of children playing sport at different times during school and non-school days



Physical activity versus screen time

Over half of all children aged 5–14 years are spending more time watching television and videos than in the school classroom. The overwhelming competitor for physical activity is screen time — television, video games, cinema and texting. Every extra hour of sport reduces screen time by 20–24 minutes. During the critical window period, children are three to four times more likely to be in front of a screen than playing sport. 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’.

Sport versus play

Qualitative studies have suggested that terms such as ‘sport’, ‘play’ and ‘physical activity’ have quite different resonances for children (MacDougall et al. 2003). ‘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 the decline in free play. Free, unsupervised play in the neighbourhood, once a dominant feature on the Australian suburban 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.

Which sports are the most popular?

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

What attracts children to, or repels them from, sport?

The most commonly offered reason for not participating in (more) sport was lack of time or other time commitments such as homework and jobs (40 per cent of all responses). Focus groups raised other issues such as an emphasis on rigid rules, uniforms, training drills, competition and winning. Fear of injury also emerged in focus groups as a deterrent. However, these issues rated very low (under 5 per cent) of questionnaire responses. When asked what would facilitate their involvement in sport, the most common responses were the ability to play with friends and family (24 per cent of all mentions), and various logistical issues, such as transport, facilities and cost (35 per cent). New forms of locomotion (for example, skateboards and micro-scooters) were chosen by 9 per cent of children.

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. 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 per cent of the variability in sports participation. 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.

Gender

By far the best predictor of the amount and type of physical activity a child enjoys is based on their gender. There is overwhelming evidence that boys are more active than girls at any age. Boys' daily physical activity levels are about 5–10 per cent greater than girls'. On average, boys spend about 68 minutes per day playing sport, compared to 36 minutes for girls. This equates to 19 per cent of boys' total daily energy expenditure, but only 12 per cent 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. Sports dominated by boys include Australian football (seven boys for each girl), cricket (three to one) and soccer (2.5 to 1). Sports dominated by girls include netball (11 to 1) and dance (four to one). Finally, boys have different motivations for sports participation; they tend to value extrinsic motivations (rewards and prizes) more than girls.

Age

After gender, the next best predictor is age. Overall levels of physical activity decline with age, with sharp falls around puberty. This is a common pattern for a wide range of species, 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. Declines in adolescence tend to be largely in non-organised physical activity rather than in organised sports, particularly among girls. When children are divided into activity clusters, girl 'screenies' (high levels of television and video games, low sport) tend to be older than other clusters. The amount of time spent playing sport decreases at a rate of 7 per cent per year of age in girls, and 3 per cent in boys, while the percentage of daily energy expenditure devoted to sport is fairly constant. There are declines in participation with age in most sports, particularly in aerobics, swimming and dance (declines of 30–50 per cent per year), and cricket, soccer and basketball (15–23 per cent per year). Participation in Australian football and tennis is constant across the 10–14-year-age band, while table tennis becomes increasingly popular. Finally, older children prefer less adult and family involvement in their play, prefer to mix with larger groups of friends and are less influenced by high-profile athletes, coaches and other adults.

Socio-economic status

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

Family structure

Aspects of family structure (single versus two parents; siblings versus no siblings) can overlap with socio-economic status. We divided families into four structural types: 10 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. 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 were less likely to consider active play to be fun. Some of these effects are probably due to the synergistic effect of siblings. The reduction in average family size is of concern for future activity patterns.

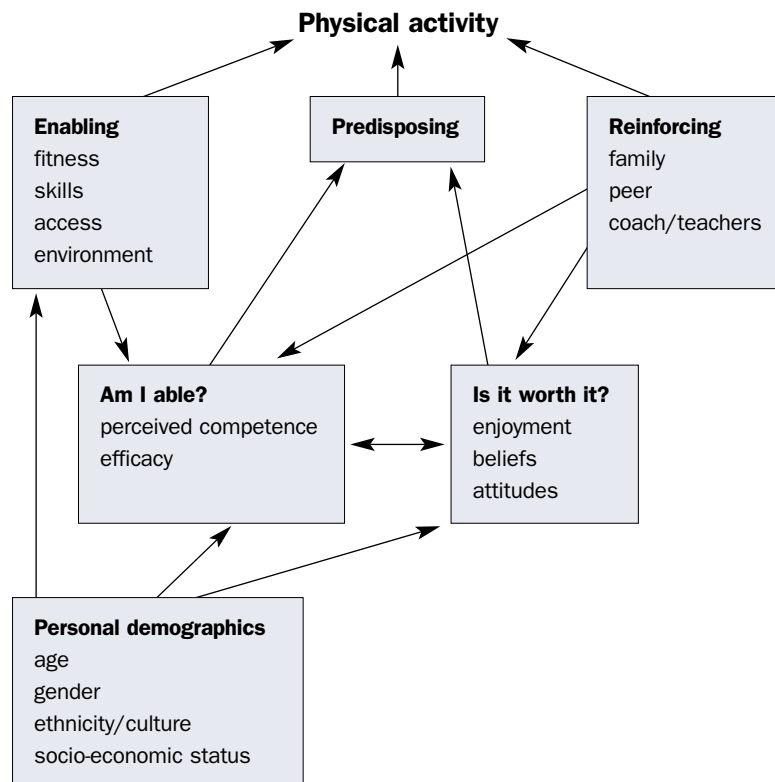
Parents as models

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 cited parents as the main influence on their activity choices. The effect of direct modelling, however, appears to be small. Children, particularly older children, rank the influence of parents as motivators uniformly low. Children who reported that their fathers were involved in sport reported playing more sports themselves and twice as many weekly sessions of play. There were no associations between reports of mother's involvement and self-reported sports participation.

The play environment

Both the amount of play space available and its layout affect activity levels of children. In most industrial countries, there has been a trend away from open, unstructured areas to suburbanised, closed, divided and structured cityscapes. The amount of physical activity equipment in the home and the school affects play behaviours, as does the available play space. This is particularly true for boys, whose games tend to be more wide ranging. Smaller backyards reduce the amount of free play. 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.

Figure 3 A conceptual diagram of the Youth Physical Activity Promotion Model highlighting the different variables that lead to physical activity



Source: Adapted from Welk, Corbin and Dale 2000

‘Good news’ stories about the benefits of sport

Most recent findings about children and physical activity are negative. The context is that children are getting fatter, aerobic fitness is declining and physical activity is 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 that is increasingly ‘toxic for exercise’. Furthermore, a substantial number of children combine high levels of physical activity with high levels of social activity.

The context: fitness, fatness and physical activity

About 20–25 per cent of Australian children are overweight or obese, and the proportion is increasing at an accelerating rate, particularly since the mid-1980s — a trend that reflects international patterns. At the same time, the aerobic fitness of children has taken a sharp downward turn since 1970–80, trending downwards at about 0.4 per cent per annum. This is again in line with international trends. Increasing fatness and decreasing fitness appear to be associated not with increased energy intake, but rather with declines in physical activity. There has been a fall in participation in organised club and school sports, decreases in active transport, failure to reach physical education targets and changes in the built environment (such as reduced open space, more arterial roads and disintegration of community focal points) that have created an environment that is ‘toxic for exercise’.

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. Attitudes towards physical education, physical activity and school sport have been consistently positive since 1985. Very few children (under 6 per cent) say that they ‘are not into sport’, and a similar percentage avoid sport out of fear of injury. In response to the Multimedia Activity Recall for Children and Adolescents psychosocial questionnaire, only 19 per cent of girls and 6 per cent of boys said that they would prefer to use two hours of free time for ‘quiet’ as opposed to ‘active’ or ‘mixed’ activities.

Sport is generally perceived by young people as being a way of building and solidifying friendship networks, improving skills and achieving physical fitness

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’. 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. Physical activity also improves quality of life and is associated with reduced antisocial behaviour among young people. A range of economic analyses shows that promotion of physical activity is 2–25 times more cost effective than either primary or secondary health care approaches to certain behaviours (for example, smoking). In addition, each extra hour of sport reduces screen time by 20–24 minutes.

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 minutes per day on average playing sport. For girls, the figure is 65 minutes per day. This can represent 30–40 per cent 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 per cent, we would increase average daily energy expenditure by 10–22 per cent, which equates to a relative loss of six kilograms of body weight each year.

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 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 able-bodied and disabled children, and there are positive correlations between levels of physical activity and academic performance.

Sport can be successfully combined with a range of other leisure pursuits

About one-third of boys fall into an activity cluster labelled 'sporties' or 'techno-actives'. These boys combine high levels of sports participation (118 minutes per day as opposed to 33 minutes per day for other boys) with above-average levels of screen time. About one quarter of girls are labelled 'players' and combine very high levels of informal physical activity (140 versus 80 minutes per day) with large amounts of low-level social activity (chores, schoolwork, etc.). In face-to-face interviews, it was striking how busy children were and how much they enjoyed being active.

Strategies to encourage involvement in sport and physical activity

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. For example, 'techno-active' children, who combine high levels of physical activity with large amounts of time in front of a screen, might not benefit greatly from strategies designed to promote participation in physical activity. 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 that 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 that links multimedia technology with physical activity.

Home-based strategies

- **Reduce screen time** — The use of negotiated contracts and various reward systems for replacing screen time with active 'backyard' time is a promising strategy.
- **Remodel the home environment** — 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. Parents can consciously create a culture of physical activity in the family.

School-based strategies

- **Remodel the school environment** — Optimise the use of play space by staggering break times. Recent research in South Australian schools confirms that play area, and population density in particular, impact on willingness to play. 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.
- **Upskill teachers and provide specialist physical education teachers** — Through in-servicing of classroom teachers, raise awareness of innovative approaches to physical education delivery. Several studies have shown that the quality of primary-school physical education

can be enhanced 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. Reported enjoyment levels are higher in classes characterised by frequent encouragement and praise, where students do not select teams and where winning is not emphasised.

- **Integrate physical education into homework policy** — Physical education ‘homework’ is being trialed in schools in several countries. Innovative strategies to increase the quantity of active homework (for example, through calendars with daily ‘fun’ activities) and the quality of movement skill (for example, through checklists for mastery of specific skills) have been introduced with encouraging results.
- **Maximise physical activity opportunities in out-of-school-hours centres** — The out-of-school-hours centre setting is particularly appropriate for physical activity interventions, not only because of the growing population they serve, but also because children attend out-of-school-hours centres during the critical window of opportunity for children’s play. A recent trial in South Australian out-of-school-hours centre sites demonstrated that the provision of developmentally appropriate, fun-orientated, non-competitive activities reduced the number of children choosing sedentary indoor alternatives.
- **Give students and parents a voice** — Listen to the opinions and preferences of children. Most schools encourage democratic decision-making through student representative councils. As recent surveys confirm that young people prefer to have some control over the development of their sporting activities, the student representative council 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.

Community-based strategies

- **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, and information sharing regarding opportunities for organised sport or safe free play.

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.

Peer group influence

Very little is known about the effect of peer groups on the amount and nature of physical activity in children. Recent studies in the psychological literature regarding personality and behavioural development in young people have under-emphasised the impact of the family and stressed the importance of the friendship group (see for example, Harris 1999). Consider the case of language, where children from families of non-English speaking backgrounds learn to speak accent-free idiomatic English with ease in spite of the parents’ poor English skills. Harris’s 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.

Physical activity and academic performance

Recent meta-analyses have suggested that acute and chronic exposure to physical activity can significantly improve cognitive performance (Shephard 1997). Some intervention studies have been carried out 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 physical education is being squeezed out of a crowded curriculum, and fear of decrements in academic performance is driving some parents to discourage their children from 'too much' involvement in physical activity.

Independent effects of screen time

There is some evidence that sedentary behaviour (that is, screen time) is an independent risk factor for paediatric fatness. 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' who combine high screen time and high sports participation.

Trickle down

There is a powerful and appealing argument in political circles that increasing resources for elite-level sport will eventually 'trickle down' to grassroots 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 and Norton 2000) has found no evidence in support of this hypothesis. Another (Olds et al. 2004) found only weak relationships between children's fitness and Olympic success across 37 countries. In the Multimedia Activity Recall for Children and Adolescents psychosocial questionnaire, fewer than 5 per cent 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.

Winding the clock forward

Many studies have compared a relatively rosy picture of youth in the 1960s (lean, active and fit) to the situation today (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 sporting clubs, return to old-style physical education classes, redesign traditional neighbourhoods, reduce screen time). These suggestions fly in the face of large-scale socio-economic and demographic trends (economic rationalism that is reshaping retail neighbourhoods, increasing suburbanisation that increases dependence on automobiles, and technological energy-saving devices that reduce the energy cost of work, consumption and daily life). What has not been done is to brainstorm solutions for the world as it will be. Such solutions might include harnessing children's fascination with electronic technologies, fitting in with modern rhythms of work by expanding out-of-school-hours care that also exploits the critical window of activity, creating new forms of physical activity using mobile phones and the internet. In other words, we need lateral, futuristic solutions that adapt to the new social realities.

National uniform 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. Systems should be set up allowing national uniform monitoring systems. These should include measures of overweight, that is, body mass index, 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 do not exercise because they have 'no time', the amount of information conveyed is virtually zero.

The watershed of puberty

Pre-pubertal children have a natural drive to exercise, while post-pubertal children need to be coerced. There is a sudden drop-off in physical activity at puberty in both boys and girls. 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. Research is needed on the social and physiological determinants of this change. An evolutionary psychology model may prove fruitful, as may neuropsychological approaches.

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