No changes in adolescent's sedentary behaviour across Europe between 2002 and 2017

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Abstract

Background: Health organizations have been alerted to the high levels of sedentary behaviour (SB) among adolescents as well as to the health and social consequences of excess sedentary time. However, SB changes of European Union (EU) adolescents over time are yet to be reported. This study aimed to identify SB changes the EU adolescents (15-17 years) between 2002 and 2017, and to analyse the prevalence of SB according to the gender.

Methods: SB of 2542 adolescents (1335 boys and 1207 girls) as a whole sample and country-by-country was analysed in 2002, 2005, 2013, and 2017 using the Sport and Physical Activity EU Special Eurobarometers' data. SB was measured using the sitting time question from the short version of the International Physical Activity Questionnaire (IPAQ), such that 4h30min of daily sitting time was the delineating point to determine excess SB behaviour (≥4h30min of sitting time) or not (≤4h30min of sitting time). A χ² test was used to compare the prevalence of SB between survey years. Furthermore, SB prevalence between genders was analysed using a Z-Score test for two population proportions.

Results: The prevalence of SB among EU adolescents across each of the four survey years ranged from 74.2% and 76.8%, rates that are considered high. High levels of SB were also displayed by both genders (girls: 76.8% to 81.2%; boys: 71.7% to 76.7%). No significant differences in the prevalence of SB among years (p>0.05) were found for the whole sample, girls, or boys. Also, no significant differences in the prevalence of SB between girls and boys were found.

Conclusion: The SB prevalence in adolescents is extremely high (76.8% in 2017) but remained steady from 2002-2017, and European girls and boys reported similar prevalence of SB across the same time frame.

Background

Sedentary behaviour (SB) represents those behaviours performed in sitting or lying position with a low level of energy expenditure (≤1.5 METs) [1]. In adolescents, these behaviours represent between 60 -70% of daily time spent awake [2-4]. SB has become one of the main risk factors for weight and adiposity weight [5-7], psychological health problems (e.g., anxiety, depression, aggression, attention problems) [8, 9], and is also seen as increasing the vulnerability to suicide in adolescents [10]. Furthermore, evidence concludes that SB adopted during adolescence will be maintained into adulthood [11] and it is therefore a strong predictor of cardiovascular diseases during later in life [12, 13].

Although there is no sufficient evidence for SB’s determinants in young people [14], adolescents spend prolonged periods of their awake time sitting in controlled, required, environments such as schools [15, 16], which thereby hinders the possibility of limiting SB time. Alongside this, the electronic revolution has transformed people's movement patterns, significantly increasing the amount of daily time in front of the screen (e.g., televisions, computers) [17, 18], and by gender, girls usually report slightly higher prevalence of SB than boys [3]. Furthermore, there seem to be gender differences in how SB is accumulated, with boys reporting more screen time (televisions or computer games) and girls spending more time in communication-based SB (surfing the internet, texting, talking on the phone) [17, 18]. For those reasons, concerns among parents, health care professionals, governments, educators, and researchers about SB's effects on young people's health have increased.

Despite this, to our knowledge, there is not a European guideline or policy about SB in adolescents. Moreover, the existing SB guidelines published by the World Health Organization are for children under 5 years old [19]. It was not until 2011 when the first national SB guideline for children and adolescents was published, in Canada [20], providing an important and timely recommendation for advancing of SB public health agenda. Regarding the EU, despite the recommendations to reduce SB in school-age children from the EU Physical Activity Guidelines in 2008 [21], only a few countries (e.g., Germany, France, Spain, or United Kingdom) have included some actions since then to reduce SB in their national guidelines [22-24]. However, none of these guidelines have included gender-related recommendations [25]. Furthermore, most of the reports about PA from the EU countries, which include an evaluation of the SB indicators about the compliance of the no more of 2-hours screen time recommendations, show poor compliance with the existing guidelines [26]. Therefore, organizations and governments should place a greater emphasis on reducing SB during adolescence [27] through establishment of guidelines and policies with specific goals and key performance indicators, and this should be done with consideration to gender-based differences in SB [11, 28].

Based on this, it is relevant to monitor the trends in adolescent SB across the EU in the last 15 years. This is especially important since the WHO's Global Action Plans emphasises the need to implement effective and coordinated actions aiming to reduce SB for both adults and children [29, 30]. However, the lack of studies monitoring the prevalence of SB prevents the establishment of a baseline, and therefore
determining long-term objectives and success [29, 30]. The Special Eurobarometer, in which the International Questionnaire of Physical Activity (IPAQ) is administered, might be a good opportunity to identifying this baseline point in the EU and for analysing the effect of future policy development on SB in middle and long term. In fact, the IPAQ questionnaire asks about daily sitting time, which has proved to be useful for analysing the prevalence of SB in European adults and for evaluating over different time periods [31, 32].

This study aimed to analyse the SB prevalence in EU adolescents (15-17 years) between 2002 and 2017, considering data from the four separate Sport and Physical Activity Eurobarometer's data. A secondary objective of this research was to compare the prevalence of SB according to the gender.

**Methods**

**Data source**

All methods were carried out in accordance with relevant guidelines and regulations. The European Commission conducts public opinion surveys simultaneously on all EU state members to identify the levels of PA, sports participation, and SB among its citizens. These surveys were conducted in 2002, 2005, 2013, and 2017 through the Sport and Physical Activity and Health and Food Special Eurobarometer’s.

For the purposes of this study, data from adolescents (15-17 years old) were obtained from four successive Eurobarometer surveys, December 2002 (Special Eurobarometer 183.6; n = 543), December 2005 (Special Eurobarometer 246; n = 929), December 2013 (Special Eurobarometer 412; n = 592), and December 2017 (Special Eurobarometer 472; n = 478), with a final sample of 2542 adolescents (1207 girls and 1335 boys) from the 28 European Union member countries (Austria, Belgium, Bulgaria, Czech Republic, Croatia, Cyprus Republic, Denmark, Estonia, Finland, France, Germany [combined West and East Deutschland], Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden). Data from Northern Cyprus and Turkey were not analysed because they do not belong to the EU member countries. Northern Ireland was also not considered due to its unique characteristics.

**Measures**

The IPAQ is a valid and reliable questionnaire to obtain data on SB [33]. The IPAQ short form records PA at three intensity levels along with the total sitting time on an average day (i.e., How much time do you spend sitting on a usual day? This may include time spent at a desk, visiting friends, studying, or watching television?). In the 2002 and 2005 surveys, participants were asked to estimate their usual weekday sitting time using an open-ended response scale. On the contrary, for the 2013 and 2017 surveys, participants were given a choice of 11 categorical response options ranging from ‘≤ 60 mins’ to ‘>8h30mins’.

For this study, surpassing the cut-off point of 4 h and 30 min of sitting time was considered as SB. This value was based on the cut-off point for increased risk of cardiovascular diseases [34, 35]. Individuals answering “don’t know” on the sitting question were removed from the analysis.

**Statistical analysis**

Descriptive statistics presented as a proportion (%) with the 95% confidence interval (95% CI) were calculated for the SB dichotomic variable. The χ² test was implemented for studying the association between sedentary lifestyle (SB and non-SB) with the studied years (2002, 2005, 2013, and 2017). Due to the number of EU countries increasing from 15 to 28 in 2004, two analysis were performed. The first analysis compared outcomes from 2002 to 2017 considering data from all countries participating in each Special Eurobarometer. The second analysis also compared the outcomes from 2002 to 2017 but only considering the data from the first 15 countries [31]. The differences by gender in SB for each studied year were analysed using a Z-Score for two population proportions. A priori alpha level was set at 0.05. Z-score analyses were performed with Microsoft Excel version 1709 (Microsoft Corporation; Redmond, Washington, United States of America). The remaining analyses were performed using the Statistical Package for Social Sciences (version 22.0, SPSS Inc., Chicago, IL, USA).

**Results**

Table 1 displayed the descriptive outcomes for non-SB and SB among the studied years for each of the analysed countries. The rates of SB across the four survey years were high as they ranged from 74.2% and 76.8%. High levels of SB across these four years were also displayed by both genders (girls: 76.8% to 81.2%; boys: 71.7% to 76.7%).

Page 3/10
Table 1. Prevalence (%) of sedentary behaviour (SB) in adolescents (15-17 years old) in the European Union (EU) countries between 2002 and 2017.
| Countries      | EU total | 2002 | SB (%) | 95% CI | EU boys | 2005 | SB (%) | 95% CI | EU girls | 2013 | SB (%) | 95% CI | EU girls | 2017 | SB (%) | 95% CI | 2002-2017 | χ²   | p-value |
|----------------|----------|------|--------|--------|---------|------|--------|--------|----------|------|--------|--------|----------|------|--------|--------|-----------|------|---------|
|                |          |      |        |        |         |      |        |        |          |      |        |        |          |      |        |        |           |      |         |
| Austria        |          | 42   | 66.7   | 52.4-81.0 | 21     | 66.7 | 47.6-85.7 | 90    | 76.9    | 53.8-100 | 9     | 88.9   | 66.7-100 | 2,170   | 538     |
| Belgium        | 40       | 85.0 | 72.5-95.0 | 36     | 88.9  | 77.8-97.2 | 13    | 68.4    | 47.4-89.5 | 20    | 80.0   | 60.0-95.0 | 2,004   | 367     |
| Bulgaria       |          | 44   | 84.1   | 72.7-93.2 | 44     | 71.0 | 54.8-87.1 | 19    | 80.0    | 50.0-100 | 13    | 92.3   | 76.9-100 | 2,448   | 294     |
| Croatia        | 31       | 71.0 | 54.8-87.1 | 31     | 71.0  | 54.8-87.1 | 10    | 80.0    | 50.0-100 | 15    | 60.0   | 33.3-86.7 | 5,205   | 0.074   |
| Cyprus Republic| 28       | 89.3 | 78.6-100 | 16     | 81.3  | 62.5-100 | 16    | 85.7    | 65.0-100 | 12    | 83.3   | 58.3-100 | 0,147   | 0.929   |
| Czech Republic | 32       | 87.5 | 75.0-96.9 | 20     | 85.0  | 65.0-100 | 18    | 88.9    | 72.2-100 | 15    | 93.3   | 80.0-100 | 3,225   | 0.358   |
| Denmark        |          | 17   | 100    | 100-100 | 17     | 100  | 100-100 | 18    | 88.9    | 72.2-100 | 15    | 93.3   | 80.0-100 | 3,225   | 0.358   |
| Estonia        | 44       | 95.5 | 88.6-100 | 19     | 84.2  | 63.2-100 | 19    | 63.2    | 42.1-84.2 | 11,106| 0.004 |
| Finland        | 46       | 84.8 | 73.9-95.7 | 34     | 85.3  | 73.5-97.0 | 16    | 87.5    | 68.8-100 | 16    | 75.0   | 50.2-93.8 | 1,169   | 0.760   |
| France         | 25       | 64.0 | 44.0-88.0 | 26     | 88.5  | 73.1-100 | 20    | 100     | 100-100 | 24    | 70.8   | 54.2-87.5 | 11,424  | 0.010   |
| Germany        | 46       | 76.1 | 63.0-87.0 | 43     | 88.4  | 76.8-97.7 | 34    | 76.5    | 61.8-91.2 | 15    | 86.7   | 66.7-100 | 3,023   | 0.388   |
| Great Britain  | 26       | 57.7 | 38.5-76.9 | 24     | 58.3  | 41.7-75.0 | 27    | 55.6    | 37.0-74.1 | 18    | 72.2   | 50.0-88.9 | 1,428   | 0.699   |
| Greece         | 34       | 76.5 | 61.8-91.2 | 21     | 90.5  | 76.2-100 | 32    | 68.8    | 53.1-83.1 | 31    | 77.4   | 61.3-90.3 | 3,403   | 0.334   |
| Hungary        | 25       | 84.0 | 68.0-96.0 | 15     | 93.3  | 80.0-100 | 5     | 60.0    | 20.0-100 | 3     | 3176.9 | 3,403   | 0.334   |
| Italy          | 32       | 90.6 | 81.3-100 | 30     | 66.7  | 46.7-83.3 | 10    | 60.0    | 30.0-90.0 | 3     | 33.3   | 27.2-100 | 9,170   | 0.027   |
| Ireland        | 57       | 73.7 | 61.4-84.2 | 29     | 75.9  | 58.6-89.7 | 28    | 67.9    | 50.0-85.7 | 19    | 78.9   | 63.2-94.7 | 0,833   | 0.842   |
| Latvia         | 37       | 76.1 | 65.7-86.6 | 32     | 81.3  | 68.8-93.8 | 29    | 72.4    | 55.2-86.2 | 1,677 | 0.713 |
| Lithuania      | 48       | 72.9 | 60.4-85.4 | 43     | 81.4  | 69.8-93.0 | 15    | 80.0    | 60.0-100 | 1,001 | 0.606 |
| Luxembourg     | 21       | 95.2 | 85.7-100 | 29     | 93.1  | 82.8-100 | 20    | 100     | 100-100 | 19    | 89.5   | 73.7-100 | 2,172   | 0.537   |
| Malta          | 15       | 86.7 | 66.7-100 | 4      | 100   | 100-100 | 8     | 100     | 100-100 | 8     | 100   | 100-100 | 1,728   | 0.421   |
| Poland         | 50       | 84.0 | 72.1-94.0 | 13     | 69.2  | 38.5-92.3 | 15    | 80.0    | 60.0-100 | 1,456 | 0.483 |
| Portugal       | 53       | 43.4 | 30.2-56.6 | 32     | 40.6  | 25.0-59.4 | 16    | 50.0    | 25.0-75.0 | 20    | 45.0   | 25.0-69.9 | 0,396   | 0.941   |
| Romania        | 40       | 42.5 | 27.5-57.5 | 23     | 47.8  | 30.4-69.6 | 31    | 71.0    | 54.8-87.1 | 6,037 | 0.049 |
| Slovakia       | 15       | 66.7 | 46.7-86.7 | 20     | 95.0  | 85.0-100 | 3     | 100     | 100-100 | 5,786 | 0.055 |
| Slovenia       | 45       | 88.9 | 80.0-97.8 | 17     | 76.5  | 52.9-94.1 | 26    | 84.6    | 69.2-96.2 | 1,522 | 0.467 |
This study examined the data from the existing Eurobarometer reports in order to analyse how the SB prevalence in European adolescents has changed over 15 years (2002-2017) and if differences between girls and boys existed. The main findings were that (a) although EU adolescents show high levels of SB, the prevalence of SB between 2005 and 2017 remains similar (74.2% to 76.8%; p > 0.05) with no significant differences over time for girls or boys; (b) girls and boys show similar prevalence of SB in all studied years.

Previous research has assessed the prevalence of adult SB across European populations based on 2002, 2005, 2013 and 2017 Eurobarometer data [31, 32, 36] but, to the best of our knowledge, this is the first study focused on adolescents. The Global Matrix project can be used to identify the percentage of European adolescents exceeding the 2-h of recreational screen time per day [26]. However, the total daily SB performed by European adolescents was still missing, and this research provides an initial approach to mend this gap. A high proportion of European adolescents, 76.8% in 2017, reported sitting times in excess of 4h30min, which is the threshold for SB. These rates of SB are higher than what has been reported for adults from the Eurobarometer data sets [31]. Unlike adults, however, this study did not reveal significant differences by gender in the prevalence of SB [31].

Although compulsory school usually ends at the age of 16 in European countries, school attendance may still account for the high percentage of SB in adolescents, as many still attend high-school or other educational centres through the age of 18. Thus, although some exceptions might exist (physical education classes, laboratory work, fieldwork, some technology or art classes, etc.), adolescents at school tend to accumulate more than 5 h of SB just during a typical school day [37]. This may also at least partly explain the lack of differences across the years, the lack of difference between genders, and the higher prevalence of SB of adolescents compared to adults. After-school activities may also play a significant role in the total sitting time accrued, as adolescents spend an average of 59% of their after-school time in sedentary activities (from 27.7% to 88.9%) and screen-related activities usually represent the main sedentary activity [38]. Thus, in order to develop and analyse the impact of future policies and interventions addressing SB in adolescents, it is not only important to monitor daily sitting time, but to also consider the environment (i.e. educative centre or out the educative centre) and the activity itself (e.g. screen-related activity; educational-related; social-related activity; etc.).

Regarding gender differences, most existing studies with adolescents suggest that girls accrue higher average sitting time than boys [37, 39-41]. The findings from our study are not in line with this, as no gender differences were seen in any of the study years. The lack of differences may be due to SB being self-reported, as opposed to more objective data such as from an accelerometer [32, 36]. Another possible explanation of the lack of gender differences might be the low sample size in the Special Eurobarometers as previous studies reported that girls and boys engage differently in sedentary activities, with boys reporting more TV or computer games, and girls reporting more time in communication or social media activities [17, 18]. Thus, further studies are needed to verify or reject the findings reported in our study.

To the best of the authors’ knowledge, only seven of the 28 EU countries (Austria, Belgium, Finland, France, Germany, Spain and The UK) included some kind of reference for sedentariness for children and youth in their national guidelines before publication of the latest Eurobarometer report (2017) [22-24, 42-46]. This is in contrast to the EU Working Group “Sport and Health” recommendations in 2008 to reduce SB in school-age children [21]. Moreover, the existing reports about PA from the EU countries show a high percentage of...
adolescents exceeding 2-hours of screen-based entertainment per day [26], but do not monitor the daily sitting time of this same population. Since 2017, more European countries have developed or updated national guidelines related to SB in adolescents (Greece, Dutch, Latvia or the UK [47-50]). Nonetheless, other than recommendations like exist in France (“children between 6-17 years old should not accumulate sitting bouts for > 2-h long”) [43], most other existing guidelines only mention SB under a qualitative perspective [42, 44-48], with quantitative recommendations mainly focused on screen-related activities.

Limitation and strengths

This study has some limitations to be acknowledged: (a) Less than 600 adolescents were reported in three of the four Eurobarometer reports, so findings should be analysed carefully; in this regard, existing Special Eurobarometers do not allow benchmarking comparisons among countries due to the low sample size (sample size per country varies between 13 to 58) [31, 32], while no data are available for adolescents under 15 years; (b) SB was measured by a single self-reported question from the IPAQ, which is likely to underestimate the sitting time of adolescents [51]. However, as suggested with older adults, the use of the IPAQ Short form in this study should be valid as we compare groups within and between years instead of on individual basis [52]; (c) it is important to note that the sitting question of the IPAQ short version from 2002 to 2005 was an open solution of the total sitting time in a weekday, whilst, from the 2013 onwards the possible answers were closed to several categorical response options [53]. Finally, the existing reports do not distinguish between SB pattern or where they occur (at the educative centre or out the educative centre). Thus, future Eurobarometer surveys might consider making an extra effort to 1) get enough representativity to allow both benchmark comparisons among European countries and strength the comparison analysis between girls and boys; 2) target other children population (i.e. pubertal, prepuberal or young children); 3) monitor the engagement on the most common sedentary activities for each under 18 years old group and be able to collect SB patterns; 4) monitor the sitting behaviour either at or out the educative centre.

Despite these limitations, it is important to consider that it is the first work to assess the prevalence trend of SB in adolescents among the European Union countries and provides an initial approach to the studied research question. It is expected that this initial approach provides a significant insight for European researchers, guideline developers, and policy makers in developing new strategies to address SB among European adolescents. Finally, this work has identified some limitations in Eurobarometer reports that might be relevant to be addressed in future reports (e.g. low sample size or only adolescents are being monitored).

Conclusions

European adolescents show worrying levels of SB (regardless of their gender) and no improvements have been achieved between 2002 to 2017. Likewise, girls and boys have similar values of SB.

Abbreviations

CI: Confidence interval
EU: European Union
UK: United Kingdom
IPAQ: International Physical Activity Questionnaire
PA: Physical activity
SB: Sedentary behaviour
WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable because the raw data used in this study has been published by the European Commission and it is public access.

Consent for publication
Not applicable because the raw data used in this study has been published by the European Commission and it is public access.

Availability of data and materials

The raw data is owned by the European Commission and available online (Special Eurobarometer 183–6, December 2002: https://dbk.gesis.org/dbksearch/sdesc2.asp?no=3886&search=58.2&search2=&field=all&field2=all&DB=e&tab=0&notabs=&nf=1&af=&ll=10. Special Eurobarometer 246, December 2005: https://dbk.gesis.org/dbksearch/sdesc2.asp?no=4415&search=64.3&search2=&field=all&field2=&DB=e&tab=0&notabs=&nf=1&af=&ll=10. Special Eurobarometer 412, March 2014: https://dbk.gesis.org/dbksearch/sdesc2.asp?no=5877&search=Physical%20fitness%20and%20exercise&search2=&field=all&field2=&DB=e&tab=0&notabs=&nf=1&af=&ll=10. Special Eurobarometer 472, March 2018: https://dbk.gesis.org/dbksearch/sdesc2.asp?no=6939&search=Physical%20fitness%20and%20exercise&search2=&field=all&field2=&DB=e&tab=0&notabs=&nf=1&af=&ll=10).

Completing interest

Authors report no competing interest to disclose.

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Authors’ contribution

J.L-F., A.L-V., X.M. and A.J. conceived and designed the study. J.L-F. and A.L-V. analysed the data. J.L-F., A.L-V., X.M. and A.J. interpreted the data. J.L-F., A.L-V., X.M., G.L., M.A.L., R.J.C. and A.J. drafted the manuscript. J.L-F., A.L-V., X.M., G.L., M.A.L., R.J.C. and A.J. critically revised the manuscript and approved the final version of the manuscript.

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