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Sedentary behaviour among Scottish youth: prevalence and determinants

PROJECT *STIL* (SCOTLAND)

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Professor Stuart Biddle, Loughborough University
Dr Simon Marshall, San Diego State University
Dr Trish Gorely, Loughborough University
Professor Noel Cameron, Loughborough University
Dr Ian Murdey, Loughborough University
Claire Mundy, Loughborough University
Andrew Vince, Loughborough University
Sarah Whitehead, Loughborough University

Loughborough University

Project STIL
Sedentary Teenagers & Inactive Lifestyles

BHF National Centre
physical activity+health

Contents

Acknowledgements

Summary

Principal Investigator: Professor Stuart Biddle

Co-grant holders: Dr Simon Marshall, Dr Trish Gorely, Professor Noel Cameron, Mr Len Almond

Report authors: Professor Stuart Biddle[1], Dr Simon Marshall, Dr Trish Gorely, Professor Noel Cameron, Dr Ian Murdey, Ms Sarah Whitehead

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Summary

1. There is a great deal of concern about young people's overweight and obesity. Sedentary lifestyles are thought to be particularly important in weight gain yet it is common in the popular media and academic literature to simplify matters by stating that electronic media, such as the television and computer games, are primarily the cause of a 'couch kids' culture.

2. Project *STIL* ('Sedentary Teenagers and Inactive Lifestyles') at Loughborough University is research focusing on a wide range of sedentary and physically active behaviours. Project *STIL* (Scotland) investigated a Scottish sample with the dual purpose of a) obtaining estimates for the prevalence of sedentary behaviour in Scottish youth, and b) investigating factors associated with sedentary behaviour.

3. The principal data collection instrument was a self-report diary of "free-time" behaviours that school students completed outside of school hours (3 weekdays and 1 weekend day). The diary asked the participants to write down what they were doing at 15-minute time intervals. In addition, they recorded where they were. Demographic variables were also assessed.

4. Assessment took place in 27 schools from 14 local education authorities. Data were collected in two phases: October-November 2002 and February-May 2003 with school Years S2-S4 (ages 13-15 yrs). The final sample comprised 396 boys and 620 girls (total n=1016).

5. Boys averaged just over 2hrs TV viewing per day during the week and 3hr and 15mins at weekends; boys in Year S4 watched less TV than those in Years S3 and S2. Girls averaged just under 2hrs of TV viewing per day during the week and 2hr and 39mins at weekends; girls in Year S2 watched more TV than those in Years S3 and S4.

6. Other prominent sedentary behaviours included motorised travel, computer use, homework, and 'hanging out' with friends.

7. Boys were markedly more active than girls in sports and exercise

8. Results were minimally affected by ethnicity and socio-economic status.

9. Relationships between TV viewing and physically active behaviours were very small.

10. After school, there was a slight shift in likelihood of behaviour from motorised to active travel compared to before school, suggesting that active travel is possible for some children who use motorised means of travel to school.

11. The greatest likelihood of playing sport and exercise during the school week was in the early evening, whereas the likelihood of watching TV peaked later, suggesting some temporal displacement between the two behaviours.

12. There was never a time during the week when sports and exercise were more likely than TV viewing, but sports and exercise were more likely during periods of the weekend day for boys.

13. TV viewing was no greater for those with TV sets in their bedroom than those without, although for those with TVs in their bedroom, there was a 26% chance of watching TV, when in the bedroom, for girls and 35% for boys during the week, and at weekends 40% for boys and 29% for girls.

14. 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.

15. 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.

16. When considering high and low sedentary groups, the amount of sports and exercise and time outside show much greater differences, all revealing large effect sizes. This confirms our view that while TV viewing is a prevalent sedentary behaviour, it is a 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.

17. Using cluster analysis, diverse groupings across sedentary and active behaviours were found for both boys and girls. This suggests that no one sedentary behaviour is likely to be an effective intervention target for the majority of adolescents. In addition, the clusters confirmed that TV viewing is not necessarily in opposition to sports and exercise.

1. 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 that they do inadequate amounts of physical activity? These are key questions we do not have definite answers to. This project was established to investigate the amount and types of sedentary behaviour in Scottish adolescents and what factors are related to sedentary behaviour.

Concurrent with this project, we collected data for the UK, through Project *STIL* ('Sedentary Teenagers and Inactive Lifestyles') but sampling estimates meant that only 4 schools in Scotland were assessed. There was a need, therefore, for a larger, more representative, Scottish sample for reliable estimates for the prevalence of sedentary behaviour. Additional funding was therefore offered in 2002 by the young People's Programme at NHS Health Scotland[2] to increase the size of the Scottish sample to make it more representative.

Project *STIL* (Scotland) addressed two fundamental questions concerning sedentary behaviour outside school time in adolescent boys and girls in Scotland:

- What is the prevalence of key sedentary behaviours in young people in Scotland?
- What are the main determinants of sedentary behaviour?

2. Measurement of sedentary behaviour in youth

2.1 Method
The principal data collection instrument was a self-report diary of "free-time" behaviours that school students completed outside of school hours. Because we were primarily interested in behaviours where young people had some element of choice, behaviours in school were not assessed. The diary was based on principles of Ecological Momentary Assessment (EMA) and was divided into two parts. The first 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 hypothesized to correlate with sedentary behaviour and physical activity. The second part was for recording the behaviours and locations that young people engage in each day in their free time. Reliable estimates of behaviour have been found (Marshall, Biddle, Murdey, Gorely, & Cameron, 2003).

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 behaviour in response to a single item: "What are you doing now?". At each interval, participants also responded to the closed-response items "Where are you?" (LOCATION) by selecting one location from a list of 12, and "Who's with you?". This last question will not be analysed and reported here due to limitations of space. An example diary page can be seen in Appendix 1.

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[2] Formerly Health Education Board for Scotland (HEBS)

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 behaviour, 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 behaviour during the day and events that may have affected diary entries (e.g., weather, injury/illness, etc.).

The behaviours were first coded into 23 mutually exclusive categories. To estimate the time spent in each behaviour 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 minutes per day (min.day^{-1}), across weekdays. The outcome variables for all analyses are min.day^{-1} engaged in 23 categories of behaviour in 12 locations (see Table 2.1).

2.1.1 Sampling
Sampling took place across 14 local education authorities (LEAs), randomly drawn from the total of 32: Aberdeenshire, Dumfries and Galloway, Dundee, East Ayrshire, South Ayrshire, Edinburgh, Falkirk, Fife, Glasgow, Highland, North Lanarkshire, South Lanarkshire, Perth and Kinross, and Renfrewshire. 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 discarded for reasons of representativeness, and another randomly selected.

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 including three sets of 30 diaries (approximately 75 for distribution and the rest as spares in case of loss, damage etc) and an evaluation form. Useable data were returned by 27 schools.

In Phase 1 (October-November 2002), one class from each of the Year Groups S2 (mean age=13.24 years), S3 (mean age=14.24y), and S4 (mean age=15.18y) 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. Schools were offered the incentive of £1 for the return of each completed diary. 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 in February-May 2003. Each school that returned Phase 1 data was asked to select a second set of Year S2, S3, and S4 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. Mean ages at Phase 2 were S2=13.62 years, S3=14.55y, and S4=15.55y.

Table 2.1 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		

Of the 1056 participants who returned diaries, 60% were girls. Assuming there is an equal proportion of girls and boys in the school population, our sample reflects a gender bias beyond that expected by chance (Chi-square (X^2) = 38.64, df = 1, $\underline{p}$ < .01). Of the returned diaries, girls were also more likely to provide complete data (χ^2 (4, $\underline{N}$ = 1056) = 40.66, $\underline{p}$ = .0001). Forty participants (4%) returned diaries with completed demographic data but no diary data (i.e., partial responders) and were therefore excluded from further analyses. Partial responders were more likely to be male (χ^2 (1, $\underline{N}$ = 1056) = 22.14, $\underline{p}$ = .0001), slightly younger than full responders (13.7 vs. 14.1 y; t $_{(1059)}$ = -2.58, $\underline{p}$ = .01), and live in a less affluent area ($\underline{p}$ = .001), but they did not differ by ethnicity ($\underline{p}$ = 0.68) nor whether they found the diary harder to understand ($\underline{p}$ = 0.57), compared to full responders. See Table 2.2 for summary data on participants.

Table 2.2 Demographic characteristics of the final sample

	N	%
Gender		
Male	396	39
Female	620	61
School Year		
S2	451	45%
S3	290	29%
S4	257	26%
Ethnicity		
White	981	98%
Asian/Pacific Islander	17	2%
Black	3	<1%
Other	3	<1%

3. What is the prevalence of sedentary behaviour in Scottish youth?

Results for this report will address the prevalence of key sedentary behaviours and physically active pursuits, as well as descriptive summary data on these behaviours. To keep the volume of data manageable, variables were conceptualised as follows:
- sedentary behaviours: TV/video viewing, playing computer/video games, using the computer (excluding computer-based homework and games), using motorised transport.
- physically active behaviours: active transport, sports and exercise.

Results are reported for boys during the school week (Table 3.1) and at weekends (Table 3.2), and for girls during the school week (Table 3.3) and at weekends (Table 3.4). Each table shows results by school year and for the whole of the subsample.

Table 3.1 Prevalence of key sedentary and physically active behaviours during weekdays for boys

Behaviour and prevalence categories (mins/day)	Year S2 (n=182)	95% Confidence Intervals (CI)		Year S3 (n=118)	95% Confidence Intervals (CI)		Year S4 (n=85)	95% Confidence Intervals (CI)		ALL boys (n=385)	95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Motorised Transport												
0	24.70%	24.637	24.763	26.30%	26.221	26.379	25.90%	25.807	25.993	25.50%	25.456	25.544
1-29m	26.40%	26.336	26.464	25.40%	25.321	25.479	28.20%	28.104	28.296	26.50%	26.456	26.544
30-59m	35.20%	35.131	35.269	37.30%	37.213	37.387	36.50%	36.398	36.602	36.10%	36.052	36.148
60-120m	12.60%	12.552	12.648	9.30%	9.248	9.352	8.20%	8.142	8.258	10.60%	10.569	10.631
120-240m	1.10%	1.085	1.115	1.70%	1.677	1.723	1.20%	1.177	1.223	1.30%	1.289	1.311
240+m												
TV/Video Viewing												
0	1.10%	1.085	1.115	2.50%	2.472	2.528	4.70%	4.655	4.745	2.30%	2.285	2.315
1-29m	3.80%	3.772	3.828	3.40%	3.367	3.433	2.40%	2.367	2.433	3.40%	3.382	3.418
30-59m	7.10%	7.063	7.137	11.90%	11.842	11.958	10.60%	10.535	10.665	9.40%	9.371	9.429
60-120m	39.00%	38.929	39.071	23.70%	23.623	23.777	43.50%	43.395	43.605	35.30%	35.252	35.348
120-240m	39.60%	39.529	39.671	49.20%	49.110	49.290	36.50%	36.398	36.602	41.80%	41.751	41.849
240+m	9.30%	9.258	9.342	9.30%	9.248	9.352	2.40%	2.367	2.433	7.80%	7.773	7.827
Computer Use												
0	78.60%	78.540	78.660	63.60%	63.513	63.687	63.50%	63.398	63.602	70.60%	70.554	70.646
1-29m	11.50%	11.454	11.546	16.10%	16.034	16.166	16.50%	16.421	16.579	14.00%	13.965	14.035
30-59m	6.60%	6.564	6.636	11.00%	10.944	11.056	8.20%	8.142	8.258	8.30%	8.272	8.328
60-120m	3.30%	3.274	3.326	6.80%	6.755	6.845	9.40%	9.338	9.462	5.70%	5.677	5.723
120-240m				2.50%	2.472	2.528	2.40%	2.367	2.433	1.30%	1.289	1.311
240+m												

Computer/video Games												
0	41.20%	41.128	41.272	40.70%	40.611	40.789	49.40%	49.294	49.506	42.90%	42.851	42.949
1-29m	19.80%	19.742	19.858	17.80%	17.731	17.869	14.10%	14.026	14.174	17.90%	17.862	17.938
30-59m	20.90%	20.841	20.959	18.60%	18.530	18.670	15.30%	15.223	15.377	19.00%	18.961	19.039
60-120m	14.80%	14.748	14.852	17.80%	17.731	17.869	16.50%	16.421	16.579	16.10%	16.063	16.137
120-240m	3.30%	3.274	3.326	4.20%	4.164	4.236	4.70%	4.655	4.745	3.90%	3.881	3.919
240+m				0.80%	0.784	0.816				0.30%	0.295	0.305
Sport & exercise												
0	41.80%	41.728	41.872	41.50%	41.411	41.589	27.10%	27.006	27.194	38.40%	38.351	38.449
1-29m	13.70%	13.650	13.750	12.70%	12.640	12.760	15.30%	15.223	15.377	13.80%	13.766	13.834
30-59m	15.40%	15.348	15.452	18.60%	18.530	18.670	11.80%	11.731	11.869	15.60%	15.564	15.636
60-120m	19.80%	19.742	19.858	21.20%	21.126	21.274	29.40%	29.303	29.497	22.30%	22.258	22.342
120-240m	7.70%	7.661	7.739	5.10%	5.060	5.140	15.30%	15.223	15.377	8.60%	8.572	8.628
240+m	1.60%	1.582	1.618	0.80%	0.784	0.816	1.20%	1.177	1.223	1.30%	1.289	1.311
Active transport												
0	23.10%	23.039	23.161	24.60%	24.522	24.678	17.60%	17.519	17.681	22.30%	22.258	22.342
1-29m	32.40%	32.332	32.468	38.10%	38.012	38.188	41.20%	41.095	41.305	36.10%	36.052	36.148
30-59m	30.20%	30.133	30.267	30.50%	30.417	30.583	27.10%	27.006	27.194	29.60%	29.554	29.646
60-120m	14.30%	14.249	14.351	6.80%	6.755	6.845	12.90%	12.829	12.971	11.70%	11.668	11.732
120-240m							1.20%	1.177	1.223	0.30%	0.295	0.305
240+m												

Table 3.2 Prevalence of key sedentary and physically active behaviours during weekends for boys

Behaviour and prevalence categories (mins/day)	Year S2 (n=162)			Year S3 (n=111)			Year S4 (n=80)			ALL boys (n=353)		
Motorised transport		95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
0	46.90%	46.823	46.977	49.50%	49.407	49.593	47.50%	47.391	47.609	47.90%	47.848	47.952
1-29m	6.20%	6.163	6.237	8.10%	8.049	8.151	6.30%	6.247	6.353	6.80%	6.774	6.826
30-59m	20.40%	20.338	20.462	13.50%	13.436	13.564	23.80%	23.707	23.893	19.00%	18.959	19.041
60-120m	19.80%	19.739	19.861	17.10%	17.030	17.170	11.30%	11.231	11.369	17.00%	16.961	17.039
120-240m	6.80%	6.761	6.839	9.90%	9.844	9.956	10.00%	9.934	10.066	8.50%	8.471	8.529
240+m				1.80%	1.775	1.825	1.30%	1.275	1.325	0.80%	0.791	0.809
TV/video viewing												
0	3.70%	3.671	3.729	6.30%	6.255	6.345	8.80%	8.738	8.862	5.70%	5.676	5.724
1-29m	0.60%	0.588	0.612				2.50%	2.466	2.534	0.80%	0.791	0.809
30-59m	7.40%	7.360	7.440	3.60%	3.565	3.635	6.30%	6.247	6.353	5.90%	5.875	5.925
60-120m	9.90%	9.854	9.946	14.40%	14.335	14.465	16.30%	16.219	16.381	12.70%	12.665	12.735
120-240m	45.70%	45.623	45.777	42.30%	42.208	42.392	42.50%	42.392	42.608	43.90%	43.848	43.952
240+m	32.70%	32.628	32.772	33.30%	33.212	33.388	23.80%	23.707	23.893	30.90%	30.852	30.948
Computer use												
0	85.20%	85.145	85.255	78.40%	78.323	78.477	81.30%	81.215	81.385	82.20%	82.160	82.240
1-29m	0.60%	0.588	0.612				2.50%	2.466	2.534	0.80%	0.791	0.809
30-59m	1.90%	1.879	1.921	4.50%	4.461	4.539	6.30%	6.247	6.353	3.70%	3.680	3.720
60-120m	8.60%	8.557	8.643	9.90%	9.844	9.956	5.00%	4.952	5.048	8.20%	8.171	8.229
120-240m	3.10%	3.073	3.127	4.50%	4.461	4.539	2.50%	2.466	2.534	3.40%	3.381	3.419
240+m	0.60%	0.588	0.612	2.70%	2.670	2.730	2.50%	2.466	2.534	1.70%	1.687	1.713

Computer games

0	44.40%	44.323	44.477	52.30%	52.207	52.393	56.30%	56.191	56.409	49.60%	49.548	49.652
1-29m	0.60%	0.588	0.612	2.70%	2.670	2.730				1.10%	1.089	1.111
30-59m	13.00%	12.948	13.052	7.20%	7.152	7.248	6.30%	6.247	6.353	9.60%	9.569	9.631
60-120m	20.40%	20.338	20.462	20.70%	20.625	20.775	17.50%	17.417	17.583	19.80%	19.758	19.842
120-240m	15.40%	15.344	15.456	13.50%	13.436	13.564	16.30%	16.219	16.381	15.00%	14.963	15.037
240+m	6.20%	6.163	6.237	3.60%	3.565	3.635	3.80%	3.758	3.842	4.80%	4.778	4.822

Sports & exercise

0	46.90%	46.823	46.977	48.60%	48.507	48.693	50.00%	49.890	50.110	48.20%	48.148	48.252
1-29m	0.60%			1.80%	1.775	1.825				0.80%	0.791	0.809
30-59m	3.70%	3.671	3.729	3.60%	3.565	3.635	3.80%	3.758	3.842	3.70%	3.680	3.720
60-120m	16.00%	15.944	16.056	10.80%	10.742	10.858	8.80%	8.738	8.862	12.70%	12.665	12.735
120-240m	22.20%	22.136	22.264	25.20%	25.119	25.281	20.00%	19.912	20.088	22.70%	22.656	22.744
240+m	10.50%	10.453	10.547	9.90%	9.844	9.956	17.50%	17.417	17.583	11.90%	11.866	11.934

Active transport

0	68.50%	68.428	68.572	64.00%	63.911	64.089	62.50%	62.394	62.606	65.70%	65.650	65.750
1-29m	10.50%	10.453	10.547	13.50%	13.436	13.564	15.00%	14.922	15.078	12.50%	12.465	12.535
30-59m	14.80%	14.745	14.855	10.80%	10.742	10.858	10.00%	9.934	10.066	12.50%	12.465	12.535
60-120m	4.90%	4.867	4.933	10.80%	10.742	10.858	7.50%	7.442	7.558	7.40%	7.373	7.427
120-240m	1.20%	1.183	1.217	0.90%	0.882	0.918	5.00%	4.952	5.048	2.00%	1.985	2.015
240+m												

Table 3.3 Prevalence of key sedentary and physically active behaviours during weekdays for girls

Behaviour and prevalence categories (mins/day)	Year S2 (n=266)			Year S3 (n=171)			Year S4 (n=169)			ALL (n=606)		
Motorised transport		95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)			95% Confidence Intervals (CI)	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
0	19.90%	19.852	19.948	18.10%	18.042	18.158	12.40%	12.350	12.450	17.30%	17.270	17.330
1-29m	27.10%	27.047	27.153	22.80%	22.737	22.863	34.30%	34.228	34.372	27.90%	27.864	27.936
30-59m	37.20%	37.142	37.258	42.10%	42.026	42.174	40.20%	40.126	40.274	39.40%	39.361	39.439
60-120m	15.00%	14.957	15.043	14.60%	14.547	14.653	12.40%	12.350	12.450	14.20%	14.172	14.228
120-240m	0.80%	0.789	0.811	2.30%	2.278	2.322	0.60%	0.588	0.612	1.20%	1.191	1.209
240+m												
TV/video viewing												
0	0.40%	0.392	0.408	0.60%	0.588	0.612	3.60%	3.572	3.628	1.30%	1.291	1.309
1-29m	4.10%	4.076	4.124	3.50%	3.472	3.528	6.50%	6.463	6.537	4.60%	4.583	4.617
30-59m	12.00%	11.961	12.039	14.00%	13.948	14.052	15.40%	15.346	15.454	13.50%	13.473	13.527
60-120m	38.00%	37.942	38.058	40.40%	40.326	40.474	46.20%	46.125	46.275	40.90%	40.861	40.939
120-240m	41.00%	40.941	41.059	36.80%	36.728	36.872	25.40%	25.334	25.466	35.50%	35.462	35.538
240+m	4.50%	4.475	4.525	4.70%	4.668	4.732	3.00%	2.974	3.026	4.10%	4.084	4.116
Computer Use												
0	70.30%	70.245	70.355	66.70%	66.629	66.771	61.50%	61.427	61.573	66.80%	66.763	66.837
1-29m	16.20%	16.156	16.244	16.40%	16.345	16.455	17.20%	17.143	17.257	16.50%	16.470	16.530
30-59m	8.30%	8.267	8.333	9.90%	9.855	9.945	13.00%	12.949	13.051	10.10%	10.076	10.124
60-120m	4.90%	4.874	4.926	5.30%	5.266	5.334	6.50%	6.463	6.537	5.40%	5.382	5.418
120-240m				1.80%	1.780	1.820	1.80%	1.780	1.820	1.00%	0.992	1.008
240+m	0.40%	0.392	0.408							0.20%	0.196	0.204
Computer games												
0	84.20%	84.156	84.244	85.40%	85.347	85.453	89.90%	89.855	89.945	86.10%	86.072	86.128

1-29m	11.70%	11.661	11.739	9.40%	9.356	9.444	6.50%	6.463	6.537	9.60%	9.577	9.623
30-59m	3.80%	3.777	3.823	4.70%	4.668	4.732	3.00%	2.974	3.026	3.80%	3.785	3.815
60-120m	0.40%	0.392	0.408	0.60%	0.588	0.612	0.60%	0.588	0.612	0.50%	0.494	0.506
120-240m												
240+m												
Sports & exercise												
0	53.80%	53.740	53.860	57.30%	57.226	57.374	55.60%	55.525	55.675	55.30%	55.260	55.340
1-29m	12.40%	12.360	12.440	17.50%	17.443	17.557	18.90%	18.841	18.959	15.70%	15.671	15.729
30-59m	20.30%	20.252	20.348	17.50%	17.443	17.557	11.80%	11.751	11.849	17.20%	17.170	17.230
60-120m	9.40%	9.365	9.435	5.80%	5.765	5.835	11.80%	11.751	11.849	9.10%	9.077	9.123
120-240m	3.80%	3.777	3.823	1.80%	1.780	1.820	1.80%	1.780	1.820	2.60%	2.587	2.613
240+m	0.40%	0.392	0.408							0.20%	0.196	0.204
Active transport												
0	11.70%	11.661	11.739	17.00%	16.944	17.056	11.20%	11.152	11.248	13.00%	12.973	13.027
1-29m	38.00%	37.942	38.058	32.20%	32.130	32.270	39.60%	39.526	39.674	36.80%	36.762	36.838
30-59m	37.20%	37.142	37.258	38.60%	38.527	38.673	37.30%	37.227	37.373	37.60%	37.561	37.639
60-120m	13.20%	13.159	13.241	12.30%	12.251	12.349	11.20%	11.152	11.248	12.40%	12.374	12.426
120-240m							0.60%	0.588	0.612	0.20%	0.196	0.204
240+m												

Table 3.4 Prevalence of key sedentary and physically active behaviours during weekends for girls

Behaviour and prevalence categories (mins/day)	Year S2 (n=241)	95% Confidence Intervals (CI)		Year S3 (n=162)	95% Confidence Intervals (CI)		Year S4 (n=164)	95% Confidence Intervals (CI)		ALL (n=567)	95% Confidence Intervals (CI)	
Motorised transport		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
0	32.00%	31.941	32.059	29.00%	28.930	29.070	23.20%	23.135	23.265	28.60%	28.563	28.637
1-29m	8.30%	8.265	8.335	11.70%	11.651	11.749	7.30%	7.260	7.340	9.00%	8.976	9.024
30-59m	24.50%	24.446	24.554	27.80%	27.731	27.869	26.80%	26.732	26.868	26.10%	26.064	26.136
60-120m	24.10%	24.046	24.154	22.20%	22.136	22.264	28.70%	28.631	28.769	24.90%	24.864	24.936
120-240m	8.70%	8.664	8.736	8.00%	7.958	8.042	12.80%	12.749	12.851	9.70%	9.676	9.724
240+m	2.50%	2.480	2.520	1.20%	1.183	1.217	1.20%	1.183	1.217	1.80%	1.789	1.811
TV/video viewing												
0	5.80%	5.770	5.830	9.30%	9.255	9.345	13.40%	13.348	13.452	9.00%	8.976	9.024
1-29m	3.30%	3.277	3.323	1.90%	1.879	1.921	1.80%	1.780	1.820	2.50%	2.487	2.513
30-59m	7.10%	7.068	7.132	8.60%	8.557	8.643	9.10%	9.056	9.144	8.10%	8.078	8.122
60-120m	18.30%	18.251	18.349	15.40%	15.344	15.456	26.20%	26.133	26.267	19.80%	19.767	19.833
120-240m	39.40%	39.338	39.462	35.80%	35.726	35.874	32.30%	32.228	32.372	36.30%	36.260	36.340
240+m	26.10%	26.045	26.155	29.00%	28.930	29.070	17.10%	17.042	17.158	24.30%	24.265	24.335
Computer Use												
0	79.30%	79.249	79.351	79.60%	79.538	79.662	78.00%	77.937	78.063	79.00%	78.966	79.034
1-29m	2.10%	2.082	2.118	1.20%	1.183	1.217	0.60%	0.588	0.612	1.40%	1.390	1.410
30-59m	6.60%	6.569	6.631	6.80%	6.761	6.839	8.50%	8.457	8.543	7.20%	7.179	7.221
60-120m	7.90%	7.866	7.934	8.00%	7.958	8.042	8.50%	8.457	8.543	8.10%	8.078	8.122
120-240m	3.30%	3.277	3.323	4.30%	4.269	4.331	4.30%	4.269	4.331	3.90%	3.884	3.916
240+m	0.80%	0.789	0.811							0.40%	0.395	0.405

Computer games												
0	88.80%	88.760	88.840	90.10%	90.054	90.146	94.50%	94.465	94.535	90.80%	90.776	90.824
1-29m	2.50%	2.480	2.520	1.20%	1.183	1.217	0.60%	0.588	0.612	1.60%	1.590	1.610
30-59m	3.30%	3.277	3.323	1.90%	1.879	1.921	0.60%	0.588	0.612	2.10%	2.088	2.112
60-120m	4.10%	4.075	4.125	4.30%	4.269	4.331	2.40%	2.377	2.423	3.70%	3.684	3.716
120-240m	0.80%	0.789	0.811	1.90%	1.879	1.921	1.80%	1.780	1.820	1.40%	1.390	1.410
240+m	0.40%	0.392	0.408	0.60%	0.588	0.612				0.40%	0.395	0.405
Sports & exercise												
0	66.00%	65.940	66.060	74.10%	74.033	74.167	78.70%	78.637	78.763	72.00%	71.963	72.037
1-29m	2.90%	2.879	2.921	1.20%	1.183	1.217	2.40%	2.377	2.423	2.30%	2.288	2.312
30-59m	3.30%	3.277	3.323	4.30%	4.269	4.331	3.70%	3.671	3.729	3.70%	3.684	3.716
60-120m	14.10%	14.056	14.144	9.30%	9.255	9.345	6.70%	6.662	6.738	10.60%	10.575	10.625
120-240m	9.50%	9.463	9.537	8.00%	7.958	8.042	4.90%	4.867	4.933	7.80%	7.778	7.822
240+m	4.10%	4.075	4.125	3.10%	3.073	3.127	3.70%	3.671	3.729	3.70%	3.684	3.716
Active transport												
0	56.80%	56.737	56.863	63.00%	62.926	63.074	50.60%	50.523	50.677	56.80%	56.759	56.841
1-29m	15.80%	15.754	15.846	13.00%	12.948	13.052	14.60%	14.546	14.654	14.60%	14.571	14.629
30-59m	15.40%	15.354	15.446	13.00%	12.948	13.052	20.10%	20.039	20.161	16.00%	15.970	16.030
60-120m	10.80%	10.761	10.839	9.90%	9.854	9.946	10.40%	10.353	10.447	10.40%	10.375	10.425
120-240m	1.20%	1.186	1.214	1.20%	1.183	1.217	4.30%	4.269	4.331	2.10%	2.088	2.112
240+m												

3.2 TV/video viewing
3.2.1 Boys
Results in Table 3.1 show that half (48%) 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). Overall, boys averaged 2 hours and 7 minutes of TV viewing per weekday. Trends showed boys in Year S4 to be less likely to watch more than 2 hour.day^{-1} during the week (39%) than those in Years S3 (58.5%) and S2 (49%). Mean scores reflected this trend: Year S2=130 min.day^{-1}; S3=135 min.day^{-1}; S4=109 min.day^{-1}.

Prevalence estimates increased at weekends (Table 3.2) with only 19% watching 2 hours or less per day and nearly one-third (31%) exceeding 4 hours. Average daily weekend viewing time is 3 hours and 15 minutes. Trends showed boys in Year S4 are less likely to watch more than 4 hour.day^{-1} during the weekend (24%) than those in Years S3 (33%) and S2 (33%). Mean scores reflected this with a decline from Years S2 (207 min.day^{-1}) and S3 (190 min.day^{-1}) to S4 (177 min.day^{-1}).

3.2.2 Girls
Results in Table 3.3 show that 59% of girls watched up to 2 hours of TV per weekday with only a small minority (4%) exceeding 4 hour.day^{-1}. Overall, girls averaged 1 hour and 49 minutes of TV viewing per weekday – 18 mins less than boys. Girls in Year S4 were less likely to watch more than 2 hour.day^{-1} during the week (28%) than those in Years S3 (41.5%) and S2 (45%). Mean scores reflected this with a decline in TV viewing from Year S2 (116 min.day^{-1}) to S3 (109 min.day^{-1}) and to S4 (98 min.day^{-1}).

Prevalence estimates increased at weekends (Table 3.4) with 30% watching 2 hours or less per day and a quarter (24%) exceeding 4 hours. Average daily weekend viewing time was 2 hours and 39 minutes – 36 mins less than boys. Trends showed girls in Year S4 to be less likely to watch more than 4 hour.day^{-1} during the weekend (17%) than those in Years S3 (29%) and S2 (26%). Mean scores reflected this with fewer minutes of TV viewing at weekends for those girls in S4 (131 min.day^{-1}) compared with their younger counterparts (S2=170 min.day^{-1}; S3=171 min.day^{-1}).

For TV viewing data, we conclude that:
- many boys and girls have 'acceptable' viewing levels during the week
- unsurprisingly, weekends provide opportunity for large amounts of TV viewing, with a significant minority watching more than 4 hour.day^{-1}
- TV viewing is greater for boys and younger participants.

3.3 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 31 min.day^{-1} playing computer games (60 minutes at weekends) and a further 11.5 min.day^{-1} using the computer for other purposes. This contrasted with girls who averaged 3 minutes (7 at weekends) and 13 minutes respectively. However, many boys (43%) reported no computer game playing on weekdays and less than a quarter (20%) reported playing more than one hour per day. Boys showed minimal age trends. Other computer use was quite low with 71% of boys and 67% of girls reporting no use at all during the week. It should be noted, however, that this does not include computer-based homework.

Girls reported spending an average of 32 min.day^{-1} in motorised transport during the week, and 51 min.day^{-1} at weekends. Boys reported similar use during the week (28 min.day^{-1}) but less at weekends (36 min.day^{-1}) compared to girls. Only 25.5% of boys and 17% of girls spent no time in motorised transport during the week, whereas more than one-third of boys (39%) and girls (35%) spent between 30 and 60 minutes daily, with some boys (12%) and girls (15%) spending more than 1 hour in motorised transport.

Homework was also a prevalent sedentary behaviour, with boys averaging 29 min.day^{-1} during the week, and girls 39 min.day^{-1}. At weekends, this gender difference was maintained with boys taking 14 and girls 26 min.day^{-1}.

From the data on other prevalent sedentary behaviours, we conclude that:
- boys are significantly more attracted to playing computer games than girls, although a large minority of boys play no computer games during the week
- computer use, excluding use of computers in homework, is quite low
- use of motorised transport is quite high.

3.4 Physically active pursuits

During the week, boys (44 min.day^{-1}) were markedly more active than girls (21.5 min.day^{-1}) in sports and exercise, although these figures excluded school physical education. However, 38% of boys and 55% of girls reported no sports and exercise at all during the week, figures rising to 48% and 72% at weekends, respectively. The least active in sports and exercise were Year S3 girls, averaging only 17.5 min.day^{-1} during the week and 30 min.day^{-1} at weekends. No sport and exercise was reported by 57% of girls in Year S3 during the week and by 79% of girls in S4 at weekends.

Time in active transport, such as walking to school, averaged 26 min.day^{-1} during the week for boys and 30 min.day^{-1} for girls. These dropped to 14.5 and 19 min.day^{-1} respectively at weekends. Nearly one-quarter of boys (22%) took no active transport during the week, but this was much less in girls (13%).

For sports and exercise and active transport during the week in combination, boys averaged 70 min.day^{-1} of physical activity, meeting the national recommendation of one hour per day of moderate intensity physical activity on most days of the week (Biddle, Sallis, & Cavill, 1998). Girls averaged 51.5 min.day^{-1} in these two activities, with Year S3 being the least active with 46 min.day^{-1}. Many boys, however, did meet the recommended 60 minute target. This was achieved by 48% during the week and 50% at weekends. But only 31% of girls achieved 60 minutes during the week and only 26% on the weekend.

From the data on physically active behaviours, we conclude that:
- boys are significantly more active than girls, confirming prior research
- there is still a sizeable minority of boys, and a majority of girls, choosing no sports and exercise
- active transport data give some signs for optimism, but coupled with the data on motorised transport, there is room for a shift to more active forms of transport

- average physical activity levels of boys, but not girls, appear to meet national recommendations.

3.5 Analyses by ethnicity

White-European ethnicity comprised 98% of the sample. Other ethnic groups are shown in Table 2.2. Conclusions concerning ethnic differences in sedentary and physically active behaviours are therefore not possible due to small sample sizes. However, the small group of young people of Asian ethnicity, in comparison to those reporting themselves to be White-European, showed, for weekday data, higher rates of TV viewing and use of active transport, but markedly less involvement in sports and exercise (4 min.day^{-1} vs. 30 [3]).

3.6 Analyses by socio-economic status

Using deprivation categories based on participant's postcodes, and created from the Medical Research Council's data base[4], we found no significant relationship between deprivation category score (1=more affluent; 7=more deprived) and the behaviours of TV viewing, active transport, or sports and exercise, for either boys or girls.

In addition, two groups were created (scores 1-3 = 'affluent group'; 5-7 = 'deprived group'; those with a mid-range score of 4 were excluded) to test for differences across behaviours. For males, there were no differences in TV viewing, playing computer games, active transport, or sports and exercise. However, those in the more affluent group reported greater time spent on the computer than those in the more deprived group (p=.009). For girls, there were no differences between groups in TV viewing, playing computer games, time spent on the computer, active transport, or sports and exercise. Overall, socio-economic status was largely unrelated to the key behaviours in this sample.

We conclude that:
- ethnicity and socio-economic status have little or no effect on our data, although given the distribution of the sample by ethnicity, this finding needs to be treated with some caution.

4. What are the main determinants of sedentary behaviour?

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? Or can the behaviours co-exist within complex lifestyles? This is an important issue to address because much has been made in the media about so-called 'couch kids' and the assumption that if they are inactive at certain times (e.g., watching TV), then they will always be inactive.

In our meta-analysis of the relationship between physical activity and TV viewing and computer game playing in young people (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004), we found very small associations, suggesting that the behaviours

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[3] Cohen's d effect size = 0.89, described as 'large'
[4] www.msoc-mrc.gla.ac.uk/Publications/pub/Carstairs_MAIN.html

may be independent of each other. For the present sample, this was replicated, as shown in Figure 4.1. Correlations, for Scottish youth, between TV viewing and the active behaviours of sports/exercise and active travel were small, all explaining less than 5% of shared variance.

4.1 Patterning of sedentary and physically active behaviours
4.1.1 Temporal patterning of behaviours
Another way is 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 minute 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.
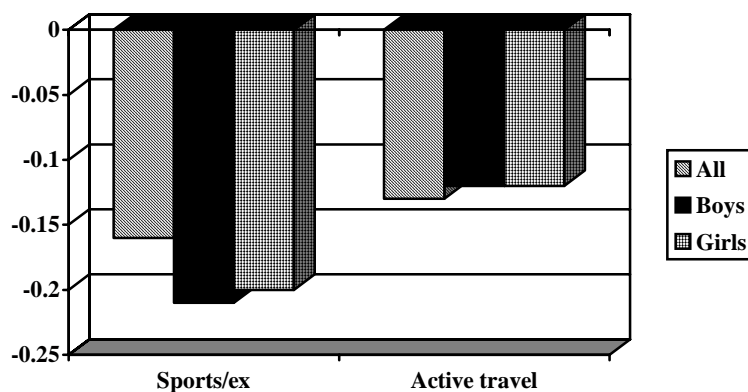
Figure 4.1 Correlations between TV viewing and physically active behaviours
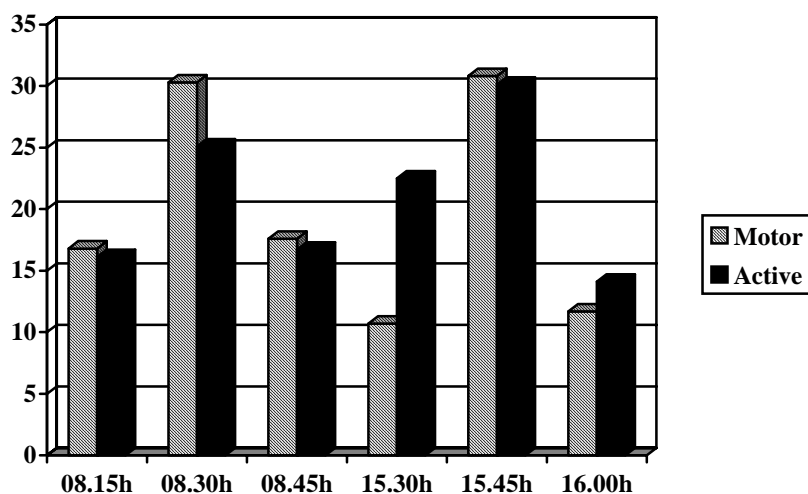
Figure 4.2 Motorised and active travel for girls: Likelihood of these behaviours occurring at the times specified, expressed as a percentage

Predictable patterns emerged for weekday data with motorised transport most likely early in the day for boys and girls (30% likelihood of occurrence for each at 08.30h). At same time the likelihood of active travel was 22% for boys and 25% for girls. There was a slight drop in the likelihood of motorised travel, in favour of active travel, after school. This suggests that many young people are able to walk to and from school, but are more likely to be driven to school in the morning, probably to accommodate parental work patterns. 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. Figure 4.2 shows the likelihood of motorised and active travel before and after school for girls.

For sports and exercise, peaks occurred at 19.15h for boys (18% likelihood) and girls (8%). Between 18.30-20.00h, boys had a 16-18% chance of being active through sports and exercise, whereas for a similar evening period (19.00-20.00h) for girls, the likelihood was only 7-8%. During this mid-evening period, behaviours that were most likely for girls, in addition to TV, were homework (10-12%) and 'hanging out' with friends (9-13%). For boys, other fairly prominent behaviours in the mid-evening were computer games (8-10%), 'hanging out' with friends (8-10%), and homework (7-9%).

Contrary to the displacement hypothesis, TV/video viewing peaked much later in the evening than sports and exercise, with 43% of occurrences for boys 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 competition between them. In short, there appears to be time for both. Nevertheless, there was never a time when boys or girls were more likely to be playing sports and exercise than watching TV, thus suggesting there is still plenty of scope for behaviour change in favour of more physically active alternatives.

Some age differences were noted when trends for young people in Year S2 were compared with those in Year S4. Younger boys showed a higher peak of TV viewing later in the evening (42-46% likelihood between 21.00-22.00h). This was partly explained by the older boys taking part in more diverse behaviours, such as using the computer, playing computer games, and doing homework. At 23.15h, there was still a 9% chance that Year S2 boys were watching TV.

Although travel patterns were similar between S2 and S4 girls, the older girls showed more likelihood of doing homework and less TV viewing in the evening. Whereas S4 girls peaked their TV viewing at 21.45h (28% chance), S2 girls were above a 30% likelihood between 20.45-22.00h, and peaked at 34%. At 23.15h, there was a 6% chance that S2 girls were still watching TV. Both age groups showed a low likelihood of physical activity and often 2-3 times more likelihood for TV over sports/exercise. Likelihood of computer use was low for both age groups, and especially for computer game playing (<1.5%).

During weekends behaviours were more variable with respect to when they occurred, due to a more freely structured day compared to a school day. However, for boys, evening TV viewing was highly likely, with always a greater than 20% chance after 17.45h, more than 30% between 19.30-23.15h, and a peak between 21.15-22.30h of 41-46%. Nevertheless, earlier in the day boys were more likely to be playing sports/exercise than watching TV. There was a greater than 10% chance of sports

between 10.30-17.30h, with 19-20% likelihood between 13.30-15.45h. The 5-hour period between 12.00-17.00h showed that sport was more likely than TV. This was not the case for girls, who never had a likelihood for sports greater than TV at weekends. They were never more likely than 8% to be playing sports, whereas TV peaked at 36% between 21.30-22.00h.

Concerning the temporal patterning of behaviours, we conclude that:
- the greater likelihood of motorised over active travel to school was reduced slightly after school, suggesting possible shifts to more active forms of transport for some young people
- the greatest likelihood of playing sport and exercise during the school week was in the early evening, whereas the likelihood of watching TV peaked later, suggesting some temporal displacement between the two behaviours
- there was never a time during the week when sports and exercise were more likely than TV viewing, but sports and exercise were more likely during periods of the weekend day for boys.

4.1.2 Environmental patterning of behaviours
In addition to analysing what young people were doing at different times across the day, we also analysed where young people were for certain behaviours. This allowed us to look at possible environmental 'prompts' for behaviours. Results showed that during a weekday, if in the lounge, there was a 70% chance for boys and 62.5% for girls that they would be watching TV, showing this location to be highly predictive of this sedentary behaviour. Although having a TV in one's bedroom is often a predictor of higher TV viewing, being in one's bedroom yielded a 26% chance of watching TV for girls and 35% for boys in the present sample of Scottish youth when analysing only those with TVs in their bedroom.

At weekends, the likelihood was even greater, with a 74% chance for boys and 64% for girls that TV would be the primary behaviour when in the lounge. The figures for the bedroom also increased for TV viewing for the weekend to 40% for boys and 29% for girls. However, for boys and girls combined, those with a TV in the bedroom (M=133.5 min.day^{-1}) did not watch more TV throughout the whole week than those without (M=121.7 min.day^{-1}; t $_{(842)}$ = -1.62, $\underline{p}$ = .11, ES=-0.09).

For physically active pursuits, locations outside of the house were important during the week. For sports and exercise, locations most predictive for boys were the garden (67%), 'other outside area' (38%), town (outside) (27.5%) and 'other inside area' (30.5%). For girls, however, when they were in the garden (27%) or other outside area (12%), they were less likely to be active in those environments.

At weekends, if boys were active in sport and exercise, they were likely to be outside, with likelihoods being 49% for 'other outside area', 22% for the garden, and 21% for town (outside). For girls, if they were active in sports/exercise, they were most likely to be at school (35%).

For environmental patterning of behaviours, we conclude that:
- when in the lounge, TV viewing is highly likely
- those with TVs in their bedroom do not watch significantly more TV than those without

- when in an outside area, the likelihood of being physically active was quite high
- The location where girls were more likely to be active was The garden for younger girls and other inside area for older girls.

4.2 Predictors of sedentary behaviour

Having shown that sedentary behaviour is more complex than sometimes assumed in the popular media, where TV viewing is often singled-out as the prime 'cause' of a lack of physical activity in youth, there is a need to look at a more comprehensive cluster of sedentary behaviour. To this end, we calculated a measure of sedentary behaviour by including the following 8 behaviours: TV viewing, motorised transport, sitting doing nothing, talking with family and friends, reading, listening to music, total computer use (work and games), and cognitive hobbies.

We 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 outside: in the garden, in the town (outside), and in another outside area.

Results are summarised as follows:

- <u>for boys during the week</u>, the predictor variables accounted for 37.1% of the variance in sedentary behaviour
- time spent outside (garden, town – outside, and other area) added an additional 19.2% 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 in sports and exercise, greater numbers of TVs in the house, and less time outside
- <u>for girls during the week</u>, the predictor variables accounted for 20.6% of the variance in sedentary behaviour
- sport and exercise accounted for only 5.8% of the variance, with active transport (3.2%) adding small extra variance; the number of TVs in the house and number of internet computers in the house did not account for additional extra variance
- time spent outside (garden, town – outside, and other area) added an additional 11.6% 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 in sports and exercise, and less time outside
- <u>for boys during the weekend</u>, the predictor variables accounted for 26% of the variance in sedentary behaviour
- sport and exercise accounted for only 4.6% of the variance, with active transport (1.2%), number of TVs in the house (0.3%), and number of internet computers in the house (0.2%), adding small extra variance (6.3% in total)

- time spent outside (garden, town – outside, and other area) added an additional 19.7% 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
- <u>for girls during the weekend</u>, the predictor variables accounted for only 15.9% of the variance in sedentary behaviour
- sport and exercise accounted for only 2.5% of the variance, with active transport (0.6%) and number of TVs in the house (0.4%) adding small extra variance (3.5% in total); the number of internet computers in the house did not account for additional extra variance
- time spent outside (garden, town – outside, and other area) added an additional 12.4% 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 in sports and exercise and less time outside.

These analyses show clearly that while physical activity is an inverse predictor of a cluster of sedentary behaviours, the prediction is greatly enhanced by accounting for the time young people spend outside. 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.

Concerning predictors of sedentary behaviour, we conclude that:
- time spent outside predicts sedentary behaviour over and above that accounted for by time in sports and exercise.

4.3 Identifying 'at risk' groups
Much of the analyses so far have focussed on the whole sample, or 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 selected key variables:

- low vs. high TV viewers, with low <120 $min.day^{-1}$ and high >239 $min.day^{-1}$, in line with the recommendations of the American Academy of Pediatrics (1986)
- low vs. high sedentary behaviour, with sedentary behaviour represented by the 8 behaviours analysed in section 4.2. Groups were classified as the lowest and highest 33% of the total distribution, with low <211 $min.day^{-1}$ and high > 314 $min.day^{-1}$.

Data were analysed using independent t-tests and effect sizes were calculated using Cohen's d [5]. Interpretation of effect sizes is:
- 0 - 0.29: 'small'
- 0.30 – 0.69: 'moderate'
- 0.70+: 'large'.

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[5] Cohen's d = mean1-mean2/pooled SD

4.3.1 TV viewing

Results showed:

- for males, high TV viewers (n=182) participated in significantly less sports and exercise during the week (M=35.5 min.day^{-1}) than low TV viewers (n=203) (52 min.day^{-1}) (p<.003); effect size (ES) = 0.30
- the same was true for females, with high TV viewers (n=220) participating in significantly less sports and exercise during the week (M=16 min.day^{-1}) than those in the low TV group (n=386) (25 min.day^{-1}) (p<.001); effect size (ES) = 0.27
- for males, high TV viewers spent significantly less time in 'another outside area' during the week (M=62 min.day^{-1}) than those in the low TV group (102 min.day^{-1}) (p<.0001); effect size (ES) = 0.43
- the same was true for females, with high TV viewers spending significantly less time in 'another outside area' during the week (M=52 min.day^{-1}) than those in the low TV group (76 min.day^{-1}) (p<.0001); effect size (ES) = 0.36.

4.3.2 Sum of 8 sedentary behaviours

Results showed:

- for males, the high sedentary group (n=66) participated in significantly less sports and exercise during the week (M=18 min.day^{-1}) than the low sedentary group (n=159) (62 min.day^{-1}) (p<.0001); effect size (ES) = 0.94
- the same was true for females, with the high sedentary group (n=55) participating in significantly less sports and exercise during the week (M=4.5 min.day^{-1}) than the low sedentary group (n=308) (30 min.day^{-1}) (p<.0001); effect size (ES) = 0.96
- for males, the high sedentary group spent significantly less time in 'another outside area' during the week (M=34 min.day^{-1}) than the low sedentary group (124 min.day^{-1}) (p<.0001); effect size (ES) = 1.09
- the same was true for females, with the high sedentary group spending significantly less time in 'another outside area' during the week (M=31 min.day^{-1}) than the low sedentary group (86 min.day^{-1}) (p<.0001); effect size (ES) = 0.94.

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. This is mainly due to high variability around the means. When considering high and low sedentary groups, however, variables show much greater differences, all revealing large effect sizes. This confirms our view that while TV viewing is a prevalent sedentary behaviour, it is a not a good marker of total sedentary behaviour. Interventions might be better targeted at a profile of several sedentary behaviours rather than TV alone.

Concerning analyses of 'at risk' groups, we conclude that:

- time in sports and exercise and time spent outside differ much more between high and low sedentary groups than between high and low TV viewers
- TV viewing may not be representative of 'total' sedentary behaviour.

4.4 Cluster analyses to identify different sedentary groups

Our results show that sedentary behaviour is multi-faceted and complex and one behaviour, such as TV viewing, may not be an appropriate marker of overall

sedentary behaviour. An additional test of this is a cluster analysis to see if different groups (clusters) of boys and girls emerge 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 (standardised z-score) of zero; these can then be used to label the cluster. Scores deviating +/- z=0.5 (one-half standard deviation) are most important. Three clusters were identified for boys (Figure 4.1):

- *'sociable non-academics'* were a small group (n=54; 16%) characterised by average levels of sports and exercise, high amounts of 'hanging out' but below average time on homework; in addition, they had average TV viewing and computer game playing, ,but spent less time on behavioural hobbies and in motorised transport
- *'techno non-socialising inactives'* (n=80; 23%) were characterised by above average levels of computer game playing, TV and behavioural hobbies, and below average sports and exercise
- *'techno non-socialising actives'* represented the largest group of boys (n=212; 61%) and were characterised by above average participation in sports and exercise and computer game playing, and below average 'hanging out' and sitting and talking.

Chi-square analysis revealed no significant differences between cluster groups on deprivation categories (*p=0.13)* nor on school year (*p=0.60)*.

Three clusters were identified for girls (Figure 4.2):
- *'high TV, socialising inactives'* (n=188; 33%) were characterised by higher TV viewing and 'hanging out', but less than average scores on behavioural hobbies and sports and exercise
- *'low TV, socialising inactives'* (n=133; 23%) were characterised by more time sitting and talking, doing behavioural hobbies, and in motorised transport, but less time watching TV and playing sports/exercise
- *'scholarly socialisers'* (n=246; 44%) were characterised by average sports and exercise participation, greater time sitting and talking, being on the phone, and listening to music, as well as doing homework.

Chi-square analysis revealed a significant difference between cluster groups on school grade (*p=0.03),* but not on deprivation categories (*p=0.64)*. School grade differences showed that a greater percentage of Year S4 girls were in the 'scholarly socialisers' cluster compared to those in Years S2 and S3.

These diverse groupings, for both boys and girls, suggest that no one sedentary behaviour is likely to be an effective intervention target for the majority of adolescents. In addition, the clusters confirm that TV viewing is not necessarily in opposition to sports and exercise. For example, for girls, the 'high TV, socialising in-actives' cluster comprised girls with high TV viewing and low sports and exercise whereas the 'low TV, socialising in-actives' cluster had similar levels of sports and exercise yet watching considerably less TV.

Concerning analyses of clusters, we conclude that:

- both boys and girls are represented by clusters of diverse sedentary behaviours, alongside sports and exercise.
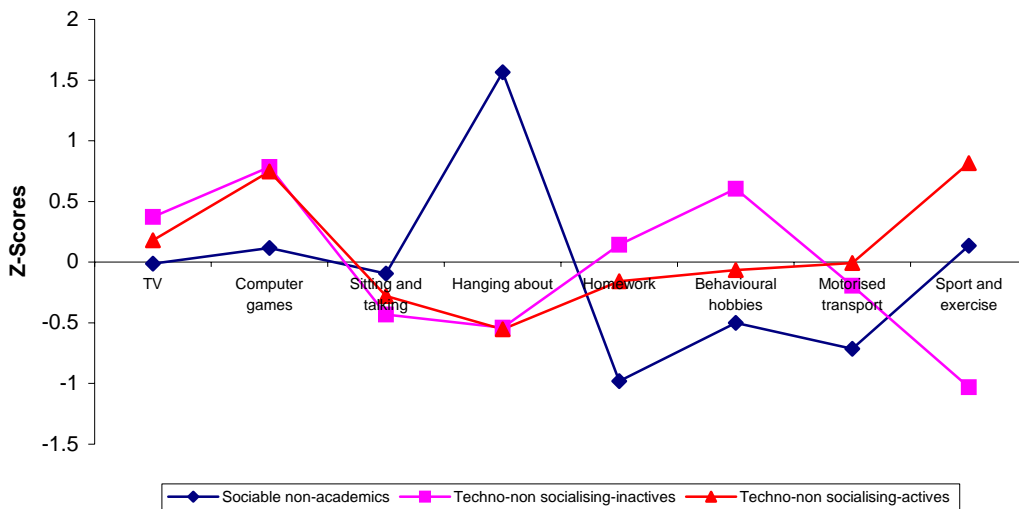

Figure 4.1 Standard scores of cluster centroids on sedentary behaviour and sport and exercise among adolescent boys (n=346)
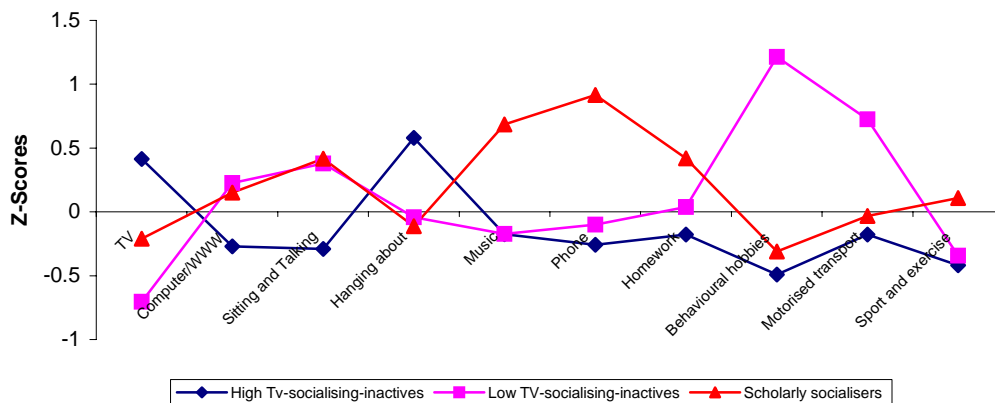

Figure 4.2 Standard scores of cluster centroids on sedentary behaviour and sport and exercise among adolescent girls (n=567)

5. References

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Appendix 1. Sample page from the EMA diary

BEFORE SCHOOL			SCHOOL DAY 1
Time	**What are you doing?** **(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*[6]

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 Behavioural 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

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

Biddle, S. J. H., Marshall, S. J., Gorely, T. J., Murdey, I., & Cameron, N. (2004). Sedentary and physically active behaviours of young people living in the UK: Temporal, environmental and social factors.

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.

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[6] Not all of these outputs refer to the data from Scotland, but they are listed for sake of completeness and relevance to the current project.

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, Saltzburg, 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.