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*Sedentary Behaviour in
Young People: Prevalence
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STIL*

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**Sedentary Behaviour in Young People:
Prevalence and Determinants
*PROJECT STIL***

BHF Project Grant (PG/2000124)
Report to the British Heart Foundation

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Project *STIL* (*Sedentary Teenagers and Inactive Lifestyles*) addressed three fundamental questions concerning sedentary behaviour in adolescent boys and girls in the UK:

- 1. What is the prevalence of key sedentary behaviours in young people?**
- 2. What links exist between sedentary behaviours and other health-related behaviours?**
- 3. What are the main determinants of sedentary behaviour?**

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EXECUTIVE SUMMARY

1. There is a great deal of concern about overweight and obesity in young people. Excessive weight gain during childhood and adolescence has been 'blamed' on sedentary lifestyles, particularly the use of electronic media such as television and computer games.

Project *STIL*

2. Project *STIL* ('Sedentary Teenagers and Inactive Lifestyles') at Loughborough University is a research programme that focuses on a wide range of sedentary and physically active behaviours. The current project had three main purposes: a) obtaining estimates for the prevalence of sedentary behaviour in youth, b) examining the links between sedentary behaviours and other health-related behaviours, and c) investigating factors associated with sedentary behaviour.
3. The key research questions were addressed using three methods: a) three systematic literature reviews, including one meta-analysis, b) a large cross-sectional study of prevalence and correlates of sedentary behaviour using a time-use diary method, and c) data from an 18-month longitudinal study of sedentary behaviour.
4. The reviews comprised a) a systematic review of prevalence, incidence and trends in youth sedentary behaviour, b) a systematic review of correlates of TV viewing in children and adolescents (Gorely, Marshall, & Biddle, 2004), and c) a meta-analysis of the relationships between TV viewing and computer game playing with body fatness and physical activity in young people (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004).
5. Review-level data showed that TV viewing in children and youth is consistently and positively related to ethnicity (being non-white), body weight, between-meal snacking, parents' TV viewing habits, weekend day, and having a TV in the bedroom.
6. Review-level data also showed that TV viewing in children and youth is consistently and negatively associated with parent income, parent education, and the number of parents living in the house.

Methods

7. The principal data collection instrument for the assessment of sedentary behaviour, in both the UK cross-sectional and longitudinal studies, was a self-report diary of "free-time" behaviours. School students completed the diary outside of school hours (3 weekdays and 1 weekend day). It asked the participants to write down what they were doing at 15-minute time intervals and participants also recorded where they were. Demographic variables were also assessed.
8. In the longitudinal study, conducted in the East Midlands, England, measures were taken at baseline, 6 months, 1 year, and 18 months. In addition to the diary, measures included pubertal status, height, weight, and body image.

9. For the cross-sectional UK study, assessment took place in 46 schools from 15 local education authorities in England, Northern Ireland, Scotland, and Wales. Data were collected in three phases: March-June and October-November 2002, September 2002-January 2003, and October-November 2003 with school Years 9-11 (ages 13-16 yrs). The final sample comprised 566 boys and 927 girls (total n=1493).

Prevalence and Patterns of Sedentary Behaviour

10. Review-level estimates showed young people watch an average of 2 hours 14 mins of TV per day, which decreases with age.
11. Review-level estimates showed that the majority (66%) of young people are 'low' users of TV (<2 hour.day⁻¹), but 28% watch more than 4 hour.day⁻¹. Watching more than 4 hours of TV per day during childhood is considered "excessive" by the American Academy of Pediatrics.
12. Review-level secular data suggest that the number of hours young people watch TV has probably not increased over the past 50 years.
13. Our national UK data showed that boys averaged 2hr and 6mins of TV viewing per day during the week and 3hr and 14mins at weekends; 49% watched up to 2 hours of TV per weekday with only a small minority (8%) exceeding 4 hour.day⁻¹. This increased at weekends to 32% exceeding 4 hour.day⁻¹. Boys in Year 9 watched more TV than those in Years 10 and 11.
14. Girls averaged 1hr and 41mins of TV viewing per day during the week and 2hr and 35mins at weekends; 62% watched up to 2 hours of TV per weekday with only a small minority (2%) exceeding 4 hour.day⁻¹. This increased at weekends to 29% exceeding 4 hour.day⁻¹. Girls in Year 9 watched more TV than those in Years 10 and 11.
15. During the week, boys averaged 24 min.day⁻¹ playing computer games (52 minutes at weekends) and a further 18 min.day⁻¹ using the computer for other purposes. 57% of boys reported no computer game playing on weekdays.
16. Girls averaged only 2 minutes (4 min at weekends) playing computer games and 13 minutes using the computer for other purposes.
17. Girls spent 46 min.day⁻¹ in motorised transport during the week, and 56 min.day⁻¹ at weekends. Boys reported similar use during the week (46 min.day⁻¹) but slightly less than girls at weekends (42 min.day⁻¹). Only 15% of boys and 12% of girls reported no time in motorised transport during the week, whereas nearly one-third of boys (30%) and girls (35%) spent between 30 and 60 minutes daily in motorised transport.
18. Homework was a prevalent sedentary behaviour, with boys averaging 57 min.day⁻¹ during the week and 41 at weekends, and girls 63 min.day⁻¹ during the week and 43 at weekends.
19. During the week, boys (32 min.day⁻¹) were markedly more active than girls (19 min.day⁻¹) in sports and exercise. 46% of boys and 57% of girls reported no sports and exercise at all during the week, with figures rising to 48% and 66% at weekends, respectively. The least active in sports and exercise were Year 11 girls.

20. White Europeans spent more time in sports and exercise at weekend than other ethnicities.
21. Time in active transport averaged 22 min.day⁻¹ during the week for boys and 23 min.day⁻¹ for girls. 28% of boys and 22% of girls took no active transport during the week.
22. Results were minimally affected by socio-economic status.

Correlates of Sedentary Behaviour

23. Data from our meta-analysis and national sample showed relationships between TV viewing and physically active behaviours to be very small.
24. After school, there was a decline in the likelihood of motorised travel compared to before school, suggesting that children may rely more on motorised transport before school than after school. This also suggests that active travel may be possible for some children who use motorised means of travel to school.
25. Sport and exercise during the school week was most often reported in the early evening, watching TV was reported most often in the later evening. This suggests that the two behaviours may be able to co-exist to some extent.
26. There was never a time during the week when sports and exercise were more likely to occur than TV viewing, but at weekends the two behaviours occurred equally for boys during the day.
27. TV viewing was greater for those with TV sets in their bedroom than those without, and this appeared especially true for girls.
28. Longitudinal data showed that boys with more advanced pubertal status spent more time in sedentary behaviour during the week than their less mature counterparts.
29. Changes in sedentary behaviour were largely unrelated to changes in body image, except for girls during the week when greater sedentary behaviour was predicted by a change towards less positive body perceptions.
30. Physical activity was an inverse predictor of a cluster of sedentary behaviours, and the prediction was enhanced by accounting for the time young people spent outside. Interventions should focus on increasing opportunities for time outside of the house, requiring a mix of initiatives, ranging from structured activities, such as some sports, to environmental modifications based on attractiveness, accessibility, and safety.
31. While high and low TV viewing groups do differ in the amount of sports and exercise and time outside, the effect sizes are small-to-moderate.
32. When considering high and low sedentary groups, the amount of sports and exercise and time outside show much greater differences, revealing moderate and large effect sizes. This confirms our view that while TV viewing is a prevalent sedentary behaviour, it is not a good marker of total sedentary behaviour. Interventions might be better targeted at a profile of several sedentary behaviours rather than TV alone, as well as time spent outside.
33. Using cluster analysis, diverse groupings across sedentary and active behaviours were found for both boys and girls. This suggests that no

single sedentary behaviour is likely to be an effective intervention target for the majority of adolescents. In addition, the clusters confirmed that TV viewing and electronic media do not have to compete for time spent in sports and exercise.

Conclusions

34. Project *STIL* has provided comprehensive review-level and primary data on sedentary and physically active behaviours in youth. It shows that the widely-held assumption that popular electronic media (such as TV's, computers, and computer games) are to blame for current trends in juvenile obesity is an over-simplification of a complex issue, and may even be wrong.
35. TV viewing is the most prevalent sedentary behaviour for young people but is only weakly related to physical activity and body fatness.
36. Most young people watch 'acceptable' amounts of TV each day (<2 hour.dy⁻¹), but a significant minority watch what is considered by experts to be 'excessive' amounts.
37. TV viewing peaks in the later evening, a time when more active pursuits are less likely
38. If a reduction in TV viewing is desired, avoiding having a TV in the bedroom is a possible strategy, although our data suggest that the difference in TV viewing between those having a TV set in the bedroom and those who do not is small-to-moderate.
39. A better indication of sedentary behaviour is to assess various sedentary pursuits in combination. When this is done, young people engaging in high levels of sedentary behaviour do show clear tendencies to do less sport and exercise and spend less time outside. Time outside appears to be more powerful in accounting for sedentary behaviour than TV viewing per se and provides guidance for possible interventions
40. No single sedentary behaviour can adequately account for the complex ways young people spend their free time
41. Interventions to reduce sedentary behaviour and increase physical activity need to be multi-faceted and target those most in need of change.

INTRODUCTION

A great deal of media coverage has been devoted to the issue of physical inactivity in children and young people. Do they watch too much TV and sit for too long at the computer? Does this mean they do inadequate amounts of physical activity? These are key questions we do not have definite answers to. This project was established to describe the type and amount of sedentary behaviour that adolescents engage in, whether this is related to their physical activity habits, and to identify factors are related to their sedentary behaviour.

There is a growing public health concern over the effects that sedentary lifestyles are having on the health of young people, particularly, although not exclusively, in relation to overweight and obesity. Recent rapid increases in juvenile obesity in many industrialised countries have been attributed partly to television viewing and other sedentary behaviours which are thought to compete with physical activity and encourage the consumption of energy-dense foods. Reducing the time young people spend being inactive may be particularly important for two reasons:

- reallocating small amounts of sedentary time in favour of more active behaviour may impact energy balance and fitness
- data suggest that physical inactivity tracks better than physical activity from childhood to adolescence (Pate et al., 1999) and from adolescence to early adulthood (Malina, 1996).

Despite the public health importance of studying inactivity among young people, very little is known about health outcomes associated with sedentary behaviour and the biological, psychosocial and behavioural aetiology of habitual sedentariness. Although studying sedentary behaviour as a concept distinct from physical activity has been advocated recently (Owen, Leslie, Salmon, & Fotheringham, 2000), one factor that has confounded our understanding is the conceptual and definitional ambiguity over what inactivity actually is.

Many large-scale epidemiologic surveys have attempted to assess the prevalence of sedentariness in a population by measuring against a minimum criterion for physical activity or energy expenditure thought necessary to obtain health benefits. While a central function of these surveys is simply to provide a description of patterns of (in)activity in a population, these measures often fail to capture the diversity of physical inactivity behaviour and tell us nothing about what inactive people are actually doing. These problems are compounded when assessing inactivity patterns of young people because of the intermittent nature of their physical activity and the greater proportion of time spent in unstructured leisure pursuits. It is therefore proposed that 'physical inactivity' is an inadequate label to describe patterns of sedentariness because the definitional premise is one of 'activity absence', thus failing to capture the complexity of sedentary behaviour. It is suggested that a typology of sedentary behaviour be developed and conceptualised as a distinct class of behaviours characterised by low energy expenditure. This definition acknowledges that both the topography of movement (what they are

actually doing), and the energy cost, are equally important features for understanding behaviour.

SYSTEMATIC LITERATURE REVIEWS: SUMMARY METHODS AND FINDINGS

Review 1: Prevalence, incidence, & trends in the sedentary behaviours of young people²

The purpose of this systematic review was to:

- estimate the prevalence and incidence of television (TV) viewing, video game playing and computer use
- assess developmental and secular trends in TV viewing among youth.

Published English-language studies were located from computerised literature searches, reference sections of narrative reviews and primary studies, and manual searches of personal archives. Studies (n = 87) included in the review presented at least one finding on incidence or prevalence of the target behaviours. Independent samples (n = 532) were used as the unit of analysis.

Results showed that:

- young people watch approximately 134 (SD = 35.6) minutes of TV per day
- those with access to video games or computers average a further 40 minutes and 34 minutes respectively, engaging with these technologies
- most (66%) young people are 'low users' of TV but 28% watch more than 4 hours per day
- developmental data suggest that TV viewing decreases during adolescence, but those considered to be 'high users' at young ages are likely to remain high users when older
- secular data suggest that the number of hours young people watch TV has not increased over the past 50 years
- measurement issues limit the quality of the data available
- it is possible that media-based inactivity, and TV viewing in particular when viewed in isolation, is being unfairly implicated in the aetiology of contemporary overweight and obesity trends.

Review 2: Correlates of television viewing among youth (Gorely et al., 2004)

TV viewing is the most prevalent sedentary behaviour for young people. The purpose of this systematic review was to:

- investigate the published empirical correlates of television/video viewing among youth (2-18 years)

² Paper by Marshall et al (2004) under review: see Appendix 2.

A descriptive semi-quantitative review was conducted based on 68 primary studies. Results showed:

- variables consistently and positively associated with greater TV/video viewing were non-white ethnicity, body weight, between meal snacking, parents' TV viewing habits, weekend day, and having a TV in the bedroom
- variables consistently and negatively associated with greater TV/video viewing were: parent income, parent education, and number of parents in the house
- variables consistently unrelated to TV/video viewing were: sex, other indicators of socio-economic status, body fatness, cholesterol levels, aerobic fitness, strength, other indicators of fitness, self-perceptions, emotional support, physical activity, other diet variables, and being an only child
- few modifiable correlates were identified
- further research should aim to identify modifiable correlates of TV/video viewing if interventions are to be successfully tailored to reduce this aspect of inactivity among youth.

Review 3: Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis (Marshall et al., 2004)

The objective of this meta-analysis was:

- to review the empirical evidence of associations between television (TV) viewing, video/computer game use and: a) body fatness, and b) physical activity

Published English-language studies were located from computerised literature searches, bibliographies of primary studies and narrative reviews, and manual searches of personal archives. Included studies presented at least one empirical association between TV viewing, video/computer game use and body fatness or physical activity among samples of children and youth aged 3-18 years. Mean sample-weighted corrected effect size (Pearson r) was the main outcome measure.

Results showed:

- based on data from 52 independent samples, the mean sample-weighted effect size between TV viewing and body fatness was 0.066 (95% CI = 0.056 to 0.078; total N = 44,707). The sample-weighted fully corrected effect size was 0.084
- based on data from 6 independent samples, the mean sample-weighted effect size between video/computer game use and body fatness was 0.070 (95% CI = -0.048 to 0.188; total N = 1722). The sample-weighted fully corrected effect size was 0.128
- based on data from 39 independent samples, the mean sample-weighted effect size between TV viewing and physical activity was -0.096 (95% CI = -0.080 to -0.112; total N = 141,505). The sample-weighted fully corrected effect size was -0.129

- based on data from 10 independent samples, the mean sample-weighted effect size between video/computer game use and physical activity was -0.104 (95% CI = -0.080 to -0.128; total N = 119,942). The sample-weighted fully corrected effect size was -0.141.

A statistically significant relationship exists between TV viewing and body fatness among children and youth although it is likely to be too small to be of substantial clinical relevance. The relationship between TV viewing and physical activity is small but negative. The strength of these relationships remained virtually unchanged even after correcting for common sources of bias known to impact study outcomes. While the total amount of time per day engaged in sedentary behaviour is inevitably prohibitive of physical activity, media-based inactivity may be unfairly implicated in recent epidemiologic trends of overweight and obesity among children and youth. Relationships between sedentary behaviour and health are unlikely to be explained using single markers of inactivity such as TV viewing or video/computer game use.

MEASUREMENT AND PREVALENCE OF SEDENTARY BEHAVIOUR IN YOUTH

To address the key research questions in relation to UK youth, we assessed sedentary and other behaviours through a large-scale, cross-sectional, diary-based study as well as an 18-month longitudinal investigation.

Method

The principal data collection instrument was a self-report diary of “free-time” behaviours that school students completed outside of school hours³. The diary used was based on principles of Ecological Momentary Assessment (EMA) and was divided into two parts. The first part involved questions about child-level variables (9 items; “About You”), family-level variables (11 items; “About your Family”), and environmental-level variables (15 items; “About your Home”) that have been hypothesised to correlate with sedentary behaviour and physical activity. The second part was for recording the behaviours, locations, and social contexts⁴ that young people engage in each day in their free time. See Appendix 1 for a sample diary page.

Participants were instructed to complete the diary for four days (three weekdays and one weekend day). At 15-minute intervals, participants self-reported (free-response) their main behavior in response to a single item: “What are you doing now?” At each interval, participants also responded to two closed-response items: “Where are you?” (LOCATION) and “Who’s with you?” (WHO). For LOCATION, participants selected one location from a list of 12. For the WHO item, participants selected one context from a list of five

³ We were primarily interested in behaviours in which young people had some element of choice, hence behaviours in school were not assessed.

⁴ For sake of brevity, results concerning social context will not be reported. They are available on request.

(alone, with friends, with family, with friends and family, with other). See Table 1 for the categories of behaviour and location.

Data collection days were randomly assigned by weekday and weekend day. For each weekday, 44 time-samples were obtained (one every 15 minutes from 07:00h to 08.45h and from 15:00h to 23.45h). For the weekend day, 68 time-samples were obtained (one every 15 minutes from 07:00h to 23.45h). To control for different levels in school-based physical activity affecting out-of-school behavior, two items assessed participation in physical education ("Did you take part in a PE lesson today?") and engagement in moderate-to-vigorous physical activity ("At school today, did you run round or breathe hard enough to make you sweat?"). At the end of each diary day, participants also responded to an additional 10 closed-response items that solicited information about snacking behavior during the day and events that may have affected diary entries (e.g., weather, injury/illness, etc.).

The behaviours were first coded into 22 mutually exclusive categories. These emerged from pilot data we collected using focus groups with young people. To estimate the time spent in each behavior category, at each location, and in each social context, the interval-level data were aggregated for each individual (separately by weekday and weekend day) by multiplying the daily frequency of the event by 15 (1 interval = 15 minutes). The weekday data were then aggregated further to produce a mean, in min.day^{-1} , across weekdays. The outcome variables for all analyses are min.day^{-1} engaged in 22 categories of behavior, in 12 locations, and in five social contexts.

Sampling

Sampling took place across England (10 regions), Northern Ireland (North Eastern), Scotland (East Ayrshire, Glasgow, and South Lanarkshire), and Wales (Cardiff). Within the 10 regions sampled in England, the LEAs were: North (Durham), North-West (Lancashire), Yorkshire and Humberside (Leeds), East Midlands (Lincolnshire), West Midlands (Birmingham), East (Essex), Inner London (Haringey), Outer London (Croydon), South-East (Kent), and South-West (Gloucestershire). Within each region of England and the other countries, the total number of secondary and independent schools was noted and the largest local education authority (LEA) in each that was representative in terms of the ratio of secondary to independent schools was chosen. Schools were then randomly selected from each LEA to be approached to take part in the study. Ratios of secondary to independent schools were maintained in the selection process. From www.schoolsnet.com a list of schools in each of the selected LEAs was printed before random numbers were generated and the corresponding schools selected. If a selected school had less than 300 pupils, the school was not included and another was randomly selected.

Table 1. Behaviours and locations assessed using EMA diaries

Behaviours	Example behaviours and clarifiers	Locations
Sleep		Bedroom
Personal care	e.g., washing, dressing	Living room (lounge)
Eating		Kitchen
School		Bathroom
Motorised travel		Other room in the house
Active travel		Friend's house
TV/video viewing		In town (inside)
Computer/internet	<u>Excludes</u> school-related internet and computer use	In town (outside)
Computer games	e.g., PC games, video gaming and mobile phone games	In car, bus, train, taxi
Talking with friends and family	e.g., chatting, but not when in car, bus etc.	At school
Hanging out/shopping		Other inside area
Listening to music		Other outside area
Telephone		Garden
Homework	Includes school-related internet and computer use; school-related reading	
Reading (non-school)	e.g., newspapers, books	
Hobbies (behavioural)	Looking after pets, playing musical instrument, sedentary games, such as darts	
Hobbies (cognitive)	e.g., doing puzzles, playing cards, board games	
Unstructured play	e.g., messing about, playing with the dog	
Chores	e.g., washing up, tidying bedroom	
Paid work	e.g., paper round	
Sitting	e.g., 'doing nothing'	
Sports and exercise		

Schools identified were contacted by letter and invited to participate. The aims and expectations of the study were outlined and schools that agreed to take part were sent a pack included three sets of 30 diaries (approximately 75 for distribution and the rest as spares in case of loss, damage etc), an evaluation form, and a set of lesson plans to help introduce the study to students and provide an educational basis for taking part. These lesson plans were written

for use in either Mathematics or 'Personal, Health and Social Education' (PHSE) lessons. Participating schools were asked to indicate whether they wished to use the lesson plans and, if so, which was their preferred subject. Use of the lesson plans was voluntary and many schools chose to distribute the diaries without using them.

In Phase 1 (March-June 2002 for England, Northern Ireland and Wales; October-November 2002 for Scotland), one class from each of the Year Groups 9, 10, and 11⁵ was chosen at random by a co-ordinator at the school and each student within the chosen class was given a diary to complete in their free-time.

In order to assess, and control for, possible seasonal variations in behaviour a second phase of testing was carried out six months after Phase 1. Phase 2 was September-January 2002/3 in England, Northern Ireland and Wales; February-May 2003 in Scotland). Each school that returned Phase 1 data was asked to select a second set of Year 9, 10, and 11 classes and repeat the study. It was stressed that Phase 2 classes should not include any student who had previously returned data in Phase 1. A participant inclusion hierarchy is shown in Figure 1.

Table 2. Demographic characteristics of the final sample (see also Figure 1).

	n	%
Gender		
Male	566	38
Female	927	62
School year/grade		
9 th	611	41
10 th	497	33
11 th	385	26
Ethnicity		
White-European	1298	87
Asian	109	7
Black (African & Caribbean)	16	1
Chinese	24	2
Other	33	2
Missing	13	1
Age (yrs)	Mean	SD
Year 9	13.8	.48
Year 10	14.8	.47
Year 11	15.8	.51

⁵ The Scottish education system uses the label S2 to refer to school year 9 from elsewhere in the UK. Year 9 is age 12-13 years, Year 10 is age 13-14 years, and Year 11 is age 14-15/16 years.

Finally, a third (top-up) phase of testing was carried out 12 months after Phase 2 in order to increase the sample size in regions where diary returns were low (Phase 3 was October-November 2003 in England, Northern Ireland and Wales only). Schools selected for Phase 3 had not previously been approached to take part in the study and therefore did not include anyone who had completed Phases 1 or 2. The total number of schools providing useable data was 46. See Table 2 for details of the sample.

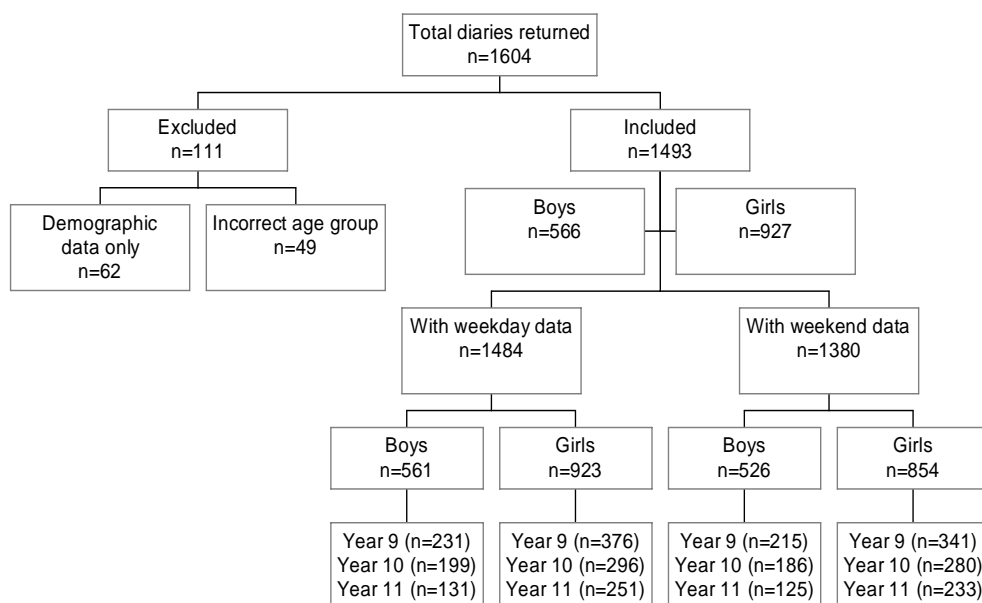


Figure 1. A participant inclusion hierarchy

Results

Results will address the prevalence of key sedentary behaviours and physically active pursuits, as well as descriptive summary data on these behaviours⁶. The sedentary behaviours selected include: TV/video viewing, playing computer/video games, using the computer⁷, and using motorised transport. Physically active behaviours include active transport and sports and exercise. Data on prevalence are reported for boys during the school

⁶ More detailed findings are available on request.

⁷ This excludes computer-based homework and games

week (Table 3) and at weekends (Table 4), and for girls during the school week (Table 5) and at weekends (Table 6) for the whole of each sample and separately by the three age (school year) groups. Descriptive data (means and standard deviations) are reported in Table 7.

TV/video viewing

Boys. Results in Table 3 show that half (49%) of boys watched up to 2 hours of TV per weekday with only a small minority (8%) exceeding 4 hour.day⁻¹. Two hours or less is considered acceptable by the American Academy of Pediatrics (1986). Although many (35.5%) report watching between 1 and 2 hours, more (41%) watch 2-4 hours. Overall, boys averaged 2 hours and 6 minutes of TV viewing per weekday. Trends showed boys in Year 11 to be less likely to watch more than 2 hour.day⁻¹ during the week (38%) than those in Years 10 (49%) and 9 (54%). Mean scores reflected this with a decline from Year 9 to 11 (see Figure 2).

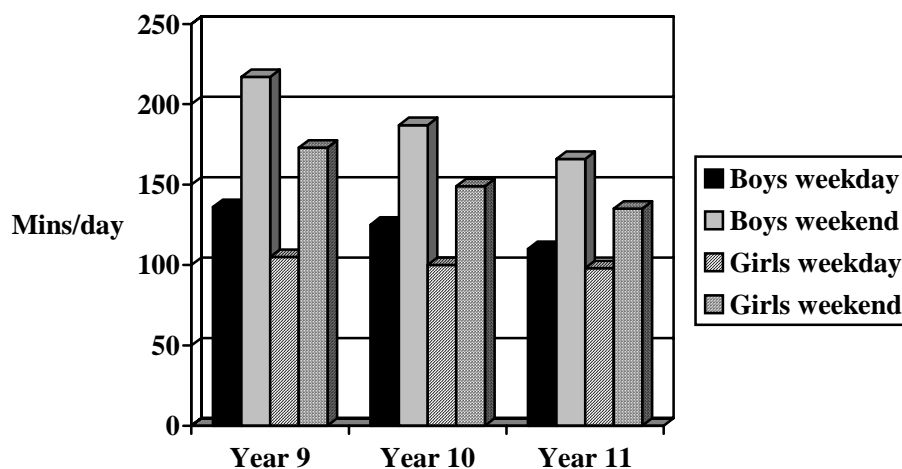


Figure 2. Mean minutes per day for watching TV, showing greater TV at weekends than during the week, for males more than females, and a decline by age.

Compared to weekdays, TV viewing was higher at weekends (Table 4), with only 20% watching up to 2 hours per day and a third (32%) exceeding 4 hours. Average daily weekend viewing time is 3 hours and 14 minutes. Trends showed boys in Year 11 are less likely to watch more than 4 hour.day⁻¹ during the weekend (22%) than those in Years 10 (32%) and 9 (39%). Mean scores reflected this with a decline from Year 9 to 11 (see Figure 2).

Girls. Results in Table 5 show that one-third (62%) of girls watched up to 2 hours of TV per weekday with only a small minority (2%) exceeding 4 hour.day⁻¹. Many (41%) report watching between 1 and 2 hours, with one-third (35.5%) watching 2-4 hours. Overall, girls averaged 1 hour and 41 minutes of TV viewing per weekday – 25 minutes less than boys. Trends showed girls in Year 11 were slightly less likely to watch more than 2 hour.day⁻¹ during the week (33%) than those in Years 10 (36%) and 9 (37%). Mean scores reflected this with a small decline from Year 9 to 11 (see Figure 2).

Prevalence of TV viewing increased at weekends (Table 6) with only 29% watching up to 2 hour.day⁻¹ and more than a quarter (29%) exceeding 4 hours. Average daily weekend viewing time was 2 hours and 35 minutes – 39 min less than boys. Trends showed girls in Year 11 to be less likely to watch more than 4 hour.day⁻¹ during the weekend (16%) than those in Years 10 (20%) and 9 (29%). Mean scores reflected this with a decline from Year 9 to 11 (see Figure 2).

Other prevalent sedentary behaviours

TV viewing is the most prevalent leisure-time sedentary behaviour for young people. However, there are many other opportunities to be sedentary, including the use of new technologies. During the week, boys averaged 24 min.day⁻¹ playing computer games (52 mins at weekends) and a further 18 min.day⁻¹ using the computer for other purposes. This contrasted with girls who averaged 2 mins (4 at weekends) and 13 mins respectively. However, the majority of boys (57%) reported no computer game playing on weekdays and a third (32.5%) reported playing more than one hour per day. Boys in Year 11 tended to play less on the computer than their younger counterparts (see Tables 3-6).

Other computer use was quite low with 75% of boys and 60% of girls reporting no use at all during the week⁸. Boys averaged 18 min.day⁻¹ during the week and 30 min.day⁻¹ at weekends.

Girls reported spending an average of 46 min.day⁻¹ in motorised transport during the week, and 56 min.day⁻¹ at weekends. Similar figures were reported by boys, although slightly less at weekends (46 and 42 min.day⁻¹ respectively). Only 15% of boys and 12% of girls spent no time in motorised transport during the week, whereas about one-third of boys (30%) and girls (35%) spent between 30 and 60 mins daily, with about one-third of boys (34%) and girls (29%) spending 1-2 hours.

⁸ This does not include computer-based homework.

Table 3. Prevalence of key sedentary and physically active behaviours during weekdays for boys

Behaviour and prevalence categories (mins/day)	Year 9 (n=231)			Year 10 (n=199)			Year 11 (n=131)			ALL boys (n=561)		
		95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Motorised transport												
0	17.70%	17.65	17.75	15.10%	15.05	15.15	9.90%	9.85	9.95	15.00%	14.970	15.030
1-29m	19.00%	18.95	19.05	25.60%	25.54	25.66	17.60%	17.54	17.66	21.00%	20.966	21.034
30-59m	30.30%	30.24	30.36	29.10%	29.03	29.16	29.00%	28.92	29.08	29.60%	29.562	29.638
60-120m	28.60%	28.54	28.66	26.60%	26.54	26.66	36.60%	36.52	36.68	29.80%	29.762	29.838
120-240m	4.30%	4.27	4.33	3.50%	3.47	3.53	6.90%	6.86	6.94	4.60%	4.583	4.617
240+m	0%											
TV/Video Viewing												
0	0.90%	0.89	0.91	4.50%	4.471	4.529	2.30%	2.274	2.326	2.50%	2.487	2.513
1-29m	1.70%	1.68	1.72	3.00%	2.976	3.024	4.60%	4.564	4.636	2.90%	2.886	2.914
30-59m	8.70%	8.66	8.74	8.50%	8.461	8.539	17.60%	17.535	17.665	10.70%	10.674	10.726
60-120m	34.60%	34.54	34.66	35.20%	35.134	35.266	37.40%	37.317	37.483	35.50%	35.460	35.540
120-240m	45.00%	44.94	45.06	41.20%	41.132	41.268	32.80%	32.720	32.880	40.80%	40.759	40.841
240+m	9.10%	9.06	9.14	7.50%	7.463	7.537	5.30%	5.262	5.338	7.70%	7.678	7.722
Computer Use												
0	70.10%	70.04	70.16	59.80%	59.732	59.868	52.70%	52.615	52.785	62.40%	62.360	62.440
1-29m	12.60%	12.56	12.64	17.60%	17.547	17.653	18.30%	18.234	18.366	15.70%	15.670	15.730
30-59m	7.80%	7.77	7.83	12.60%	12.554	12.646	13.00%	12.942	13.058	10.70%	10.674	10.726
60-120m	7.80%	7.77	7.83	7.50%	7.463	7.537	13.70%	13.641	13.759	9.10%	9.076	9.124

Table 4. Prevalence of key sedentary and physically active behaviours during weekends for boys

Behaviour and prevalence categories (mins/day)	Year 9 (n=215)			Year 10 (n=186)			Year 11 (n=125)			ALL boys (n=526)		
		95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Motorised transport												
0	46.50%	46.433	46.567	45.20%	45.128	45.272	33.60%	33.517	33.683	43.00%	42.958	43.042
1-29m	8.40%	8.363	8.437	8.10%	8.061	8.139	8.00%	7.952	8.048	8.20%	8.177	8.223
30-59m	16.70%	16.650	16.750	16.10%	16.047	16.153	20.00%	19.930	20.070	17.30%	17.268	17.332
60-120m	18.60%	18.548	18.652	21.50%	21.441	21.559	27.20%	27.122	27.278	21.70%	21.665	21.735
120-240m	8.80%	8.762	8.838	7.50%	7.462	7.538	10.40%	10.346	10.454	8.70%	8.676	8.724
240+m	0.90%	0.887	0.913	1.60%	1.582	1.618	0.80%	0.784	0.816	1.10%	1.091	1.109
TV/video viewing												
0	3.70%	3.675	3.725	9.10%	9.059	9.141	8.80%	8.750	8.850	6.80%	6.778	6.822
1-29m	2.30%	2.280	2.320	3.80%	3.773	3.827	0.80%	0.784	0.816	2.50%	2.487	2.513
30-59m	5.10%	5.071	5.129	4.30%	4.271	4.329	8.00%	7.952	8.048	5.50%	5.481	5.519
60-120m	9.80%	9.760	9.840	12.40%	12.353	12.447	16.80%	16.734	16.866	12.40%	12.372	12.428
120-240m	40.50%	40.434	40.566	38.70%	38.630	38.770	43.20%	43.113	43.287	40.50%	40.458	40.542
240+m	38.60%	38.535	38.665	31.70%	31.633	31.767	22.40%	22.327	22.473	32.30%	32.260	32.340
Computer use												
0	75.80%	75.743	75.857	74.20%	74.137	74.263	73.60%	73.523	73.677	74.70%	74.663	74.737
1-29m	1.40%	1.384	1.416	1.60%	1.582	1.618				1.10%	1.091	1.109
30-59m	5.60%	5.569	5.631	6.50%	6.465	6.535	4.00%	3.966	4.034	5.50%	5.481	5.519
60-120m	9.80%	9.760	9.840	7.00%	6.963	7.037	12.00%	11.943	12.057	9.30%	9.275	9.325

Behaviour and prevalence categories (mins/day)	Year 9 (n=376)			Year 10 (n=296)			Year 11 (n=251)			ALL (n=923)		
Computer games												
0	84.60%	84.564	84.636	89.20%	89.165	89.235	95.20%	95.174	95.226	88.90%	88.880	88.920
1-29m	12.20%	12.167	12.233	9.10%	9.067	9.133	4.00%	3.976	4.024	9.00%	8.982	9.018
30-59m	2.70%	2.684	2.716	1.40%	1.387	1.413	0.40%	0.392	0.408	1.60%	1.592	1.608
60-120m	0.50%	0.493	0.507	0.30%	0.294	0.306	0.40%	0.392	0.408	0.40%	0.396	0.404
120-240m	0%											
240+m	0%											
Sports & exercise												
0	53.50%	53.450	53.550	55.40%	55.343	55.457	63.30%	63.240	63.360	56.80%	56.768	56.832
1-29m	21.30%	21.259	21.341	14.50%	14.460	14.540	16.70%	16.654	16.746	17.90%	17.875	17.925
30-59m	14.10%	14.065	14.135	18.20%	18.156	18.244	12.00%	11.960	12.040	14.80%	14.777	14.823
60-120m	9.00%	8.971	9.029	9.80%	9.766	9.834	6.40%	6.370	6.430	8.60%	8.582	8.618
120-240m	2.10%	2.086	2.114	2.00%	1.984	2.016	1.60%	1.584	1.616	0.20%	0.197	0.203
240+m	0%											
Active transport												
0	24.50%	24.457	24.543	20.90%	20.854	20.946	19.90%	19.851	19.949	22.10%	22.073	22.127
1-29m	38.30%	38.251	38.349	43.20%	43.144	43.256	41.00%	40.939	41.061	40.60%	40.568	40.632
30-59m	29.80%	29.754	29.846	28.70%	28.648	28.752	30.70%	30.643	30.757	29.70%	29.671	29.729
60-120m	7.20%	7.174	7.226	6.40%	6.372	6.428	8.00%	7.966	8.034	7.20%	7.183	7.217
120-240m	0.30%	0.294	0.306	0.70%	0.691	0.709	0.40%	0.392	0.408	0.40%	0.396	0.404
240+m	0%											

Table 6. Prevalence of key sedentary and physically active behaviours during weekends for girls

Behaviour and prevalence categories (mins/day)	Year 9 (n=341)			Year 10 (n=280)			Year 11 (n=233)			ALL (n=854)		
		95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Motorised transport												
0	29.60%	29.552	29.648	27.10%	27.048	27.152	29.60%	29.541	29.659	28.80%	28.770	28.830
1-29m	8.20%	8.171	8.229	6.40%	6.371	6.429	3.90%	3.875	3.925	6.40%	6.384	6.416
30-59m	22.00%	21.956	22.044	22.90%	22.851	22.949	22.70%	22.646	22.754	22.50%	22.472	22.528
60-120m	26.10%	26.053	26.147	31.10%	31.046	31.154	27.50%	27.443	27.557	28.10%	28.070	28.130
120-240m	11.40%	11.366	11.434	10.70%	10.664	10.736	14.20%	14.155	14.245	11.90%	11.878	11.922
240+m	2.60%	2.583	2.617	1.80%	1.784	1.816	2.10%	2.082	2.118	2.20%	2.190	2.210
TV/video viewing												
0	7.90%	7.871	7.929	9.30%	9.266	9.334	14.60%	14.555	14.645	10.20%	10.180	10.220
1-29m	1.80%	1.786	1.814	3.20%	3.179	3.221	2.10%	2.082	2.118	2.30%	2.290	2.310
30-59m	7.60%	7.572	7.628	8.90%	8.867	8.933	10.30%	10.261	10.339	8.80%	8.781	8.819
60-120m	15.20%	15.162	15.238	19.30%	19.254	19.346	20.20%	20.148	20.252	17.90%	17.874	17.926
120-240m	38.10%	38.048	38.152	39.60%	39.543	39.657	36.50%	36.438	36.562	38.20%	38.167	38.233
240+m	29.30%	29.252	29.348	19.60%	19.554	19.646	16.30%	16.253	16.347	22.60%	22.572	22.628
Computer Use												
0	77.10%	77.055	77.145	71.80%	71.747	71.853	76.40%	76.345	76.455	75.20%	75.171	75.229
1-29m	2.60%	2.583	2.617	2.90%	2.880	2.920	1.30%	1.285	1.315	2.30%	2.290	2.310
30-59m	9.40%	9.369	9.431	8.90%	8.867	8.933	10.30%	10.261	10.339	9.50%	9.480	9.520
60-120m	8.50%	8.470	8.530	11.80%	11.762	11.838	8.60%	8.564	8.636	9.60%	9.580	9.620
120-240m	2.10%	2.085	2.115	2.90%	2.880	2.920	3.00%	2.978	3.022	2.60%	2.589	2.611
240+m	0.30%	0.294	0.306	1.80%	1.784	1.816	0.40%	0.392	0.408	0.80%	0.794	0.806

Behaviour and prevalence categories (mins/day)	Year 9 (n=341)			Year 10 (n=280)			Year 11 (n=233)			ALL (n=854)		
Computer games												
0	88.90%	88.867	88.933	93.60%	93.571	93.629	94.40%	94.370	94.430	91.90%	91.882	91.918
1-29m	2.10%	2.085	2.115	0.40%	0.393	0.407	0.40%	0.392	0.408	1.10%	1.093	1.107
30-59m	5.30%	5.276	5.324	3.90%	3.877	3.923	3.90%	3.875	3.925	4.40%	4.386	4.414
60-120m	3.20%	3.181	3.219	1.40%	1.386	1.414	0.90%	0.888	0.912	2.00%	1.991	2.009
120-240m	0.60%	0.592	0.608	0.70%	0.690	0.710	0.40%	0.392	0.408	0.60%	0.595	0.605
240+m	0%											
Sports & exercise												
0	62.50%	62.449	62.551	64.60%	64.544	64.656	71.20%	71.142	71.258	65.60%	65.568	65.632
1-29m	1.20%	1.188	1.212	1.10%	1.088	1.112	2.10%	2.082	2.118	1.40%	1.392	1.408
30-59m	8.20%	8.171	8.229	7.10%	7.070	7.130	7.00%	6.967	7.033	7.60%	7.582	7.618
60-120m	11.70%	11.666	11.734	17.90%	17.855	17.945	10.70%	10.660	10.740	13.50%	13.477	13.523
120-240m	12.30%	12.265	12.335	7.90%	7.868	7.932	7.30%	7.267	7.333	9.50%	9.480	9.520
240+m	4.10%	4.079	4.121	1.40%	1.386	1.414	1.30%	1.285	1.315	2.50%	2.490	2.510
Active transport												
0	65.10%	65.049	65.151	60.40%	60.343	60.457	57.50%	57.437	57.563	61.50%	61.467	61.533
1-29m	11.40%	11.366	11.434	13.20%	13.160	13.240	12.40%	12.358	12.442	12.30%	12.278	12.322
30-59m	12.00%	11.966	12.034	14.30%	14.259	14.341	18.00%	17.951	18.049	14.40%	14.376	14.424
60-120m	8.50%	8.470	8.530	10.00%	9.965	10.035	11.20%	11.160	11.240	9.70%	9.680	9.720
120-240m	2.30%	2.284	2.316	2.10%	2.083	2.117	0.90%	0.888	0.912	1.90%	1.891	1.909
240+m	0.60%	0.592	0.608	0%?						0.20%	0.197	0.203

Table 7. Descriptive statistics for all behaviours

Behaviour	Weekday				Weekend			
	Boys (n=561)		Girls (n=923)		Boys (n=526)		Girls (n=854)	
	Mean (min.day ⁻¹)	SD	Mean (min.day ⁻¹)	SD	Mean (min.day ⁻¹)	SD	Mean (min.day ⁻¹)	SD
Sleep	103.83	48.96	96.28	42.23	208.86	103.90	196.19	94.88
Personal care	41.05	23.47	64.21	29.11	38.76	32.81	71.22	48.38
Eating	43.90	19.39	41.88	18.32	69.07	39.99	69.54	39.23
At school	47.94	24.72	56.36	31.80	2.42	25.31	5.62	34.58
Motorised transport	46.43	38.21	46.37	35.90	41.98	57.84	55.63	62.68
Active transport	21.77	22.44	22.98	22.25	11.78	28.56	17.71	33.13
Watching television	126.27	72.19	101.64	57.25	194.40	133.76	154.66	116.78
Using a computer	17.75	32.99	12.97	23.10	29.89	70.71	17.61	43.85
Playing computer/ video games	24.19	37.63	2.02	7.70	51.65	84.99	4.06	16.73
Sitting and talking	15.42	24.30	28.79	33.79	37.44	79.07	61.76	80.73
Shopping/hanging out in town	18.33	43.67	21.41	40.15	56.64	100.78	84.03	102.43
Listening to music	9.47	17.78	14.88	20.08	15.17	33.85	21.32	34.83
Using the telephone	3.42	9.80	11.40	18.80	5.73	17.27	14.65	27.16
Doing homework	57.28	49.52	62.57	43.83	41.41	71.02	42.79	66.99
Reading	7.55	18.27	10.44	17.66	9.38	28.38	14.65	32.15
Behavioural hobbies	14.28	30.70	18.14	30.47	48.14	96.82	55.84	98.71
Cognitive hobbies	1.53	7.97	1.73	6.74	4.36	23.30	5.30	24.35
Unstructured play	2.76	15.35	2.32	9.46	7.96	37.43	8.19	30.26
Doing chores	4.02	9.94	8.59	17.51	13.63	36.57	20.18	44.80
Paid work	8.66	30.59	4.18	18.65	26.18	101.29	34.48	105.36
Sitting doing nothing	2.57	12.83	2.32	8.45	3.02	14.82	3.72	19.44
Sports and exercise	31.63	46.06	18.52	29.92	78.65	104.69	35.95	66.13

Note: Minutes of sleep are only those recorded between 07.00-23.45h.

Homework was a prevalent sedentary behaviour, with boys averaging 57 min.day⁻¹ during the week and 41 at weekends, and girls 63 min.day⁻¹ during the week and 43 at weekends.

Physically active pursuits

During the week, boys spent more time in sports and exercise⁹ than girls (32 vs. 19 min.day⁻¹, respectively) However, 46% of boys and 57% of girls reported no sports and exercise at all during the week. During the weekend, this rose to 48% and 66%, respectively. The least active in sports and exercise were Year 11 girls, averaging 15 min.day⁻¹ during the week and 27 min.day⁻¹ at weekends. Two-thirds (63%) of girls in Year 11 reported no sport and exercise during the week.

At no time during the week were sports and exercise reported more often than TV viewing. However, at weekends, these two behaviours were reported equally, especially between 10.00 and 16.00h for boys. There was a trend for Year 9 boys to have a greater chance of being involved in sports and exercise throughout the weekend day than watching TV.

The time spent in active transport, such as walking to school, averaged 22 min.day⁻¹ during the week for boys and 23 min.day⁻¹ for girls. These dropped to 11 and 17 min.day⁻¹ respectively at weekends. About one-quarter of boys (28%) and girls (22%) take no active transport during the week.

In combination, the time spent in sports and exercise and active transport totalled 53 min.day⁻¹ during the week. This is important because it provides a more realistic estimate of boys' physical activity than simply counting the minutes spent in sports and exercise alone. Assuming that these activities were performed at least at a moderate intensity, this almost meets the national recommendation of one hour per day on most days of the week (Biddle, Sallis, & Cavill, 1998). Year 10 boys were more active than those in Years 9 and 11. Girls averaged 42 min.day⁻¹ in these two activities, with Year 11 being the least active with only 39 min.day⁻¹. However, only 32% of boys and 22% of girls actually exceeded 60 min.day⁻¹ of activity during the week when accounting for sports and exercise combined with active transport. At weekends, this increased to 47% for boys and 30% for girls.

Analyses by ethnicity

As shown in Table 2, 87% of the sample were White-Europeans. Other ethnic groups included Asian, Black Caribbean/African and Chinese (see Table 2). Conclusions concerning ethnic differences in sedentary and physically active behaviours are necessarily tentative due to small sample sizes.

There was a trend for non-white European children to watch slightly less TV during weekdays than their white European counterparts (100 vs. 113

⁹ These data exclude school physical education.

min.day⁻¹). However, Asians had similar levels to white Europeans (113 min.day⁻¹). Most behaviours did not differ greatly between ethnic groups, separately or when combined, with the exception of participation in sports and exercise. White Europeans spent more time in sports and exercise (25 min.day⁻¹) on weekdays than Asians (9 min.day⁻¹¹⁰) or other ethnic groups combined (11 min.day⁻¹).

Analyses by socio-economic status

Socio-economic status (SES) was assessed by using the father's occupation. The Standard Occupation Classification system was used and occupations were classified into 16 categories. These were collapsed into 4: 'senior positions' (managers and senior officials, professional occupations, and associate professional and technical), 'admin/skilled' (administrative and secretarial, skilled trades, personal service, and sales and customer service), 'less skilled' (process, plant and machine operatives, and elementary occupations), and 'others' (including student, unemployed and retired). We used the first three categories to see if there were differences in the duration of sedentary behaviour by occupational status. There were no significant differences between SES groups, for either gender, for TV viewing, using the computer, playing computer games, active transport, or sports and exercise. Similarly, there were no significant correlations, using Spearman's rho, between SES and these behaviours for boys. However, for girls there was a negative association between minutes per day in motorised transport and SES, suggesting that lower SES is associated with greater use of motorised transport (rho = -.336, $p < .0001$). Overall, socio-economic status seems largely unrelated to the key behaviours in this sample.

Patterning of sedentary and physically active behaviours

Temporal patterning. A common assumption is that sedentary behaviours displace more physically active pursuits – the so-called 'displacement hypothesis'. While this will inevitably be the case at any one moment, is it true across the day or week? More specifically, can different types of behaviours – such as active and sedentary - co-exist within the context of adolescent lifestyles?

In our meta-analysis of the relationship between physical activity and TV viewing and computer game playing in young people (Marshall et al., 2004), we found very small associations, suggesting that the behaviours may be independent. Another way to look at this is to see how behaviours unfold across the day. To do this we summed the number of occurrences of each behaviour across all days for all participants at each 15 min time interval. Summed values were divided by the total number of observations at that interval and multiplied by 100 to give a percentage. Aggregates were computed separately for week and weekend days.

¹⁰ Cohen's d effect size = 0.58, described as 'moderate'

Predictable patterns emerged for weekday data with motorised transport most likely to be reported early in the day for boys (37% of behavioural occurrences at 08.15h) and girls (40% at 08.15h). At 08.30h, 15% of boys' and 14.5% of girls' behaviours were active transport. The reporting of motorised travel after school declined (see Figure 2 for girls), suggesting that parental work patterns may often determine motorised travel to school when their off-spring may be able to walk or cycle. Clearly these two forms of transport do compete with each other, thus showing good potential for more young people to walk or cycle to school.

For sports and exercise, involvement peaked at 19.00h for boys (13% of occurrences) and 19.00-19.15 for girls (7% at each). However, contrary to the displacement hypothesis, TV/video viewing peaked much later in the evening with 44% of occurrences for boys being at 21.30h and 31% for girls at 21.45h. These data suggest that TV and sports/exercise are more likely to occur at different times of the day, thus reducing the chance that they compete for the same time, although it should be noted that TV was always reported to a greater extent after school than sports and exercise.

Some age differences were noted when trends for young people in Year 9 were compared with those in Year 11. Younger boys showed fewer occurrences of motorised travel at 08.15h, but had a higher peak of TV viewing later in the evening. This was partly explained by the older boys taking part in more diverse behaviours, such as using the computer. At 23.30h, 4% of behaviours for Year 9 boys was TV viewing.

Although travel patterns were similar between Year 9 and 11 girls, the older girls reported greater use of the internet in the middle of the evening. At 23.30h, 4% of behaviours for Year 9 girls was TV viewing.

Weekend patterns were more varied than during the week. This is likely due to less structure in the day when young people are not at school. For boys, sports and exercise accounted for 10-16% of behaviours between 10.00-17.00h whereas for girls it only peaked at 5-7% between 10.15-16.45h. Concerning technology-based sedentary behaviours, 26% of behaviours for boys between 18.30 and 23.00h, peaking at 40% at 20.30h, was TV viewing. Girls had 30% of behaviours as TV viewing between 20.15 and 22.00h, but their use of the computer was low (less than 4%), especially for games (less than 2%). Both boys and girls demonstrated a propensity for morning TV at weekends with 10-15% for girls between 09.30-12.30h and greater than 10% for boys from 09.30h through to when they go to bed. For boys, from 09.30-13.00h, 12-17% of behaviours was watching TV, figures slightly greater than for sports and exercise. Computer games were moderately popular throughout the day for boys only (5-9% between 11.00 and 22.15h).

Age differences were evident such that boys in Year 9 were more likely than those in Year 11 to be watching TV, especially in the evening (peaking at 45% of behaviours at 21.00h). Similar age trends were noted for girls, with those in Year 9 watching more TV in the evening (greater than 31% of behaviours between 19.30-22.15h) than those in Year 11 (22-27% between 19.00-

22.30h). Younger boys showed slightly more sport and computer game behaviours than their older counterparts. Younger girls reported more occurrences of sports and exercise throughout the day than older girls.

Environmental patterning. Analyses were also undertaken concerning where young people were for certain behaviours. Results showed that during a weekday, if in the communal living room of the house, 71% of behaviours for boys and 67% for girls was watching TV, showing this location to be highly predictive of this sedentary behaviour. Although having a TV in one's bedroom is a predictor of higher TV viewing (Gorely et al., 2004), we found only 18% of behaviours for girls and 28% for boys was TV viewing when in the bedroom. Nevertheless, those with a TV set in their bedroom did watch more TV than those without, as shown in Figure 3 (boys: $t=-3.85$, $p<.001$, effect size ¹¹ $d = 0.20$; girls: $t=-6.04$, $p<.001$; effect size $d = 0.46$). It should be noted that the effect size is small for boys and moderate for girls.

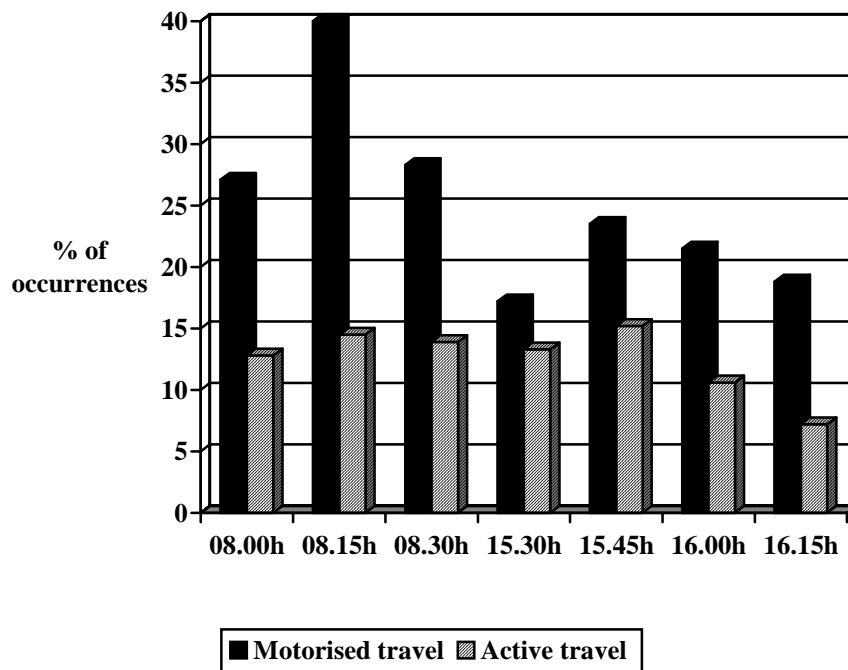


Figure 3. Occurrence of active or motorised travel for girls before and after school.

¹¹ Cohen's $d = \text{mean1} - \text{mean2} / \text{pooled SD}$

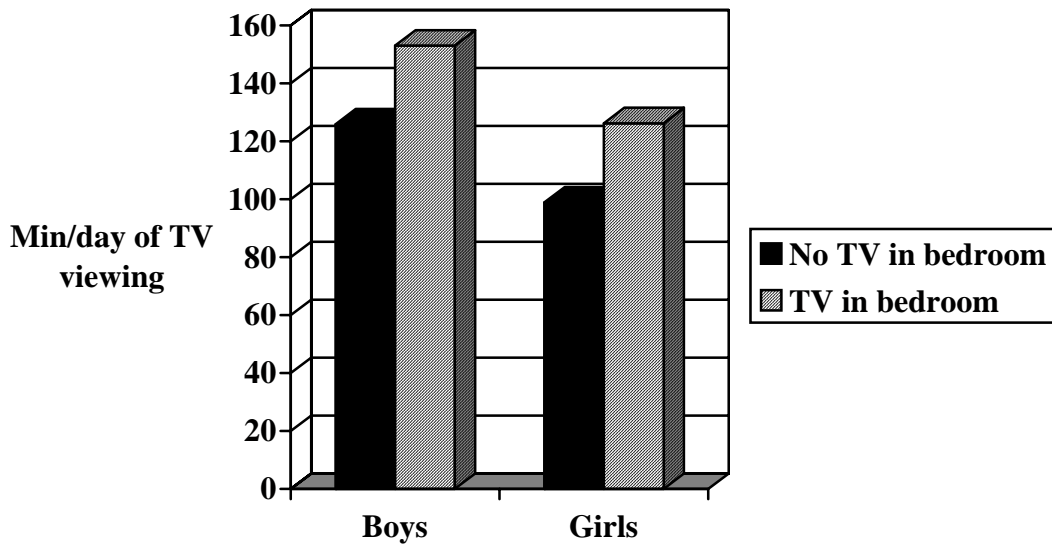


Figure 4. Mean minutes per day of TV viewing for those with and without TV sets in their bedroom

For physically active pursuits, locations outside of the house were important. Locations where sports and exercise were most frequently reported were the garden (girls: 35%; boys: 69%) and 'other outside area' (girls: 19%; boys: 35%), as well as 'other inside area' (girls: 23%; boys: 26%). These gender differences are striking, with boys who are outside reporting a higher percentage of their behaviours as physical activity. When in the garden, for example, 35% of girls' behaviours were sports and exercise, 23% 'behavioural hobbies' and 16% unstructured play, only some of which is likely to be physically active. Boys, on the other hand, predominantly use the garden for sport (69% of occurrences) and unstructured play (15%). Strong age trends also emerged. For boys in Year 9, 78% of behaviours in the garden were sports, a figure that drops to 65% in Year 10, with no incidences reported at all in Year 11. Girls in Year 9, when in the garden, reported 48% of their behaviours as sports and exercise, a figure declining to 37% in Year 10, and only 6% in Year 11. For Year 11 girls, when in 'another outside area', 17% of behaviours were sports and exercise. This figure was 35% for Year 11 boys.

When boys reported being with members of their family, 45% of behaviours was watching TV and 23% eating. For girls, these figures were 38% and 21% respectively.

KEY DETERMINANTS OF SEDENTARY BEHAVIOURS

Determinants of any behaviour can be wide-ranging. We studied demographic, biological, psychological and environmental aspects of likely determinants (or correlates¹²) of key sedentary behaviours through our systematic literature reviews (see earlier for summary findings), the national cross-sectional diary study, and the longitudinal study.

For the longitudinal sample, 83 school students, aged 10 – 15 years, were studied during three phases at 6-month intervals. The longitudinal data comprised anthropometric and pubertal measures, behaviours assessed by the EMA diary, and perceptions of body image.

Demographic determinants

Using the prevalence data presented earlier, there are several demographic trends in our UK sample. Greater TV/video viewing was observed for boys in comparison to girls and for younger children in comparison to their older counterparts. The gender difference was more marked for computer game use, with much greater time spent by boys. As expected, boys were more active in sports and exercise than girls, but there were no differences in active travel. The data on TV viewing concerning age differences were supported by our literature review, but not the evidence for gender differences.

Our primary data on ethnicity needs to be treated with caution due to small sample sizes, but, as indicated earlier, trends suggested that non-white European ethnicities watch slightly less TV during weekdays than those of white European ethnicity. This contradicts evidence from our systematic review. Asians showed similar levels to white Europeans. Asian and other ethnic groups combined spent less time in sports and exercise on weekdays than white Europeans.

Review evidence suggests that greater TV viewing is likely for young people in households of low parental income and education, but not necessarily other indicators of socio-economic status.

Biological determinants

From the longitudinal element of the project, we investigated biological measures through body mass index ($BMI = \text{weight}/\text{height}^2$), percentage body fat (sum of triceps and subscapular skinfolds), waist-hip ratio, and self-reported pubertal status. The latter allowed the creation of four groups: pre-

¹² The term 'determinants' suggests causality when such an assumption often cannot be met. The term 'correlates' has often been adopted instead.

pubertal, early pubertal, late pubertal, and post- pubertal. Sample sizes are shown in Table 8.

Table 8. Sample sizes from the longitudinal phase.

Group	Baseline		Phase 3 (12 months after baseline)	
Gender				
Boys	64		43	
Girls	55		40	
Pubertal status	Boys	Girls	Boys	Girls
Pre	23	12	no change n=26 =>1 stage change n=17	no change n=29 =>1 stage change n=11
Early	15	12		
Late	18	25		
Post	8	6		
School year				
6	22	18	18 (from Yr 6 cohort at baseline)	14
8	22	26	14	19
10	20	11	11	7

At baseline, boys' and girls' sedentary behaviour (a composite measure of 8 sedentary behaviours) was less for pre-pubertal compared with those of at least early pubertal status. Similar trends were shown for age. However, when the amount of sleep was taken into account, statistically significant differences between the levels of pubertal status were removed, suggesting that greater sedentary behaviour by more mature young people is partly explained by greater availability of time due to less sleep (i.e., they simply have more time in the day) (Murdey, Cameron, Biddle, Marshall, & Gorely, 2004).

From the analyses of the longitudinal data, and controlling for sleep and baseline sedentary behaviour, it was shown that boys who advanced in pubertal status spent more time in sedentary behaviour during a weekday than their less mature counterparts. This trend was not evident for weekend data nor for girls at weekends or for a weekday. Changes in sedentary time were unrelated to changes in body composition.

Body weight and fatness are often thought to be related to TV viewing, but the evidence is equivocal. Despite assertions to the contrary (Bar-Or et al., 1998), our meta-analysis concluded that the association between TV viewing and body fatness in youth may be too small to be of clinical significance. Although our systematic review of correlates of TV viewing suggested that body weight was associated with greater TV viewing, the literature showed that body fatness was not.

Psychological determinants

At baseline in our longitudinal study, perceptions of body image were not related to sedentary behaviour in boys but a small trend was evident for girls ($r = -.23$, $p = .054$). Changes in sedentary behaviour over time were largely unrelated to changes in body image with the exception of girls during the week. A reduction in body image in girls predicted an increase in sedentary behaviour.

Environmental determinants

Using our cross-sectional EMA diary data, we found very small associations between time during weekdays in sports and exercise and the sedentary pursuits of TV viewing ($r = -.14$), using a computer ($-.07$), and playing computer/video games ($.04$). Similar results were found for weekends. However, correlations were larger for girls during the week (Year 9 $r = -.23$ & Year 11 $r = -.26$).

We calculated a measure of sedentary behaviour by including the following 8 behaviours: TV viewing, motorised transport, sitting doing nothing, sitting and talking, reading, listening to music, total computer use (work and games), and cognitive hobbies. We then conducted forward multiple regression analyses, separately by gender and day (weekday and weekend day) to predict sedentary behaviour. We entered variables in the following order:

1. minutes spent in sports and exercise
2. minutes spent in active transport
3. number of TVs in the house
4. number of internet computers in the house
5. the environmental variables of minutes spent in the garden, in the town (outside), and in another outside area.

Results are summarised as follows:

- for the boys during the week, the predictor variables accounted for 27.9% of the variance in sedentary behaviour
- sport and exercise accounted for 7.2% of the variance, with active transport (4.6%), and the number of TVs in the house (2%) adding small extra variance (13.8% in total). The number of internet computers in the house did not predict (0%)
- time spent outside (garden, town – outside, and other outside area) added an additional 14.1% of the variance, showing this cluster of variables to be an important predictor of sedentary behaviour
- standardised beta coefficients showed that greater sedentary behaviour was best predicted by less time outside
- for the girls during the week, the predictor variables accounted for 13.5% of the variance in sedentary behaviour
- sport and exercise accounted for only 6% of the variance, with active transport (2.7%), the number of TVs in the house (0.3%), and the

number of internet computers in the house (1%) adding small extra variance (10% in total)

- time spent outside (garden, town – outside, and other area) added an additional 3.5% of the variance, showing this cluster of variables to be a less important predictor of sedentary behaviour than for boys
- standardised beta coefficients showed that greater sedentary behaviour was best predicted by less time in sports and exercise and less time outside
- for the boys during the weekend, the predictor variables accounted for 28.3% of the variance in sedentary behaviour
- sport and exercise accounted for only 6.7% of the variance, with active transport (1%), and number of internet computers in the house (0.2%), adding small extra variance (7.1% in total), but with no added variance for number of TVs in the house
- time spent outside (garden, town – outside, and other area) added an additional 21.2% of the variance, showing this cluster of variables to be an important predictor of sedentary behaviour
- standardised beta coefficients showed that greater sedentary behaviour was best predicted by less time outside
- for the girls during the weekend, the predictor variables accounted for only 7.5% of the variance in sedentary behaviour
- sport and exercise accounted for only 1.8% of the variance, with active transport (0.1%) adding only small extra variance (1.9% in total). Neither the number of TVs in the house nor the number of internet computers in the house accounted for additional extra variance
- time spent outside (garden, town – outside, and other area) added an additional 5.6% of the variance, showing this cluster of variables to be a less important predictor of sedentary behaviour than for boys
- standardised beta coefficients showed that greater sedentary behaviour was best predicted by less time outside.

These analyses show clearly that while physical activity can be an inverse predictor of a cluster of sedentary behaviours, the prediction is greatly enhanced by accounting for the time young people spend outside, particularly for boys. A clear implication for the reduction of sedentary behaviours, based on these cross-sectional findings, is that interventions should focus on increasing opportunities for time outside of the house. This will require a mix of initiatives, ranging from structured activities, such as some sports, to environmental modifications based on attractiveness, accessibility, and safety.

Identifying ‘at risk’ groups

Much of the analyses so far have focussed on the whole sample, or large group comparisons such as those based on gender and age. Such analyses are important to see differences and relationships across the population being analysed. However, they may also mask important sub-group differences. Therefore, we compared the following groups on time spent in sports and exercise and time outside (outside in the town, in the garden, and in another outside area):

- low vs. high TV viewers (weekday and weekend combined), with low <math><120 \text{ min.day}^{-1}</math> and high $>239 \text{ min.day}^{-1}$, in line with the recommendations of the American Academy of Pediatrics (1986)
- low vs. high sedentary behaviour (weekday and weekend combined), with sedentary behaviour represented by the 8 behaviours analysed earlier. Groups were classified as the lowest and highest 33% of the total distribution, with low <math><210 \text{ min.day}^{-1}</math> and high $> 285 \text{ min.day}^{-1}$.

Data were analysed using independent t-tests and effect sizes were calculated using the Cohen's *d* statistic. Interpretation of the Cohen's *d* statistic is as follows:

- 0 - 0.29: 'small'
- 0.30 – 0.69: 'moderate'
- 0.70+: 'large'.

TV Viewing

Weekday results showed:

- for males, there was no significance difference between high TV viewers ($n=253$) ($M=27.8 \text{ min.day}^{-1}$) and low TV viewers ($n=308$) ($34.8 \text{ min.day}^{-1}$) ($p=.07$) concerning participation in sports and exercise; effect size (ES) = 0.15
- for females, high TV viewers ($n=295$) participated in significantly less sports and exercise ($M=12.1 \text{ min.day}^{-1}$) than those in the low TV group ($n=628$) ($21.5 \text{ min.day}^{-1}$) ($p<.001$); ES = 0.34
- for males, high TV viewers spent significantly less time outside ($M=70.7 \text{ min.day}^{-1}$) than those in the low TV group ($105.7 \text{ min.day}^{-1}$) ($p<.0001$); ES = 0.42
- for females, high TV viewers spent significantly less time outside ($M=53 \text{ min.day}^{-1}$) than those in the low TV group ($69.4 \text{ min.day}^{-1}$) ($p<.001$); ES = 0.29.

Weekend results showed:

- for males, there was trend showing a difference between high TV viewers ($n=340$) ($M=73.2 \text{ min.day}^{-1}$) and low TV viewers ($n=171$) ($94.3 \text{ min.day}^{-1}$) ($p=.051$) concerning participation in sports and exercise; effect size (ES) = 0.19
- for females, high TV viewers ($n=453$) showed no difference in sports and exercise participation ($M=33.2 \text{ min.day}^{-1}$) than those in the low TV group ($n=390$) ($40.2 \text{ min.day}^{-1}$) ($p>.05$); ES = 0.11
- for males, high TV viewers spent significantly less time outside ($M=175.2 \text{ min.day}^{-1}$) than those in the low TV group ($297.4 \text{ min.day}^{-1}$) ($p<.0001$); ES = 0.55
- for females, high TV viewers spent significantly less time outside ($M=117.7 \text{ min.day}^{-1}$) than those in the low TV group ($162.9 \text{ min.day}^{-1}$) ($p<.0001$); ES = 0.30.

Sum of 8 sedentary behaviours

Weekday results showed:

- for males, the high sedentary group participated in significantly less sports and exercise ($M = 18.2 \text{ min.day}^{-1}$) than the low sedentary group (48 min.day^{-1}) ($p < .0001$); $ES = 0.68$
- for females, the high sedentary group participated in significantly less sports and exercise ($M = 7.4 \text{ min.day}^{-1}$) than the low sedentary group ($25.7 \text{ min.day}^{-1}$) ($p < .0001$); $ES = 0.70$
- for males, the high sedentary group spent significantly less time outside ($M = 50.2 \text{ min.day}^{-1}$) than the low sedentary group ($143.8 \text{ min.day}^{-1}$) ($p < .0001$); $ES = 1.18$
- for females, the high sedentary group spent significantly less time outside ($M = 43.1 \text{ min.day}^{-1}$) than the low sedentary group ($79.4 \text{ min.day}^{-1}$) ($p < .0001$); $ES = 0.65$.

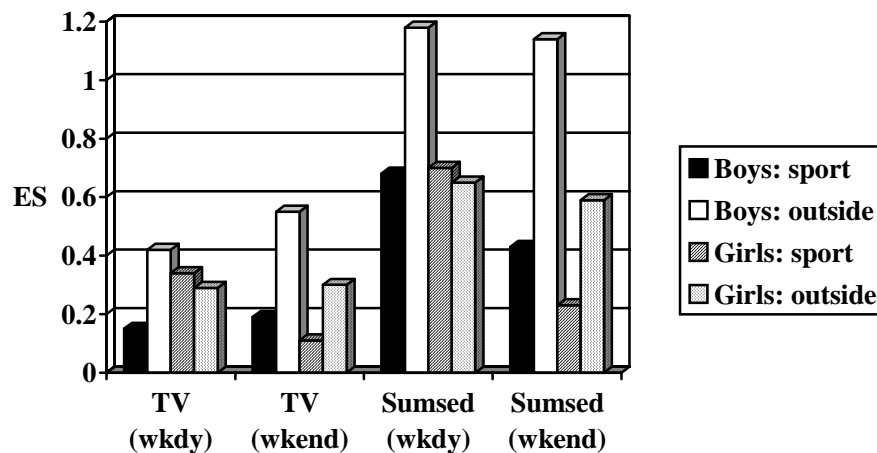


Figure 5. Effect sizes for group differences on a) time in sports and exercise (sport) and b) time outside for high versus low TV viewers (TV) and high versus low sedentary groups (sumsed) for weekdays (wkdy) and weekend day (wkend).

Weekend results showed:

- for males, the high sedentary group participated in significantly less sports and exercise ($M = 67.1 \text{ min.day}^{-1}$) than the low sedentary group ($n=83$) ($118.7 \text{ min.day}^{-1}$) ($p < .004$); $ES = 0.43$
- for females, the high sedentary group participated in significantly less sports and exercise ($M = 32 \text{ min.day}^{-1}$) than the low sedentary group ($48.6 \text{ min.day}^{-1}$) ($p < .03$); $ES = 0.23$
- for males, the high sedentary group spent significantly less time outside ($M = 152.8 \text{ min.day}^{-1}$) than the low sedentary group ($413.8 \text{ min.day}^{-1}$) ($p < .0001$); $ES = 1.14$

- for females, the high sedentary group spent significantly less time outside ($M=113 \text{ min.day}^{-1}$) than the low sedentary group ($212.4 \text{ min.day}^{-1}$) ($p<.0001$); $ES = 0.59$.

Effect sizes are illustrated in Figure 5. While high and low TV viewing groups do differ in respect of the amount of sports and exercise and time outside, the effect sizes are small-to-moderate. When considering high and low sedentary groups, however, variables show much greater differences, revealing mainly moderate-to-large effect sizes. For boys in particular, high and low sedentary groups were very clearly differentiated by time spent outside at weekends and during the week.

These findings confirm our view that while TV viewing is a prevalent sedentary behaviour, it is not a good marker of total sedentary behaviour. Interventions might be better targeted at a profile of several sedentary behaviours rather than TV alone, and at time spent outside.

Cluster analyses to identify different sedentary groups

Results so far suggest that sedentary behaviour is multi-faceted and complex and, consequently, single behaviours, such as TV viewing, may not be appropriate markers of overall sedentary behaviour. We tested this by conducting cluster analysis to see if different groups (clusters) of boys and girls emerged based on their scores on sedentary and active behaviours.

To interpret a cluster analysis, we are primarily interested in variables that deviate from the overall mean score (standardised z-score) of zero. Scores deviating ± 0.5 (one-half standard deviation) are often considered to be meaningfully different from zero. Three clusters were identified for boys (see Figure 6):

- 'sociable techno in-actives' ($n=156$; 33.6%) were characterised by higher TV viewing, computer game playing, and 'hanging out', but less time spent in sports and exercise
- 'scholarly low techno in-actives' ($n=133$; 28.7%) were characterised by more time spent on homework and behavioural hobbies, more time on the computer, but less on computer games and sports and exercise
- 'sociable actives' ($n=175$; 37.7%) were characterised by less time on homework but more time spent sitting and talking and playing sports and exercise

Three clusters were identified for girls (Figure 7):

- 'sociable in-actives' ($n=333$; 41.6%) were characterised by higher use of the telephone, more time listening to music, and less time spent in sports and exercise
- 'low socialising TV viewers' ($n=233$; 29.1%) were characterised by less time sitting and talking and being on the telephone, and more time spent on homework and TV viewing; they also had average sport and exercise involvement

- 'low TV actives' (n=235; 29.3%) were characterised by less time watching TV but more time spent in behavioural hobbies and playing sports and exercise.

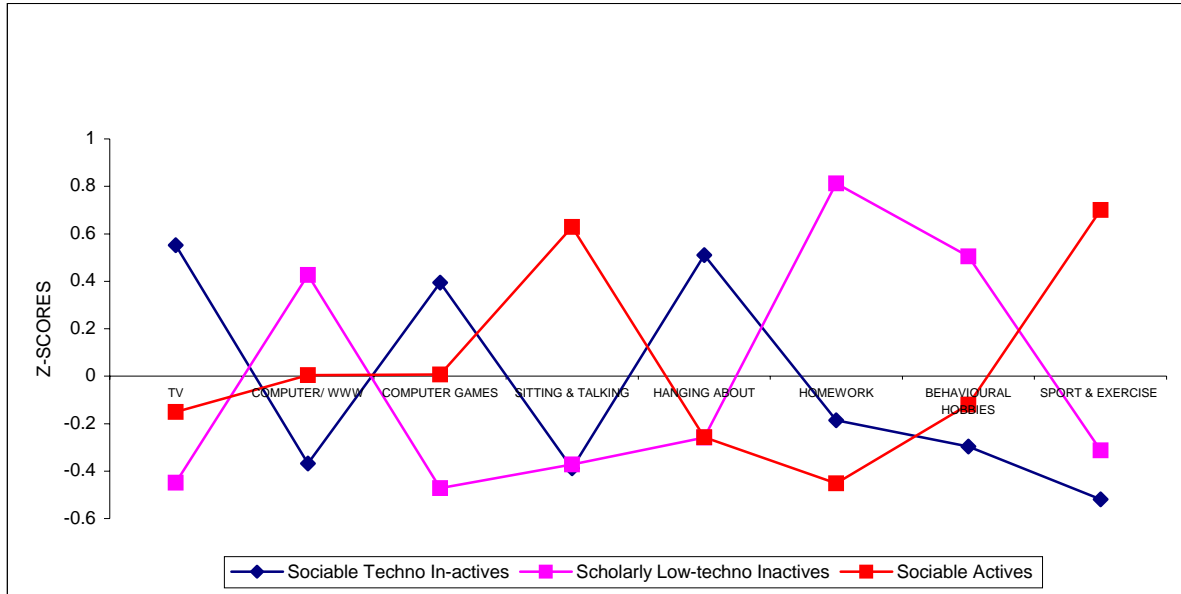
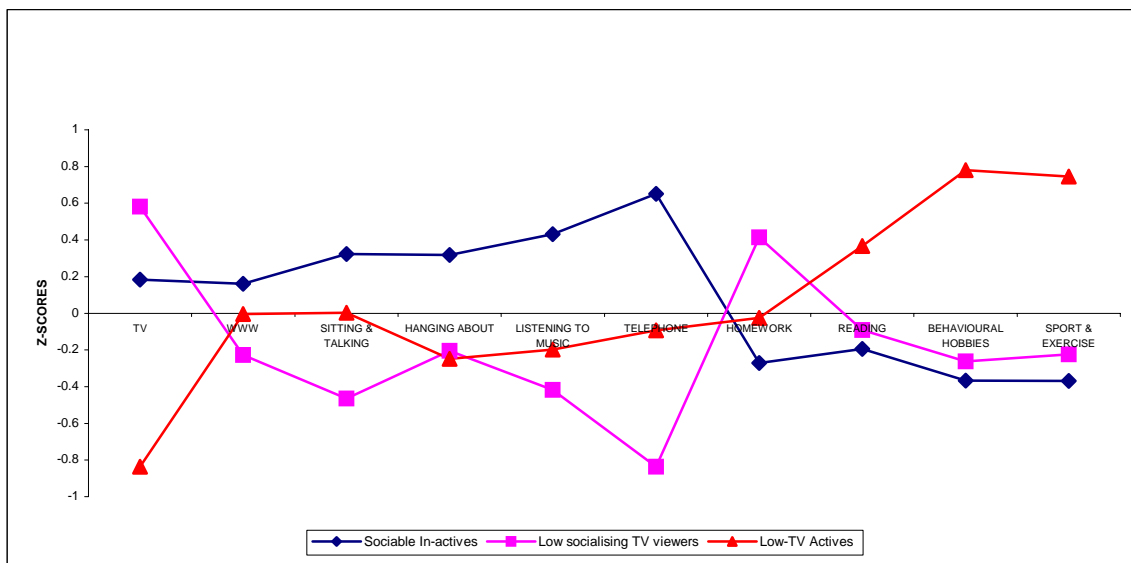


Figure 6 (above: boys, n=464) & Figure 7 (below: girls, n=801). Standard scores of cluster centroids on sedentary behaviour and sport and exercise



These diverse groupings suggest that no one sedentary behaviour is likely to be an effective intervention target for the majority of adolescents.

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Appendix 1. Sample page from the EMA diary

BEFORE SCHOOL		SCHOOL DAY 1	
Time	<u>What are you doing?</u> (Write activity) e.g., sleeping, eating, doing homework, talking with friends, watching TV, listening to music, on telephone, walking to school, etc.	Where are you? (Circle one number) 1 = My bedroom, 2 = Living room 3 = Kitchen 4 = Bathroom 5 = Other room in own house 6 = Friend's house 7 = In town (inside) 8 = In town (outside) 9 = At school 10 = In car, bus, train, taxi, etc. 11 = Other inside area (please describe) 12 = Other outside area (please describe)	Who's with you? (Circle one number) 1 = I'm alone 2 = Friends 3 = Family 4 = Friends & Family 5 = Other (e.g., teacher, coach, doctor, dentist, etc).
7:00 am 1	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
7:15 am 2	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
7:30 am 3	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
7:45 am 4	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
8:00 am 5	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
8:15 am 6	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
8:30 am 7	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5
8:45 am 8	THE MAIN THING I AM DOING IS:	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5

Appendix 2. Publications and other research outputs from Project STIL

Publications

Biddle, S. J. H. & Gorely, T. (in press). Couch kids: Myth or reality? *The Psychologist*.

Murdey, I. D., Cameron, N., Biddle, S. J. H., Marshall, S. J., & Gorely, T. (in press). Short term changes in sedentary behaviour during adolescence: Project STIL. *Annals of Human Biology*.

Gorely, T., Marshall, S. J., & Biddle, S. J. H. (2004). Couch kids: Correlates of television viewing among youth. *International Journal of Behavioral Medicine*, 11, 152-163

Biddle, S. J. H., Gorely, T., Marshall, S. J., Murdey, I., & Cameron, N. (2004). Physical activity and sedentary behaviours in youth: Issues and controversies. *Journal of the Royal Society for the Promotion of Health*, 124(1), 29-33.

Marshall, S. J., Biddle, S. J. H., Gorely, T., Cameron, N., & Murdey, I. (2004). Relationships between media use, body fatness and physical activity in children and youth: A meta-analysis. *International Journal of Obesity*, 28, 1238-1246.

Murdey, I. D., Cameron, N., Biddle, S. J. H., Marshall, S. J., & Gorely, T. (2004). Pubertal development and sedentary behaviour during adolescence. *Annals of Human Biology*, 31, 75-86.

Papers under review

Biddle, S. J. H., Marshall, S. J., Gorely, T. J., Murdey, I., & Cameron, N. Sedentary and physically active behaviours of young people living in the UK: Temporal, environmental and social factors.

Marshall, S. J., Gorely, T., & Biddle, S. J. H. (2004). Sedentary behaviours of young people: Prevalence, incidence, and trends.

Papers in preparation

Marshall, S. J., Biddle, S. J. H., Murdey, I., Gorely, T. J., & Cameron, N. Developing ecological self-reports of sedentary behaviour and physical activity among youth: A momentary time-sampling approach.

Published abstracts

Biddle, S. J. H., Marshall, S. J., Gorely, P. J., Cameron, N., & Murdey, I. (2003). Sedentary behaviors, body fatness and physical activity in youth: A meta-analysis [abstract]. *Medicine and Science in Sports and Exercise*, 35(5, Suppl.), S178.

Gorely, T. J., Vince, A. J., Biddle, S. J. H., Marshall, S. J., Murdey, I. D., & Cameron, N. (2004). Clustering of sedentary behaviours and physical activity in adolescents [abstract]. *International Journal of Behavioral Medicine*, 11(Supplement), 141-142.

Marshall, S. J., Biddle, S. J. H., Murdey, I., Gorely, T., & Cameron, N. (2003). But what are you doing now? Ecological momentary assessment of sedentary behavior among youth [abstract]. *Medicine and Science in Sports and Exercise*, 35(5, Suppl.), S180.

Vince, A. J., Gorely, T. J., Biddle, S. J. H., Marshall, S. J., Murdey, I. D., & Cameron, N. (2004). Clustering of sedentary behaviours in adolescents: Environmental determinants [abstract]. *International Journal of Behavioral Medicine*, 11(Supplement), 148-149.

Gorely, T., Marshall, S., Biddle, S., Murdey, I., Cameron, N., Whitehead, S. & Mundy, C. (2004). Sedentary behavior and physical activity among British adolescent girls [abstract]. *Annals of Behavioral Medicine*, 27(suppl), S090.

Conference presentations Research

Gorely, T., Marshall, S., Biddle, S., Murdey, I., & Cameron, N. (2002). Couch kids: A descriptive epidemiology of youth sedentary behaviour. International Congress of Behavioural Medicine, Helsinki.

Biddle, S. J. H., Marshall, S. J., Gorely, T., Murdey, I., & Cameron, N. (2003). Profiles of youth sedentary behaviours and physical activity. 11th European Congress of Sport Psychology, Copenhagen, Denmark.

Biddle, S. J. H., Gorely, P. J., Marshall, S. J., Murdey, I., & Cameron, N. (2003). Media use and physical inactivity in young people: Observations from Project *STIL*. IOC Pre-Olympic Congress, Athens, Greece.

Biddle, S. J. H., Marshall, S. J., Gorely, P. J., Cameron, N., & Murdey, I. (2003). Sedentary behaviors, body fatness and physical activity in youth: A meta-analysis. American College of Sports Medicine, San Francisco, USA.

Marshall, S. J., Biddle, S. J. H., Murdey, I., Gorely, T., & Cameron, N. (2003). But what are you doing now? Ecological momentary assessment of sedentary behavior among youth. American College of Sports Medicine, San Francisco, USA.

Biddle, S. J. H., Marshall, S. J., Gorely, P. J., Cameron, N., & Murdey, I. (2003). Sedentary behaviour in young people: Implications for promoting physical activity. European College of Sport Science, Salzburg, Austria.

Vince, A. J., Gorely, T. J., Biddle, S. J. H., Marshall, S. J., Murdey, I. D., & Cameron, N. (2004). Clustering of sedentary behaviours in adolescents:

Environmental determinants. International Society of Behavioral Medicine, Mainz, Germany.

Gorely, T. J., Vince, A. J., Biddle, S. J. H., Marshall, S. J., Murdey, I. D., & Cameron, N. (2004). Clustering of sedentary behaviours and physical activity in adolescents. International Society of Behavioral Medicine, Mainz, Germany.

Gorely, T., Marshall, S., Biddle, S., Murdey, I., Cameron, N., Whitehead, S. & Mundy, C. (2004). Sedentary behavior and physical activity among British adolescent girls. Society of Behavioral Medicine 25th Annual Meeting, Baltimore, USA.

Invited lectures

Biddle, S. J. H. (2002). Motivation of young people for sport and physical activity. Institute of Sport & Recreation Management, *Building Our Sporting Future* conference, Manchester, September.

Biddle, S. J. H. (2002). What do children and young people do? Couch potatoes may also be runner beans! Institute of Leisure & Amenity Management, Children in Sport & Exercise Conference, Leicester, September.

Biddle, S. J. H. (2003). Social psychology of physical activity and sedentary behaviour in young people. Invited lecture, 22nd Pediatric Work Physiology meeting, Porto, Portugal.

Biddle, S. J. H. (2003). Sedentary behaviours in adolescence. The Society for the Study of Human Biology and The Biosocial Society Annual Symposium, Loughborough, December.

Biddle, S. J. H. (2003). Physical activity and sedentary living in children. 11th Annual Public Health Forum, Cardiff, March.

Biddle, S. J. H. (2003). Physical activity and sedentary behaviour: Interventions and policy implications. British Heart Foundation National Centre for Physical Activity & Health annual conference, Birmingham, November.

Gorely, T. (2003). Physical activity and sedentary behaviour: Outcomes, prevalence and correlates. British Heart Foundation National Centre for Physical Activity & Health annual conference, Birmingham, November.