PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR, USE OF ELECTRONIC MEDIA, AND SNACKING AMONG YOUTH: AN INTERNATIONAL STUDY

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Abstract:

This study examined physical activity, sedentary behaviours, location of electronic media and snacking among children from five countries. These variables were assessed by ecological momentary assessment (EMA) using a free-time diary. Data were obtained from 812 secondary-school students (348 male, 464 female) aged from 12 to 18 years in United Kingdom, China, Hungary, Romania and Slovakia. We found that less than half the students met the recommended guideline of 60 minutes daily physical activity (48% of British, 40% of Romanian, 34% of Slovakian, 20% of Hungarian and only 4% of Chinese students met this criterion). Ninety-six percent of British and 86% of Hungarian youth had more than one TV set in their home, followed by Romanian (64%), Slovakian (64%) and Chinese (29%) counterparts. Most British (73%) youths had televisions in their bedroom, followed by Hungarians (66%), Romanians (37%), Slovakians (35%) and Chinese (4%). When compared to females, male students spent significantly more time on TV/DVD/video viewing (on average 110.7 vs 90.2 minutes/day; $p<.001$) and playing computer games (on average 34.0 vs 10.5 minutes/day; $p<.001$). Students who had a TV in their bedroom spent more time watching TV compared to those without a TV in their bedroom (on average 109 vs 91 minutes/day, $p<.001$). Higher levels of TV viewing were associated with more snack food consumption ($r=.13$, $p<.01$). In order to promote less TV viewing and snacking, it may be useful to keep TVs out of the bedrooms of children and adolescents.

***Key words**: electronic media, bedroom, sedentary behaviours, physical activity, snacking*

Introduction

Electronic media infiltrate all aspects of the lives of young people. However, while the benefits of electronic media are clear for communication and learning, there may be negative effects related to long periods of sitting and unhealthy snack consumption (Pearson & Biddle, 2011; Tremblay, et al., 2011). With television viewing being the dominant sedentary behaviour in adolescents, one major concern is the increase in sedentary time due to sitting in front of screens (Burton, Khan, Brown, & Turrell, 2012). Increasingly sedentary school and work environments, car-dominated community design and a lack of face-to-face social connectedness can lead to major negative health, social and economic consequences (GAPA & ISPAH, 2010; Wilmot, et al., 2013). In addition, most adolescents fail to meet physical activity and diet guidelines (Sanchez, et al., 2007), which is likely to lead to poor health outcomes.

Snacking frequency, portion sizes and the energy density (ED) of snack foods are also influenced by family dietary profiles, which in turn directly influence young people's eating styles (GoreFoster, DiLillo, Kirk, & West, 2003). According to Saelens et al. (2002), the location of electronic media in the home is also important, as the presence of a television (TV) in a child's bedroom is associated with greater TV viewing (Gorely, Marshall, & Biddle, 2004). Therefore, a TV's presence in the bedroom may be associated with detrimental behaviours, such as reduced sleep duration (Nuutinen, Ray, & Roos, 2013) and unhealthy eating habits (Lipsky & Iannotti, 2012). This is especially found for boys, who are more likely to play video or computer games in their bedrooms (Delmas, et al., 2007). Thus, increased adiposity may be associated with

home environmental influences, such as having a TV in the bedroom, and mediated by higher exposure to food advertisements and the absence of parental control (Strauss & Knight, 1999). Screen time is associated with poorer dietary patterns (Pearson & Biddle, 2011). Excessive television viewing and snacking are also significant risk factors for children being overweight, especially for girls who consume more snacks while viewing (Francis, Lee, & Birch, 2003). Even in early life (aged between 1-5 years) there is a higher risk of being overweight in individuals having a TV in the bedroom (Dennison, Erb, & Jenkins, 2002), and as most children watch TV by age 2, Dennison et al. (2002) suggest keeping TVs out of a child's bedroom.

However, while our previous work has examined sedentary behaviour correlates and TV viewing (Gorely, et al., 2004; Biddle, Gorely, & Marshall, 2009; Biddle, Gorely, Marshall, & Cameron, 2009), there is still little evidence about the association between electronic media and sedentary behaviour and snacking in children, especially from different countries. Furthermore, many previous studies may have been affected by memory bias, because they were reliant on retrospective recalls of activities. The current study addresses this issue by using Ecological Momentary Assessment (EMA; Dunton, Whalen, Jamner, Henker, & Floro, 2005) to make cross-cultural comparisons in five countries. Therefore, the aim of this study was to describe physical activity (PA), sedentary behaviour, ownership of electronic media and snacking among children, and to determine interrelationships between presence of electronic media in the bedroom, sedentary behaviour (TV time and computer use) and snacking.

Methods

Participants

Secondary-school students (n=812; 348 male [43%], 464 female [57%]; mean age 15.6±1.0 years [range: 11.9 to 17.9 years]) from Hungary (n=301), Romania (n=195), Slovakia (n=127), the United Kingdom (n=77) and China (n=112) participated in this study.

State secondary schools were selected from a convenience sample in the five countries in 2006-2008. Neither special PE classes nor sports college students were involved in the study. Students were randomly selected to take part in the study, but did so voluntarily. Ethical approval was granted by the university research ethics committee of the first author, as well as the responsible institutional committees of the other countries in line with requirements of the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all participants, parents and head teachers of the schools involved.

Instruments

The principal data collection instrument was a 'free time diary' that students completed outside of school hours. Diary methods are useful for assessing everyday events and experiences because they can be completed in naturalistic settings and are less prone to reporting bias caused by recall error (Bolger, Davis, & Rafaeli, 2003). The diary used in the present study is based on principles of Ecological Momentary Assessment (EMA) (Dunton, et al., 2005) and has been found to be a valid and reliable tool for assessing sedentary behaviour and physical activity in secondary school children (Gorely, et al., 2007).

The diary was divided into two parts, and both student and parent/carer consent forms were included. 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 hypothesized to correlate with sedentary behaviour and physical activity (Sallis, Prohaska, & Taylor, 2000). The first part also asked about the number and location of electronic devices. The second part of the diary was for recording the behaviours, locations, and social contexts that young people engaged in each day. This is described in more detail below. As part of the diary, data for snacking habits were collected regarding the portions of sweets and crisps that were consumed on the three days participants completed the diaries.

The time-sampling diary

Participants were instructed to complete the diary for three weekdays, as weekend data would likely have shown different patterns of behaviour (Biddle, et al., 2009). Data collection days were randomly assigned. At 15-minute intervals, participants self-reported (free-response) their behaviour in response to a single item: "What are you doing now?" Participants were instructed to wear a wristwatch during diary completion days so that the recording schedule (15-minute intervals) could be followed. Pilot work found the 15-minute time frame to be the most useful when compared to a diary that records behaviours in 'real time'. To help solicit an appropriate level of response, examples common to young people were provided (e.g. talking with friends, watching TV, walking to school, etc.). To reduce response ambiguity for children who were engaged in multiple behaviours (e.g. "doing homework and listening to the radio") each free-response box included the stem "The *main* thing I am doing now is…". Participants also responded to two closed-response items for each time period concerning their location and social context.

Because there is no academic consensus about the number of measurement days needed for a

reliable assessment of habitual sedentary behaviour using diaries among youth, we decided to assess students' behaviours over three weekdays. For each data collection day, 44 time-samples were obtained (one every 15 minutes from 7:00 a.m. to 8.45 a.m. (or from 6:00 a.m. to 8:00 a.m. in some countries, where schools started earlier) and from 3:00 p.m. (or whenever the school day ended) to 11.45 p.m.). Data were not collected during school hours because the focus of the study was on free-choice out of school behaviour ('leisure-time') and because there was potential for the diary assessment procedures to disrupt academic learning time.

At the end of each diary day (at the time of the final entry if prior to 11:45 p.m.), participants also responded to additional items to give feedback on the data collection instrument as well as on the punctuality of the responses (how close to each 15-minute interval students completed the diary).

Diary scoring procedures

Behavioural reports were coded into 23 mutually exclusive categories of leisure-time behaviour that had been derived inductively from pilot studies of the diary, as well as focus group research (Marshall, 2002). To estimate the time spent in each behaviour category, interval-level weekdays data were aggregated for each individual by multiplying the daily frequency of the event by 15 (1 interval = 15 minutes). Data were then aggregated further to produce a mean, in min/day^{-1}, across days. When participants stated they were engaged in more than one activity in particular time slots than as in other work (e.g. Biddle, et al., 2009), the activity that took the longest time was used

The original English diary was translated into Hungarian, Romanian, Slovakian and Chinese languages by a bilingual speaker in the four countries. Then in each country another bilingual speaker compared the translations with the original diary. Final versions of the diary were sent to the principal investigator to check the format for consistency.

Procedure

In all countries the response rate was over 90%; however, only 75% of the diaries were properly completed (i.e. there were no missing days) and subsequently used for data analysis.

Behaviour categories

Technological sedentary behaviours are defined as electronic entertainment, including TV/DVD/video viewing, internet use (use for entertainment and for study were separately recorded) and computer games in participants' free time. Socializing sedentary behaviours included sitting and talking, and study-related sedentary behaviours comprised doing homework and reading. Physical activity included sports activities and exercise, organized and non-organized games, as well as active travel (e.g. walking or cycling).

Data handling

SPSS for Windows v21 (SPSS Inc. IBM Company, Chicago, IL) was used for data handling and analyses. Demographic data and time sampling data were coded and entered in SPSS templates (for demographic and time sampling data), the description of data coding and entering procedure and the behaviours' codes were sent to the regional co-ordinators in each country who coded and entered their national data. The first author received a sample (10 completed diaries) from each country for quality control and to check that the diary data had been entered into SPSS correctly. In addition, the main investigator had meetings with all national co-ordinators in order to clarify the procedure for data collection, coding or the overall conduct of the project.

All raw data were sent to the main investigator. Data cleaning was carried out by two of the authors. The time sampling data were aggregated into means, and then the four countries' data sets were merged into one analysis file.

Data analysis

Descriptive statistics and multivariate analysis of variance (MANOVA) were performed to test associations and group differences in sedentary behaviours, physical activity, two locations (house and bedroom) as well as snacking, by gender, country and age (older versus younger students). A 2 (gender) x 5 (country) x 2 (age) MANOVA was conducted to test for differences in sedentary and physically active behaviours, the location of electronic media as well as snacking habits. Dependent variables were sedentary behaviours (TV/DVD/video viewing, internet use, computer games), and physical activity (active travel, and sport and exercise), as well as snacking crisps and sweets. A median split was used to identify older and younger age groups. Pearson correlation was also computed to analyse the relationship between TV viewing and unhealthy snacking, like snacking crisps, sweets and other snacks (fruit snacking was not included). An independent samples *t*-test was computed in order to test the differences regarding TV viewing time, if a TV set was or was not allocated in the bedroom.

Results

Physical activity

According to the UK physical activity guidelines (WHO, 2010), young people are recommended to do at least 60 minutes physical activity a day. Of the participants, 48% of British, 40% of Romanian, 34% of Slovakian, 20% of Hungarian and only 4% of Chinese students met this criterion (Table 1). No significant differences were found between gen-

Table 1. The prevalence of meeting the physical activity recommendations (at least 60 minutes/day) by country and gender

Country	Gender	More than 60 minutes PA/day	Some PA, but less than 60 min/day	No PA
United Kingdom	Male	53%	43%	4%
	Female	40%	50%	10%
China	Male	7%	49%	44%
	Female	0%	48%	52%
Hungary	Male	21%	60%	19%
	Female	20%	71%	9%
Romania	Male	36%	54%	10%
	Female	48%	50%	2%
Slovakia	Male	44%	50%	6%
	Female	26%	70%	4%

ders and age groups in meeting physical activity guidelines.

There were significant 2-way interactions for country x gender (Pillai's Trace = .033, $F_{8,1584}$ = 3.338, p=.001) and country x age group (Pillai's Trace = .025, $F_{8,1584}$ = 2.469, p=.012). There were significant multivariate main effects for country (Pillai's Trace = .269, $F_{8,1584}$ = 30.720, p<.001), and gender (Pillai's Trace = .018, $F_{2,791}$= 5.027, p=.001). Univariate tests showed significant differences by country for active transport (F=46.990, p<.001) and playing sport (F=17.170, p<.001); by gender for playing sport (F=13.246, p<.001), but not for active transport (p>.05); and by age group for active transport (F=5.946, p=.015), but not for playing sport (p>.05).

Our data (Table 2) show that British students spent the most time in physical activity (playing sport and active transport), followed by Romanian youth. Male students spent significantly more time in playing sports than female students, while females used significantly more time for active transport than males (Table 4).

Technological sedentary behaviours

There were significant 2-way interactions for country x gender (Pillai's Trace = .067, $F_{12,2376}$ = 4.555, p<.001) and country x age group (Pillai's Trace = .033, $F_{12,2376}$ = 2.347, p=.01). There were significant multivariate main effects for country (Pillai's Trace = .248, $F_{12,2376}$ = 17.814, p<.001) and gender (Pillai's Trace = .082, $F_{3,790}$ = 23.644, p<.001), as well as for age group (Pillai's Trace = .020, $F_{3,790}$ = 17.814, p=.001). Univariate tests showed significant differences by TV/DVD/video viewing (F=31.361, p<.001), using a computer (F=8.034, p<.001) and playing computer games (F=15.326, p<.001; by gender for TV/DVD/video viewing (F=16.641, p<.001) and playing computer games (F=48.193, p<.001), but not for using a computer (p>.05); and by age group for TV/DVD/video viewing (F=14.418, p<.001), but not for using a computer and playing computer games (p>.05).

British and Slovakian students spent most time on technological sedentary behaviours (TV/DVD/video viewing, using a computer for non-homework purposes, playing computer games and using a telephone) (Table 2). Male students spent significantly more time on TV/DVD/video viewing and playing computer games than females, while females used the telephone more (Table 4).

Comparing the two age groups, our data revealed that younger students spent significantly more time on TV/DVD/video viewing than older ones, and older students spent significantly more time on phone calls than younger counterparts (Table 5).

Electronic media in the home

A 2-way interaction for gender x age group (Pillai's Trace = .025, $F_{5,772}$ = 2.245, p=.002) was significant, but not for country x gender and country x age group (p>.05). There were significant multivariate main effects for country (Pillai's Trace = .552, $F_{20,3100}$ = 24.799, p<.001) and age group (Pillai's Trace = .016, $F_{5,772}$ = 4.866, p=.030), but not gender (p>.05). Univariate tests showed significant differences by country for the number of TV sets at home (F=77.626, p<.001), number of DVD/video machines at home (F=92.217, p<.001), number of video game players at home (F=26.419, p<.001), number of internet-enabled computers at home (F=33.021, p<.001) and number of non-internet enabled computers at home (F=8.470, p<.001), as well as by age group for the number of internet computers at home (F=9.891, p=.002), but not gender (p>.05). The highest number of electronic media (TV, DVD, video) were located in British and Hungarian households. Ninety-six percent of British and 86% of Hungarian youth had more than one TV set in their home, followed by Romanian (64%), Slovakian (64%) and Chinese (29%) counterparts. No significant gender or age differences were found in the ownership of other electronic media in the home.

Table 2. Key behaviours in five countries

Behaviour	Country	Mean ±SD time (minutes/day)	95% confidence interval (CI) for mean	
			Lower bound	Upper bound
Playing sport	UK	32.1±38.1	23.5	40.7
	China	4.0±19.2	0.4	7.6
	Hungary	11.2±24.4	8.4	14.0
	Romania	9.5±21.3	6.5	12.5
	Slovakia	24.0±45.6	16.0	32.0
Active transport	UK	33.5±25.7	27.7	39.3
	China	6.5±14.1	3.9	9.2
	Hungary	25.1±20.3	22.8	27.5
	Romania	44.9±30.3	40.6	49.1
	Slovakia	30.2±23.5	26.1	34.3
TV/DVD/video viewing	UK	118.6±70.8	102.6	134.7
	China	54.2±60.6	42.8	65.5
	Hungary	100.3±64.9	93.0	107.7
	Romania	87.1±55.0	79.3	94.8
	Slovakia	141.7±73.1	128.8	154.5
Using a computer (not for homework)	UK	11.1±23.2	5.8	16.4
	China	2.7±8.2	1.2	4.3
	Hungary	7.6±19.5	5.3	9.8
	Romania	14.5±36.6	9.3	19.6
	Slovakia	2.8±15.4	0.5	5.5
Playing computer games	UK	36.8±41.1	27.5	46.2
	China	0.9±8.5	0.0	2.5
	Hungary	25.6±40.1	21.1	30.2
	Romania	16.3±35.4	11.3	21.3
	Slovakia	22.7±41.8	15.4	30.0
Using a telephone	UK	6.8±17.4	2.8	10.7
	China	1.7±3.6	1.0	2.3
	Hungary	3.5±8.9	2.5	4.5
	Romania	4.4±7.5	3.3	5.4
	Slovakia	4.6±10.6	2.7	6.5
Motorized transport	UK	41.6±31.3	34.4	48.7
	China	38.0±17.2	34.8	41.2
	Hungary	45.1±44.6	40.0	50.1
	Romania	8.9±20.0	6.1	11.7
	Slovakia	25.2±30.0	20.0	30.5
Sitting and talking	UK	23.3±29.5	16.6	30.0
	China	27.1±25.3	22.4	31.8
	Hungary	34.3±37.2	30.0	38.5
	Romania	30.2±34.3	25.3	35.0
	Slovakia	28.1±34.2	22.1	34.1
Doing homework	UK	54.5±45.6	44.1	64.8
	China	238.3±113.3	217.0	259.5
	Hungary	78.1±44.3	73.1	83.2
	Romania	96.7±65.4	87.5	106.0
	Slovakia	69.5±53.9	60.1	79.0
Reading (not for homework)	UK	10.9±18.3	6.7	15.1
	China	20.0±24.9	15.4	24.7
	Hungary	12.0±21.8	9.5	14.5
	Romania	18.4±25.5	14.8	22.0
	Slovakia	2.7±8.00	1.3	4.1
Snacking crisps (portions/day)	UK	0.54±0.66	0.39	0.69
	China	0.29±0.36	0.22	0.36
	Hungary	0.13±0.45	0.08	0.18
	Romania	0.28±0.50	0.20	0.34
	Slovakia	0.26±0.40	0.19	0.33
Snacking sweets (portions/day)	UK	1.02±1.09	0.77	1.27
	China	0.10±0.23	0.05	0.14
	Hungary	0.95±0.95	0.84	1.10
	Romania	0.88±1.01	0.74	1.02
	Slovakia	1.13±0.87	0.98	1.28
Snacking fruit (portions/day)	UK	1.11±1.37	0.80	1.43
	China	0.17±0.45	0.08	0.25
	Hungary	1.13±1.19	0.99	1.26
	Romania	1.25±1.31	1.06	1.43
	Slovakia	1.44±1.25	1.22	1.66
Snacking other (portions/day)	UK	0.41±0.93	0.19	0.62
	China	0.19±0.35	0.12	0.25
	Hungary	0.31±0.64	0.24	0.38
	Romania	0.39±0.68	0.30	0.49
	Slovakia	0.42±0.79	0.28	0.56

Electronic media in the bedroom

A 2-way interaction for country x gender (Pillai's Trace = .054, $F_{20,3036}$ = 2.245, p=.004) was significant, but not for country x age group and gender x age group (p>.05). There were significant multivariate main effects for country (Pillai's Trace = .437, $F_{20,3036}$ = 24.799, p<.001) and gender (Pillai's Trace = .023, $F_{5,756}$ = 4.866, p=.003), but not for age group (p>.05). Univariate tests showed significant differences by country for the number of TVs in the bedroom (F=33.858, p<.001), number of DVD/video machines in the bedroom (F=42.343, p<.001), number of video game players in the bedroom (F=18.627, p<.001), number of internet computers in the bedroom (F=7.335, p<.001) and number of non-internet computers in the bedroom (F=6.267, p<.001); and by gender for the number of TV sets in the bedroom (F=5.593, p=.018), number of video game players in the bedroom (F=4.583, p<.033) and number of non-internet computer in the bedroom (F=10.031, p=.002), but not age group (p>.05).

Most British (73%) youths had televisions in their bedroom, followed by Hungarian peers (66%), then Romania (37%), Slovakia (35%) and China (4%). However, no significant differences were found between genders and age groups in relation to electronic media in the bedroom. The ownership of electronic media in the home, as well as in the bedroom is presented in Table 3.

Table 3. Ownership of electronic media in the home and in the bedroom (Mean±SD)

	UK	China	Hungary	Romania	Slovakia
Number of TV sets at home	3.96±1.36	1.32±0.54	2.59±1.05	1.86±0.89	1.87±1.87
TV sets in the bedroom	0.88±0.49	0.04±0.19	0.67±0.49	0.43±0.63	0.35±0.48
Video machines at home	2.52±1.36	0.60±0.49	1.29±0.70	0.51±0.62	0.87±0.55
Video machines in the bedroom	0.65±0.56	0.11±0.31	0.26±0.44	0.64±0.60	0.07±0.26
Video game players at home	1.79±1.50	0.27±0.47	0.56±1.13	0.32±0.62	0.33±0.63
Video game players in the bedroom	0.79±0.91	0.02±0.13	0.29±0.84	0.57±056	0.15±0.42
Internet computer access at home	1.29±0.89	0.88±0.74	0.78±0.87	0.43±0.63	0.28±0.53
Internet computer access in the bedroom	0.26±0.44	0.19±0.39	0.32±0.48	0.16±0.37	0.08±0.27
Non-internet computer access at home	0.48±0.62	0.24±0.43	0.66±0.76	0.64±0.60	0.63±0.55
Non-internet computer access in the bedroom	0.12±0.32	0.13±0.34	0.32±0.48	0.18±0.45	0.34±0.48

Table 4. Key behaviours by gender

Behaviour	Gender	Mean±SD time (min/day)	95% confidence interval (CI) for mean		p value*
			Lower bound	Upper bound	
Playing sport	Male	18.7±36.7	14.8	22.6	<.001
	Female	10.1±23.4	8.0	12.2	
Active transport	Male	26.4±25.7	23.7	29.1	.019
	Female	30.8±26.4	28.3	33.2	
TV/DVD/video viewing	Male	110.7±74.7	102.8	118.6	<.001
	Female	90.2±62.5	84.5	95.9	
Using a computer (not for homework)	Male	8.0±26.2	5.3	10.8	>.050
	Female	8.2±22.3	6.2	10.3	
Playing computer games	Male	34.0±47.9	29.0	39.1	<.001
	Female	10.5±23.2	8.4	12.6	
Using a telephone	Male	2.3±8.3	1.5	3.2	<.001
	Female	5.1±10.3	4.2	6.1	
Motorized transport	Male	31.2±34.3	27.6	34.8	>.050
	Female	32.6±37.7	29.1	36.0	
Sitting and talking	Male	26.0±32.4	22.5	29.4	.002
	Female	33.5±34.9	30.3	36.7	
Doing homework	Male	94.3±84.3	85.4	103.1	.048
	Female	106.2±86.1	98.4	114.1	
Reading (not for homework)	Male	10.6±21.2	8.4	12.9	.006
	Female	14.9±22.6	12.8	17.0	

**t*-test p-value

Table 5. Key behaviours by age group

Behaviour	Age Group	Mean±SD time (min/day)	95% confidence interval (CI) for mean		p value*
			Lower bound	Upper bound	
Playing sport	Younger	15.1±30.9	12.3	17.9	>.050
	Older	12.0±28.9	8.9	15.0	
Active transport	Younger	27.6±24.7	25.4	29.8	>.050
	Older	30.7±27.9	27.7	33.6	
TV/DVD/Video viewing	Younger	107.5±70.4	101.1	113.9	<.001
	Older	87.3±64.6	80.4	94.1	
Using a computer (not for homework)	Younger	7.5±21.0	5.6	9.4	>.050
	Older	9.0±27.6	6.1	11.9	
Playing computer games	Younger	22.0±38.6	18.5	25.5	>.050
	Older	18.7±36.6	14.8	22.6	
Using a telephone	Younger	3.3±9.5	2.4	4.2	.028
	Older	4.8±9.7	3.8	5.8	
Motorized transport	Younger	30.8±34.2	27.7	33.9	>.050
	Older	33.6±38.9	29.5	37.7	
Sitting and talking	Younger	28.0±34.5	24.9	31.1	.024
	Older	33.4±33.2	29.9	37.0	
Doing homework	Younger	87.4±71.7	80.8	93.9	<.001
	Older	119.9±98.5	109.4	130.3	
Reading (not for homework)	Younger	12.9±22.2	10.9	15.0	>.050
	Older	13.3±22.1	10.9	15.6	

**t*-test p-value

Associations between TV viewing, TV in bedroom and snacking

Of students who watched TV for less than two hours a day, 43% had a TV in their bedroom, while 58% of students who watched TV for four or more hours had a TV in their bedroom. Students who had a TV in their bedroom spent significantly more time watching TV (109 minutes/day) compared to those without a TV in their bedroom (91 minutes/day, $p<.001$).

A low but significant correlation was found between TV viewing time and snacking, with higher levels of TV viewing associated with more snack food consumption ($r=.13$, $p<.01$). Snaking portions average is presented in Table 2.

Discussion and conclusions

Although the study of sedentary behaviour in young people has increased greatly in recent years, a substantial challenge remains in identifying the correlates of sedentary behaviours, including screen time. One environmental correlate appears to be the presence of a TV in the bedroom. Our study indicated that having a TV in young people's bedrooms was associated with higher levels of TV viewing. Removing them is therefore likely to reduce the amount viewed, potentially leading to a decrease in overall sedentary behaviour. Of course, other sedentary behaviours could be substituted, but it is a strategy worth considering and parents should be discouraged from providing TVs in the bedroom. Behaviour change interventions may therefore be better targeted at parents (Wickel, 2013) rather than their children, an area that is currently underexplored.

Screen time was associated with unhealthy snacking, confirming review-level data (Pearson & Biddle, 2011). This may be due to various reasons, including TV prompts via advertising and the coupling of food with TV over time, but also people may adopt 'mindless' eating patterns while viewing screens. Indeed, the link between TV and weight may be as much about diet as sedentary behaviour. A strategy to break this coupling is to encourage family meals at the dinner table without a TV, as this has been associated with healthier eating (Woodruff, Hanning, McGoldrick, & Brown, 2010). While this behaviour is still sedentary, there is no coupling of TV viewing with eating, and there may also be additional social benefits.

Although there were no age or gender differences in meeting physical activity guidelines, the current study confirmed previous findings showing higher levels of computer gaming in boys than girls. This supports the view that research into sedentary

behaviour needs to account for varied sedentary behaviours and possible moderators, such as gender. Interventions to reduce sedentary behaviour may need tailoring to specific populations. Moreover, the way in which computers are used is likely to change rapidly, and often much quicker than researchers are able to follow in their studies.

The physical activity reported by participants from the United Kingdom, Romania and Slovakia corresponds with other work, which reported that only 42% of youth achieve the physical activity recommendation of 60 minutes per day (Troiano, et al., 2008). The complexity of sedentary behaviour is shown in the diversity of findings across countries in this study. Screen time, and associated co-behaviours such as diet, may be a function of financial wealth, cultural norms and family structure, as well as environmental factors such as home space; however, this was not examined in the current study. There is a possibility that completion of diaries may have been affected by differential biases, such as social acceptability of different activities across the five countries, such as compulsory physical activity and/or physical education in Chinese schools that may reduce physical activity in their free time (Moller, et al., 2014).

Limitations of the present study include the cross-sectional design and uneven sample sizes across countries, as well as the fact that we used convenience sampling which may mean that the findings are not necessarily generalizable to the respective populations. Moreover, we cannot guarantee that diaries were completed in real time, although previous data suggests that over 61% complete their responses within one hour (Biddle, et al. 2009). Strengths include the diverse nature of the sample and the inclusion of countries under-represented in the international literature.

In conclusion, we used ecological momentary assessment to provide data on the prevalence and correlates of sedentary behaviours, physical activity and snacking in young people across different countries. The current study also used real-time activity diaries instead of retrospective surveys, and analysed type-specific physical activity and sedentary behaviours. In order to promote less sedentary behaviour and snacking, and possibly more physical activity, it may be useful to keep TVs out of the bedrooms of children and adolescents. These data may be used to support the advice that health professionals give young people in relation to healthy living.

Conflict of interest

None declared

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