

REVIEW

Open Access



# Variation in population levels of sedentary time in European children and adolescents according to cross-European studies: a systematic literature review within DEDIPAC

Maité Verloigne<sup>1</sup>, Anne Loyen<sup>2\*</sup>, Linde Van Hecke<sup>3,4</sup>, Jeroen Lakerveld<sup>2</sup>, Ingrid Hendriksen<sup>5,6</sup>, Ilse De Bourdheaudhuij<sup>1</sup>, Benedicte Deforche<sup>3</sup>, Alan Donnelly<sup>7</sup>, Ulf Ekelund<sup>8</sup>, Johannes Brug<sup>2</sup> and Hidde P. van der Ploeg<sup>9,10</sup>

## Abstract

**Background:** A high amount of sedentary time has been proposed as a risk factor for various health outcomes in adults. While the evidence is less clear in children and adolescents, monitoring sedentary time is important to understand the prevalence rates and how this behaviour varies over time and by place. This systematic literature review aims to provide an overview of existing cross-European studies on sedentary time in children (0-12y) and adolescents (13-18y), to describe the variation in population levels of sedentary time, and to discuss the impact of assessment methods.

**Methods:** Six literature databases were searched (PubMed, EMBASE, CINAHL, PsycINFO, SportDiscus and OpenGrey), followed by backward- and forward tracking and searching authors' and experts' literature databases. Included articles were observational studies reporting on levels of sedentary time in the general population of children and/or adolescents in at least two European countries. Population levels were reported separately for children and adolescents. Data were reviewed, extracted and assessed by two researchers, with disagreements being resolved by a third researcher. The review protocol is published under registration number CRD42014013379 in the PROSPERO database.

**Results:** Forty-two eligible articles were identified, most were cross-sectional ( $n = 38$ ). The number of included European countries per article ranged from 2 to 36. Levels of sedentary time were observed to be higher in East-European countries compared to the rest of Europe. There was a large variation in assessment methods and reported outcome variables. The majority of articles used a child-specific questionnaire (60 %). Other methods included accelerometers, parental questionnaires or interviews and ecological momentary assessment tools. Television time was reported as outcome variable in 57 % of included articles (ranging from a mean value of 1 h to 2.7 h in children and 1.3 h to 4.4 h in adolescents), total sedentary time in 24 % (ranging from a mean value of 192 min to 552 min in children and from 268 min to 506 min in adolescents).

(Continued on next page)

\* Correspondence: a.loyen@vumc.nl

<sup>2</sup>Department of Epidemiology and Biostatistics, VU University Medical Center, EMGO+ Institute for Health and Care Research, De Boelelaan 1089a, 1081 HV Amsterdam, The Netherlands

Full list of author information is available at the end of the article



(Continued from previous page)

**Conclusion:** A substantial number of published studies report on levels of sedentary time in children and adolescents across European countries, but there was a large variation in assessment methods. Questionnaires (child specific) were used most often, but they mostly measured specific screen-based activities and did not assess total sedentary time. There is a need for harmonisation and standardisation of objective and subjective methods to assess sedentary time in children and adolescents to enable comparison across countries.

**Keywords:** Youth, Prevalence, Assessment method, Health behaviour, Europe

## Background

Sedentary behaviour is defined as “any waking behaviour characterised by an energy expenditure of  $\leq 1.5$  metabolic equivalents while in a sitting or reclining position” [1]. The time spent in those sedentary behaviours has been defined as sedentary time. Although there is debate on the association between sedentary time and health outcomes in adults [2, 3], there are several studies, systematic reviews and meta-analyses showing that sedentary time has been positively associated with type 2 diabetes, cardiovascular diseases, metabolic syndrome and all-cause mortality among adults, independently from moderate to vigorous physical activity or subcomponents of physical activity [4–9]. Among children and adolescents, the evidence is less conclusive [10–12]. A possible reason is that some of the health outcomes may not be easily manifested in childhood or adolescence [10]. However, a recent review of reviews has suggested that there is an association between children’s screen-time behaviours (i.e. domain-specific sedentary behaviours) and obesity, blood pressure, total cholesterol, self-esteem, social behaviour problems, physical fitness and academic achievement [4]. Moreover, since sedentary time in early life may track into adulthood where it may have potential health implications and since children and adolescents spend a lot of time sedentary [13], actions may be considered to reduce time spent sedentary in children and adolescents. An important step to guide targeted action is to monitor the levels of sedentary time among children and adolescents across countries. This step is needed to study how the mean population levels of sedentary time vary by place, how it changes over time, and to evaluate preventive strategies and policies. In addition, it would be relevant to study and monitor the population levels of sedentary time specifically in Europe as it has its own governing structures but also a wide range of different cultures. Although the countries within Europe are diverse regarding political, economic, (socio-)cultural and physical environmental contexts, they are currently all struggling with an alarming increase in lifestyle related diseases such as overweight and obesity. This means that more effective efforts to reduce sedentary time in Europe are needed and monitoring the behaviour is a first step to address this need [14].

Focusing on specific European evidence is important to formulate public health guidelines and policy recommendations at the appropriate European level.

The DEDIPAC (DEterminants of DIet and Physical ACTivity) Knowledge Hub was established in 2013 by twelve European Union Member States [14]. One of the aims of DEDIPAC is “to enable a better standardised and more continuous cross-European monitoring of behaviours (including sedentary time) and changes in these behaviours across the life course and within populations to identify both targets and target populations for (policy) interventions”. A first and crucial step within DEDIPAC towards standardisation and harmonisation is to provide an overview of existing cross-European surveillance studies in order to describe population levels of (un)healthy behaviour by conjointly performing four systematic literature reviews. The reason to focus on cross-European studies is based on a 2010 WHO report concluding that even though population levels of health behaviour are frequently monitored across Europe, national surveys are not comparable due to differences in assessment methods [15]. Thus, focusing on cross-European initiatives at least enables within-study country comparison.

Therefore, this systematic literature review aims (a) to provide an overview of the existing cross-European studies (including data of at least two European countries) on sedentary time in children, (b) to describe the variation in population levels of sedentary time in European children and adolescents (0-18 years) according to these studies, and (c) to discuss the impact of assessment methods used. The other three reviews focus on the population levels of (1) sedentary time in adults [16], (2) physical activity in adults [17], and (3) physical activity in youth [18].

## Methods

As described in the introduction, this systematic literature review is part of a set of four reviews. Because the four systematic reviews originate from the same project, have similar objectives (although for different behaviours and/or age groups) and share their methodology, the introduction, methods and discussion sections of the review articles have obvious similarities. The search, article

selection, data extraction and quality assessment were conducted conjointly for all four reviews. Subsequently, the included articles were allocated to the appropriate review article(s). If an article included both youth (<18 years) and adults ( $\geq 18$  years) and presented stratified results, those stratified results were used in the appropriate review. If the article did not present stratified results, the article was allocated to the most appropriate review, based on the mean age (and age distribution) of the study sample. One article could be included in multiple reviews. Before the search commenced, review protocols were written based on the "Centre for Reviews and Dissemination's guidance for undertaking reviews in health care" [19], and registered in the PROSPERO database (<http://www.crd.york.ac.uk/PROSPERO/>). The review protocol on sedentary time in youth is published under registration number CRD42014013379. The reporting of this systematic review adheres to the preferred reporting items of the PRISMA-P checklist (see Additional file 1).

### Search strategy

The search was conducted in June 2014 and updated on the 29<sup>th</sup> of February, 2016. Six databases (PubMed, EMBASE, CINAHL, PsycINFO, SportDiscus and OpenGrey) were searched using similar search strategies, adapted to each database. The following search terms were used: 'Physical activity' OR 'Sedentary behaviour' AND 'Europe' (including all individual country names) AND 'Countries'/'Multicountry'/'International'. Both the index terms and the title and abstract were searched and synonyms (e.g. for sedentary behaviour: sitting, screen time, etc.) were used. The complete search string can be found in Additional file 2. Based on the in- and exclusion criteria described below, search filters of the databases were used when possible, for example to select the appropriate publication period or language. In addition, complementary search strategies were used. After the full-text review phase, the reference lists of the included articles were scanned (backward tracking) and a citation search was performed for the included articles (forward tracking) to identify potentially appropriate articles. Also, several experts in the field of physical activity and sedentary time were contacted to provide additional articles. Finally, all authors involved in the four reviews were asked to search their own literature databases for appropriate articles. All additionally retrieved articles underwent the same selection process as the original articles - as described below.

### Article selection

All retrieved records were imported into Reference Manager 12 (Thomson Reuters, New York). Duplicates were hand-searched and removed. Records were

included if they were journal articles, reports or doctoral dissertations (further referred to as 'articles') written in English. To be included, articles needed to report on observational studies conducted after 01-01-2000 in the general, healthy population. This was done to avoid the reporting of outdated data. In addition, articles were only included if they provided data for two or more European countries (as defined by the Council of Europe) [20]. Articles were included if they reported total sedentary time (e.g. minutes/day), time spent sitting at school, time spent on screen-time behaviours (e.g. television viewing, using a computer) and/or time spent at any other sedentary activity. Both subjective (e.g. questionnaires) and objective (e.g. accelerometers) measures were included.

Three researchers (AL, LVH, MV) were involved in the article selection, data extraction and quality assessment. For the title selection, the three researchers each independently reviewed 1/3 of the titles of the retrieved articles. For the abstract and the full-text selection, data extraction and quality assessment, the three researchers each covered 2/3 of the articles, so that each article was independently reviewed, extracted and assessed by two different researchers. Disagreement between the two researchers was resolved by the third researcher.

### Data extraction

A standardised data extraction file was used to extract data regarding the study characteristics, study sample, assessment methods, reported outcomes, and findings. We did not obtain the original data. The complete data extraction file can be found in Additional file 3. To present the data more clearly and to allow for comparisons between age groups, the results are presented and discussed separately for children (aged 0-12 years) and adolescents (aged 13-18 years).

### Quality assessment

A quality score was used to provide a general overview of the quality of the included articles. The 'Standard quality assessment criteria for evaluating primary research papers from a variety of fields' was used for the assessment [21]. The checklist consists of fourteen items to be scored 'Yes' (2 points), 'Partial' (1 point), 'No' (0 points) and 'Not applicable'. The summary score was calculated as follows: Total sum ((number of 'Yes' x 2) + (number of 'Partial' x 1))/Total possible sum (28 - (number of 'Not applicable' x 2)). This instrument was chosen because it provides the opportunity to assess and compare the quality of different study designs, focuses on both the research and the reporting, and allows researchers to indicate that an item is not applicable, without affecting the total quality score. The complete quality assessment file can be found in Additional file 4.

## Results

### Overview of the existing cross-European studies on sedentary time in children

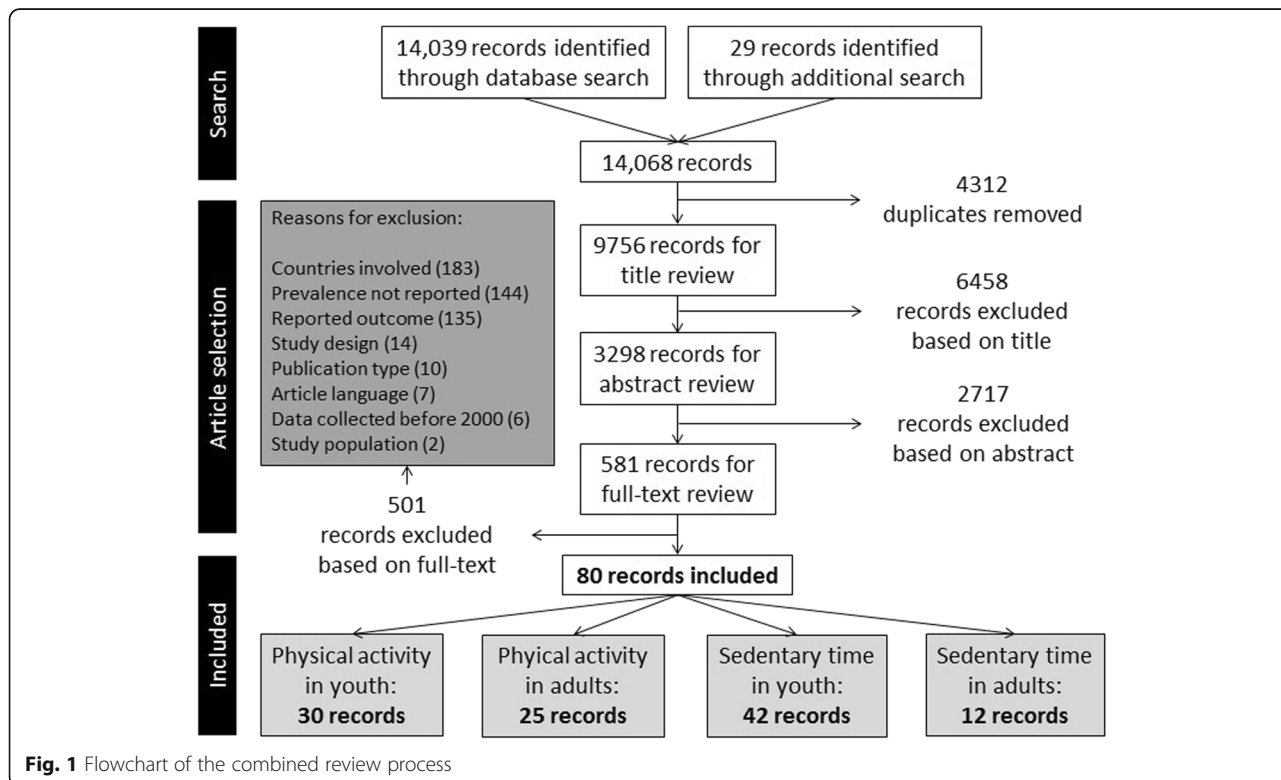
The search resulted in 9756 articles, after duplicates were removed. Based on titles and abstracts, the full text of 581 potentially relevant articles was retrieved and reviewed. This resulted in a total of 80 articles, of which 42 reported on levels of sedentary time in children and/or adolescents (Fig. 1) [22–63]. Table 1 provides an overview of the characteristics of the included articles. In brief, most articles were cross-sectional ( $n = 38$ ), the quality score ranged from 0.64 to 1.0 on a scale from 0 to 1, the number of included European countries ranged from 2 to 36, and sample size ranged from 503 to 443,821. The majority of articles ( $n = 37$ ) were part of a larger European study, that is the COSI study (1 article), ENERGY (6 articles), EYHS (5 articles), HBSC 01/02 (5 articles), HBSC 05/06 (3 articles), HBSC 09/10 (2 articles), HBSC 13/14 (1 article), ICAD (3 articles), IDEFICS (3 articles), ISAAC (1 article), ISCOLE (2 articles), Pro Children (2 articles), and Toybox (2 articles). One study reported data of HBSC 01/02, 05/06 and 09/10 together [49], which makes it possible to look at trends in sedentary time over time. Therefore, to describe the variation in population levels of sedentary time, we did not include all articles. If there was more than one article within a larger study reporting exactly the same outcome variable in a similar way in the same sample, only one

article was included. These studies included data of all European countries, except for Andorra, Azerbaijan, Bosnia and Herzegovina, Georgia, Liechtenstein, Monaco, Montenegro, San Marino and Serbia.

### Variation in population levels of sedentary time in European children and adolescents

The population levels of sedentary time in children (0-12y) and adolescents (13-18y) are presented by country in Tables 2 and 3, respectively. For this research question, 24 articles were included. In Table 1, these 24 studies are indicated in bold. The first column of both Tables 2 and 3 shows how the specific type of sedentary activity (e.g. total sedentary time, TV time) was reported (e.g. percentage or minutes) over a specific time period (e.g. weekend day, after school). To keep the Tables as comparable as possible, we only included values of the total sample, except if an article only reported results for boys and girls separately. Some articles also reported the outcome variable separately for regions within a country. For the HBSC-report that was released in 2016 with data of 2013/2014 [50], the values of the 11-year-olds were included in the Table for children, and the values of the 15-year-olds were included in the Table for adolescents.

The data clearly show a large variation in reported outcome variables and assessment methods by article,



**Fig. 1** Flowchart of the combined review process

**Table 1** Study information and sample characteristics of the articles included in the systematic review

Publication	Study	Study design	Quality score (0-1)	Number of EU countries	Number of EU participants	Demographics				Sedentary time assessment method	Reported sedentary time variable
						Age range	Gender, girls	SES	Weight status		
<b>Biddle et al. (2009)<sup>a</sup> [22]</b>	/	CS	0.91	3	623	13-18y	60.4 %	15.0 - 36.1 % low SES	n.r.	Ecological Momentary Assessment diary	min/weekday and min/weekend day technical sedentary behaviours, social sedentary behaviours
Soos et al. (2012) [23]	/	CS	0.83	2	635	13.1-18.0y	60.5 %	n.r.	n.r.	Ecological Momentary Assessment diary	min/day television viewing, doing homework, motorised transport, sitting and talking, computer use, reading, sitting doing nothing, videogames
<b>Soos et al. (2014) [24]</b>	/	CS	0.86	4	700	11.9-17.9y	57 %	n.r.	n.r.	Ecological Momentary Assessment diary	min/day television viewing, computer use, playing computer games, telephone use, motorised transport, sitting and talking, doing homework, reading
<b>Cinar &amp; Murtomaa (2008)<sup>a</sup> [25]</b>	/	CS	0.77	2	619	10-12y	43.9 - 49.1 %	n.r.	18.7 kg/m <sup>2</sup>	Child questionnaire	% favorable: <2 h/day television viewing % unfavorable: >2 h/day television viewing
<b>Hanewinkel et al. (2012) [26]</b>	/	CS	0.95	6	16551	10-19y	49 %	10 % low SES	n.r.	Child questionnaire	h/schoolday television viewing: % None, % less than 1 h, % 1-2 h, % 3-4 h, % >4 h
<b>Börnhorst et al. (2015) [27]</b>	COSI	CS	0.95	5	10453	6.0-9.9y	49.4 %	16.5 % par. Master's degree or higher	26.9 % overweight	Child questionnaire	h/day television time, computer time, screen-time
<b>Brug et al. (2012)<sup>a</sup> [28]</b>	ENERGY	CS	1.00	7	7234	10-12y	52 %	15.7-48.4 % low par. edu.	18.1 - 20.6 kg/m <sup>2</sup>	Child questionnaire	min/day screen-time, television viewing and computer use (FQ and 24 h-recall)
Brug et al. (2012) <sup>a</sup> [29]	ENERGY	CS	0.91	7	7307	10-12y	52 %	29-59 % low par. edu.	19.0-19.5 kg/m <sup>2</sup>	Child questionnaire	min/day screen-time
Fernandez-Alvira et al. (2013) [30]	ENERGY	CS	0.95	7	5284	10-12y	54.3 %	32.5 % low par. edu.	20.4 % overweight	Child questionnaire	min/day screen-time
<b>van Stralen et al. (2014) [31]</b>	ENERGY	CS	0.95	5	1025	10-12y	51 %	45 % low par. edu.	19.0 kg/m <sup>2</sup>	ActiGraph accelerometer	min/school-time sedentary time + percentage of total school-time spent in sedentary activities
<b>Verloigne et al. (2012) [32]</b>	ENERGY	CS	0.95	5	687	10-12y	53 %	n.r.	19.0 kg/m <sup>2</sup>	ActiGraph accelerometer	min/day sedentary time

**Table 1** Study information and sample characteristics of the articles included in the systematic review (Continued)

Yildirim et al. (2014) [33]	ENERGY	CS	0.95	5	722	10-12y	53 %	14 % not speaking native language at home	n.r.	ActiGraph accelerometer	min/day sedentary time
Ekelund et al. (2004) [34]	EYHS	CS	1.00	4	1292	9-10y	50.6 %	n.r.	17.2 kg/m <sup>2</sup>	MTI ActiGraph accelerometer	% sedentary activity per day
Jago et al. (2008) [35]	EYHS	CS	0.95	4	2670	9y and 15y	51.1 %	n.r.	13.1 % overweight	Child questionnaire	% <2 h, % ≥2 h television viewing after school % <1 h, % ≥1 h/day computer use
<b>Nilsson et al. (2009)<sup>a</sup> [36]</b>	EYHS	CS	1.00	4	1954	9y and 15y	47.9 – 63.2 %	n.r.	n.r.	MTI ActiGraph accelerometer	min/weekday, min/weekend day, min/school-time, min/leisure-time sedentary time
<b>Ortega et al. (2013)<sup>a</sup> [37]</b>	EYHS	LT cohort	0.91	2	503	15y and 18y	55.4-56.7 %	27.6-33.3 % mother university (baseline)	16.4 – 17.3 kg/m <sup>2</sup> (base-line)	ActiGraph accelerometer	min/day, weekday and weekend day sedentary time
<b>van Sluijs et al. (2008)<sup>a</sup> [38]</b>	EYHS	CS	0.95	4	2107	9y and 15y	43.9-54.4 %	6.7-10.8 mean edu./income (3-16)	18.1-19.2 kg/m <sup>2</sup>	Child questionnaire	% >1 h television before school % >2 h television after school % >1 h/day computer use
<b>Janssen et al. (2005)<sup>a</sup> [39]</b>	HBSC 01/02	CS	0.95	29	128845	10-16y	47.1 - 53.3 %	n.r.	5.1 - 25.4 % overweight	Child questionnaire	% high television viewing = >3 h/weekday % high computer use = >2 h/weekday
Kuntsche et al. (2006) [40]	HBSC 01/02	CS	0.91	5	19877	11y, 13y, 15y	52.6 %	n.r.	n.r.	Child questionnaire	h/weekday and h/weekend day television viewing
Richter et al. (2009) <sup>a</sup> [41]	HBSC 01/02	CS	0.95	24	76794	13y, 15y	52.2 %	22.7-41.9 % low FAS	n.r.	Child questionnaire	% ≥ 4 h/day television viewing
Vereecken et al. (2006) [42]	HBSC 01/02	CS	0.91	28	148150	11y, 13y, 15y	n.r.	n.r.	n.r.	Child questionnaire	h/day television viewing
HBSC report 2004 <sup>a</sup> [43]	HBSC 01/02	CS	0.73	28	146368	11y, 13y, 15y	51.5 %	27.6 % low FAS	7.1 – 12.1 % pre-obese	Child questionnaire	% ≥4 h/weekday and weekend day television viewing % ≥3 h/weekday and weekend day computer use % ≥3 h/weekday and weekend day homework
<b>Haug et al. (2009)<sup>a</sup> [44]</b>	HBSC 05/06	CS	1.00	34	187657	11y, 13y, 15y	49.3 %	n.r.	6.3 – 18.5 % pre-obese	Child questionnaire	% less than 2 h/day television viewing, computer games, computer use



**Table 1** Study information and sample characteristics of the articles included in the systematic review (Continued)

Torsheim et al. (2010) [45]	HBSC 05/06	CS	0.91	5	31022 (all 6 countries)	11y, 13y, 15y	n.r.	n.r.	n.r.	Child questionnaire	h/day of computer use, computer games, television viewing
HBSC report 2008 <sup>a</sup> [46]	HBSC 05/06	CS	0.68	35	188147	11y, 13y, 15y	50.7 %	2-70 % low FAS	13-14 % over-weight	Child questionnaire	% ≥ 2 h/weekday television viewing, computer use, computer games/game console
Nuutinen et al. (2015) [47]	HBSC 09/10	CS	1.00	3	5402	15y	53 %	n.r.	n.r.	Child questionnaire	h:min/day computer use schooldays
HBSC report 2012 <sup>a</sup> [48]	HBSC 09/10	CS	0.68	35	178531	11y, 13y, 15y	51 %	2 %-42 % low FAS	10-18 % over-weight	Child questionnaire	% ≥ 2 h/weekday of television viewing
<b>Bucksch et al. (2016)<sup>a</sup> [49]</b>	HBSC 01/02, HBSC 05/06, HBSC 09/10	CS	0.82	24	443821 (total sample)	11y, 13y, 15y	51.2-51.4 % (total sample)	n.r.	n.r.	Child questionnaire	h/weekday and weekend day television viewing, computer use
<b>HBSC report 2016<sup>a</sup> [50]</b>	HBSC 13/14	CS	0.64	36	199316	11y, 13y, 15y	50.7 %	38-76 FAS score (0-100)	15 % over-weight	Child questionnaire	% ≥ 2 h/weekday of television viewing % ≥ 2 h/weekday of computer use ≥ 2 h/weekday of playing games
<b>Atkin et al. (2014)<sup>a</sup> [51]</b>	ICAD	Pooled data (CS and LT)	0.82	5	5474	8-17y	48.9-56.7 %	4.8-52.6 % mother university	9.4-24.0 % over-weight	Child or parental questionnaire	% ≥ 2/day screen time
<b>Ekelund et al. (2012)<sup>a</sup> [52]</b>	ICAD	Pooled data (CS and LT)	0.91	7	15614	4-18y	51.6 %	n.r.	19.1-19.4 kg/m <sup>2</sup>	ActiGraph accelerometer	min/day sedentary time
Hildebrand et al. (2015) [53]	ICAD	Pooled data (CS and LT)	0.91	6	10367	6-18y	53 %	n.r.	15.9 % over-weight; 4.8 % obese	ActiGraph accelerometer	min/day sedentary time
<b>Hense et al. (2011) [54]</b>	IDEFICS	CS	0.91	8	8542	2-9y	49.2 %	27.2 % low SES	20.2 % over-weight	Parental questionnaire	h/day screen-time. % not at all, % <0.5 h, % 0.5-1 h, % 1-2 h, % 2-3 h, % >3 h
Hunsberger et al. (2012) <sup>a</sup> [55]	IDEFICS	CS	0.86	8	12720	2-9y	47.7-51.4 %	1.2 – 30.8 % low edu. household	7.7 – 41.9 % over-weight	Parental questionnaire	% <1 h/day screen-time
Kovács et al. (2015) [56]	IDEFICS	CS	0.95	16	16228	2-9.9y	49.1 %	10.7 % low edu. level	Mean BMI z-score: 0.33	Parental questionnaire	% <1 h/day screen-time (pre-schoolers) % <2 h/day screen-time (school children)
<b>Mitchell et al. (2013) [57]</b>	ISAAC	CS	0.86	6-7y: 6 13-14y: 7	6-7ys: 33901 13-14y: 61954	6-7y and 13-14y	n.r.	n.r.	n.r.	Child questionnaire	h/day television viewing: % < 1 h, % 1-3 h, % 3-5 h, % > 5 h

**Table 1** Study information and sample characteristics of the articles included in the systematic review (Continued)

Katzmaryk et al. (2015) <sup>a</sup> [58]	ISCOLE	CS	0.95	3	1664	9-11y	53.8-55.9 %	n.r.	17.7-19.5 kg/m <sup>2</sup>	ActiGraph accelerometer	min/day sedentary time
<b>LeBlanc et al. (2015)<sup>a</sup> [59]</b>	ISCOLE	CS	0.95	3	1496	9-11y	53.1-57.2 %	21.1-73.2 % high par. edu.	24.3-45.7 % overweight	ActiGraph accelerometer and child questionnaire	h/day sedentary time h/day screen-time % ≥ 2 h/day of screen-time
<b>Klepp et al. (2007)<sup>a</sup> [60]</b>	Pro Children	CS	1.00	9	12773	8.8-13.8y	49.8 %	71.6 - 82.1 % not in social class I-II	n.r.	Child questionnaire	h/day television viewing
<b>te Velde et al. (2007) [61]</b>	Pro Children	CS	0.95	9	12538	8.8-13.8y	50.1 %	n.r.	n.r.	Child questionnaire	% <2 h/day television viewing % >1 h/day computer use
<b>De Craemer et al. (2015) [62]</b>	Toybox	CS	0.95	6	8117	3.5-5.5y	47 %	n.r.	n.r.	Parental questionnaire	min/weekday and weekend day television viewing, computer use, quiet play % <1 h/day screen-time weekday and weekend day
<b>van Stralen et al. (2012)<sup>a</sup> [63]</b>	ToyBox	Pooled data (CS)	0.91	5	6097	4-7y	47.4 - 52.0 %	n.r.	15.9 – 16.8 kg/m <sup>2</sup>	Parental questionnaire	h/day television viewing, % ≥ 2 h/day of television viewing, h/day screen-time, min/day sedentary time (sedentary play-time + screen-time)

COSI WHO European Childhood Obesity Surveillance Initiative, ENERGY EuropeaN Energy balance Research to prevent excessive weight Gain among Youth, EYHS European Youth Heart Study, HBSC Health Behaviour in School-aged Children, ICAD International Children's Accelerometer Database, IDEFICS Identification and prevention of Dietary and lifestyle induced health Effects In Children and infants, ISAAC International Study of Asthma and Allergies in Childhood, ISCOLE The International Study of Childhood Obesity, Lifestyle and the Environment, CS cross-sectional, LT longitudinal, n.r. not reported, SES socio-economic status, par. edu. parental education, inc. income, FAS Family Affluence Scale, FQ frequency question, <sup>a</sup>These articles only presented stratified demographics, so the range is reported; articles in bold were included in Tables 2 and 3



**Table 2** Levels of sedentary time in children (0-12 years) across European countries

Total sedentary time	Armenia	Albania	Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech Republic
Min, h or %/day				478 min(B) <sup>33</sup> , 511 min(G) <sup>33</sup> , 232 min <sup>64</sup>				
Min or %/weekday								
Min or %/weekend day								
Min or %/school time				65 % (G) <sup>32</sup> , 61 % (B) <sup>32</sup>				
Min or %/leisure time								
<b>Television time</b>								
Min or h/day			2.2 h <sup>61</sup>	116 min(G) <sup>29,FQ</sup> , 110 min(B) <sup>29,FQ</sup> , 78 min(G) <sup>29,recall</sup> , 77 min(B) <sup>29,recall</sup> , 2.7 h <sup>61</sup>	1.8 h <sup>28</sup> , 1.8 h <sup>64</sup>			1.2 h <sup>28</sup>
Min or h/weekday				67 min <sup>63</sup>	79 min <sup>63</sup>			
Min or h/weekend day				116 min <sup>63</sup>	131 min <sup>63</sup>			
% >1 h before school								
% >2 h/day			36(B) <sup>62</sup> , 32(G) <sup>62</sup>	50(B) <sup>62</sup> , 42(G) <sup>62</sup>				
% >2 h/weekday	48(B) <sup>51</sup> , 47(G) <sup>51</sup>	51(B) <sup>51</sup> , 47(G) <sup>51</sup>	50(B) <sup>51</sup> , 40(G) <sup>51</sup>	55(B,FL) <sup>51</sup> , 54(G,FL) <sup>51</sup> , 48(B,FR) <sup>51</sup> , 43(G,FR) <sup>51</sup>	64(B) <sup>51</sup> , 66(G) <sup>51</sup>	49(B) <sup>51</sup> , 47(G) <sup>51</sup>		62(B) <sup>51</sup> , 48(G) <sup>51</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day								
<b>Computer time</b>								
Min or h/day				89 min(B) <sup>29,FQ</sup> , 69 min(G) <sup>29,FQ</sup> , 47 min(B) <sup>29,recall</sup> , 29 min(G) <sup>29,recall</sup>	0.7 h <sup>28</sup>			0.5 h <sup>28</sup>
Min or h/weekday				15 min <sup>63</sup>	28 min <sup>63</sup>			
Min or h/weekend day				29 min <sup>63</sup>	44 min <sup>63</sup>			
% >1 h/day			41(B) <sup>62</sup> , 16(G) <sup>62</sup>	35(B) <sup>62</sup> , 20(G) <sup>62</sup>				
% >2 h/weekday	27 <sup>51</sup>	20 <sup>51</sup>	26 <sup>51</sup>	32(FL) <sup>51</sup> , 28(FR) <sup>51</sup>	50 <sup>51</sup>	26 <sup>51</sup>		35 <sup>51</sup>
<b>Videogames time</b>								
% >2 h/weekday	23 <sup>51</sup>	28 <sup>51</sup>	31 <sup>51</sup>	33(FL) <sup>51</sup> , 33(FR) <sup>51</sup>	56 <sup>51</sup>	25 <sup>51</sup>		37 <sup>51</sup>

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

<b>Total screen-time</b>							
Min or h/day			205 min(B) <sup>29,FQ</sup> , 178 min(G) <sup>29,FQ</sup> , 124 min(B) <sup>29,recall</sup> , 107 min(G) <sup>29,recall</sup>	2.5 h <sup>28</sup>			1.7 h <sup>28</sup>
% <1 h/weekday			43 <sup>63</sup>	25 <sup>63</sup>			
% <1 h/weekend day			16 <sup>63</sup>	9 <sup>63</sup>			
% >2 h/day							
% not at all, <0.5 h, 0.5-1 h, 1-2 h, 2-3 h, >3 h/day			2, 13, 32, 28, 15, 11 <sup>55</sup>			2, 8, 20, 32, 17, 12 <sup>55</sup>	
<b>Total sedentary time</b>	<b>Denmark</b>	<b>Estonia</b>	<b>Finland</b>	<b>France</b>	<b>Germany</b>	<b>Greece</b>	<b>Hungary</b>
Min, h or %/day	268 min <sup>53</sup> , 356 min <sup>53</sup>	343 min <sup>53</sup>	8.8 h <sup>60</sup>			526 min(B) <sup>33</sup> , 510 min(G) <sup>33</sup> ,	487 min(B) <sup>33</sup> , 475 min(G) <sup>33</sup>
Min or %/weekday	311 min(B) <sup>37</sup> , 309 min(G) <sup>37</sup>	277 min(B) <sup>37</sup> , 307 min(G) <sup>37</sup>					
Min or %/weekend day	299 min(B) <sup>37</sup> , 280 min(G) <sup>37</sup>	239 min(B) <sup>37</sup> , 257 min(G) <sup>37</sup>					
Min or %/school time	115 min(B) <sup>37</sup> , 128 min(G) <sup>37</sup>	122 min(B) <sup>37</sup> , 138 min(G) <sup>37</sup>				61 % (B) <sup>32</sup> , 66 % (G) <sup>32</sup>	65 % (B) <sup>32</sup> , 70 % (G) <sup>32</sup>
Min or %/leisure time	152 min(B) <sup>37</sup> , 136 min(G) <sup>37</sup>	132 min(B) <sup>37</sup> , 146 min(G) <sup>37</sup>					
<b>Television time</b>							
Min or h/day	2.2 h <sup>61</sup>					126 min(B) <sup>29,FQ</sup> , 120 min(G) <sup>29,FQ</sup> , 99 min(B) <sup>29,recall</sup> , 89 min(G) <sup>29,recall</sup> , 2.2 h <sup>64</sup>	123 min(B) <sup>29,FQ</sup> , 116 min(G) <sup>29,FQ</sup> , 90 min(B) <sup>29,recall</sup> , 85 min(G) <sup>29, recall</sup>
Min or h/weekday					43 min <sup>63</sup>	89 min <sup>63</sup>	
Min or h/weekend day					65 min <sup>63</sup>	134 min <sup>63</sup>	
% >1 h before school	4 <sup>39</sup>	14 <sup>39</sup>					
% >2 h/day	38(B) <sup>62</sup> , 32(G) <sup>62</sup>		15 <sup>26</sup>				
% >2 h/weekday	15 <sup>39</sup> , 60(B) <sup>51</sup> , 49(G) <sup>51</sup>	42 <sup>39</sup> , 61(B) <sup>51</sup> , 56(G) <sup>51</sup>	58(B) <sup>51</sup> , 55(G) <sup>51</sup>	50(B) <sup>51</sup> , 39(G) <sup>51</sup>	45(B) <sup>51</sup> , 36(G) <sup>51</sup>	53(B) <sup>51</sup> , 45(G) <sup>51</sup>	47(B) <sup>51</sup> , 40(G) <sup>51</sup>
% <1 h/day, 1-3 h/ day, 3-5 h/day, >5 h/ day		9, 58, 24, 8 <sup>58</sup>					17, 63, 14, 5 <sup>58</sup>

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

<b>Computer time</b>									
Min or h/day								88 min(B) <sup>29,FQ</sup> , 60 min(G) <sup>29,FQ</sup> , 55 min(B) <sup>29,recall</sup> , 33 min(G) <sup>29,recall</sup>	110 min(B) <sup>29,FQ</sup> , 82 min(G) <sup>29,FQ</sup> , 75 min(B) <sup>29,recall</sup> , 46 min(G) <sup>29,recall</sup>
Min or h/weekday							9 min <sup>63</sup>	18 min <sup>63</sup>	
Min or h/weekend day							15 min <sup>63</sup>	30 min <sup>63</sup>	
% >1 h/day	15 <sup>39</sup> , 39(B) <sup>62</sup> , 13(G) <sup>62</sup>			16 <sup>39</sup>					
% >2 h/weekday	40 <sup>51</sup>			37 <sup>51</sup>	33 <sup>51</sup>	29 <sup>51</sup>	27 <sup>51</sup>	25 <sup>51</sup>	27 <sup>51</sup>
<b>Videogames time</b>									
% >2 h/weekday	53 <sup>51</sup>			43 <sup>51</sup>	30 <sup>51</sup>	33 <sup>51</sup>	25 <sup>51</sup>	28 <sup>51</sup>	34 <sup>51</sup>
<b>Total screen-time</b>									
Min or h/day					2.7 <sup>60</sup>		0.7 h <sup>64</sup>	214 min(B) <sup>29,FQ</sup> , 179 min(G) <sup>29,FQ</sup> , 155 min(B) <sup>29,recall</sup> , 122 min(G) <sup>29,recall</sup>	233 min(B) <sup>29,FQ</sup> , 198 min(G) <sup>29,FQ</sup> , 166 min(B) <sup>29,recall</sup> , 131 min(G) <sup>29,recall</sup>
% <1 h/weekday							71 <sup>63</sup>	29 <sup>63</sup>	
% <1 h/weekend day							52 <sup>63</sup>	12 <sup>63</sup>	
% >2 h/day	34 <sup>52</sup> , 47 <sup>52</sup>			62 <sup>52</sup>	57 <sup>60</sup>				
% not at all, <0.5 h, 0.5-1 h, 1-2 h, 2-3 h, >3 h/day				1, 6, 19, 24, 18, 32 <sup>55</sup>			4, 12, 26, 26, 14, 13 <sup>55</sup>		4, 15, 27, 25, 15, 12 <sup>55</sup>
<b>Total sedentary time</b>	<b>Iceland</b>	<b>Ireland</b>	<b>Italy</b>	<b>Latvia</b>	<b>Lithuania</b>	<b>Luxembourg</b>	<b>Malta</b>	<b>Moldova</b>	<b>Netherlands</b>
Min, h or %/day									447 min(B) <sup>33</sup> , 457 min(G) <sup>33</sup>
Min or %/weekday									
Min or %/weekend day									
Min or %/school time									65 % (B) <sup>32</sup> , 68 % (G) <sup>32</sup>
Min or %/leisure time									
<b>Television time</b>									
Min or h/day	2.0 h <sup>61</sup>				1.8 h <sup>28</sup>				116 min(B) <sup>29, FQ</sup> , 104 min(G) <sup>29, FQ</sup> , 83 min(B) <sup>29, recall</sup> , 67 min(G) <sup>29, recall</sup> , 2.7 h <sup>61</sup>

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

	Norway	Poland	Portugal	Romania	Russian Federation	Slovakia	Slovenia		
Min or h/weekday									
Min or h/weekend day									
% >1 h before school									
% >2 h/day	35(B) <sup>62</sup> , 23(G) <sup>62</sup>						50(B) <sup>38</sup> , 46(G) <sup>38</sup>		
% >2 h/weekday	40(B) <sup>51</sup> , 30(G) <sup>51</sup>	46(B) <sup>51</sup> , 42(G) <sup>51</sup>	47(B) <sup>51</sup> , 40(G) <sup>51</sup>	63(B) <sup>51</sup> , 56(G) <sup>51</sup>	59(B) <sup>51</sup> , 54(G) <sup>51</sup>	44(B) <sup>51</sup> , 37(G) <sup>51</sup>	53(B) <sup>41</sup> , 41(G) <sup>51</sup>	54(B) <sup>51</sup> , 53(G) <sup>51</sup>	61(B) <sup>51</sup> , 61(G) <sup>51</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day					19, 64, 15, 2 <sup>58</sup>				
<b>Computer time</b>									
Min or h/day					0.9 h <sup>28</sup>		106 min (B) <sup>29,FQ</sup> , 81 min (G) <sup>29,FQ</sup> , 71 min(B) <sup>29,recall</sup> , 45 min(G) <sup>29,recall</sup>		
Min or h/weekday									
Min or h/weekend day									
% >1 h/day	36(B) <sup>62</sup> , 12(G) <sup>62</sup>							53(B) <sup>62</sup> , 26(G) <sup>62</sup>	
% >2 h/weekday	31 <sup>51</sup>	29 <sup>51</sup>	27 <sup>51</sup>	38 <sup>51</sup>	26 <sup>51</sup>	27 <sup>51</sup>	35 <sup>51</sup>	31 <sup>51</sup>	42 <sup>51</sup>
<b>Videogames time</b>									
% >2 h/weekday	39 <sup>51</sup>	31 <sup>51</sup>	32 <sup>51</sup>	39 <sup>51</sup>	40 <sup>51</sup>	29 <sup>51</sup>	42 <sup>51</sup>	36 <sup>51</sup>	49 <sup>51</sup>
<b>Total screen-time</b>									
Min or h/day					2.6 h <sup>28</sup>			223 min(B) <sup>29,FQ</sup> , 185 min(G) <sup>29,FQ</sup> , 153 min(B) <sup>29,recall</sup> , 112 min(G) <sup>29,recall</sup>	
% <1 h/weekday									
% <1 h/weekend day									
% >2 h/day									
% not at all, <0.5 h, 0.5-1 h, 1-2 h, 2-3 h, >3 h/day			2, 8, 20, 27, 19, 24 <sup>55</sup>						
<b>Total sedentary time</b>									
Min, h or %/day	325 min <sup>53</sup>			367 min <sup>53</sup> , 9.2 h <sup>60</sup>					
Min or %/weekday	298 min(B) <sup>37</sup> , 314 min(G) <sup>37</sup>			318 min(B) <sup>37</sup> , 344 min(G) <sup>37</sup>					
Min or %/weekend day	289 min(B) <sup>37</sup> , 280 min(G) <sup>37</sup>			269 min(B) <sup>37</sup> , 279 min(G) <sup>37</sup>					

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

Min or %/school time	128 min(B) <sup>37</sup> 140 min(G) <sup>37</sup>		146 min(B) <sup>37</sup> 153 min(G) <sup>37</sup>				
Min or %/leisure time	137 min(B) <sup>37</sup> 138 min(G) <sup>37</sup>		153 min(B) <sup>37</sup> 169 min(G) <sup>37</sup>				
<b>Television time</b>							
Min or h/day	105 min(B) <sup>29,FQ</sup> , 97 min(G) <sup>29,FQ</sup> , 72 min(B) <sup>29,recall</sup> , 62 min(G) <sup>29,recall</sup> , 2.2 h <sup>61</sup>		1.3 h <sup>28</sup> , 2.7 h <sup>61</sup>			120 min(B) <sup>29,FQ</sup> , 108 min(G) <sup>29,FQ</sup> , 78 min(B) <sup>29,recall</sup> , 68 min(G) <sup>29,recall</sup>	
Min or h/weekday		71 min <sup>63</sup>					
Min or h/weekend day		116 min <sup>73</sup>					
% >1 h before school	9 <sup>39</sup>		15 <sup>39</sup>				
% >2 h/day	38(B) <sup>62</sup> , 35(G) <sup>62</sup>		49(B) <sup>62</sup> , 42(G) <sup>62</sup>				
% >2 h/weekday	25 <sup>39</sup> , 46(B) <sup>51</sup> , 41(G) <sup>51</sup>	56(B) <sup>51</sup> , 49(G) <sup>51</sup>	31 <sup>39</sup> , 52(B) <sup>51</sup> , 45(G) <sup>51</sup>	67(B) <sup>51</sup> , 56(G) <sup>51</sup>	57(B) <sup>51</sup> , 52(G) <sup>51</sup>	59(B) <sup>51</sup> , 54(G) <sup>51</sup>	49(B) <sup>51</sup> , 40(G) <sup>51</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day		18, 69, 11, 3(Krakow) <sup>58</sup> , 11, 73 12, 3(Poznan) <sup>58</sup>	13, 58, 23, 6 <sup>58</sup>				
<b>Computer time</b>							
Min or h/day	91 min(B) <sup>29,FQ</sup> , 71 min(G) <sup>29,FQ</sup> , 60 min(B) <sup>29,recall</sup> , 40 min(G) <sup>29,recall</sup>		0.5 h <sup>28</sup>			93 min(B) <sup>29,FQ</sup> , 64 min(G) <sup>29,FQ</sup> , 52 min(B) <sup>29,recall</sup> , 33 min(G) <sup>29,recall</sup>	
Min or h/weekday		16 min <sup>63</sup>					
Min or h/weekend day		32 min <sup>63</sup>					
% >1 h/day	27 <sup>39</sup> , 24(B) <sup>62</sup> , 10(G) <sup>62</sup>		27 <sup>39</sup> , 40(B) <sup>62</sup> , 17(G) <sup>62</sup>				
% >2 h/weekday	34 <sup>51</sup>	35 <sup>51</sup>	24 <sup>51</sup>	35 <sup>51</sup>	42 <sup>51</sup>	40 <sup>51</sup>	25 <sup>51</sup>
<b>Videogames time</b>							
% >2 h/weekday	31 <sup>51</sup>	33 <sup>51</sup>	25 <sup>51</sup>	44 <sup>51</sup>	42 <sup>51</sup>	43 <sup>51</sup>	24 <sup>51</sup>
<b>Total screen-time</b>							
Min or h/day	196 min(B) <sup>29,FQ</sup> , 168 min(G) <sup>29,FQ</sup> , 132 min(B) <sup>29,recall</sup> , 101 min(G) <sup>29,recall</sup>		1.8 h <sup>28</sup> , 2.3 h <sup>60</sup>			213 min(B) <sup>29, FQ</sup> , 174 min(G) <sup>29, FQ</sup> , 131 min(B) <sup>29, recall</sup> , 100 min(G) <sup>29, recall</sup>	
% <1 h/weekday		37 <sup>63</sup>					
% <1 h/weekend day		16 <sup>63</sup>					

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

	Spain	Sweden	Switzerland	Macedonia	Turkey	Ukraine	UK
% >2 h/day	49 <sup>52</sup>		64 <sup>52</sup> , 49 <sup>60</sup>				
% not at all, <0.5 h, 0.5-1 h, 1-2 h, 2-3 h, >3 h/day							
<b>Total sedentary time</b>							
Min, h or %/day			467 min(B) <sup>33</sup> , 498 min(G) <sup>33</sup> , 236 min <sup>53</sup> , 278 min <sup>53</sup>				356 min <sup>53</sup> , 362 min <sup>53</sup> , 352 min <sup>53</sup> , 192 min(SC) <sup>53</sup> , 8.3 h <sup>60</sup>
Min or %/weekday							
Min or %/weekend day							
Min or %/school time							
Min or %/leisure time							
<b>Television time</b>							
Min or h/day	109 min(B) <sup>29,FQ</sup> , 97 min(G) <sup>29,FQ</sup> , 77 min(B) <sup>29,recall</sup> , 64 min(G) <sup>29,recall</sup> , 2.2 h <sup>61</sup>	1.3 h <sup>28</sup> , 2.1 h <sup>61</sup>					
Min or h/weekday	66 min <sup>63</sup>						
Min or h/weekend day	122 min <sup>63</sup>						
% >1 h before school							
% >2 h/day	37(B) <sup>62</sup> , 31(G) <sup>62</sup> , 8 <sup>64</sup>	32(B) <sup>62</sup> , 31(G) <sup>62</sup>			28 <sup>26</sup>		
% >2 h/weekday	43(B) <sup>51</sup> , 30(G) <sup>51</sup>	58(B) <sup>51</sup> , 51(G) <sup>51</sup>	32(B) <sup>51</sup> , 29(G) <sup>51</sup>	46(B) <sup>51</sup> , 43(G) <sup>51</sup>		52(B) <sup>51</sup> , 46(G) <sup>51</sup>	51(B,ENG) <sup>51</sup> , 51(G,ENG) <sup>51</sup> , 60(B,SC) <sup>51</sup> , 51(G,SC) <sup>51</sup> , 62(B,WAL) <sup>51</sup> , 53(G,WAL) <sup>51</sup>
% <1 h/day, 1-3 h/ day, 3-5 h/day, >5 h/ day	24, 62, 12, 2(A Coruña) <sup>58</sup> ; 27, 59, 11, 3(Asturias) <sup>58</sup> ; 19, 59, 19, 3(Barcelona) <sup>58</sup> ; 34, 54, 10, 2(Bilbao) <sup>58</sup> ; 15, 63, 19, 4(Cartagena) <sup>58</sup> ; 18, 61, 18, 3(Madrid) <sup>58</sup> ; 22, 61, 14, 2(Valencia) <sup>58</sup>						

**Table 2** Levels of sedentary time in children (0-12 years) across European countries (Continued)

<b>Computer time</b>							
Min or h/day	85 min(B) <sup>29,FQ</sup> , 63 min(G) <sup>29,FQ</sup> , 45 min(B) <sup>29,recall</sup> , 25 min(G) <sup>29,recall</sup>	0.6 h <sup>28</sup>					
Min or h/weekday	13 min <sup>63</sup>						
Min or h/weekend day	31 min <sup>63</sup>						
% >1 h/day	22(B) <sup>62</sup> , 15(G) <sup>62</sup>	35(B) <sup>62</sup> , 18(G) <sup>62</sup>					
% >2 h/weekday	22 <sup>51</sup>	40 <sup>51</sup>	18 <sup>51</sup>	36 <sup>51</sup>		33 <sup>51</sup>	
<b>Videogames time</b>							
% >2 h/weekday	23 <sup>51</sup>	44 <sup>51</sup>	20 <sup>51</sup>	34 <sup>51</sup>		33 <sup>51</sup>	41(ENG) <sup>51</sup> , 51(SC) <sup>51</sup> , 49(WAL) <sup>51</sup>
<b>Total screen-time</b>							
Min or h/day	193 min(B) <sup>29,FQ</sup> , 160 min(G) <sup>29,FQ</sup> , 122 min(B) <sup>29,recall</sup> , 89 min(G) <sup>29,recall</sup>	1.9 h <sup>28</sup>					2.9 h <sup>60</sup>
% <1 h/weekday	44 <sup>63</sup>						
% <1 h/weekend day	12 <sup>63</sup>						
% >2 h/day							47(ENG) <sup>52</sup> , 59(ENG) <sup>52</sup> , 68 <sup>60</sup>
% not at all, <0.5 h, 0.5-1 h, 1-2 h, 2-3 h, >3 h/day	6, 22, 28, 26, 12, 6 <sup>55</sup>						

This table displays a summary of the results reported in the articles included in the systematic review; *B* boys, *G* girls, *min* minutes, *h* hours, *FQ* usual frequency question, *FL* Flemish part of Belgium, *FR* French part of Belgium, *ENG* England, *SC* Scotland, *WAL* Wales; references are displayed in superscript to avoid confusion with the levels of sedentary time



**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries

Total sedentary time	Albania	Armenia	Austria	Belgium	Bulgaria	Croatia	Czech Republic
Min or %/day							
Min or %/weekday							
Min or %/weekend day							
Min or %/school time							
Min or %/leisure time							
<b>Television time</b>							
Min or h/day							
Min or h/weekday				2.6-2.5-2.3 h(B,FL) <sup>50</sup> , 2.3-2.4-2.2 h(G,FL) <sup>50</sup> , 2.2-2.2-2.0 h(B,FR) <sup>50</sup> , 2.1-1.9-1.8 h(G,FR) <sup>50</sup>		3.0-3.0-2.7 h(B) <sup>50</sup> , 2.7-2.8-2.6 h(G) <sup>50</sup>	2.8-2.5-2.3 h(B) <sup>50</sup> , 2.5-2.3-2.2 h(G) <sup>50</sup>
Min or h/weekend day				3.7-3.4-3.2 h(B,FL) <sup>50</sup> , 3.1-3.2-3.1 h(G,FL) <sup>50</sup> , 3.5-3.4-3.2 h(B,FR) <sup>50</sup> , 3.2-3.1-3.1 h(G,FR) <sup>50</sup>		3.9-3.5-3.3 h(B) <sup>50</sup> , 3.7-3.4-3.2 h(G) <sup>50</sup>	3.2-3.2-3.0 h(B) <sup>50</sup> , 2.9-2.9-2.7 h(G) <sup>50</sup>
% >2 h/day			38(B) <sup>45</sup> , 33(G) <sup>45</sup>	40(B,FL) <sup>45</sup> , 40(G,FL) <sup>45</sup> , 33(B,FR) <sup>45</sup> , 26(G,FR) <sup>45</sup>	60(B) <sup>45</sup> , 66(G) <sup>45</sup>	44(B) <sup>45</sup> , 50(G) <sup>45</sup>	42(B) <sup>45</sup> , 38(G) <sup>45</sup>
% >2 h/weekday	73(B) <sup>51</sup> , 75(G) <sup>51</sup>	73(B) <sup>51</sup> , 66(G) <sup>51</sup>	54(B) <sup>51</sup> , 57(G) <sup>51</sup>	61(B,FL) <sup>51</sup> , 59(G,FL) <sup>51</sup> , 64(B,FR) <sup>51</sup> , 55(G,FR) <sup>51</sup>	70(B) <sup>51</sup> , 72(G) <sup>51</sup>	66(B) <sup>51</sup> , 59(G) <sup>51</sup>	65(B) <sup>51</sup> , 59(G) <sup>51</sup>
% >3 h/weekday			31 <sup>40</sup>	40(FL) <sup>40</sup> , 34(FR) <sup>40</sup>		53 <sup>40</sup>	47 <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day				9, 39, 31, 20 <sup>58</sup>			
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday							
<b>Computer time</b>							
Min or h/day							
Min or h/weekday				1.4-3.3-3.2 h(B,FL) <sup>50</sup> , 0.9-2.5-2.5 h(G,FL) <sup>50</sup> , 1.4-2.9-2.8 h(B,FR) <sup>50</sup> , 0.7-2.4-2.4 h(G,FR) <sup>50</sup>		1.2-2.7-3.8 h(B) <sup>50</sup> , 0.5-1.6-2.9 h(G) <sup>50</sup>	1.6-3.2-4.0 h(B) <sup>50</sup> , 0.7-1.9-3.0 h(G) <sup>50</sup>
Min or h/weekend day				2.3-4.7-4.7 h(B,FL) <sup>50</sup> , 1.4-3.4-3.5 h(G,FL) <sup>50</sup> , 2.5-5.1-4.9 h(B,FR) <sup>50</sup> , 1.2-4.0-4.2 h(G,FR) <sup>50</sup>		1.9-3.7-5.0 h(B) <sup>50</sup> , 0.9-2.2-3.9 h(G) <sup>50</sup>	1.9-4.0-4.8 h(B) <sup>50</sup> , 0.8-2.4-3.6 h(G) <sup>50</sup>

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

	Denmark	Estonia	Finland	France	Germany	Greece	
% >2 h/day		20(B) <sup>45</sup> , 15(G) <sup>45</sup>	23(B,FL) <sup>45</sup> , 23(G,FL) <sup>45</sup> , 17(B,FR) <sup>45</sup> , 15(G,FR) <sup>45</sup>	30(B) <sup>45</sup> , 24(G) <sup>45</sup>	12(B) <sup>45</sup> , 10(G) <sup>45</sup>	14(B) <sup>45</sup> , 14(G) <sup>45</sup>	
% >2 h/weekday	50 <sup>51</sup>	48 <sup>51</sup>	25 <sup>40</sup> , 53 <sup>51</sup>	26(FL) <sup>40</sup> , 22(FR) <sup>40</sup> , 60(FL) <sup>51</sup> , 60(FR) <sup>51</sup>	69 <sup>51</sup>	20 <sup>40</sup> , 57 <sup>51</sup>	26 <sup>40</sup> , 65 <sup>51</sup>
<b>Videogames time</b>							
Min or h/day							
% >2 h/day		28(B) <sup>45</sup> , 12(G) <sup>45</sup>	22(B,FL) <sup>45</sup> , 8(G,FL) <sup>45</sup> , 23(B,FR) <sup>45</sup> , 15(G,FR) <sup>45</sup>	44(B) <sup>45</sup> , 18(G) <sup>45</sup>	25(B) <sup>45</sup> , 5(G) <sup>45</sup>	31(B) <sup>45</sup> , 7(G) <sup>45</sup>	
% >2 h/weekday	40 <sup>51</sup>	35 <sup>51</sup>	36 <sup>51</sup>	32(FL) <sup>51</sup> , 49(FR) <sup>51</sup>	53 <sup>51</sup>	32 <sup>51</sup>	42 <sup>51</sup>
<b>Total screen-time</b>							
Min or h/day							
Min or h/weekday							
<b>Total sedentary time</b>							
Min or %/day	268 min <sup>53</sup> , 356 min <sup>53</sup>	506 min(B) <sup>38</sup> , 496 min(G) <sup>38</sup> , 343 min <sup>53</sup>					
Min or %/weekday	454 min(B) <sup>37</sup> , 457 min(G) <sup>37</sup>	388 min(B) <sup>37</sup> , 344 min(G) <sup>37</sup> , 526 min(B) <sup>38</sup> , 521 min(G) <sup>38</sup>					
Min or %/weekend day	412 min(B) <sup>37</sup> , 412 min(G) <sup>37</sup>	331 min(B) <sup>37</sup> , 367 min(G) <sup>37</sup> , 459 min(B) <sup>38</sup> , 434 min(G) <sup>38</sup>					
Min or %/school time	205 min(B) <sup>37</sup> , 218 min(G) <sup>37</sup>	186 min(B) <sup>37</sup> , 227 min(G) <sup>37</sup>					
Min or %/leisure time	205 min(B) <sup>37</sup> , 191 min(G) <sup>37</sup>	168 min(B) <sup>37</sup> , 187 min(G) <sup>37</sup>					
<b>Television time</b>							
Min or h/day							
Min or h/weekday	2.6-2.4-2.4 h(B) <sup>50</sup> , 2.5-2.3-2.2 h(G) <sup>50</sup>	3.4-2.8-2.4(B) <sup>50</sup> , 3.0-2.7-2.4 h(G) <sup>50</sup>	2.3-2.0-2.0 h(B) <sup>50</sup> , 2.3-1.9-1.8 h(G) <sup>50</sup>	2.3-2.3-2.1 h(B) <sup>50</sup> , 2.1-2.1-2.0 h(G) <sup>50</sup>	2.4-2.3-2.1 h(B) <sup>50</sup> , 2.2-2.1-2.0 h(G) <sup>50</sup>	2.5-2.7-2.7 h(B) <sup>50</sup> , 2.1-2.8-2.5 h(G) <sup>50</sup>	
Min or h/weekend day	3.3-3.2-3.2 h(B) <sup>50</sup> , 3.1-3.0-3.0 h(G) <sup>50</sup>	4.0-3.5-3.3(B) <sup>50</sup> , 3.9-3.5-3.2 h(G) <sup>50</sup>	3.3-2.8-2.8 h(B) <sup>50</sup> , 3.1-2.7-2.7 h(G) <sup>50</sup>	3.2-3.2-3.0 h(B) <sup>50</sup> , 3.0-2.9-2.9 h(G) <sup>50</sup>	3.4-3.5-3.3 h(B) <sup>50</sup> , 3.0-3.1-3.0 h(G) <sup>50</sup>	3.5-3.6-3.6 h(B) <sup>50</sup> , 3.3-3.6-3.5 h(G) <sup>50</sup>	
% >1 h before school	40(B) <sup>45</sup> , 36(G) <sup>45</sup>	51(B) <sup>45</sup> , 50(G) <sup>45</sup>	28(B) <sup>45</sup> , 27(G) <sup>45</sup>	37(B) <sup>45</sup> , 32(G) <sup>45</sup>	36(B) <sup>45</sup> , 33(G) <sup>45</sup>	48(B) <sup>45</sup> , 53(G) <sup>45</sup>	
% >2 h/day							
% >2 h/weekday	71(B) <sup>51</sup> , 68(G) <sup>51</sup>	59(B) <sup>51</sup> , 57(G) <sup>51</sup>	61(B) <sup>51</sup> , 52(G) <sup>51</sup>	62(B) <sup>51</sup> , 58(G) <sup>51</sup>	66(B) <sup>51</sup> , 60(G) <sup>51</sup>	71(B) <sup>51</sup> , 65(G) <sup>51</sup>	

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

% >3 h/weekday	45 <sup>40</sup>	63 <sup>40</sup>	40 <sup>40</sup>	34 <sup>40</sup> , 64 <sup>51</sup>	39 <sup>40</sup>	38 <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day		4, 28, 40, 28 <sup>58</sup>	5, 39, 37, 19 <sup>58</sup>			
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday					25, 52, 17, 6 <sup>27</sup>	
<b>Computer time</b>						
Min or h/day						
Min or h/weekday	1.9-3.6-4.3 h(B) <sup>50</sup> , 0.7-2.1-2.9 h(G) <sup>50</sup>	1.8-4.4-4.5 h(B) <sup>50</sup> , 0.9-3.0-3.5 h(G) <sup>50</sup>	1.4-3.2-3.4 h(B) <sup>50</sup> , 0.6-2.0-2.5 h(G) <sup>50</sup>	1.0-2.7-3.3 h(B) <sup>50</sup> , 0.6-1.9-2.6 h(G) <sup>50</sup>	1.5-3.2-3.2 h(B) <sup>50</sup> , 0.7-2.2-2.6 h(G) <sup>50</sup>	1.2-2.6-3.7 h(B) <sup>50</sup> , 0.5-1.1-2.3 h(G) <sup>50</sup>
Min or h/weekend day	2.3-4.4-5.4 h(B) <sup>50</sup> , 0.8-2.5-3.4 h(G) <sup>50</sup>	2.3-5.5-5.7 h(B) <sup>50</sup> , 1.1-3.8-4.4 h(G) <sup>50</sup>	2.0-4.2-4.7 h(B) <sup>50</sup> , 0.8-2.7-3.5 h(G) <sup>50</sup>	1.5-4.1-4.9 h(B) <sup>50</sup> , 0.9-2.9-3.9 h(G) <sup>50</sup>	2.0-4.7-4.8 h(B) <sup>50</sup> , 1.0-3.0-3.7 h(G) <sup>50</sup>	1.9-4.2-5.5 h(B) <sup>50</sup> , 0.8-1.8-3.7(G) <sup>50</sup>
% >1 h/day						
% >2 h/day	20(B) <sup>45</sup> , 17(G) <sup>45</sup>	32(B) <sup>45</sup> , 30(G) <sup>45</sup>	17(B) <sup>45</sup> , 17(G) <sup>45</sup>	16(B) <sup>45</sup> , 16(G) <sup>45</sup>	19(B) <sup>45</sup> , 17(G) <sup>45</sup>	10(B) <sup>45</sup> , 4(G) <sup>45</sup>
% >2 h/weekday	29 <sup>40</sup> , 67 <sup>51</sup>	32 <sup>40</sup> , 72 <sup>51</sup>	23 <sup>40</sup> , 59 <sup>51</sup>	16 <sup>40</sup>	25 <sup>40</sup> , 66 <sup>51</sup>	21 <sup>40</sup> , 59 <sup>51</sup>
<b>Videogames time</b>						
Min or h/day						
% >2 h/day	32(B) <sup>45</sup> , 8(G) <sup>45</sup>	41(B) <sup>45</sup> , 14(G) <sup>45</sup>	24(B) <sup>45</sup> , 6(G) <sup>45</sup>	20(B) <sup>45</sup> , 6(G) <sup>45</sup>	25(B) <sup>45</sup> , 10(G) <sup>45</sup>	26(B) <sup>45</sup> , 6(G) <sup>45</sup>
% >2 h/weekday	42 <sup>51</sup>	41 <sup>51</sup>	29 <sup>51</sup>	38 <sup>51</sup>	50 <sup>51</sup>	38 <sup>51</sup>
<b>Total screen-time</b>						
Min or h/day						
Min or h/weekday						
<b>Total sedentary time</b>	<b>Hungary</b>	<b>Iceland</b>	<b>Ireland</b>	<b>Italy</b>	<b>Latvia</b>	<b>Lithuania</b>
Min or %/day						
Min or %/weekday						
Min or %/weekend day						
Min or %/school time						
Min or %/leisure time						
<b>Television time</b>						
Min or h/day	100 min <sup>25</sup>					
Min or h/weekday	2.4-2.3-2.2 h(B) <sup>50</sup> , 2.2-2.1-2.1 h(G) <sup>50</sup>			2.3-2.3-2.1 h(B) <sup>50</sup> , 2.5-2.2-2.0 h(G) <sup>50</sup>	3.4-3.0-2.5 h(B) <sup>50</sup> , 2.9-2.8-2.5 h(G) <sup>50</sup>	
Min or h/weekend day	4.0-3.7-3.6 h(B) <sup>50</sup> , 3.9-3.6-3.5 h(G) <sup>50</sup>			2.6-2.6-2.6 h(B) <sup>50</sup> , 2.6-2.4-2.4 h(G) <sup>50</sup>	4.4-3.6-3.2 h(B) <sup>50</sup> , 4.1-3.5-3.2 h(G) <sup>50</sup>	
% >2 h/day	40(B) <sup>45</sup> , 36(G) <sup>45</sup>	36(B) <sup>45</sup> , 29(G) <sup>45</sup>		36(B) <sup>45</sup> , 37(G) <sup>45</sup>		
% >2 h/weekday	62(B) <sup>51</sup> , 58(G) <sup>51</sup>	58(B) <sup>51</sup> , 54(G) <sup>51</sup>	56(B) <sup>51</sup> , 54(G) <sup>51</sup>	59(B) <sup>51</sup> , 52(G) <sup>51</sup>	68(B) <sup>51</sup> , 67(G) <sup>51</sup>	58(B) <sup>51</sup> , 58(G) <sup>51</sup>

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

% >3 h/weekday	39 <sup>40</sup>			38 <sup>40</sup>	43 <sup>40</sup>	63 <sup>40</sup>	57 <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day	7, 48, 32, 14 <sup>58</sup>						12, 51, 26, 11 <sup>58</sup>
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday			29, 55, 13, 3 <sup>27</sup>		20, 48, 23, 9 <sup>27</sup>		
<b>Computer time</b>							
Min or h/day	8 min <sup>25</sup>						
Min or h/weekday	1.4-3.0-3.7 h(B) <sup>50</sup> , 0.7-1.8-2.6 h(G) <sup>50</sup>				1.1-2.3-3.1 h(B) <sup>50</sup> , 0.7-1.4-2.7 h(G) <sup>50</sup>	1.4-3.6-3.9 h(B) <sup>50</sup> , 0.7-2.4-2.8 h(G) <sup>50</sup>	
Min or h/weekend day	2.4-5.2-6.2 h(B) <sup>50</sup> , 1.2-3.2-4.5 h(G) <sup>50</sup>				1.3-2.7-3.8 h(B) <sup>50</sup> , 0.8-1.6-3.3 h(G) <sup>50</sup>	2.0-4.3-4.8 h(B) <sup>50</sup> , 1.0-2.9-3.5 h(G) <sup>50</sup>	
% >1 h/day							
% >2 h/day	18(B) <sup>45</sup> , 12(G) <sup>45</sup>		26(B) <sup>45</sup> , 23(G) <sup>45</sup>		9(B) <sup>45</sup> , 8(G) <sup>45</sup>		
% >2 h/weekday	23 <sup>40</sup> , 58 <sup>51</sup>		61 <sup>51</sup>	61 <sup>51</sup>	20 <sup>40</sup> , 55 <sup>51</sup>	27 <sup>40</sup> , 65 <sup>51</sup>	23 <sup>40</sup> , 46 <sup>51</sup>
<b>Videogames time</b>							
Min or h/day	26 min <sup>25</sup>						
% >2 h/day	24(B) <sup>45</sup> , 8(G) <sup>45</sup>		27(B) <sup>45</sup> , 3(G) <sup>45</sup>		17(B) <sup>45</sup> , 4(G) <sup>45</sup>		
% >2 h/weekday	44 <sup>51</sup>		40 <sup>51</sup>	30 <sup>51</sup>	41 <sup>51</sup>	39 <sup>51</sup>	48 <sup>51</sup>
<b>Total screen-time</b>							
Min or h/day	156 min(B) <sup>23</sup> , 114 min(G) <sup>23</sup>						
Min or h/weekday	282 min(B) <sup>23</sup> , 192 min(G) <sup>23</sup>						
<b>Total sedentary time</b>							
	<b>Luxembourg</b>	<b>Moldova</b>	<b>Malta</b>	<b>Netherlands</b>	<b>Norway</b>	<b>Poland</b>	<b>Portugal</b>
Min or %/day					325 min <sup>55</sup>		367 min <sup>55</sup>
Min or %/weekday					445 min(B) <sup>37</sup> , 466 min(G) <sup>37</sup>		411 min(B) <sup>37</sup> , 435 min(G) <sup>37</sup>
Min or %/weekend day					385 min(B) <sup>37</sup> , 402 min(G) <sup>37</sup>		344 min(B) <sup>37</sup> , 351 min(G) <sup>37</sup>
Min or %/school time					206 min(B) <sup>37</sup> , 228 min(G) <sup>37</sup>		206 min(B) <sup>37</sup> , 217 min(G) <sup>37</sup>
Min or %/leisure time					189 min(B) <sup>37</sup> , 190 min(G) <sup>37</sup>		183 min(B) <sup>37</sup> , 191 min(G) <sup>37</sup>
<b>Television time</b>							
Min or h/day							
Min or h/weekday				2.8-3.0-2.8 h(B) <sup>50</sup> , 2.4-2.7-2.6 h(G) <sup>50</sup>	2.7-2.1-2.0 h(B) <sup>50</sup> , 2.6-2.2-2.0 h(G) <sup>50</sup>	3.0-2.6-2.5 h(B) <sup>50</sup> , 2.6-2.4-2.3 h(G) <sup>50</sup>	2.8-3.0-2.5 h(B) <sup>50</sup> , 2.9-3.0-2.5 h(G) <sup>50</sup>

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

	Romania	Russian Federation	Slovakia	Slovenia	Spain	Sweden	
Min or h/weekend day				3.6-3.4-3.2 h(B) <sup>50</sup> , 3.3-3.3-3.1 h(G) <sup>50</sup>	3.6-3.0-2.9 h(B) <sup>50</sup> , 3.3-2.9-2.9 h(G) <sup>50</sup>	4.0-3.8-3.4 h(B) <sup>50</sup> , 3.7-3.7-3.4 h(G) <sup>50</sup>	3.9-4.0-3.8 h(B) <sup>50</sup> , 3.8-4.0-3.9 h(G) <sup>50</sup>
% >2 h/day	32(B) <sup>45</sup> , 28(G) <sup>45</sup>			50(B) <sup>45</sup> , 44(G) <sup>45</sup>		55(B) <sup>45</sup> , 41(G) <sup>45</sup>	54(B) <sup>45</sup> , 56(G) <sup>45</sup>
% >2 h/weekday	66(B) <sup>51</sup> , 61(G) <sup>51</sup>	73(B) <sup>51</sup> , 77(G) <sup>51</sup>	65(B) <sup>51</sup> , 54(G) <sup>51</sup>	73(B) <sup>51</sup> , 75(G) <sup>51</sup>	63(B) <sup>51</sup> , 61(G) <sup>51</sup>	62(B) <sup>51</sup> , 64(G) <sup>51</sup>	55(B) <sup>51</sup> , 51(G) <sup>51</sup>
% >3 h/weekday			43 <sup>40</sup>	45 <sup>40</sup>	48 <sup>40</sup>	53 <sup>40</sup>	52 <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day						9, 46, 29, 17(Krakow) <sup>58</sup> , 8, 54, 27, 12(Poznan) <sup>58</sup>	11, 37, 30, 22(Funchal) <sup>58</sup> , 5,36, 36, 23(Lisbon) <sup>58</sup> , 7, 36, 34, 23(Portimao) <sup>58</sup> , 8, 45, 30, 18(Porto) <sup>58</sup>
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday				24, 57, 17, 2 <sup>27</sup>		19, 49, 24, 8 <sup>27</sup>	
<b>Computer time</b>							
Min or h/day							
Min or h/weekday				1.7-4.6-4.5 h(B) <sup>50</sup> , 1.0-3.2-3.4 h(G) <sup>50</sup>	1.9-3.1-3.3 h(B) <sup>50</sup> , 0.8-2.2-2.5 h(G) <sup>50</sup>	1.6-4.2-4.8 h(B) <sup>50</sup> , 0.8-2.2-3.2 h(G) <sup>50</sup>	1.5-3.8-3.8 h(B) <sup>50</sup> , 0.7-2.6-2.8 h(G) <sup>50</sup>
Min or h/weekend day				2.4-5.1-4.9 h(B) <sup>50</sup> , 1.4-3.7-3.6 h(G) <sup>50</sup>	2.3-4.1-4.1 h(B) <sup>50</sup> , 1.0-2.8-2.8 h(G) <sup>50</sup>	2.5-6.0-6.5 h(B) <sup>50</sup> , 1.3-3.4-4.7 h(G) <sup>50</sup>	2.2-5.2-5.9 h(B) <sup>50</sup> , 1.0-3.4-4.3 h(G) <sup>50</sup>
% >1 h/day					26.8 <sup>12</sup>		29.7 <sup>30</sup>
% >2 h/day	18(B) <sup>45</sup> , 17(G) <sup>45</sup>		31(B) <sup>45</sup> , 31(G) <sup>45</sup>	36(B) <sup>45</sup> , 35(G) <sup>45</sup>		30(B) <sup>45</sup> , 21(G) <sup>45</sup>	23(B) <sup>45</sup> , 22(G) <sup>45</sup>
% >2 h/weekday	67 <sup>51</sup>	66 <sup>51</sup>	20 <sup>40</sup> , 69 <sup>51</sup>	31 <sup>40</sup> , 78 <sup>51</sup>	31 <sup>40</sup> , 74 <sup>51</sup>	32 <sup>40</sup> , 70 <sup>51</sup>	25 <sup>40</sup> , 49 <sup>51</sup>
<b>Videogames time</b>							
Min or h/day							
% >2 h/day	21(B) <sup>45</sup> , 9(G) <sup>45</sup>			37(B) <sup>45</sup> , 10(G) <sup>45</sup>		36(B) <sup>45</sup> , 8(G) <sup>45</sup>	36(B) <sup>45</sup> , 14(G) <sup>45</sup>
% >2 h/weekday	44 <sup>51</sup>	41 <sup>51</sup>	57 <sup>51</sup>	56 <sup>51</sup>	48 <sup>51</sup>	32 <sup>51</sup>	32 <sup>51</sup>
<b>Total screen-time</b>							
Min or h/day							
Min or h/weekday							
<b>Total sedentary time</b>	<b>Romania</b>	<b>Russian Federation</b>	<b>Slovakia</b>		<b>Slovenia</b>	<b>Spain</b>	<b>Sweden</b>
Min or %/day							486 min(B) <sup>38</sup> , 482 min(G) <sup>38</sup>
Min or %/weekday							498 min(B) <sup>38</sup> , 503 min(G) <sup>38</sup>
Min or %/weekend day							455 min(B) <sup>38</sup> , 430 min(G) <sup>38</sup>
Min or %/school time							
Min or %/leisure time							
<b>Television time</b>							
Min or h/day	87 min <sup>25</sup>		142 min <sup>25</sup>				

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

Min or h/weekday		3.2-2.8-2.5 h(B) <sup>50</sup> , 2.8-2.8-2.6 h(G) <sup>50</sup>		2.5-2.4-2.1 h(B) <sup>50</sup> , 2.2-2.1-1.9 h(G) <sup>50</sup>	2.5-2.2-2.2 h(B) <sup>50</sup> , 2.4-2.1-2.0 h(G) <sup>50</sup>	2.3-2.1-2.2 h(B) <sup>50</sup> , 2.2-2.0-2.1 h(G) <sup>50</sup>
Min or h/weekend day		3.9-3.7-3.2 h(B) <sup>50</sup> , 3.7-3.7-3.4 h(G) <sup>50</sup>		3.3-3.2-2.9 h(B) <sup>50</sup> , 2.9-3.0-2.8 h(G) <sup>50</sup>	3.3-3.0-2.7 h(B) <sup>50</sup> , 3.2-2.8-2.5 h(G) <sup>50</sup>	3.2-2.8-3.0 h(B) <sup>50</sup> , 2.9-2.6-2.8 h(G) <sup>50</sup>
% >2 h/day	40(B) <sup>45</sup> , 52(G) <sup>45</sup>	49(B) <sup>45</sup> , 50(G) <sup>45</sup>	57(B) <sup>45</sup> , 56(G) <sup>45</sup>	39(B) <sup>45</sup> , 33(G) <sup>45</sup>	36(B) <sup>45</sup> , 33(G) <sup>45</sup>	
% >2 h/weekday	73(B) <sup>51</sup> , 75(G) <sup>51</sup>	63(B) <sup>51</sup> , 60(G) <sup>51</sup>	70(B) <sup>51</sup> , 69(G) <sup>51</sup>	59(B) <sup>51</sup> , 50(G) <sup>51</sup>	63(B) <sup>51</sup> , 59(G) <sup>51</sup>	70(B) <sup>51</sup> , 67(G) <sup>51</sup>
% >3 h/weekday		56 <sup>40</sup>	40 <sup>40</sup>		43 <sup>40</sup>	37 <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day					12, 52, 26, 11(A Coruña) <sup>58</sup> , 13, 50, 27, 11(Asturias) <sup>58</sup> ; 10, 44, 31, 16(Barcelona) <sup>58</sup> ; 12, 47, 27, 14(Bilbao) <sup>58</sup> ; 8, 41, 34, 17(Cartagena) <sup>58</sup> ; 9, 45, 32, 14(Madrid) <sup>58</sup> , 14, 50, 25, 11(San Sebastian) <sup>58</sup> , 9, 47, 30, 15(Valencia) <sup>58</sup> ; 8, 46, 31, 15(Valladolid) <sup>58</sup>	
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday						
<b>Computer time</b>						
Min or h/day	15 min <sup>25</sup>		3 min <sup>25</sup>			
Min or h/weekday		1.7-2.8-4.3 h(B) <sup>50</sup> , 0.7-1.8-3.6 h(G) <sup>50</sup>		1.3-3.1-3.4 h(B) <sup>50</sup> , 0.6-1.9-2.5 h(G) <sup>50</sup>	1.1-2.2-3.2 h(B) <sup>50</sup> , 0.7-1.6-2.8 h(G) <sup>50</sup>	1.8-3.6-4.1 h(B) <sup>50</sup> , 0.9-2.3-3.1 h(G) <sup>50</sup>
Min or h/weekend day		2.4-3.8-5.6 h(B) <sup>50</sup> , 1.0-2.6-4.7 h(G) <sup>50</sup>		2.1-4.2-4.6 h(B) <sup>50</sup> , 1.1-2.7-3.3 h(G) <sup>50</sup>	1.8-3.7-4.1 h(B) <sup>50</sup> , 1.1-2.5-3.7 h(G) <sup>50</sup>	2.3-4.3-5.1 h(B) <sup>50</sup> , 1.1-2.7-3.7 h(G) <sup>50</sup>
% >1 h/day						
% >2 h/day	24(B) <sup>45</sup> , 16(G) <sup>45</sup>	12(B) <sup>45</sup> , 9(G) <sup>45</sup>	17(B) <sup>45</sup> , 13(G) <sup>45</sup>	17(B) <sup>45</sup> , 16(G) <sup>45</sup>	11(B) <sup>45</sup> , 10(G) <sup>45</sup>	
% >2 h/weekday	59 <sup>51</sup>	30 <sup>40</sup> , 70 <sup>51</sup>	23 <sup>40</sup> , 68 <sup>51</sup>	58 <sup>51</sup>	20 <sup>40</sup> , 67 <sup>51</sup>	32 <sup>40</sup> , 74 <sup>51</sup>
<b>Videogames time</b>						
Min or h/day	16 min <sup>25</sup>		23 min <sup>25</sup>			
% >2 h/day	45(B) <sup>45</sup> , 24(F) <sup>45</sup>	30(M) <sup>45</sup> , 13(F) <sup>45</sup>	35(B) <sup>45</sup> , 11(G) <sup>45</sup>	26(B) <sup>45</sup> , 6(G) <sup>45</sup>	16(B) <sup>45</sup> , 7(G) <sup>45</sup>	
% >2 h/weekday	46 <sup>51</sup>	42 <sup>51</sup>	47 <sup>51</sup>	27 <sup>51</sup>	39 <sup>51</sup>	46 <sup>51</sup>
<b>Total screen-time</b>						
Min or h/day	125 min(B) <sup>23</sup> , 111 min(G) <sup>23</sup>		118 min(B) <sup>23</sup> , 139 min(G) <sup>23</sup>			
Min or h/weekday	152 min(B) <sup>23</sup> , 120 min(G) <sup>23</sup>		252 min(B) <sup>23</sup> , 196 min(G) <sup>23</sup>			

**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

Total sedentary time	Switzerland	Macedonia	Turkey	Ukraine	UK
Min or %/day					356 min <sup>53</sup> , 362 min <sup>53</sup> , 352 min <sup>53</sup>
Min or %/weekday					
Min or %/weekend day					
Min or %/school time					
Min or %/leisure time					
<b>Television time</b>					
Min or h/day					119 min <sup>25</sup>
Min or h/weekday	1.8-1.6-1.4 h(B) <sup>50</sup> , 1.7-1.4-1.3 h(G) <sup>50</sup>	2.8-2.5-2.4 h(B) <sup>50</sup> , 2.5-2.5-2.4 h(G) <sup>50</sup>		3.6-2.9-2.5 h(B) <sup>50</sup> , 3.3-3.0-2.6 h(G) <sup>50</sup>	2.9-2.7-2.5 h(B,SC) <sup>50</sup> , 2.8-2.5- 2.3 h(G,SC) <sup>50</sup> , 2.9-2.6-2.6 h(B,WAL) <sup>50</sup> , 2.9- 2.5-2.3 h(G,WAL) <sup>50</sup>
Min or h/weekend day	2.9-2.6-2.5 h(B) <sup>50</sup> , 2.6-2.4-2.4 h(G) <sup>50</sup>	3.5-3.5-3.1 h(B) <sup>50</sup> , 3.3-3.6-3.2 h(G) <sup>50</sup>		4.5-3.7-3.2 h(B) <sup>50</sup> , 4.5-4.0-3.3 h(G) <sup>50</sup>	3.4-3.2-3.2 h(B,SC) <sup>50</sup> , 3.2-2.8- 2.9 h(G,SC) <sup>50</sup> , 3.4-3.2-3.2 h(B,WAL) <sup>50</sup> , 3.5- 3.0-2.9 h(G,WAL) <sup>50</sup>
% >2 h/day	19(B) <sup>45</sup> , 17(G) <sup>45</sup>	44(B) <sup>45</sup> , 45(G) <sup>45</sup>	43(B) <sup>45</sup> , 41(G) <sup>45</sup>	54(B) <sup>45</sup> , 57(G) <sup>45</sup>	37(B, ENG) <sup>45</sup> , 31(G,ENG) <sup>45</sup>
% >2 h/weekday	58(B) <sup>51</sup> , 51(G) <sup>51</sup>	57(B) <sup>51</sup> , 56(G) <sup>51</sup>		61(B) <sup>51</sup> , 64(G) <sup>51</sup>	67(B,ENG) <sup>51</sup> , 66(G,ENG) <sup>51</sup> , 72(B,SC) <sup>51</sup> , 64(G,SC) <sup>51</sup> , 72(B,WAL) <sup>51</sup> , 73(G,WAL) <sup>51</sup>
% >3 h/weekday	24 <sup>40</sup>	48 <sup>40</sup>		66 <sup>40</sup>	52(ENG) <sup>40</sup> , 50(SC) <sup>40</sup> , 53(WAL) <sup>40</sup>
% <1 h/day, 1-3 h/day, 3-5 h/day, >5 h/day		3, 34, 41, 23 <sup>58</sup>			
% ≤0.5 h, 1-2 h, 3-4 h, >4 h/schoolday					22, 50, 20, 8(SC) <sup>27</sup>
<b>Computer time</b>					
Min or h/day					11 min <sup>25</sup>
Min or h/weekday	1.1-2.2-2.3 h(B) <sup>50</sup> , 0.6-1.4-1.8 h(G) <sup>50</sup>	1.4-3.0-3.4 h(B) <sup>50</sup> , 0.8-2.1-3.4 h(G) <sup>50</sup>		1.1-2.6-2.8 h(B) <sup>50</sup> , 0.4-1.2-2.1(G) <sup>50</sup>	2.1-3.9-4.5 h(B,SC) <sup>50</sup> , 1.2-2.8- 3.5 h(G,SC) <sup>50</sup> , 1.7-3.6-4.2 h(B,WAL) <sup>50</sup> , 1.0- 2.8-3.5 h(G,WAL) <sup>50</sup>
Min or h/weekend day	1.9-3.8-4.0 h(B) <sup>50</sup> , 1.0-2.4-3.1 h(G) <sup>50</sup>	2.0-4.9-6.0 h(B) <sup>50</sup> , 1.2-3.6-5.2 h(G) <sup>50</sup>		1.6-3.7-3.7 h(B) <sup>50</sup> , 0.5-1.8-2.9 h(G) <sup>50</sup>	2.5-4.6-5.6(B,SC) <sup>50</sup> , 1.3-3.2- 4.2 h(G,SC) <sup>50</sup> , 2.2-4.4-5.1 h(B,WAL) <sup>50</sup> , 1.3- 3.3-4.2 h(G,WAL) <sup>50</sup>
% >1 h/day					
% >2 h/day	12(B) <sup>45</sup> , 8(G) <sup>45</sup>	16(B) <sup>45</sup> , 13(G) <sup>45</sup>	18(B) <sup>45</sup> , 16(G) <sup>45</sup>	12(B) <sup>45</sup> , 5(G) <sup>45</sup>	25(B,ENG) <sup>45</sup> , 25(G,ENG) <sup>45</sup>
% >2 h/weekday	16 <sup>40</sup> , 53 <sup>51</sup>	26 <sup>40</sup> , 55 <sup>51</sup>		17 <sup>40</sup> , 64 <sup>51</sup>	37(ENG) <sup>40</sup> , 39(SC) <sup>40</sup> , 33(WAL) <sup>40</sup> , 72(ENG) <sup>51</sup> , 78(SC) <sup>51</sup> , 72(WAL) <sup>51</sup>



**Table 3** Levels of sedentary time in adolescents (13-18 years) across European countries (Continued)

<b>Videogames time</b>					
Min or h/day					37 min <sup>25</sup>
% >2 h/day	11(B) <sup>45</sup> , 3(G) <sup>45</sup>	26(B) <sup>45</sup> , 12(G) <sup>45</sup>	22(B) <sup>45</sup> , 8(G) <sup>45</sup>	25(B) <sup>45</sup> , 8(G) <sup>45</sup>	25(B,ENG) <sup>45</sup> , 8(G,ENG) <sup>45</sup>
% >2 h/weekday	31 <sup>51</sup>	36 <sup>51</sup>		43 <sup>51</sup>	45(ENG) <sup>51</sup> , 54(SC) <sup>51</sup> , 50(WAL) <sup>51</sup>
<b>Total screen-time</b>					
Min or h/day					
Min or h/weekday					

This table displays a summary of the results reported in the articles included in the systematic review; *B* boys, *G* girls, *min* minutes, *h* hours, *FL* Flemish part of Belgium, *FR* French part of Belgium, *ENG* England, *SC* Scotland, *WAL* Wales; references are displayed in superscript to avoid confusion with the levels of sedentary time

which makes it difficult to describe the child and adolescent population levels. Despite this large variation, in general, higher values for sedentary time were observed in children and adolescents from more East-European countries as compared to the rest of Europe, especially for television viewing.

Further, large differences were observed between articles from the same country. One study illustrated the large differences that can be observed between assessment methods even within the same study, namely there were differences in television viewing, computer use and total screen-time recorded between the usual frequency and the 24 h-recall question type [28].

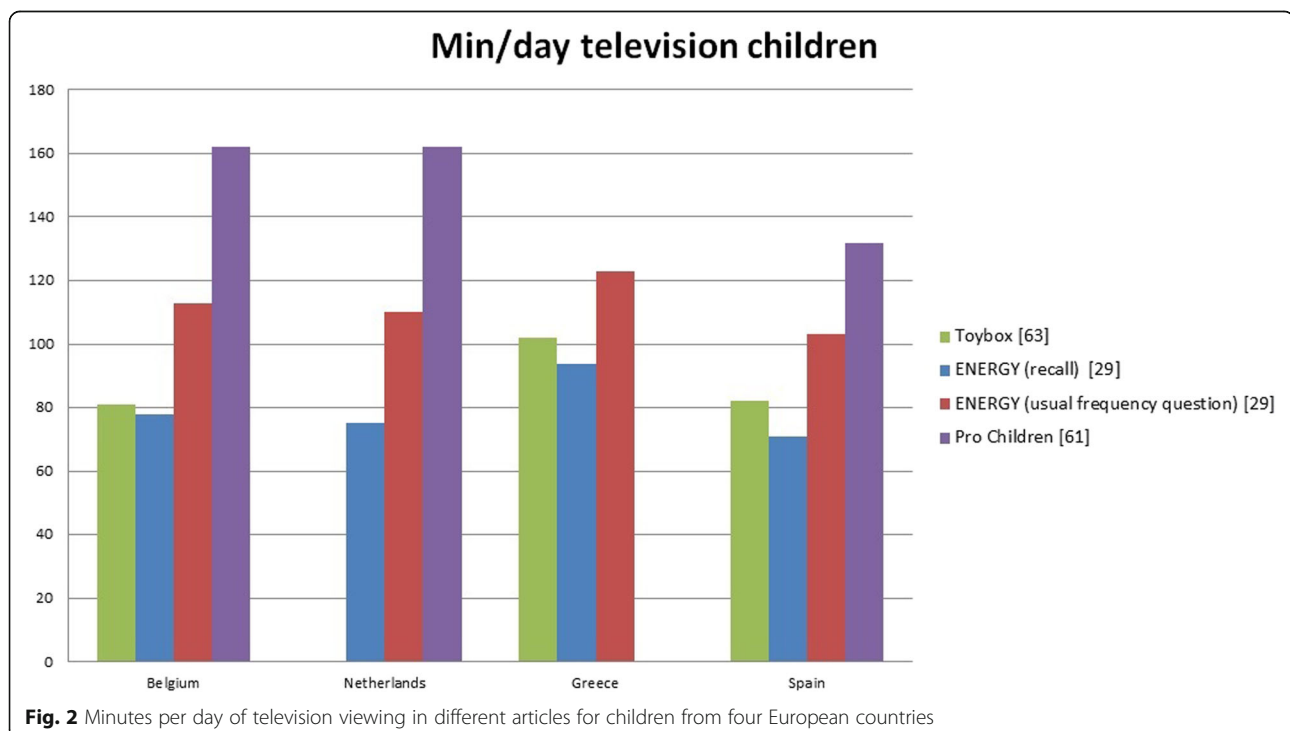
To provide a more accessible overview of the results, the bar charts in Fig. 2 display the amount of minutes per day that children spent in watching television across four countries using different assessment methods. Three articles were available [28, 60, 62]: one article had data for the four countries [28] and two articles had data for three out of four countries [60, 62]. In one article [28], television time was assessed by both a usual frequency and 24 h-recall questionnaire. In the article using data from the Toybox study [60], we calculated minutes of television time per day by following formula:  $((\text{min}/\text{weekday} * 5) + (\text{min}/\text{weekend day} * 2)) / 7$ . The highest levels of television time were observed within the article containing data from the Pro Children study (9-11-year-olds), followed by the article containing usual frequency questionnaire data from the ENERGY study (10-12-year-olds).

#### Variation in assessment methods and reported sedentary time variables

Table 4 provides an overview of the assessment methods and sedentary time outcome variables used in the retrieved articles. To describe this variation, we have again included all eligible articles ( $n = 42$ ), as articles from the same European study sometimes reported different outcome variables or reported the same outcome variable differently. Some articles used several assessment methods and/or reported several outcome variables. Most articles used a child questionnaire ( $n = 25$ ), with others using accelerometers ( $n = 10$ ). Interview with parents was conducted in one study, and in three other studies adolescents were asked to complete an ecological momentary assessment. Questionnaires were used to assess time spent in domains of sedentary time, whilst accelerometers were used to assess total sedentary time. With regard to the domains of sedentary time, television time was assessed in 24 articles, computer time in 15 articles, total screen-time in 11 articles and total sedentary time in 10 articles. Some articles described a specific time period, such as before ( $n = 1$ ), during ( $n = 2$ ) and after school hours ( $n = 3$ ). The outcome variables were mostly expressed in minutes ( $n = 16$ ) or hours ( $n = 11$ ) over a specific time period or the percentage exceeding more than 2 h per day ( $n = 12$ ).

#### Discussion

This systematic review aimed to provide an overview of existing cross-European studies assessing sedentary time



**Table 4** Assessment methods and reported outcome variables in the articles included in the systematic review

	Number	Reference number
<b>Measurement</b>		
ActiGraph accelerometer (100 cpm cut-point and 10 min non-wear time)	1	EYHS[36]
ActiGraph accelerometer (100 cpm cut-point and 20 min non-wear time)	6	ENERGY [31–33], EYHS [37], ISCOLE [58, 59]
ActiGraph accelerometer (100 cpm cut-point and 60 min non-wear time)	2	ICAD [52, 53]
ActiGraph accelerometer (500 cpm cut-point and 10 min non-wear time)	1	EYHS [34]
Self-administered child questionnaire	25	[25, 26], COSI [27], ENERGY [28–30], EYHS [35, 38], HBSC 01/02 [39–43], HBSC 05/06 [44–46], HBSC 09/10 [47–49], HBSC 13/14 [50], ICAD [51], ISAAC [57], ISCOLE [59], Pro Children [60, 61]
Self-administered parental questionnaire	7	ICAD [51], IDEFICS [54–56], ISAAC [57], Toybox [62, 63]
Parental questionnaire interview	1	Toybox [63]
Ecological Momentary Assessment Diary	3	[22–24]
<b>Child and parental questionnaire: question type</b>		
Usual frequency	28	[26], COSI [27], ENERGY [28–30], EYHS [35, 38], HBSC 01/02 [39–43], HBSC 05/06 [44–46], HBSC 09/10 [47–49], HBSC 13/14 [50], ICAD [51], IDEFICS [54–56], ISAAC [57], ISCOLE [59], Pro Children [60, 61], Toybox [62]
Recall	1	ENERGY [28]
Unknown	2	[25], Toybox [63]
<b>Child and parental questionnaire: answer type</b>		
Questions with answer categories	26	[26], COSI [27], ENERGY [28–30], EYHS [35, 38], HBSC 01/02 [39–43], HBSC 05/06 [44–46], HBSC 09/10 [47–49], HBSC 13/14 [50], IDEFICS [54–56], ISCOLE [59], Pro Children [60, 61], Toybox [62]
Questions without answer categories	-	-
Unknown	4	[25], ICAD [51], ISAAC [57], Toybox [63]
<b>Reported specific sedentary time variable</b>		
Total sedentary time	10	ENERGY [31–33], EYHS [34, 36, 37], ICAD [52, 53], ISCOLE [58, 59]
Television time	24	[23–26], COSI[27], ENERGY [28], EYHS [35, 38], HBSC 01/02 [39–43], HBSC 05/06 [44–46], HBSC 09/10 [48, 49], HBSC 13/14 [50], ISAAC [57], Pro Children [60, 61], Toybox [62, 63]
Computer time	15	[23, 24], COSI [27], ENERGY [28], EYHS [35, 38], HBSC 01/02 [39, 43], HBSC 05/06 [44–46], HBSC 09/10 [47, 49], HBSC 13/14 [50], Toybox [62]
Videogames time	6	[23, 24], HBSC 05/06 [44–46], HBSC 13/14 [50]
Screen-time	11	[22], COSI [27], ENERGY [28–30], ICAD [51], IDEFICS [54–56], ISCOLE [59], Toybox [62]
Homework	3	[23, 24], HBSC 01/02 [43]
Other sedentary activities	4	[22–24], Toybox [62]
<b>Reported time period</b>		
Day	28	[24, 25],COSI [27], ENERGY [28–30, 32], EYHS [34, 35, 37, 38], HBSC 01/02 [41, 42], HBSC 05/06 [44, 45], ICAD [51–53], IDEFICS [54–56], ISAAC [57], ISCOLE [58, 59], Pro Children [60, 61], Toybox [62, 63]
Weekday	14	[22, 23, 26], EYHS [36, 37], HBSC 01/02 [39, 40, 43], HBSC 05/06 [46], HBSC 09/10 [47–49], HBSC 13/14 [50], Toybox [62]
Weekend day	8	[22, 23], EYHS [36, 37], HBSC 01/02 [40, 43], HBSC 09/10 [49], Toybox [62]
School time	2	ENERGY [31], EYHS [36]

**Table 4** Assessment methods and reported outcome variables in the articles included in the systematic review (*Continued*)

Before school	1	EYHS [38]
After school	3	EYHS [35, 36, 38]
Reported unit		
Minutes	16	[22–24], ENERGY [28–33], EYHS [36, 37], HBSC 09/10 [47], ICAD [52, 53], ISCOLE [58], Toybox [62]
Hours	11	COSI [27], EYHS [38], HBSC 01/02 [40, 42], HBSC 05/06 [45], HBSC 09/10 [47, 49], ISAAC [57], ISCOLE [59], Pro Children [60], Toybox [63]
% of time period	2	ENERGY [31], EYHS [34]
% >1 hour	5	EYHS [35, 38], IDEFICS [55, 56], Toybox [62]
% >2 hours	12	[25], EYHS [35, 38], HBSC 01/02 [39], HBSC 05/06 [44, 46], HBSC 09/10 [48], HBSC 13/14 [50], ICAD [51], IDEFICS [56], ISCOLE [59], Pro Children [61]
% >3 hours	2	HBSC 01/02 [39, 43]
% >4 hours	2	HBSC 01/02 [41, 43]
% not at all, <0.5 h, 0.5–1 h, 1–2 h, 2–3 h, >3 h	1	IDEFICS [54]
% <0.5 h, 1–2 h, 3–4 h, >4 h	1	[26]
% <1 h, 1–3 h, 3–5 h, >5 h	1	ISAAC [57]

*h* hours, *COSI* WHO European Childhood Obesity Surveillance Initiative, *ENERGY* European Energy balance Research to prevent excessive weight Gain among Youth, *EYHS* European Youth Heart Study, *HBSC* Health Behaviour in School-aged Children, *ICAD* International Children's Accelerometer Database, *IDEFICS* Identification and prevention of Dietary and lifestyle induced health Effects In Children and infantS, *ISAAC* International Study of Asthma and Allergies in Childhood, *ISCOLE* The International Study of Childhood Obesity, Lifestyle and the Environment

in children (0–12y) and adolescents (13–18y), to describe the variation in population levels of sedentary time and to discuss the impact of assessment methods.

#### Overview of existing cross-European studies

The literature search revealed 42 articles reporting on levels of sedentary time. Thus, the current systematic review included the highest number of eligible articles in comparison with the other three reviews on sedentary time in adults and on physical activity in youth and adults [16–18]. Although sedentary time has only received increased attention in the last few years, earlier studies have described children and adolescents' television and screen-time [64].

Nine articles that were part of the HBSC-studies included the most countries (up to 36), but there were still some countries for which no data were available in cross-European studies. These countries should therefore be included in further European surveillance studies in order to have a complete overview of the sedentary time levels among children and adolescents. Since 38 of 42 articles were cross-sectional, future longitudinal studies could shed light on how sedentary time varies over time in the same population of children and adolescents. However, conducting repeated cross-sectional studies is also of importance in terms of public health to understand trends in sedentary time.

#### Variation in population levels of sedentary time and impact of assessment methods

The tables with data on the levels of sedentary time in children and adolescents across European countries might be useful for European researchers and policy makers, as they provide an orderly reference work of conducted cross-European studies. One general conclusion that we might draw from the results is that children and adolescents from Eastern-European countries (i.e. the more eastern part of Europe such as Bulgaria, Slovakia, Ukraine) have somewhat higher levels of sedentary time compared to the rest of Europe. However, there are several plausible reasons for the large differences observed between articles. First, different assessment methods were used. Child-specific questionnaires were used in 60 % of the articles and were only designed to measure time spent in domain-specific sedentary activities. Accelerometers were the only assessment methods that measured the total sitting time and were used in 24 % of the articles, probably because greater cost incurred in using accelerometers in large-scale studies. However, as technological advances have made the accelerometers smaller, lighter, and less expensive, it has been argued that the accelerometer has now become feasible for use in large-scale studies. An important remark is that standard procedures to process accelerometer data are then needed [65]. To estimate children's total

sedentary time via accelerometers, sedentary time was measured by summing the recorded epochs during which the average accelerometer counts were equivalent to less than 100 counts per minute, which is the most commonly used threshold for sedentary time measurement [66, 67]. Another assessment method that might also be less feasible to use in large-scale studies is the ecological momentary assessment tool. This method was used in three cross-European articles, but included a rather limited number of participants and countries, as this assessment method brings along a high time burden for participants. Next to variation in assessment methods, the included articles also reported different outcome variables (e.g. television time vs. total screen-time) or reported the same outcome variable differently (e.g. television time expressed in minutes per day vs. expressed in the percentage exceeding the 2 h recommendation). Finally, the amount of sedentary time was observed to substantially vary in individual countries across different articles. Among Estonian female adolescents for example, total sedentary time on a weekday was less than six hours in one article [36] and almost nine hours in another article [37]. These differences might have emerged because of age differences between study samples. In this review, separate tables were designed for children and adolescents, but age differences can still cause the differences in population levels between and within countries, as the amount of sedentary time increases with age [68]. Thus, because of these large methodological differences between studies, we want to emphasise that cross-European comparisons are currently only possible within studies.

#### Limitations and strengths

This review has some limitations that should be acknowledged. A first limitation is that although the search was performed in several databases in combination with multiple additional search strategies (e.g. back- and forward tracking), there is still a possibility that not all existing studies on this topic were covered. Some articles might not be found in our databases searched or through our search strategy. The use of including only English published data might also contribute to this limitation, although we expect that results of cross-European studies would be published in English. Another possible limitation could be that only cross-European studies were included. Single-country studies may have provided additional information. However, the purpose was to specifically review the literature on cross-country studies so that the results across countries would at least be comparable within articles [15]. This also means that cross-European studies that did not report the outcome separately per country were excluded

in the review, such as the HELENA (Healthy lifestyle in Europe by nutrition in adolescence) study [69]. An important strength is the systematic process: there was a written protocol for all four reviews that was agreed upon by all involved researchers and the search, article selection, data extraction and quality assessment were conducted together for all four reviews. Also, each step of the review process has been conducted by two independent researchers with issues being resolved by consulting a third researcher.

#### Recommendations for the future

This systematic literature review showed that there is a need for harmonisation and standardisation of methods to assess sedentary time in European children and adolescents. The same conclusion was drawn from the other systematic reviews conducted within DEDIPAC for sedentary time in adults and for physical activity in youth and adults [16–18]. A possible approach for the future could be to add objective assessment methods in existing large cross-European surveillance systems, such as the HBSC-study. Another approach could be to conduct a pooled analysis on existing data of European children and adolescents (and adults). This is similar as the approach of the International children's accelerometry database (ICAD) which collected, pooled and reduced individual accelerometer data files using standardised methods to compare the outcome variables across studies [70]. However, it might be difficult to obtain accelerometer data from all European countries, as few countries have population representative accelerometer data. Conducting a pooled analysis on existing questionnaire data would also be difficult, as harmonisation of data from different questionnaires is even more challenging. A final approach could be to set up a new cross-European surveillance system combining objective and self-report methods (for example, accelerometers and questionnaires) to monitor levels of sedentary time and physical activity in children, adolescents and adults.

#### Conclusion

Generally, higher levels of sedentary time were observed in children and adolescents from Eastern-European countries. There was a large variation in assessment methods and outcome variables across cross-European studies. Questionnaires (child specific) were used most often, probably because of feasibility reasons. These self-report measures mostly measured screen-based activities only, rather than total sedentary time. In sum, to enable cross-European surveillance, there is a need for harmonisation and standardisation of methods to assess sedentary time in European children and adolescents. Such a surveillance system should combine objective and self-report methods.

## Additional files

**Additional file 1:** PRISMA 2009 Checklist. (PDF 195 kb)

**Additional file 2:** Search strategy. (PDF 175 kb)

**Additional file 3:** Data extraction file. (XLSX 80 kb)

**Additional file 4:** Quality assessment file. (PDF 252 kb)

## Abbreviations

B: Boys; COSI: WHO European childhood obesity surveillance initiative; ENERGY: European energy balance research to prevent excessive weight gain among youth; ENG: England; EYHS: European youth heart study; FG: Usual frequency question; FL: Flemish part of Belgium; FR: French part of Belgium; G: Girls; h: Hour; HBSC: Health behaviour in school-aged children; ICAD: International Children's Accelerometer Database; IDEFICS: Identification and prevention of dietary and lifestyle induced health Effects In Children and infantS; ISAAC: International Study of Asthma and Allergies in Childhood; ISCOLE: The International Study of Childhood Obesity, Lifestyle and the Environment; min: Minutes; SC: Scotland; SES: Socio-economic status; WAL: Wales

## Acknowledgements

Not applicable.

## Funding

The preparation of this paper was supported by the DEterminants of Diet and Physical ACTivity (DEDIPAC) knowledge hub. This work is supported by the Joint Programming Initiative 'Healthy Diet for a Healthy Life'. The funding agencies supporting this work are (in alphabetical order of participating Member State): Belgium: Research Foundation – Flanders; Ireland: The Health Research Board (HRB); The Netherlands: The Netherlands Organisation for Health Research and Development (ZonMw); Norway: The Research Council of Norway, Division for Society and Health.

## Availability of data and supporting materials

Not applicable.

## Authors' contributions

MV, AL and LvH conducted the search, article selection, data extraction and quality assessment and drafted the manuscript. JL, IH, IDB, BD, AD, UE, JB, HvdP conceptualised and designed the study. All authors were involved in critically revising the manuscript for important intellectual content and have read and approved the final manuscript.

## Competing interests

The authors declare that they have no competing interests.

## Consent for publication

Not applicable.

## Ethics approval and consent to participate

Not applicable.

## Author details

<sup>1</sup>Department of Movement and Sports Sciences, Faculty of Medicine and Health Sciences, Ghent University, Watersportlaan 2, 9000 Ghent, Belgium. <sup>2</sup>Department of Epidemiology and Biostatistics, VU University Medical Center, EMGO+ Institute for Health and Care Research, De Boelelaan 1089a, 1081 HV Amsterdam, The Netherlands. <sup>3</sup>Department of Public Health, Faculty of Medicine and Health Sciences, Ghent University, De Pintelaan 185, 9000 Ghent, Belgium. <sup>4</sup>Physical activity, Nutrition and Health Research Unit, Department of Movement and Sport Sciences, Faculty of Physical Education and Physical Therapy, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium. <sup>5</sup>TNO Expertise Centre Lifestyle, Schipholweg 77-89, 2316 ZL Leiden, The Netherlands. <sup>6</sup>Body@Work, EMGO+ Institute for Health and Care Research, VU University Medical Center, van der Boerhorststraat 7, 1081 BT Amsterdam, The Netherlands. <sup>7</sup>Centre for Physical Activity and Health Research, Department of Physical Education and Sport Sciences, University of Limerick, Limerick, Ireland. <sup>8</sup>Department of Sports Medicine, Norwegian School of Sport Sciences, PO Box 40140806 Ullevål Stadion, Oslo, Norway.

<sup>9</sup>Department of Public and Occupational Health, VU University Medical Center, EMGO Institute for Health and Care Research, van der Boerhorststraat 7, 1081 BT Amsterdam, The Netherlands. <sup>10</sup>Sydney School of Public Health, The Charles Perkins Centre (D17), University of Sydney, NSW 2006 Sydney, Australia.

Received: 2 December 2015 Accepted: 11 June 2016

Published online: 28 June 2016

## References

1. Sedentary Behaviour Research Network. Letter to the Editor: Standardized use of the terms "sedentary" and "sedentary behaviours." *Appl Physiol Nutr Metab.* 2012;37:540–2.
2. Maher C, Olds T, Mire E, Katzmarzyk PT. Reconsidering the sedentary behaviour paradigm. *PLoS One.* 2014;9(1):e86403.
3. Pulsford RM, Stamatakis E, Britton AR, Brunner EJ, Hillsdon M. Associations of sitting behaviours with all-cause mortality over a 16-year follow-up: the Whitehall II study. *Int J Epidemiol.* 2015;44(6):1909–16.
4. de Rezende LF, Rodrigues Lopes M, Rey-López JP, Matsudo VK, Luiz OC. Sedentary behavior and health outcomes: an overview of systematic reviews. *PLoS One.* 2014;9(8):e105620.
5. Proper KI, Singh AS, van Mechelen W, Chinapaw MJ. Sedentary behaviors and health outcomes among adults: a systematic review of prospective studies. *Am J Prev Med.* 2011;40(2):174–82.
6. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults. A systematic review of longitudinal studies, 1996–2011. *Am J Prev Med.* 2011;41(2):207–15.
7. van der Ploeg HP, Chey T, Korda RJ, Banks E, Bauman A. Sitting time and all-cause mortality risk in 222 497 Australian adults. *Arch Int Med.* 2012;173(6):494–500.
8. Biswas A, Oh PI, Faulkner GE, Bajaj RR, Silver MA, Mitchell MS, Alter DA. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med.* 2015;162(2):123–32.
9. Chau JY, Grunseit AC, Chey T, Stamatakis E, Brown WJ, Matthews CE, Bauman AE, van der Ploeg HP. Daily sitting time and all-cause mortality: a meta-analysis. *PLoS One.* 2013;8(11):e80000.
10. Chinapaw MJM, Proper KI, Brug J, van Mechelen W, Singh AS. Relationship between young peoples' sedentary behaviour and biomedical health indicators: a systematic review of prospective studies. *Obes Rev.* 2011;12:e621–32.
11. Tremblay MS, Leblanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2011;8:98.
12. Chinapaw M, Altenburg T, Brug J. Sedentary behaviour and health in children - evaluating the evidence. *Prev Med.* 2015;70:1–2.
13. Hancox RJ, Milne BJ, Poulton R. Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. *Lancet.* 2004;364(9430):257–62.
14. Lakerveld J, van der Ploeg HP, Kroeze W, Ahrens W, Allais O, Andersen LF, et al. Towards the integration and development of a cross-European research network and infrastructure: the DEterminants of Diet and Physical ACTivity (DEDIPAC) Knowledge Hub. *Int J Behav Nutr Phys Act.* 2014;11:143.
15. World Health Organization Regional Office for Europe. Review of Physical Activity Surveillance Data Sources in European Union Member States. 2010.
16. Loyen A, Verloigne M, Van Hecke L, Hendriksen I, Lakerveld J, Steene-Johannessen J, et al. A systematic review on the variation in adult population levels of sedentary time in European adults according to pan-European studies across European countries: a DEDIPAC-study. *Int J Behav Nutr Phys Act.* In revision. doi:10.1186/s12966-016-0397-3
17. Loyen A, Van Hecke L, Verloigne M, Hendriksen I, Lakerveld J, Steene-Johannessen J, et al. A systematic review on the variation in adult population levels of physical activity in European adults according to pan-European studies across European countries: a DEDIPAC-study. *Int J Behav Nutr Phys Act.* In revision. doi:10.1186/s12966-016-0398-2
18. Van Hecke L, Loyen A, Verloigne M, van der Ploeg HP, Lakerveld J, Brug J, et al. Variation in population levels of physical activity in European children and adolescents according to cross-European studies: a systematic literature review within DEDIPAC. In revision. doi:10.1186/s12966-016-0396-4
19. CRD. Systematic Reviews CRD's guidance for undertaking reviews in health care. 2009.



20. Council of Europe - Our Member States. Available at: <http://www.coe.int/en/web/about-us/our-member-states>. Accessed 2 May 2016.
21. Kmet LM, Lee RC, Cook LS. HTA Initiative # 13. Standard quality assessment criteria for evaluating primary research papers from a variety of fields. *HTA Initiative*. 2004;2:13.
22. Biddle SJH, Soos I, Hamar P, Sandor I, Simonek J, Karsai I. Physical activity and sedentary behaviours in youth: data from three Central-Eastern European countries. *Eur Coll Sport Sci*. 2009;9(5):295–301.
23. Soos I, Biddle S, Boros-Balint I, Sandor I, Szabo P, Hamar P, et al. Prevalence of sedentary behaviours in young people in Romania and Slovakia. *Eur Phys Edu Rev*. 2012;18:19.
24. Soos I, Biddle SJH, Ling J, Hamar P, Sandor I, Boros-Balint I, et al. Physical activity, sedentary behaviour, use of electronic media, and snacking among youth: an international study. *Kinesiology*. 2014;46(2):155–63.
25. Cinnar B, Murtooma H. Clustering of obesity and dental health with lifestyle factors among Turkish and Finnish pre-adolescents. *Obes Facts*. 2008;1:196–202.
26. Hanewinkel R, Sargent JD, Poelen EA, Scholte R, Florek E, Sweeting H, et al. Alcohol consumption in movies and adolescent binge drinking in 6 European countries. *Pediatrics*. 2012;129(4):709–20.
27. Börnhorst C, Wijnhoven TM, Kunešová M, Yngve A, Rito AI, Lissner L, et al. WHO European Childhood Obesity Surveillance Initiative: associations between sleep duration, screen time and food consumption frequencies. *BMC Public Health*. 2015;15:442.
28. Brug J, van Stralen MM, Te Velde SJ, Chinapaw MJ, De Bourdeaudhuij I, Lien N, et al. Differences in weight status and energy-balance related behaviors among schoolchildren across Europe: the ENERGY-project. *PLoS One*. 2012;7(4):e34742.
29. Brug J, van Stralen MM, Chinapaw MJ, De Bourdeaudhuij I, Lien N, Bere E, et al. Differences in weight status and energy-balance related behaviours according to ethnic background among adolescents in seven countries in Europe: the ENERGY-project. *Pediatr Obes*. 2012;7(5):399–411.
30. Fernández-Alvira JM, De Bourdeaudhuij I, Singh AS, Vik FN, Manios Y, Kovacs E, et al. Clustering of energy balance-related behaviors and parental education in European children: the ENERGY-project. *Int J Behav Nutr Phys Act*. 2013;10:5.
31. van Stralen MM, Yıldırım M, Wulp A, te Velde SJ, Verloigne M, Doessegger A, et al. Measured sedentary time and physical activity during the school day of European 10- to 12-year-old children: the ENERGY project. *J Sci Med Sport*. 2014;17(2):201–6.
32. Verloigne M, Van Lippevelde W, Maes L, Yıldırım M, Chinapaw M, Manios Y, et al. Levels of physical activity and sedentary time among 10- to 12-year-old boys and girls across 5 European countries using accelerometers: an observational study within the ENERGY-project. *Int J Behav Nutr Phys Act*. 2012;9:34.
33. Yıldırım M, Schoeni A, Singh AS, Altenburg TM, Brug J, De Bourdeaudhuij I, et al. Daily variations in weather and the relationship with physical activity and sedentary time in European 10- to 12-year-olds: the ENERGY-project. *J Phys Act Health*. 2014;11:41–425.
34. Ekelund U, Sardinha LB, Anderssen SA, Harro M, Franks PW, Brage S, et al. Associations between objectively assessed physical activity and indicators of body fatness in 9- to 10-year-old European children: a population-based study from 4 distinct regions in Europe (the European Youth Heart Study). *Am J Clin Nutr*. 2004;80(3):584–90.
35. Jago R, Page A, Froberg K, Sardinha LB, Klasson-Heggebø L, Andersen LB. Screen-viewing and the home TV environment: the European Youth Heart Study. *Prev Med*. 2008;47(5):525–9.
36. Nilsson A, Anderssen SA, Andersen LB, Froberg K, Riddoch C, Sardinha LB, Ekelund U. Between- and within-day variability in physical activity and inactivity in 9- and 15-year-old European children. *Scand J Med Sci Sports*. 2009;19(1):10–8.
37. Ortega FB, Konstabel K, Pasquali E, Ruiz JR, Hurtig-Wennlöf A, Mäestu J, et al. Objectively measured physical activity and sedentary time during childhood, adolescence and young adulthood: a cohort study. *PLoS One*. 2013;8(4):e60871.
38. van Sluijs EM, Page A, Ommundsen Y, Griffin SJ. Behavioural and social correlates of sedentary time in young people. *Br J Sports Med*. 2010;44(10):747–55.
39. Janssen I, Katzmarzyk PT, Boyce WF, Vereecken C, Mulvihill C, Roberts C, et al. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obes Rev*. 2005;6(2):123–32.
40. Kuntsche E, Pickett W, Overpeck M, Craig W, Boyce W, de Matos MG. Television viewing and forms of bullying among adolescents from eight countries. *J Adolesc Health*. 2006;39(6):908–15.
41. Richter M, Vereecken CA, Boyce W, Maes L, Gabhainn SN, Currie CE. Parental occupation, family affluence and adolescent health behaviour in 28 countries. *Int J Public Health*. 2009;54(4):203–12.
42. Vereecken CA, Todd J, Roberts C, Mulvihill C, Maes L. Television viewing behaviour and associations with food habits in different countries. *Public Health Nutr*. 2006;9(2):244–50.
43. Currie C, Roberts C, Morgan A, Smith R, Settertobulte W, Samdal O, et al. (eds) Young People's Health in Context: international report from the HBSC 2001/02 survey. *Health Policy for Children and Adolescents*, No.4. Copenhagen: WHO Regional Office for Europe; 2004.
44. Haug E, Rasmussen M, Samdal O, Iannotti R, Kelly C, Borraccino A, et al. Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) study. *Int J Public Health*. 2009;54(2):167–79.
45. Torsheim T, Eriksson L, Schnohr CW, Hansen F, Bjarnason T, Välimaa R. Screen-based activities and physical complaints among adolescents from the Nordic countries. *BMC Public Health*. 2010;10:324.
46. Currie C, Nic Gabhainn S, Godeau E, Roberts C, Smith R, Currie D, et al. (eds) Inequalities in young people's health: HBSC international report from the 2005/06 Survey. *Health Policy for Children and Adolescents*, No. 5. Copenhagen, Denmark: WHO Regional Office for Europe; 2008.
47. Nuutinen T, Roos E, Ray C, Villberg J, Välimaa R, Rasmussen M, et al. Computer use, sleep duration and health symptoms: a cross-sectional study of 15-year olds in three countries. *Int J Public Health*. 2014;59(4):619–28.
48. Currie C, Zanotti C, Morgan A, Currie D, de Looze M, Roberts C, et al. (eds) Social determinants of health and well-being among young people. *Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey*. *Health Policy for Children and Adolescents*, No. 6. Copenhagen, Denmark: WHO Regional Office for Europe; 2012.
49. Bucksch J, Sigmundova D, Hamrik Z, Troped PJ, Melkevik O, Ahluwalia N, et al. International trends in adolescent screen-time behaviors from 2002 to 2010. *J Adolesc Health*. 2016;58(4):417–25.
50. Inchley J, Currie D, Young T, Samdal O, Torsheim T, Augustson L, et al. (eds) Growing up unequal: gender and socioeconomic differences in young people's health and well-being. *Health Behaviour in School-aged Children (HBSC) study: international report from the 2013/2014 survey*. *Health Policy for Children and Adolescents*, No. 7. Copenhagen, Denmark: WHO Regional Office for Europe; 2016.
51. Atkin AJ, Sharp SJ, Corder K, van Sluijs EM, International Children's Accelerometry Database (ICAD) Collaborators. Prevalence and correlates of screen time in youth: an international perspective. *Am J Prev Med*. 2014;47(6):803–7.
52. Ekelund U, Luan J, Sherar LB, Esliger DW, Griew P, Cooper A, International Children's Accelerometry Database (ICAD) Collaborators. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *JAMA*. 2012;307(7):704–12.
53. Hildebrand M, Kelle E, Hansen BH, Collings PJ, Wijndaele K, Kordas K, et al. Association between birth weight and objectively measured sedentary time is mediated by central adiposity: data in 10,793 youth from the International Children's Accelerometry Database. *Am J Clin Nutr*. 2015;101(5):983–90.
54. Hense S, Barba G, Pohlabein H, De Henauw S, Marild S, Molnar D, et al. Factors that influence weekday sleep duration in European children. *Sleep*. 2011;34(5):633–9.
55. Hunsberger M, Formisano A, Reisch LA, Bammann K, Moreno L, De Henauw S, et al. Overweight in singletons compared to children with siblings: the IDEFICS study. *Nutr Diabetes*. 2012;2:e35.
56. Kovács E, Hunsberger M, Reisch L, Gwozdz W, Eiben G, De Bourdeaudhuij I, et al. Adherence to combined lifestyle factors and their contribution to obesity in the IDEFICS study. *Obes Rev*. 2015;16(2):138–50.
57. Mitchell EA, Beasley R, Björkstén B, Crane J, García-Marcos L, Keil U, ISAAC Phase Three Study Group. The association between BMI, vigorous physical activity and television viewing and the risk of symptoms of asthma, rhinoconjunctivitis and eczema in children and adolescents: ISAAC Phase Three. *Clin Exp Allergy*. 2013;43(1):73–84.
58. Katzmarzyk PT, Barreira TV, Broyles ST, Champagne CM, Chaput JP, Fogelholm M, et al. Physical Activity, sedentary time, and obesity in an international sample of children. *Med Sci Sports Exerc*. 2015;47(10):2062–9.



59. LeBlanc AG, Katzmarzyk PT, Barreira TV, Broyles ST, Chaput JP, Church TS, et al. Correlates of total sedentary time and screen time in 9-11 year-old children around the world: The International Study of Childhood Obesity, Lifestyle and the Environment. *PLoS One*. 2015;10(6):e0129622.
60. Klepp KI, Wind M, de Bourdeaudhuij I, Rodrigo CP, Due P, Bjelland M, Brug J. Television viewing and exposure to food-related commercials among European school children, associations with fruit and vegetable intake: a cross sectional study. *Int J Behav Nutr Phys Act*. 2007;4:46.
61. te Velde SJ, De Bourdeaudhuij I, Thorsdottir I, Rasmussen M, Hagströmer M, Klepp KI, Brug J. Patterns in sedentary and exercise behaviors and associations with overweight in 9-14-year-old boys and girls—a cross-sectional study. *BMC Public Health*. 2007;7:16.
62. De Craemer M, Lateva M, Iotova V, De Decker E, Verloigne M, De Bourdeaudhuij I, et al. Differences in energy balance-related behaviours in European preschool children: the ToyBox-study. *PLoS One*. 2015;10(3):e0118303.
63. van Stralen MM, te Velde SJ, van Nassau F, Brug J, Grammatikaki E, Maes L, et al. Weight status of European preschool children and associations with family demographics and energy balance-related behaviours: a pooled analysis of six European studies. *Obes Rev*. 2012;13(1):29–41.
64. Owen N, Healy GN, Matthews CE, Dunstan DW. Too much sitting: the population health science of sedentary behavior. *Exerc Sport Sci Rev*. 2010;38(3):105–13.
65. Lee IM, Shiroma EJ. Using accelerometers to measure physical activity in large-scale epidemiological studies: issues and challenges. *Br J Sports Med*. 2014;48(3):197–201.
66. Fischer C, Yildirim M, Salmon J, Chinapaw M. Comparing different accelerometer cut-points for sedentary time in children. *Pediatr Exerc Sci*. 2012;24(2):220–8.
67. Ridgers ND, Salmon J, Ridley K, O'Connell E, Arundell L, Timperio A. Agreement between activPAL and ActiGraph for assessing children's sedentary time. *Int J Behav Nutr Phys Act*. 2012;9:15.
68. Stierlin AS, De Lepeleere S, Cardon G, Dargent-Molina P, Hoffmann B, Murphy MH, et al. A systematic review of determinants of sedentary behaviour in youth: a DEDIPAC-study. *Int J Behav Nutr Phys Act*. 2015;12:133.
69. Moreno LA, González-Gross M, Kersting M, Molnár D, de Henauw S, Beghin L, et al. Assessing, understanding and modifying nutritional status, eating habits and physical activity in European adolescents: the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) Study. *Public Health Nutr*. 2008;11(3):288–99.
70. Sherar LB, Griew P, Esliger DW, Cooper AR, Ekelund U, Judge K, Riddoch C. International children's accelerometry database (ICAD): Design and methods. *BMC Public Health*. 2011;11:485.

Submit your next manuscript to BioMed Central and we will help you at every step:

- We accept pre-submission inquiries
- Our selector tool helps you to find the most relevant journal
- We provide round the clock customer support
- Convenient online submission
- Thorough peer review
- Inclusion in PubMed and all major indexing services
- Maximum visibility for your research

Submit your manuscript at  
[www.biomedcentral.com/submit](http://www.biomedcentral.com/submit)

