

# Prevalence of electronic device use before bed among Australian children and adolescents: a cross-sectional population level study

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In the past decade, screens and electronic devices have become ubiquitous within both schools and the homes of children and adolescents across Australia. Increases in total daily electronic device use (EDU) for children and adolescents has been associated with higher risks of obesity, unhealthy diet, depressive symptoms, lower Health Related Quality of Life (HRQoL) and poor academic performance.<sup>1-3</sup> According to parent reports, the most common screen-based activities for adolescents is engaging with social media, with almost half (46%) using it every day.<sup>4</sup> Other activities that adolescents reportedly engaged in on a daily basis were watching television and videos (40%), doing homework (39%), playing electronic games (33%) and video chat (20%).<sup>4</sup> Over time, research in this field has led to calls for parents to reduce and/or limit children and adolescents' EDU, for example, through recommendations by peak bodies such as the American Academy of Pediatrics.<sup>5</sup> These recommendations have informed the Australian government guidelines regarding children's physical activity, sedentary behaviours and sleep, strongly urging children and adolescents to limit recreational screen time to two hours per day.<sup>6</sup> Despite the evidence and government recommendations, the realities of today's modern society mean screens are, and will continue to be, prolific in the lives of children and young people. Therefore, growing attention has been given to trying to understand the context in which screen

## Abstract

**Objective:** To understand the prevalence of children and adolescents' electronic device use (EDU) in the hour before bed and identify sociodemographic groups that are at increased risk of problematic use.

**Method:** A contemporary population wide sample of South Australian school students aged 8-18 years (n = 70,936) was utilised to present descriptive statistics of EDU before bed across sociodemographic groups. Data was collected from the 2019 Wellbeing and Engagement Collection, an annual self-report census of students' health, wellbeing and school engagement.

**Results:** 90% of children used an electronic device in the hour before bed at least one night a week, with 51% using a device every night. Older adolescent females in grades 10-12 were most frequent users and children from the most socioeconomically disadvantaged communities were also more likely to use electronic devices in the hour before bed.

**Conclusion:** EDU before bed is highly prevalent among Australian children and adolescents and given the negative health and educational impacts, it requires immediate and widespread action from policy makers to ensure the health of Australia's next generation.

**Implications for public health:** The scale of the problem has now been identified; next steps rely on a public health approach to address this issue. This might include awareness raising campaigns and targeted interventions towards at-risk groups.

**Key words:** electronic media, screen time, children, adolescents, wellbeing and engagement collection

use is particularly harmful in order to inform interventions and future recommendations.<sup>7</sup>

One context in which screen use has consistently demonstrated poor outcomes for children and adolescents is EDU before bed. A systematic review and meta-analysis showed that viewing screens prior to bed is associated with later sleep onset, shorter sleep durations, lower quality sleep and increased likelihood of excessive daytime sleepiness.<sup>8</sup> Evidence has also been found

for the association between EDU in the hour before bed and higher weight status,<sup>9</sup> poorer HRQoL,<sup>10</sup> increased BMI and poorer academic performance<sup>11</sup> after controlling for a range of child and family level factors. While the understanding of how EDU before bed influences children's health and education is still emerging, there are some potential mechanisms suggested by previous research. First, exposure to short-wavelength, blue-enriched light common in LED screens can

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delay the circadian clock and suppress the sleep-promoting hormone, melatonin.<sup>12</sup> Second, bright light can increase alertness and therefore delay sleepiness and bedtime.<sup>13</sup> Finally, there is some suggestion that the type of content children watch on their electronic devices may impact sleep, with one study finding an association between children watching violent content and sleep problems.<sup>14</sup>

The negative associations of EDU before bed and health and education outcomes have led to specific Australian government recommendations that state children and adolescents should not use screen-based devices in the hour before bed.<sup>6</sup> Therefore, there is a need to understand current prevalence rates in Australia of children and adolescents' EDU before bed to know whether the current recommendations are being adhered to. Furthermore, better understanding of the sociodemographic profiles of children and young people with problematic screen use is of vital importance for health and education systems to develop more targeted strategies and improve future outcomes.

International evidence from the past decade gives some indication that a high proportion of children and adolescents engage in EDU prior to bed. The American Sleep Foundation's 2011 National Sleep Study ( $n=1,508$ , including all ages) reported 72% of American high school students aged 13–18 years ( $n=171$ ) used an electronic device in the hour before bed in the previous two weeks.<sup>15</sup> In 2013, a study found that 69% of French adolescents ( $n=338$ ;  $M_{age}=12.9$  years) reported using a device in the hour before bed at least three nights a week.<sup>16</sup> The most recent Australian data is from 2014 in a sample of high school students aged 11–17 years ( $n=1,184$ ) where it was shown almost half (46.8%) reported using a mobile phone in bed when they would normally be sleeping, at minimum a few nights a week, with almost 30% doing this every night.<sup>17</sup> Additionally, 70.5% reported having multiple devices in their bedroom before bed; notably, this predated the use of iPads and tablets as this was not included as a device option.<sup>17</sup> Given the increased accessibility to screen-based devices and child and adolescent targeted content since 2014<sup>18</sup> (when this data was last published) it is imperative for policy makers and researchers to have updated population-level prevalence estimates on this issue.

There is also very limited understanding of the sociodemographic characteristics of children and adolescents who are at greatest risk of EDU prior to bed. One study suggests that older children and males were more likely to engage in EDU before bed compared to younger children and females.<sup>19</sup> Increases with age may be due to older children having more electronic devices in the bedroom<sup>20</sup> and gender differences could be due to differences in preferred type of electronic device to use before bed. For instance, some research has indicated males were more likely to use gaming consoles whereas females were more likely to use mobile phones.<sup>21</sup> To date, research on socioeconomic differences in screen use has not focused specifically on EDU before bed. However, evidence indicates adolescents from socioeconomically disadvantaged backgrounds are more likely to spend more time watching screens throughout the day.<sup>22,23</sup> Similarly, there is limited research on EDU among children and adolescents living in rural and regional areas. Findings from the 2007 Australian National Children's Nutrition and Physical Activity Survey found children and adolescents living in cities engaged in more screen usage throughout the day and less physical activity than their regional and remote counterparts.<sup>24</sup> Whether these findings reflect EDU before bed is yet to be determined.

The current understanding of the prevalence of EDU before bed is limited by lack of knowledge on differences across sociodemographic characteristics and previous research becoming quickly outdated due to fast moving advances in electronic devices and screen-based applications. The implications of bedtime EDU for children and adolescents necessitates a better understanding of not only the prevalence across the population but identification of the current sociodemographic patterns across age, gender, socioeconomic status and geographic remoteness in order to help inform a response from health and education systems. The aim of the current research is to understand the epidemiology of child and adolescent EDU in the hour before bed based on a large, contemporary, population-wide South Australian sample. Understanding current prevalence estimates and identifying the population sub-groups among which EDU before bed is most common will support the targeting of future intervention research. Findings, if replicated, will also form a first step toward informing screen

use recommendations for this age group and designing public awareness campaigns to address EDU before bed. In turn, we anticipate that this will benefit child and adolescent health and education outcomes.

## Methods

### Data Sources

The Wellbeing and Engagement Collection (WEC) is an annual census of student wellbeing and engagement with school, with all South Australian schools invited to participate. Information on the WEC has been previously described in detail.<sup>25,26</sup> Briefly, the WEC measures four domains: Emotional Wellbeing, Engagement with School, Learning Readiness, and Health and Wellbeing Out of School, with each domain including multiple constructs.<sup>27</sup> Students are provided time during school hours to complete the survey via an online data collection system, usually taking between 25–45 minutes. The current study includes data collected during the 2019 WEC from government (i.e. public) schools only. Through a unique education identifier, students' WEC data was linked to their South Australian Department for Education enrolment records, which contains information on child-level sociodemographic characteristics. Data from non-government schools could not be included in this analysis as there was no systemic capacity to link students' sociodemographic characteristics held by the schools.

### Participants

Participants included students from South Australian government schools in grade 4–12 (aged 8–18 years) who participated in the 2019 WEC. In total, 88.8% of government schools participated ( $n=453$ ), with 77,322 students from these schools opting to complete the WEC; this represented 67.6% of eligible students. A small number of WEC instruments were deemed invalid ( $n=1,005$ , 1.3%) as students did not complete enough items. Students were excluded from the analysis if they had missing data for the electronic use before bed question ( $n=4,795$ , 6.2%) or sociodemographic characteristics items ( $n=277$ , 0.4%) or were over the age of 18 years ( $n=309$ , 0.4%). As shown in Table 1, the final analysis sample included 70,936 students, which represented 60.4% of the eligible cohort (i.e. the 2019 WEC cohort of students from South Australian government schools aged  $\leq 18$  years,  $n=117,366$ ).

## Measures

### Electronic device use before bed

The use of electronic devices in the hour before bed was measured in the Health and Wellbeing Out of School domain of the WEC. Students were asked "How often, in the hour before you go to bed, do you use an electronic device (for example mobile phone, iPad, tablet, PC, game console, TV, music player)?" with an eight-point scale response option (Never, Once a week, 2 times a week ... 6 times a week, Every day).

### Sociodemographic characteristics

The sociodemographic characteristics included in this study were: gender, school grade, socioeconomic status, and geographical remoteness. Students self-reported their gender and school grade as part of the data collected within the WEC. Gender categories included male, female or other. School grade was categorised into the following groups: 4-5, 6-7, 8-9, and 10-12. The residential postcode (i.e. zip code) for each student was sourced from the Department for Education enrolment records and based on this geographically defined area, community level socioeconomic status and geographical remoteness were assigned. The 2016 Socio-Economic Indexes for Areas Index of Relative Socio-Economic Advantage and Disadvantage (SEIFA IRSAD)<sup>28</sup> provides an area level measure of socioeconomic status. The most socioeconomically disadvantaged areas are represented in Quintile 1, whereas the most socioeconomically advantaged areas are represented in Quintile 5. The 2016 Accessibility and Remoteness Index of Australia (ARIA)<sup>29</sup> was used as an indicator of geographical remoteness. Students were categorised to be living in Major Cities, Inner Regional, Outer Regional, Remote/Very Remote areas of South Australia. Remote and Very Remote were combined in this analysis due to small numbers of students in each.

### Statistical approach

The South Australian Department for Education provided de-identified linked WEC and enrolment census data to the research team for the analysis. To demonstrate average differences in EDU across sociodemographic groups and the variability in the sample, descriptive statistics (Mean, standard deviation (SD), 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentile) were presented for the number of days an electronic device was used in the hour

**Table 1: Sociodemographic characteristics (n, %) of the analysis sample and the eligible cohort.**

	Analysis sample (n = 70,936)	Eligible cohort (n = 117,366)
<b>Gender</b>		
Male	35,649 (50.3)	60,268 (51.4)
Female	34,708 (48.9)	56,465 (48.1)
Other	579 (0.8)	633 (0.5)
<b>Grade</b>		
4-5	19,477 (27.5)	28,976 (24.7)
6-7	19,041 (26.8)	27,287 (23.3)
8-9	15,895 (22.4)	24,450 (20.8)
10-12	16,523 (23.3)	36,653 (31.2)
<b>Socioeconomic status</b>		
Quintile 1 (most disadvantaged)	18,120 (25.5)	34,005 (29.0)
Quintile 2	11,724 (16.5)	19,357 (16.5)
Quintile 3	11,252 (15.9)	18,511 (15.8)
Quintile 4	14,797 (20.9)	22,568 (19.2)
Quintile 5 (most advantaged)	15,043 (21.2)	21,932 (18.7)
Missing	0	993 (0.9)
<b>Geographical remoteness</b>		
Major Cities	49,168 (69.3)	80,101 (68.3)
Inner Regional	10,503 (14.8)	17,068 (14.5)
Outer Regional	8,794 (12.4)	14,782 (12.6)
Remote/Very Remote	2,471 (3.5)	4,439 (3.8)
Missing	0	976 (0.8)

before bed across sociodemographic characteristics. Given previous research has suggested differences between genders and across age groups, descriptive statistics were also explored for Gender x Grade and presented graphically in Figure 1. One-way analysis of variance (ANOVA) was used to test whether mean scores on EDU before bed were significantly different between sociodemographic groups (e.g. males, females, other gender). Analyses and figures were conducted using Stata SE version 16.<sup>30</sup>

### Ethics approval

Ethics approval for this study was granted by the University of Western Australian Human Research Ethics Committee (RA/4/20/6095), and research approval was received from the data custodians, the South Australian Department for Education.

## Results

The sociodemographic characteristics of the analysis sample (N=70,936) were similar to the eligible cohort (N=117,366) (see Table 1). Students' grade level and socioeconomic status were the most noticeable differences. For example, the percentage of students in grades 4-5 was slightly higher in the analysis sample relative to the eligible cohort (27.5% vs 24.7%), while the percentage of students

in grades 10-12 was lower in the analysis sample compared to the eligible cohort (23.3% vs 31.2%). Similarly, the percentage of students living in the most socioeconomically disadvantaged areas made up 25.5% of the analysis sample and 29.0% of the eligible cohort, while the percentage of students living in the most socioeconomically advantaged areas made up 21.2% of the analysis sample and 18.7% of the eligible cohort.

In total 90.0% of students reported using an electronic device before bed at least once per week, with 51.0% of students reporting using an electronic device every day. Only 10.0% of students reported never using an electronic device before bed.

As shown in Table 2, there was very little difference in the average number of days of EDU before bed between males (*mean* 4.95, *SD* 2.55) and females (*mean* 4.88, *SD* 2.58). However, students who reported 'other' gender had a higher average score (*mean* 5.40, *SD* 2.44), compared to males and females. The average number of days of EDU in the hour before bed among grade 10-12 students was higher (*mean* 5.97, *SD* 1.93) than grade 4-5 students (*mean* 3.96, *SD* 2.78). This grade-level gradient was significantly different for males and females, which is presented in Figure 1. The prevalence of EDU before bed among students in the

youngest grades (4-5 and 6-7) was higher among males (*mean* 4.17, *SD* 2.76; *mean* 4.58, *SD* 2.62) compared to females (*mean* 3.73, *SD* 2.77; *mean* 4.47, *SD* 2.63). This pattern reversed in the senior grades (8-9 and 10-12) where females (*mean* 5.57, *SD* 2.17; *mean* 6.02, *SD* 1.89) reported EDU before bed more frequently compared to males (*mean* 5.34, *SD* 2.33; *mean* 5.92, *SD* 1.96).

EDU before bed was also highly prevalent among students living in the most socioeconomically disadvantaged communities. For these students, EDU before bed was reported for an average of 5.21 nights (*SD* 2.52) per week, compared to 4.50 nights (*SD* 2.62) for students living in the most socioeconomically advantaged areas. While differences were less apparent, EDU before bed was slightly more prevalent among students living in outer and inner regional areas (*mean* 5.07, *SD* 2.55 and *mean* 5.01, *SD* 2.54, respectively) compared to students

living in major cities and remote/very remote areas (*mean* 4.87, *SD* 2.57 and *mean* 4.91, *SD* 2.58, respectively). One-way ANOVA results confirmed significant differences in mean EDU before bed based on socio-demographic characteristics (gender, grade, SES and geographic remoteness, see Table 2).

### Discussion

The current study aimed to provide a contemporary understanding of the prevalence of EDU in the hour before bed for children and adolescents, based on a large population-wide South Australian sample. Differences across gender, grade, socioeconomic status and geographical remoteness were also examined to identify groups of students with problematic use. Findings highlight that in 2019, 90% of children and adolescents aged between eight and 18 years used an electronic device in the

hour before bed at least one night a week, with 51% using their devices every night. Overall, the students with the highest average scores of EDU before bed were adolescent females in grades 10–12. When considering the grade-level gradient between males and females, males in the younger grades were more likely to use electronic devices before bed compared to females, however, this pattern reversed in the older grades. There is also a clear socioeconomic gradient, in that EDU before bed was most prevalent for children living in the most socioeconomically disadvantaged communities, compared to children in the most advantaged communities. Small differences were also observed according to geographical remoteness, with children living in outer and inner regional locations reporting higher prevalence of EDU before bed compared to those in major cities or remote/very remote communities.

These findings demonstrate increases in EDU before bed in Australia, compared to the last available data from 2014 which suggested only 46.8% of students aged 11–17 years reported using a mobile phone in bed when they should be sleeping, at least a few nights a week and just under 30% doing this every night.<sup>17</sup> International evidence also suggests higher rates of EDU before bed in the current study compared to previous estimates, with only 69% of French adolescents in 2013 using an electronic device before bed at least three nights per week<sup>16</sup> and 72% of American adolescents in 2011 reporting EDU before bed in the previous two weeks.<sup>15</sup> The fact we see higher prevalence of EDU before bed within more contemporary data is most likely a reflection of the increased ownership and overall use of mobile technology by children and adolescents in the last five years.<sup>18</sup> This highlights the pressing need to address this growing problem.

The current findings also highlight differences across sociodemographic groups that differ from previous reports. While older children remain most likely to frequently use electronic devices before bed, results here show older females report the highest usage, compared to previous reports which suggested males were more likely to use electronic media before bed.<sup>19</sup> Previous research has reported gender differences in device preference, with females preferring to use mobile phones and males preferring gaming consoles.<sup>21</sup> Accordingly, the increases in access to mobile phones for adolescents in

**Table 2: Mean number of days using an electronic device in the hour before bed (Mean, SD) by gender, grade, socioeconomic status, and geographical remoteness (n = 70,936).**

	Mean (SD)	25th Pctile	50th Pctile	75th Pctile	One-way ANOVA
<b>Gender</b>					F (2,70933) = 16.44*
Male	4.95 (2.55)	3	7	7	
Female	4.88 (2.58)	3	7	7	
Other	5.40 (2.44)	4	7	7	
<b>Grade</b>					F (3,70932) = 2433.91*
4-5	3.96 (2.78)	1	4	7	
6-7	4.53 (2.63)	2	5	7	
8-9	5.46 (2.25)	4	7	7	
10-12	5.97 (1.93)	6	7	7	
<b>Gender x Grade</b>					
<i>Male</i>					F (3,35645) = 900.64*
4-5	4.17 (2.76)	1	5	7	
6-7	4.58 (2.62)	2	6	7	
8-9	5.34 (2.33)	4	7	7	
10-12	5.92 (1.96)	5	7	7	
<i>Female</i>					F (3,34704) = 1614.18*
4-5	3.73 (2.77)	1	4	7	
6-7	4.47 (2.63)	2	5	7	
8-9	5.57 (2.17)	4	7	7	
10-12	6.02 (1.89)	6	7	7	
<b>Socioeconomic status</b>					F (4,70931) = 180.37*
Quintile 1	5.21 (2.52)	3	7	7	
Quintile 2	5.06 (2.53)	3	7	7	
Quintile 3	5.00 (2.53)	3	7	7	
Quintile 4	4.80 (2.57)	3	6	7	
Quintile 5	4.50 (2.62)	2	5	7	
<b>Geographical remoteness</b>					F (3,70932) = 21.40*
Major Cities	4.87 (2.57)	3	6	7	
Inner Regional	5.01 (2.54)	3	7	7	
Outer Regional	5.07 (2.55)	3	7	7	
Remote/Very Remote	4.91 (2.58)	3	7	7	

Note:  
\*p < .001

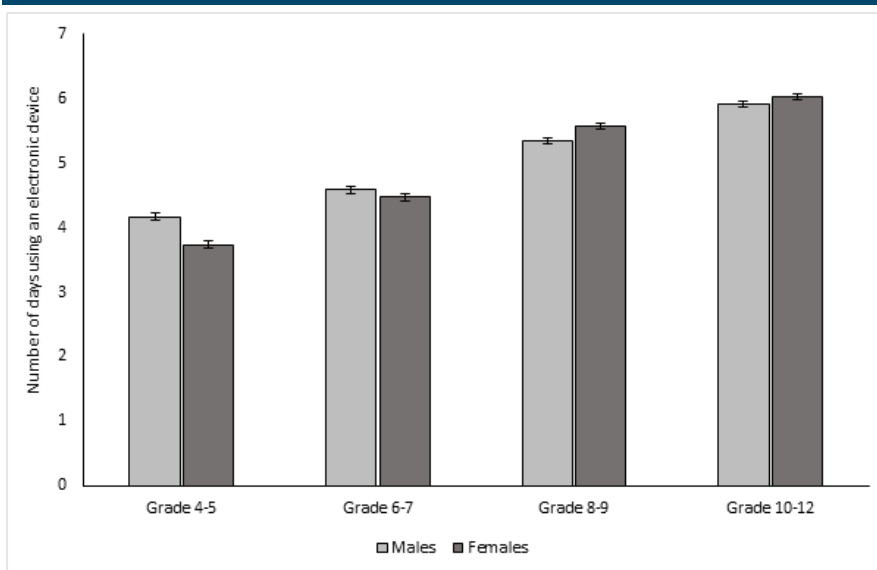


the last five years may be the reason females are now more frequent users of electronic devices before bed.<sup>18</sup>

Increases in availability and advances in mobile technology for children of all ages is of mounting concern to Australian families. This was made evident in a 2019 nationwide survey which reported 66% of adults believed technology was negatively affecting children and 73% believed the same to be true for teenagers.<sup>31</sup> This concern is not unwarranted, with EDU before bed specifically demonstrating negative consequences for both health and education outcomes in children and young people.<sup>8-11</sup> Currently, the Australian government recommends no screens or electronic media in the hour before bed for children and young people.<sup>6</sup> This is reinforced by international peak bodies, such as the American Academy of Paediatrics, who also recommend avoiding screens prior to bed.<sup>5</sup>

While health behaviours such as EDU before bed were once considered out of the remit of education and health systems, the high prevalence of this behaviour requires a public health approach to addressing the problem. Parents alone cannot be expected to lead behaviour change, especially with an increased reliance on screens by the education system. While out of scope within the current study, better understanding of the different reasons for EDU before bed could help inform public awareness campaigns for both students and families along with innovative interventions targeted towards high-risk sociodemographic groups that aim to reduce EDU before bed. The study highlighted that older adolescent females and children from socioeconomically disadvantaged communities are more likely to be using electronic devices before bed, which should help inform these campaigns and interventions. While research in this space remains limited, associations between EDU before bed and sleep disruption, obesity, physical activity and academic performance should be of significant concern to both health and education systems. Accordingly, a comprehensive public health response requires coordination across systems to support the health, wellbeing and achievement of children and young people. Limitations of the current findings are that the data is restricted to government (i.e. public) schools in South Australia, which generally include more socioeconomically disadvantaged children, and therefore may

**Figure 1: Mean number of days using an electronic device in the hour before bed by grade level among males and females.**



**Note:** Error bars are 95% confidence intervals.

over-represent children and adolescents from disadvantaged backgrounds in both South Australia and Australia. There may also be limitations in the use of student self-reported data, where objective measures (e.g. screen time reports from smart phones) may be considered more accurate when reporting electronic device use.<sup>32</sup> However, the specificity of the question (the hour before bed) may be less prone to issues of accuracy compared to self-reported screen use over a whole day. The data is also limited in that it does not provide details on the reason for use or type of electronic device. Data was also collected in 2019, prior to the COVID-19 pandemic which given the increased reliance on home-based activities during lockdowns, may in fact mean the scale of this problem is now even greater. Future research should aim to understand how and why children and adolescents are using electronic media in the hour before bed to help inform public health awareness campaigns and targeted interventions. There is also potential to explore current school policies and practices on EDU to ensure these are aligned with current recommendations and designed to promote healthy behaviours around screen time, especially for EDU prior to bed.

## Conclusion

The current study provides a population-wide contemporary understanding of South Australian children and adolescents' EDU before bed and is the first in-depth

understanding of differences across sociodemographic characteristics. Given 90% of children are using an electronic device before bed at least once a week, which has shown negative associations with numerous health and education outcomes, this emerging public health challenge requires immediate and increased attention from policy makers to ensure the health of the next generation. Both health and education systems need to work together to educate both parents and students on the current screen time recommendations and develop innovative ways to support families to practice healthy behaviours around EDU in the hour before bed.

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