2012

Physical activity and screen time behaviour in metropolitan, regional and rural adolescents: A cross-sectional study of Australians aged 9–16 years

James Dollman

Carol Maher

Tim S. Olds

Kate Ridley

Available online at www.sciencedirect.com
ScienceDirect
Journal of Science and Medicine in Sport 15 (2012) 32–37
Journal of Science and Medicine in Sport
www.elsevier.com/locate/jsams

Original research

Physical activity and screen time behaviour in metropolitan, regional and rural adolescents: A cross-sectional study of Australians aged 9–16 years

James Dollman [a,b,*], Carol Maher [b], Tim S. Olds [b], Kate Ridley [c]

[a] Nutritional Physiology Research Centre, University of South Australia, Adelaide, South Australia, Australia
[b] Health and Use of Time, School of Health Sciences, University of South Australia, Adelaide, South Australia, Australia
[c] School of Education, Flinders University, Adelaide, South Australia, Australia

Received 8 November 2010; received in revised form 15 April 2011; accepted 24 May 2011

Abstract

Objectives: While there is consistent evidence that rural adults in Australia are less active than their urban counterparts, studies relating geographical remoteness to activity patterns in Australian adolescents have yielded inconsistent results. The aim of this study was to describe objectively and subjectively measured patterns of physical activity and sedentary behaviours across remoteness categories in a representative sample of 9–16 year old Australians. *Design:* Cross-sectional observational study. *Methods:* 2071 Australian adolescents provided self-report use of time data on four days and wore a pedometer for at least 6 days within the 2007 Australian National Children's Nutrition and Physical Activity Survey. Comparisons of activity patterns were made across four objectively-determined remoteness categories (Major City, Inner Regional, Outer Regional and Remote), adjusting for household income, parental education and age. *Results:* Adolescents living in major cities self-reported 11–29 min less moderate to vigorous physical activity each day than their counterparts living in geographically more remote areas, and took 150–850 fewer steps each day. While there were no differences in time spent in sport or active transport, differences in free play participation were significant. Males in major cities also reported higher levels of screen time. Differences were somewhat more marked among males than among females. *Conclusions:* Activity levels among Australian adolescents show contrasting patterns of geographical differences to those found in Australian adults. Higher levels of free play among rural Australian adolescents may be due to more available space and less fear of traffic and stranger risks.

Keywords: Physical activity; Sedentary; Adolescent; Urban; Rural

1. Introduction

Australia's Health, 2008[1] reveals that adults living in rural and remote areas of Australia have generally poorer health than their major city counterparts, reflected in higher levels of mortality, disease and health risk factors. Data from population health surveys consistently show that adults in rural and remote areas are more likely to engage in behaviours associated with poorer health, such as sedentariness.[2]

While there is convincing evidence of relatively poor health and health-related behaviours among rural Australian adults, little is known about the life stage when these disparities originate. The few state-based regional comparisons of children and adolescents present a somewhat scattered and confused picture, with the direction and extent of differences in physical activity and sedentary behaviours between urban and rural residents varying by season,[3] participants' sex[3,4] and how physical activity is represented.[5] Moreover, previous studies of the impact of geographic location on physical activity and sedentary behaviours have used various definitions of rurality, and have largely failed to account for other salient sociodemographic factors that vary by region, such as socioeconomic position (SEP).[6]

* Corresponding author at: Health and Use of Time, School of Health Sciences, University of South Australia, Adelaide, South Australia, Australia.
E-mail address: james.dollman@unisa.edu.au (J. Dollman).

1440-2440/$ – see front matter © 2011 Sports Medicine Australia. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.jsams.2011.05.011

Table 1
Demographic characteristics of the sample, presented by sex and remoteness category.

Variables	Males				Females			
	Major city ($n=615$)	Inner regional ($n=238$)	Outer regional ($n=175$)	Remote ($n=57$)	Major city ($n=607$)	Inner regional ($n=237$)	Outer regional ($n=217$)	Remote ($n=53$)
Age (yr)	13.4 (2.2)	13.4 (2.3)	13.7 (2.1)	13.3 (2.2)	13.3 (2.2)	13.6 (2.2)	13.2 (2.3)	13.2 (2.1)
BMI (kg M^{-2})	20.43 (3.96)	20.12 (3.89)	20.82 (3.83)	20.12 (3.47)	20.89 (4.05)	21.29 (4.17)	20.96 (4.52)	22.31 (4.65)
Highest parent education (%)								
≤Year 10	5.1	7.6	9.1	10.5	7.4	7.2	8.8	0.0
Year 11	3.3	3.0	2.3	3.5	3.0	4.6	3.2	11.3
Year 12	7.7	8.9	6.3	1.8	6.9	5.5	9.7	9.4
Post-secondary certificate	25.4	34.6	38.3	42.1	23.4	35.0	36.9	50.9
Post-secondary diploma	11.7	12.2	10.3	8.8	14.5	13.1	11.1	9.4
Bachelor degree	30.8	24.1	29.1	28.1	32.5	28.7	24.0	18.9
Post-graduate	16.0	9.7	4.6	5.3	12.4	5.9	6.5	0.0
Household income (%)								
>104,000	37.3	27.2	18.0	29.6	32.4	24.9	22.2	16.7
75,000–104,000	21.9	18.0	17.4	16.7	20.5	14.7	16.9	25.0
52,000–75,000	18.0	18.9	32.3	18.5	19.6	24.0	21.7	31.3
<52,000	22.8	36.0	32.3	35.2	27.6	36.4	39.1	27.1

Age and BMI are presented as mean (SD). Highest parent education and Household income are presented as percentages.

A clear understanding of how geographic location is independently associated with physical activity and sedentary behaviours among young people will only be achieved with national datasets, compiled using rigorously tested instruments that measure behaviours in a range of forms and contexts (for instance, television as opposed to other screen-based activities, and organised sport as opposed to active transport and free play), and with a widely accepted definition of geographic location. The current study begins the process by analysing data from the Australian National Children's Nutrition and Physical Activity Survey, conducted between March and August 2007.[7] The aim of the study was to examine the independent associations of remoteness from major cities, as defined by the Australian Bureau of Statistics,[8] and the following variables among male and female Australians aged between 9 and 16 years:

1. physical activity, represented by pedometer steps, and self-reported minutes of moderate to vigorous physical activity (MVPA), differentiated into the domains of active transport, organised sport and free play.
2. total screen time (television, videogames and computer use) and television time.

2. Methods

From March to August, 2007, 2071 Australians (9–16 years) were interviewed in their homes as part of the Australian National Children's Nutrition and Physical Activity Survey.[7] Clusters of postal code areas were randomly selected from around Australia, with the exception of very remote areas. Random-digit dialing was used to contact households within each cluster, and households with at least one person in the target age range were invited to participate. One person from each household was surveyed. The overall response rate, calculated as the ratio of completing participating households to contactable eligible households, was 41%. Ethical approval for this study was obtained from the University of South Australia's Human Research Ethics Committee. Informed consent was obtained from the participants' parents, and when participants were aged 14 years and older, from the participants themselves. Participants' demographic characteristics are shown in Table 1.

The Accessibility and Remoteness Index of Australia (ARIA+) was used to define residences as: Major city; Inner regional; Outer regional; and Remote (very remote regions were not sampled). This index, compiled by the Australian Bureau of Statistics,[8] uses a standardised approach to classify 'remoteness' on the basis of accessibility by road to service centres. More remote localities have lower access to service facilities.

Household demographic data, including reported annual household income, education level, sex and age of the target child were collected during a computer-assisted interview in the home. Height and weight were measured by research assistants trained according to the protocols of the International Society for the Advancement of Kinanthropometry (ISAK).[9]

As physical activity is a multi-dimensional behaviour that occurs in a range of contexts, multiple sources of data are recommended.[10] Self-reported data were collected using the Multimedia Activity Recall for Children and Adults (MARCA).[11] Using a segmented day format with self-determined anchor points (e.g. meals, school bells) participants reported all they did on the previous day from wake-up to bedtime. The MARCA has a same-day test–retest reliability of $r = 0.84$–0.92 for moderate to vigorous physical

activity (MVPA) and physical activity level (PAL), and criterion validity with reference to pedometry of rho = 0.54 for PAL in this study.[12] To obtain an objective measure of overall daily physical activity, participants were asked to wear New Lifestyles 1000 pedometers for seven consecutive days. Previous studies have found these pedometers to have excellent validity and reliability.[13] The MARCA was also used to collect data on screen time (the number of minutes spent watching television, playing videogames and using a computer). At the in-home interview participants completed the MARCA for the preceding two days. As a second home visit was not feasible within budgetary constraints, participants received a follow-up phone interview one to three weeks later, in which they completed the MARCA for a further two days (the two days immediately preceding the day of the phone interview). Wherever possible, at least one of the four days sampled was a non-school day.

Reported household income was stratified into four bands: >AUD 104,000 (coded 1); AUD 75,000–104,000 (coded 2); AUD 52,000–75,000 (coded 3); and <AUD 52,000 (coded 4). These bands were based on Australian Bureau of Statistics classifications, and represented approximate quartiles in this sample (30%, 19%, 21% and 30% of the sample, respectively). Education level was based on the highest level achieved by either caregiver, and stratified according to the following criteria: completed Year 10 or less (coded 1); completed Year 11 (coded 2); completed Year 12 (coded 3); post-secondary certificate (coded 4); post-secondary diploma (coded 5); Bachelor degree (coded 6); and post-graduate (coded 7).

Raw body mass index (BMI) values were converted to *z*-scores using the United Kingdom (UK) 1990 reference standards.[14]

Because there are substantial differences in school and non-school activity patterns,[15] and because children spend approximately one day in two in school, use of time variables were adjusted so that school days and non-school days were equally weighted. Minutes of MVPA were calculated by summing the number of minutes participants reported in activities requiring ≥3 METs, according to published compendium data.[16]

Sport was defined as active recreation which is structured and rule-governed, typically requiring supervision, specialised equipment, a designated play area and time. Free play was defined as active recreation which is essentially unstructured, such as playground games. Typically, free play requires no special playing area, few rules and minimal supervision. Active transport was defined as locomotion where the participant provides most of the energy. For example: walking, cycling, skateboarding and rollerblading.[7]

Pedometer records with fewer than 1000steps d^{-1} on any day were excluded, as were records where the pedometer was removed for a total of more than 4 h a day during waking hours as recorded on a log sheet. At present there is no broadly accepted non-compliance time threshold for culling pedometer data. In this study 4 h was chosen; assuming an average of 10 h in bed across the sample age range and day types, this aligns the data closely with recent accelerometer studies that have insisted on at least 10 h of daily monitoring.[17,18] Pedometer values were taken as the average number of steps per day when six or more compliant days' data were available.

Analysis of Covariance (ANCOVA) was used to compare ARIA categories on the following dependent variables: MVPA (min/d); free play (min/d); sport (min/d); active transport (min/d); pedometer steps (steps/d); total screen time (min/d); and television (min/d), independent of age, BMI *z*-score, income and parent education. Variables with skewed distributions (free play and sport) were log transformed for analysis. Alpha was set at 0.05.

3. Results

Table 1 shows the representations of demographic categories in the sample, according to remoteness category.

In general, adolescents living in major cities were less active than their more remote counterparts. Specifically, males living in major cities reported lower MVPA than those living in the other three ARIA categories (see Table 2). Females in major cities reported lower MVPA than those from inner regional and remote areas. Considering domains of physical activity, there were no differences among ARIA categories in time spent on sport or active transport, among males and females. However, males in major cities spent less time in free play that those in inner regional and remote areas, while females in major cities spent less time in free play than counterparts in outer regional areas. Daily steps (from pedometers) were fewer among males and females in major cities than outer regions. For all physical activity variables, there were no differences between young people living in inner regional, outer regional and remote areas (Table 2).

Among males, television time and total screen time varied according to remoteness category. Males living in major cities and inner regions reported more daily screen time than those in remote areas, while television time was higher among inner regional residents than all other ARIA+ categories. Among females, neither total screen time nor television time differed across ARIA+ categories (see Table 2).

4. Discussion

This is the first Australia-wide survey to deliver both self-reported and objectively measured physical activity data on school age respondents, and it is evident from the findings that adolescents in major cities are less physically active than their regional counterparts. Specifically, regional differences in self-reported physical activity are almost entirely due to lower engagement in free play among major city residents compared with other ARIA+ categories. Males living in major cities also reported higher engagement in screen based activities than their regional and remote counterparts.

Table 2
Sex-specific comparisons of physical activity and screen time variables between remoteness.

Variables	Males				Females			
	Major city	Inner regional	Outer regional	Remote	Major city	Inner regional	Outer regional	Remote
Physical activity variables								
MVPA (min)	127.1[a,b,c]	146.2	147.0	155.9	100.9[a,c]	111.8	110.6	123.2
	(72.5)	(81.8)	(81.1)	(70.4)	(70.6)	(71.5)	(66.3)	(79.7)
Sport (min)	55.2	53.0	54.7	51.0	33.3	34.4	29.3	34.6
	(50.5)	(42.4)	(50.4)	(44.9)	(41.7)	(40.5)	(33.2)	(36.3)
Free play (min)	61.7[a,c]	82.5	69.0	78.2	59.1[b]	66.8	72.6	64.7
	(61.5)	(75.5)	(63.8)	(57.9)	(62.4)	(65.8)	(68.3)	(61.7)
Active transport (min)	41.8	46.7	48.2	48.4	41.4	44.9	45.5	(46.9
	(38.3)	(44.6)	(45.2)	(42.0)	(32.4)	(38.8)	(39.6)	(43.9)
Daily pedometer steps	11746[b]	11996	12591	11964	9887[b]	10063	10551	9721
	(3676)	(3505)	(4443)	(3196)	(2797)	(2719)	(2886)	(3042)
Sedentary behaviour variables								
Total screen (min)	259.1[c]	259.8[c]	246.6	226.0	209.2	199.0	195.1	206.4
	(124.4)	(113.8)	(107.1)	(120.4)	(106.9)	(95.4)	(104.4)	(97.3)
TV (min)	156.3[a]	174.1[b,c]	155.7	147.0	151.0	145.4	146.3	152.6
	(89.3)	(85.8)	(78.5)	(87.8)	(90.7)	(77.6)	(87.0)	(84.4)

MVPA = minutes of moderate-to-vigorous physical activity.
Within rows, superscripts denote where significant different exist between ARIA categories.
[a] Sig. different from Inner region.
[b] Sig. different from Outer region.
[c] Sig. different from Remote.

Across the rural and regional categories there were few differences, except that television viewing among inner regional males exceeded levels among males in other ARIA+ categories. There were no differences in TV and overall screen time among females by ARIA category.

Previous state-based Australian studies have presented an inconsistent picture of the distribution of children's physical activity by geographic location. The extent and direction of differences have often been specific to sex, season and methods of measuring and differentiating physical activity. Booth and colleagues[3] compared urban and rural school age children in New South Wales during 1997, using a previous week physical activity self report instrument. They reported that rural girls were more likely to be sufficiently active that their metropolitan counterparts in summer months. There were no differences in physical activity levels between urban and rural girls in winter months, or among boys at any time of the year.[3] Among Western Australian school children in 2005, rural secondary school students were more likely than their urban counterparts to participate in school based sport and physical education, while rural children also recorded higher daily pedometer step counts.[19] A 1997 study of South Australian children found that rural children played more club sport in the previous 12 months, while urban children played more school sport, resulting in no overall differences in sport participation.[5]

Much of the confusion could be due to the cross-cutting influence of SEP which has been shown to be associated with physical activity and television time[20] but has not always been statistically accounted for in previous comparisons of urban and rural youth.[3,4] A previous study of Australian adults reported higher levels of overweight and obesity among rural compared with urban residents, that were entirely accounted for by differences in education and employment status.[21] The current study is the first to report comparisons of physical activity and screen-based behaviours among young Australians across remoteness categories, controlling for family income and education. Independent effects of remoteness on free play point to region-specific influences other that SEP that serve to promote or inhibit this behaviour.

Reasons for lower levels of free play among young people in major cities of Australia are currently unclear, but are likely to reflect environmental and cultural differences between densely populated cities and more sparsely populated rural communities. It is widely accepted that time outdoors predicts physical activity among young people, and this has been linked to neighbourhood safety and availability of suitable outside play spaces.[22] While an inverse relationship has previously been reported between perceived neighbourhood risk and physical activity,[23] evidence is scarce for regional differences in safety and access to resources for unstructured play among Australian children and adolescents. A recent study of Cypriot children identified higher time spent outside among rural compared with city and large town residents, with rural parents reporting more available space at home and in neighbourhoods as well as lower perceived neighbourhood risk, compared with parents of urban children.[24] In Australia, studies have reported that rural life encourages outdoor leisure due to greater abundance and variety of unstructured, natural play space[25] and is characterised by lower risks of cycling and pedestrian accidents.[5]

In the current study, residents of major cities did not differ from regional and remote residents in time spent in organised sport. A previous study[5] identified no differences

in overall sport participation between urban and rural South Australian children, but higher club sport and lower school sport participation among rural children. Given the importance of sport as a significant contributor to daily physical activity,[26] future research should seek better understanding of the region-specific facilitators of organised sport for young people so that access to opportunities can be optimised.

There was a trend towards lower screen time among males in remote regions compared with other ARIA categories, with no differences evident among females. Similarly, a survey of New South Wales children and adolescents identified lower screen time among rural high school males, compared with city counterparts, while no differences were seen among females.[4] Lower screen time in regional and remote communities might be related to fewer free-to-air television channels and more restricted access to broad band in these communities. It is also feasible that higher screen time among residents of major cities is attributable to higher risks associated with outdoor play in cities,[24] but it is difficult to explain why these factors affect males and not females. Differences in physical activity and screen time across ARIA categories, at least among males, provide some support for the hypothesis that screen time displaces physical activity. Evidence for the displacement hypothesis is unconvincing,[27] with reported associations varying according to: the type of screen-based behaviour[27,28]; the physical activity levels of the study sample, with associations more likely to be found among 'active' adolescents[28]; and whether school days or weekends are considered.[29] An analysis of data from 39 countries in Europe and North America suggested that time spent playing video games displaced physical activity in adolescent males but not females.[28] Therefore it is interesting to note that males in Remote regions in the current study spent the least time using the computer and playing video games (i.e. screen time minus television time: values not reported here) and were most active. The absence of evidence for the displacement hypothesis among females in the current study may be explained by the smaller amount of time females spent playing video games.[15]

This is the first study to examine geographical differences in the activity patterns of Australian adolescents using a large, representative sample. It gathered both objective and subjective physical activity data. Use of the MARCA, a high-resolution, validated and reliable use of time instrument, allowed analysis according to overall minutes of MVPA and in separate physical activity domains, permitting a comprehensive comparison of the activity patterns of children living around Australia. Unlike previous research which has used arbitrary definitions of rurality, the current study used an objective and nationally agreed definition of remoteness. Furthermore, the study adjusted for likely confounders (income, education, age and relative weight).

It is also important to acknowledge the study's limitations. By utilising the ARIA index of remoteness, the current study did not sub-divide the Major city region into inner city and suburban areas. In a recent review, Sandercock et al.[30] reported that in developed countries, children in suburban environments were more active than children in inner city regions. They postulated that this may reflect differences in neighbourhood security, access to conducive facilities and space to be active, and SEP.[30] Such differences may have been present in the sample in the current study, but could not be detected due to the grouping of inner city and suburban areas together in the ARIA index. Similarly, the ARIA categories to not allow differentiation between rural and regional children who live in townships compared with farms. A further limitation of the current dataset was that analysis of activity patterns on the basis of season was not possible.

5. Conclusion

The finding that there were few differences in the physical activities and sedentary behaviours between rural and metropolitan children suggests that rural school age children are 'buffered' from the restrictions that apply to adult physical activity in rural communities. The main areas of difference, free play (males and females) and television viewing (males only) highlight the challenges of promoting free play opportunities for young people living in high density urban environments. The transition from school leaving age to adulthood in rural communities should be the focus of further research into higher sedentariness among rural adults in Australia.

Practical implications

- Physical activity among adolescents appears to be more restricted in metropolitan compared with non-metropolitan areas.
- Organised sport participation is independent of where adolescents live and should be vigorously promoted as a regular source of physical activity.
- Metropolitan male adolescents are particularly vulnerable to high sedentary time and should be targeted for reduction in leisure-time screen use.

Acknowledgements

This study was supported by the Australian Commonwealth Department of Health and Ageing; the Department of Agriculture, Fisheries and Forestry; and by the Australian Food and Grocery Council.

References

1. Australian Institute of Health and Welfare. *Australia's Health 2008*. Canberra: AIHW; 2008 [cat. no. AUS 99].

2. Liaw S, Kilpatrick S, editors. *A textbook of Australian Rural Health*. Canberra: Australian Rural Health Education Network; 2008.
3. Booth ML, Okely AD, Chey T, et al. Epidemiology of physical activity participation among New South Wales school students. *Aust N Z J Public Health* 2002;**26**(4):371–374.
4. Hardy L, Dobbins T, Denney-Wilson E, et al. Descriptive epidemiology of small screen recreation among Australian adolescents. *J Paediatr Child Health* 2009;**42**(11):709–714.
5. Dollman J, Norton K, Tucker G. Anthropometry, fitness and physical activity of urban and rural south Australian children. *Pediatr Exerc Sci* 2002;**14**(3):297–312.
6. Dixon J, Welch N. Researching the rural–metropolitan health differential using the 'social determinants of health'. *Aust J Rural Health* 2000;**8**(5):254–260.
7. Department of Health and Ageing. *Australian National Children's Nutrition and Physical Activity Survey – Main Findings*. Canberra: Department of Health and Ageing; 2008.
8. Australian Bureau of Statistics. *Australian Standard Geographical Classification (ASGC) remoteness structure (RA) digital boundaries, Australia, 2006 [1259.0.30.004]*. Canberra: Australian Bureau of Statistics; 2007.
9. Marfell-Jones M, Olds T, Stewart A, et al. *International standards for anthropometric assessment*. Potchefstroom, RSA: North-West University; 2006.
10. Treuth MS. Applying multiple methods to improve accuracy of activity assessments. In: Welk G, editor. *Physical activity assessments for health-related research*. Champaign, IL: Human Kinetics; 2002.
11. Ridley K, Olds TS, Hill A. The Multimedia Activity Recall for Children and Adolescents (MARCA): development and evaluation. *Int J Behav Nutr Phys Act* 2006;**3**(10) [Epub 26 May].
12. Olds T, Ridley K, Dollman J, et al. The validity of a computerised use of time recall, the Multimedia Activity Recall for Children and Adolescents. *Pediatr Exerc Sci* 2010;**22**(1):34–43.
13. Schneider PL, Crouter SE, Bassett DRJ. Pedometer measures of free-living physical activity: comparison of 13 models. *Med Sci Sports Exerc* 2004;**36**(2):331–335.
14. Cole TJ, Freeman JV, Preece MA. Body mass index reference curves for the UK, 1990. *Arch Dis Child* 1995;**73**(1):25–29.
15. Olds T, Ridley K, Dollman J. Screenieboppers and extreme screenies: the place of screen time in the time budgets of 10–13 year-old Australian children. *Aust N Z J Public Health* 2006;**30**(2):137–142.
16. Ridley K, Ainsworth B, Olds T. Development of a compendium of energy expenditures for youth. *Int J Behav Nutr Phys Act* 2008;**5**(45) [Epub 10 September].
17. Cooper AR, Wedderkopp N, Wang H, et al. Active travel to school and cardiovascular fitness in Danish children and adolescents. *Med Sci Sports Exerc* 2006;**38**(10):1724–1731.
18. Brage S, Wedderkopp N, Ekelund U, et al. Features of the metabolic syndrome are associated with objectively measured physical activity and fitness in Danish children: the European Youth Heart Study (EYHS). *Diabetes Care* 2004;**27**(9):2141–2148.
19. *Premier's Physical Activity Taskforce (W.A.). Child and Adolescent Physical Activity and Nutrition (CAPANS) Survey 2003: summary*. Government of Western Australia; 2005.
20. Dollman J, Ridley K, Magarey A, et al. Dietary intake, physical activity and TV viewing as mediators of the association of socioeconomic status with body composition: a cross-sectional analysis of Australian youth. *Int J Obes* 2007;**31**(1):45–52.
21. Cleland V, Hume C, Crawford D, et al. Urban–rural comparison of weight status among women and children living in socioeconomically disadvantaged neighbourhoods. *Med J Aust* 2010;**192**(3):137–140.
22. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc* 2000;**32**(5):963–975.
23. Weir L, Etelson D, Brand D. Parents' perceptions of neighborhood safety and children's physical activity. *Prev Med* 2006;**43**(3):212–217.
24. Loucaides CA, Chedzoy SM, Bennett N. Differences in physical activity levels between urban and rural school children in Cyprus. *Health Educ Res* 2004;**19**(2):138–147.
25. Moore R. *Children's domain: play and place in child development*. London: Croom Helm; 1986.
26. Wickel EE, Eisenmann JC. Contribution of youth sport to total daily physical activity among 6- to 12-yr-old boys. *Med Sci Sports Exerc* 2007;**39**(9):1493–1500.
27. Marshall S, Biddle S, Gorely T, et al. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *Int J Obes Relat Metab Disord* 2004;**28**(10):1238–1246.
28. Melkevik O, Torsheim T, Iannotti R, et al. Is spending time in screen-based sedentary behaviors associated with less physical activity: a cross national investigation. *Int J Behav Nutr Phys Act* 2010;**7**(1):46.
29. Devis-Devis J, Peiro-Velert C, Beltran-Carillo V, et al. Association between socio-demographic factors, screen media usage and physical activity by type of day in Spanish adolescents. *J Adolescence* 2010, doi:10.1016/j.adolescence.2010.11.009.
30. Sandercock G, Angus A, Barton B. Physical activity levels of children living in different built environments. *Prev Med* 2010;**50**(4):193–198.