INTRODUCTION

Research amongst children and adolescents shows numerous health benefits of physical activity1, and negative health consequences of sedentary behaviour, especially screen time2. Children and adolescents are generally recommended to engage in at least 60 min per day of moderate to vigorous physical activity3 of which most adolescents do not reach4. In terms of sedentary behaviour, no more than two hours of recreational screen time has been proposed as a cut-off amongst children and adolescents5.

Measuring physical activity and sedentary behaviour is important as it can offer valuable information on which groups to focus on during interventions. Sweden presented their first and second version of the Swedish Report Card on Physical Activity for Children

Abstract

Aim: The aim of this study was to investigate self-reported physical activity and sedentary behaviour by sex, age and parental education in a large representative sample of Swedish adolescents.

Methods: This study is based on data from the national dietary survey Riksmaten Adolescents, which was conducted by the Swedish Food Agency in 2016–2017. In total, 3477 students from grade five (11–12 years), eight (14–15 years) and eleven (17–18 years) were included. A web questionnaire was used to collect information about physical activity and sedentary behaviour.

Results: In total, 53% reported active transport to and from school, 93% that they usually participate in the physical education, 76% reported a physically active leisure time, and 66% reported that they participated in organised physical activities. In addition, 12% and 6% reported to two hours or less of screen time on weekdays and weekends, respectively. Participation in physical activity was generally lower amongst girls, older adolescents and for those from families with low-parental education.

Conclusion: This study provide reference values for self-reported physical activities and sedentary behaviours amongst adolescents in Sweden. Strategies to increase physical activity and reduce screen time are needed, particularly amongst girls, older adolescents and amongst those with low-parental education.

KEYWORDS
adolescent health, exercise, socioeconomic
and Youth in 2016 and 2018, respectively. It was concluded that there was lack of population-based, representative studies on objectively measured physical activity and sedentary time. In response to this, we recently published objective data from a nationally representative sample of adolescents to investigate physical activity and sedentary time amongst adolescents aged 11–12, 14–15 and 17–18 years. The study showed that 43% and 23% of boys and girls reached the physical activity recommendation, respectively. The study further showed that girls were less physically active and more sedentary compared to boys, that older adolescents were less physically active than younger, and that girls from families with low parental education were less physically active compared to those from families with high parental education.

During a typical day, children and adolescents can engage in physical activity and sedentary behaviour in different domains, such as active transportation, school and leisure time. There is evidence to suggest that children and adolescents who engage in active transport, such as walking and cycling to and from school, accumulate more daily physical activity. During the school day, children and adolescents can also engage in physical activity during physical education, and during leisure time, they might participate in organised physical activities, which might be associated with more physical activity. In relation with this, studies show that children and adolescents are more physically active during weekdays compared to weekend days. In terms of screen time, older adolescents engage in more screen time compared to their younger peers.

Objective physical activity measurements cannot provide information on active transport to and from school, participation in physical education and participation in organised physical activity. This study complement the previous study that provided reference values for objectively measured physical activity and sedentary time amongst adolescent boys and girls in these different age groups. Coupled with the reference values for self-reported physical activity and sedentary behaviours across different domains, as provided in this study, these studies constitute an important knowledge base, and offer valuable information on which groups to focus on during future interventions to promote physical activity amongst adolescents. From an international perspective, the results of the study can also be used to make cross-country comparisons of self-reported physical activity and sedentary behaviours across different domains.

The aim of this study was to investigate self-reported physical activity and sedentary behaviour by sex, age and parental education in a large representative sample of Swedish adolescents.

2 | METHODS

This study was based on data from the national dietary survey Riksmaten Adolescents that was conducted by the Swedish Food Agency in 2016–2017. Schools were selected by Statistics Sweden based on type of municipality, school organisation, that is, public or independent, and geographical location from which students in grade five, eight and eleven were recruited, corresponding to the age groups 11–12, 14–15 and 17–18 years, respectively. Approximately 200 schools from each grade level, 619 schools in total, were invited, and 131 schools agreed to take part in the study. At each school, one or two classes were selected, and all 5145 students from these classes were invited to participate. Exclusion criteria was not being able to read and write Swedish. A total of 3477 students agreed to take part in the study. Drop-out analysis showed that the participating schools and students were considered representative for the population concerning type of municipality, school organisation, and socio-economic background. A detailed overview of Riksmaten Adolescents study design, methods and participation is available elsewhere.

The Riksmaten Adolescents was approved by the Regional Ethical Review Board in Uppsala (No. 2015/190). Information letters were distributed to all students and their parents prior to data collection. As approved by the ethics committee, an opt out consent was used. However, amongst those younger than 16 years who provided biological samples, written consent was retrieved from all participants and both parents. All students could also opt out at any stage of the survey without providing any reason.

2.1 | Data collection

Trained staff from the Swedish Food Agency informed the students about the study, introduced the web questionnaires, and measured body height and weight during school hours.

A web questionnaire was used to collect information about the mode of transportation to and from school, participation in physical education, leisure time activities and participation in organised physical activities. The questionnaire also covered sedentary behaviours in form of screen time. The participants were required to have access to a computer, tablet or smartphone with an internet connection to complete the questionnaires.

The participants were asked about their usual transportation mode to and from school. This question was answered using the categories walk, cycle, bus or train, car and other alternative. The answers were dichotomised into active transportation, such as walking...
and cycling, and passive transportation, such as bus, train and car. The 48 participants who responded other was excluded from the analyses.

The participants were asked if they actively participate in the physical education. This question was answered using the categories almost always, every other session, about once a month, less than once a month, never and do not have physical education at school. The answers participate in physical education almost always and every other session were combined into usually participate in physical education and dichotomised into the categories yes and no. The 215 participants that did not have physical education were excluded from these analyses.

Information on leisure time activities was assessed by asking the participants statement that most correctly describes their leisure time activities during the last seven days. This question had the following response alternatives (1) participating in vigorous exercise or sports competition continuously and several times, (2) participating in sports such as soccer, swimming or active games for at least four hours, (3) walking, cycling or other light activities such as games, skateboarding or rollerblading for at least four hours and (4) reading, watching TV, or other sedentary activities. The first three alternatives were combined into physically active leisure time, whereas the fourth alternative was categorised as sedentary leisure time.

The participants were asked if they were active in any organisation or club such as soccer, swimming, dance and scouts with the response alternatives yes and no. If the participants responded yes, there was a follow-up question where they were asked about what types of activities and in which organisations or clubs they participated with an open response alternative. The frequency of participation in organised physical activities was assessed by asking the participants how many times per week they participate in their activities. This question was answered using the categories once per week, twice per week, three times per week, four times per week and five times or more per week.

Information on the amount of screen time was assessed by asking the participants (1) how many hours per day they sit and watch movies, videos, series or other programmes on a TV, computer, tablet or smartphone during leisure time, (2) how many hours per day they sit and play games on a console, computer, tablet or smartphone during leisure time and (3) how many hours per day they sit and use a computer, tablet or smartphone for Snapchat, Facebook, Instagram or for web surfing during leisure time. The response categories for these questions were not at all, <1 h, one hour, two hours, three hours, four hours, five hours, six hours and seven hours or more. The total time for the three questions was summed up for weekdays and weekends separately and dichotomised into the categories 2 h or less and more than 2 h.

Parental educational was reported in a separate web questionnaire completed by the parents. The highest level of education attained by either parent was used and dichotomised into low-parental education and high-parental education, representing 12 years of schooling or less and more than 12 years of schooling, respectively.

Type of municipality was reported from Statistics Sweden and categorised into one of five groups based on the Swedish municipality classification 2011. The first three groups were (1) metropolitan municipalities, (2) suburbs surrounding metropolitan areas and (3) large cities, surrounding suburbs, and these groups were categorised as urban areas. The two other groups were (1) densely populated municipalities, and (2) other municipalities such as commuter municipalities, tourism and travel industry municipalities, manufacturing municipalities, sparsely populated municipalities and municipalities in sparsely populated regions. These two groups were categorised as rural areas.

The participant reported their country of birth, and the answers were dichotomised into Sweden or outside Sweden.

Body height and weight were measured by standardised methods during school days by trained staff from the Swedish Food Agency. Bodyweight was measured to the nearest 0.1 kg with SECA 862 or 899 digital scales and body height was measured to the nearest 0.1 cm using portable SECA 213 stadiometers. These data were used to calculate body mass index (kg/m²), and weight status was defined according to recommendations by the International Obesity Task Force.

### 2.2 Statistics

All the cross-sectional analyses were performed using IBM SPSS Statistics for Windows, Version 24.0. (IBM Corp. in Armonk) and Statistica, Version 13.2 (Statsoft, Inc.). Descriptive statistics are presented as means, standard deviations and proportions. Chi-square test was used to test for differences between sex, age and parental education. The level of statistical significance was set at $p < 0.05$.

### 3 Results

Table 1 presents the descriptive characteristics of the participants. In total, 3477 participants were included in the study. Of these, 53% were girls, 61% were from families with high-parental education, 68% lived in an urban area, and 88% were born in Sweden. Overall, the prevalence of overweight and obesity was 21%. The results for physical activities and sedentary behaviours are presented in Table 2.

Approximately half of the participants reported active transport to and from school. In the total sample, 51% of the girls and 56% of the boys reported active transport ($p = 0.009$). Differences between girls and boys was also shown amongst those aged 11–12 years: 65% of the girls and 71% of the boys reported active transport ($p = 0.031$). The proportion of those reporting active transportation was lower amongst older participants: 68% amongst those aged 11–12 years, 57% amongst 14–15 years and 32% amongst 17–18 years ($p < 0.001$). Furthermore, there was no difference between those from families with low- and high-parental education in the total sample, and when stratified by age groups (all $p > 0.05$).
<table>
<thead>
<tr>
<th></th>
<th>Total sample</th>
<th>11–12 years</th>
<th>14–15 years</th>
<th>17–18 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (n = 3477)</td>
<td>Boys (n = 1635)</td>
<td>Girls (n = 1842)</td>
<td>Total (n = 3475)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>14.4 (±2.6)</td>
<td>14.5 (±2.6)</td>
<td>14.5 (±2.6)</td>
<td>14.5 (±0.4)</td>
</tr>
<tr>
<td>High-parental education</td>
<td>61</td>
<td>60</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Born in Sweden</td>
<td>88</td>
<td>87</td>
<td>89</td>
<td>90</td>
</tr>
<tr>
<td>Urban areas</td>
<td>68</td>
<td>71</td>
<td>66</td>
<td>71</td>
</tr>
<tr>
<td>Weigh status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight, %</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Normal weight, %</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>70</td>
</tr>
<tr>
<td>Overweight, %</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Obese, %</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

1 Defined as more than 12 years of schooling.
2 Defined as metropolitan municipalities, suburbs surrounding metropolitan areas, and large cities, surrounding suburbs.
3 Defined according to the International Obesity Task Force.
<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Physical activities and sedentary behaviours in the total sample, and stratified by boys and girls, and age groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T otal sample</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Transportation mode to/from school</td>
<td>n = 3398</td>
</tr>
<tr>
<td>Active, %</td>
<td>53</td>
</tr>
<tr>
<td>Passive, %</td>
<td>47</td>
</tr>
<tr>
<td>Physical education (usually participate)</td>
<td>n = 3228</td>
</tr>
<tr>
<td>Yes, %</td>
<td>93</td>
</tr>
<tr>
<td>No, %</td>
<td>7</td>
</tr>
<tr>
<td>Leisure time activities</td>
<td>n = 3433</td>
</tr>
<tr>
<td>Physically active leisure time1, %</td>
<td>76</td>
</tr>
<tr>
<td>Sedentary leisure time2, %</td>
<td>24</td>
</tr>
<tr>
<td>Organised physical activities (active)</td>
<td>n = 3337</td>
</tr>
<tr>
<td>Yes, %</td>
<td>66</td>
</tr>
<tr>
<td>No, %</td>
<td>34</td>
</tr>
<tr>
<td>Frequency of participation</td>
<td>n = 2169</td>
</tr>
<tr>
<td>Five time or more per week, %</td>
<td>21</td>
</tr>
<tr>
<td>Four times per week, %</td>
<td>20</td>
</tr>
<tr>
<td>Three times per week, %</td>
<td>24</td>
</tr>
<tr>
<td>Twice per week, %</td>
<td>21</td>
</tr>
<tr>
<td>Once per week, %</td>
<td>15</td>
</tr>
<tr>
<td>Screen time</td>
<td></td>
</tr>
<tr>
<td>Weekdays</td>
<td>n = 3454</td>
</tr>
<tr>
<td>≤2 h per day, %</td>
<td>12</td>
</tr>
<tr>
<td>&gt;2 h per day, %</td>
<td>88</td>
</tr>
<tr>
<td>Weekend days</td>
<td>n = 3454</td>
</tr>
<tr>
<td>≤2 h per day, %</td>
<td>5</td>
</tr>
<tr>
<td>&gt;2 h per day, %</td>
<td>94</td>
</tr>
</tbody>
</table>

1Walking, cycling, participation in sports or vigorous physical activity.
2Reading, watching TV or other sedentary behaviours.
Nearly, all reported that they usually participate in the physical education with no sex differences in the total sample. However, the proportion of those reporting that they usually participate was lower amongst older participants (p < 0.001). In addition, sex differences were observed when stratified by age group: 93% of the boys and 97% of the girls aged 11–12 (p < 0.001), and 87% of the girls and 93% of the boys aged 17–18 (p = 0.011) reported that they usually participate. Furthermore, 92% of those from families with low and 94% of those with high-parental education (p = 0.008) reported that they usually participate. When the analyses were further stratified by age group, differences between those from families with low- and high-parental education were only shown amongst those aged 17–18 years: 87% for low and 92% for high, respectively (p = 0.03).

In the total sample, 76% reported a physically active leisure time with no sex differences. The proportion of those reporting a physically active leisure time was lower amongst older participants (p < 0.001). There were sex differences when stratified by age groups: 78% of the boys and 83% of the girls aged 11–12 years (p = 0.036), and 66% of the girls and 72% of the boys aged 17–18 years (p = 0.040) reported a physically active leisure time. Furthermore, there was also differences between those from families with low- and high-parental education: 72% versus 79% (p < 0.001), respectively, reported a physically active leisure time. Similar differences were shown in all three age groups (all p < 0.037).

In the total sample, 66% reported that they participated in organised physical activities; 15% participated once per week, 45% two or three times per week and 41% four times or more per week. More girls than boys participated in organised physical activities (p = 0.040), and the proportion of those reporting that they participated was lower amongst older participants (p < 0.001). Sex differences were not shown when stratified by age groups. Furthermore, fewer of those from families with low-parental education participate in organised physical activities: 60% and 71% amongst those from low- and high-parental education, respectively (p < 0.001). Similar results were shown amongst those aged 11–12 years where 73% of those from low and 86% of those from families with high-parental education participate in organised physical activities (p < 0.001). Amongst those aged 14–15 years, 66% of those from low and 75% of those from families with high-parental education participate in organised physical activities (p = 0.002). However, no difference was shown amongst those aged 17–18 years (p = 0.082).

Moreover, 12% and 6% of the total sample reported 2 h or less of screen time on weekdays and weekends, respectively. The proportion of those reported two hours or less of screen time was lower amongst older participants (p < 0.001). There were differences between boys and girls during weekdays, where 10% of the boys and 13% of the girls reported two hours or less of screen time (p = 0.005). Similar results were shown when analysing boys and girls aged 11–12 years: 17% of the boys and 22% of the girls (p = 0.016). No sex difference was shown for screen time during weekends. Furthermore, 10% of those from families with low-parental education reported two hours or less on weekdays compared to 13% amongst those from families with high-parental education (p = 0.021). When age groups stratified the analyses, these differences were also shown amongst those aged 17–18 years (p = 0.025). During the weekend, however, there was no difference between participants from families with high and low-parental education. No differences were shown when age groups stratified the analyses (all, p > 0.05).

4 | DISCUSSION

This study investigated self-reported physical activity and sedentary behaviour by sex, age and parental education in a large representative sample of Swedish adolescents. The main findings show that approximately half of the adolescents reported active transport to and from school, and that nearly all reported that they usually participate in the physical education. The findings also showed that many of the adolescents reported physically active leisure time and that the majority participated in organised physical activities. In terms of screen time, the main findings showed that few reported two hours or less of screen time on weekdays and weekends.

Objective physical activity measurements, such as those collected with accelerometers, cannot provide information on active transport to and from school, participation in physical education and participation in organised physical activity. As a complement to the objective data for physical activity and sedentary time, as previously reported, this study provides reference values for self-reported physical activity and sedentary behaviour amongst adolescents in Sweden. Together, these studies constitute an important knowledge base, and offer valuable information on which groups to focus on during future interventions to promote physical activity amongst adolescents.

There are both similarities and differences when comparing these findings with the latest Swedish Report Card on Physical Activity for Children and Youth. The finding that approximately half of the adolescents reported active transport to and from school is similar to the study cited in the report card. This study showed that 48% and 57% of children and adolescents aged 6–15 year use active transportation during the winter and summer months, respectively. In a large study by the non-profit Swedish organisation Generation Pep, 66% of those aged 10–12 and 45% of those aged 13 years or older reported active transportation, such as walking and cycling. Moreover, the current study showed that 66% reported that they participated in organised physical activities. One previous study from Sweden show that 75% of adolescents aged 11–15 year participate in organised sport twice per week or more.

Another study from Sweden showed that 82% of those aged 10–12 and 69% of those aged 13 years or older reported participating in organised sport or physical activity. In terms of screen time, this study showed that only 12% and 6% of the total sample reported two hours or less of screen time on weekdays and weekends, respectively. Data from the Swedish part of the Health Behaviour in School-aged Children showed that 62% of adolescents aged 11–15 years had <2 h per day of screen time. In addition, data from Generation Pep showed that 50% of those
aged 10–12 and 27% of those aged 13 years or older reported 2 h or less per day of screen time\textsuperscript{17}. It should be stressed; however, that different questions have been used to collect information about these variables, and any similarities and differences should be interpreted with caution.

The findings that few participants reported 2 h or less of screen time is not surprising given that the questionnaire covered different types of screen time, including watching movies, videos, series or other programmes, playing games, social media and web surfing on both TV, computer, tablet or smartphone. Previous data suggest that almost all adolescents in Sweden have their own smartphone and that this relatively new technology is used for various purposes, including watching movies and videos online, and playing games\textsuperscript{19,20}. It should also be noted that research mostly have linked TV-time to negative health consequences\textsuperscript{2}, and less is known about the health consequences of tablet and smartphone use\textsuperscript{21,22}.

There were differences between age groups where participation in physical activities were lower, and screen time higher, amongst older adolescents. These findings are in line with previous studies, which shows that objectively measured physical activity decreases with age\textsuperscript{7}.

Furthermore, there were some sex differences across the different physical activities analysed. For example, the results for participation in physical education showed different sex patterns depending on age groups. Amongst those aged 11–12 years, fewer boys than girls reported that they usually participate. However, the opposite was observed amongst those aged 17–18 years, where fewer girls than boys reported that they usually participate. In this study, the proportion of boys and girls from all age groups who reported that they usually participate was 90%–95%. This is similar compared to one previous study that found that 93% of adolescents aged 14–15 years reported that they often or always participate in physical education\textsuperscript{23}. However, the figures is somewhat higher when compared to a recent study from the Swedish Schools Inspectorate, which suggested that about 80% of adolescents aged 13–15 years regularly participate in physical education\textsuperscript{24}.

A similar sex pattern was observed for physically active leisure time. Fewer boys than girls aged 11–12 years reported physically active leisure time, whereas fewer girls than boys aged 17–18 years reported physically active leisure time. In addition, fewer girls than boys participated in organised physical activities. Organised physical activities, such as sport and exercise during leisure time, has shown to be associated with more objectively measured physical activity and less sedentary time amongst these adolescents\textsuperscript{25}. In addition, that physical activity increases with higher frequency of participation in organised physical activities\textsuperscript{26}. Therefore, interventions to support participation in organised physical activities might be an effective strategy to promote physical activity amongst adolescent girls.

Another important finding was the difference between those from families with low- and high-parental education. Fewer of those from families with low-parental education reported that they usually participate in physical education, have a physically active leisure time, and participate in organised physical activities. In addition, they reported more screen time. These differences between adolescents from families with low- and high-parental education is similar to previous research. Previous reviews have suggested less physical activity\textsuperscript{25} and more screen time\textsuperscript{26} amongst adolescents from low socio-economic groups compared to those from high socio-economic groups. This suggest that interventions should support adolescents from families with low-parental education to participate in physical education, organised physical activities and to reduce screen time.

The results of this study suggest that strategies to increase physical activities and reduce screen time are needed, particularly amongst girls, older adolescents and for those with low-parental education. Although previous physical activity interventions only tend to have small effects\textsuperscript{27}, multi-component interventions seems to be promising\textsuperscript{28}. Some effective strategies might include increasing the number of physical education lessons in school, implementing physical activity into the school curriculum, after-school programmes, promotion of active transport and involvement of peers and parents\textsuperscript{28}. Strategies to reduce screen time might include mutually agreed rules and limits, and parental monitoring of screen time\textsuperscript{29}.

The strength of this study is the large, nationally representative sample of Swedish adolescents from three different age groups. Although it might be associated with recall bias and social desirability\textsuperscript{30}, self-reported data is an important complement to objective measurements physical activity and sedentary behaviour. In addition, information about physical activities in specific domains, such as mode of transportation to and from school and participation in physical education, might be challenging to measure with objective methods.

5 | CONCLUSION

The study showed sex differences for some physical activity variables and less participation in physical activities amongst older adolescents, and amongst those from families with low-parental education. This study provides reference values for self-reported physical activities and sedentary behaviours amongst adolescents in Sweden. Strategies to increase physical activities and reduce screen time are needed, particularly amongst girls, older adolescents and for those with low-parental education.

ACKNOWLEDGMENT

The authors acknowledge the school staff and all students who participated in this study. The authors also thank the staff from the Swedish Food Agency who assisted with the data collection.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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How to cite this article: Fröberg A, Kjellenberg K, Lindroos AK, Nyberg G. Self-reported physical activity and sedentary behaviour amongst adolescents in Sweden vary depending on sex, age and parental education. Acta Paediatr. 2021:00:1–8. https://doi.org/10.1111/apa.16077