

## Prevalence of Sedentary Behavior and Factors Associated with Screen Time among Thai Youths Aged 14–17 Years: A Cross-Sectional Population-Based Survey

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### Abstract:

**Objective:** To investigate the prevalence of sedentary behavior (SB) and factors associating with meeting the screen time guidelines among the Thai youth using a nationwide population-based survey.

**Material and Methods:** Data from a national representative sample of 3,900 Thai youths aged 14–17 years old across the country were drawn from the Thailand Physical Activity Children Survey. SB was classified into screen time and sitting down activity. The youths were classified as meeting the screen time guidelines if they spent less than 120 min on screen time activities. A logistic regression analysis was conducted to examine the relationship between sociodemographic factors and meeting the screen time guidelines.

**Results:** Overall, 33.7% of Thai youths were highly sedentary; only 30.5% of them met the screen time guidelines. Regarding screen time activity, the participants spent the highest amount of time using online social media; meanwhile, doing homework was the sitting down activity taking the greatest proportion of their time. The youths who were older and engaged in more screen time activities were significantly more likely to meet the screen time guidelines. Moreover, those who resided in regions other than Bangkok and had longer sleep times were significantly more likely to meet the screen time guidelines.

**Conclusion:** The prevalence estimates of meeting the screen time guideline among the Thai youth were low. Age, geographical region of residence, number of engagements in screen time activities, and sleep time were associated

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with meeting the screen time guidelines. Our findings indicate that public health policies and interventions are needed to reduce SB among Thai youths; particular attention should be paid to the associating factors of SB.

**Keywords:** screen time activity, sedentary behavior, sitting down activity, Thailand, youth

## Introduction

Sedentary behavior (SB) is defined as time spent sitting or lying with low energy expenditure ( $\leq 1.5$  metabolic equivalents; METs) while awake, in the context of educational, home, and community settings, as well as transportation<sup>1,2</sup>. Most screen time and sitting-time activities, such as watching television (TV), using a personal computer, using online social media, doing homework, driving or riding in a car, sitting and chatting on the phone, and reading are examples of SB in children and youths. Although time spent engaging in academic activities, such as reading and using the internet to acquire information, are positively associated with increased academic achievement<sup>3</sup>, findings from a previous review suggest that more time spent in SB, particularly screen time activities lasting more than 2 hours (>120 min), is associated with poorer health outcomes. In other words, spending less time on screen-based activities is beneficial to physical health<sup>4</sup>. There is no controversy regarding the claim that long periods of total SB are associated with poor disease outcomes<sup>5</sup>. Previous studies applying cross-sectional and longitudinal study designs in children and youths have demonstrated that a higher duration or frequency of time spent doing sedentary activities is significantly associated with waist circumference, BMI, overweight/obesity, health-related physical fitness, metabolic syndrome, and cardiovascular disease risk factors<sup>4</sup>.

According to the World Health Organization's (WHO) 2020 physical activity guidelines, children and youths (5–17 years old) should limit their sedentary time, particularly their recreational screen time, and replace it with physical activity (PA) of any intensity<sup>1</sup>. However, the WHO guideline

did not provide a specific or quantifiable (time-based) threshold for sedentary time, nor did it make any specific recommendations on how to break up SB<sup>6</sup>. The American Academy of Pediatrics issued the first guideline for SB in children in 1986, which was revised in 2005, recommending that SB be limited to no more than two hours/day<sup>7</sup>. This was followed by the guideline from the Australian Government Department of Health as well as the Canadian Sedentary Behaviour Guidelines for Children and Youth. The Canadian guideline proposed age-specific recommendations for SB, suggesting that children (age 5–11) and youths (age 12–17) should limit recreational screen time (watching TV, using a personal computer, playing video games, etc.) to no more than two hours/day (120 minute/day)<sup>8</sup>. Regardless, a study on the prevalence of SB among children and adolescents worldwide revealed that the average total daily sitting time was 8.1 hours; it ranged from 4.4 hours/day in children aged 2–6 years to 9.3 hours/day in adolescents aged 12–18 years<sup>9</sup>.

Studies on SB in Thai children and youths are underrepresented compared to those in PA<sup>10</sup>. The Ministry of Public Health of Thailand published the Thailand Recommendations on Physical Activity, Non-Sedentary Lifestyles, and Sleeping in 2017 and the Thai National Strategic Plan on Promotion of Physical Activity (2018–2030) in 2018, but there have been no previous national-scale studies on the prevalence of SB in Thai children and youths that could inform our national strategies. Furthermore, understanding the factors contributing to SB would help researchers and practitioners develop appropriate interventions to reduce sedentary time in this population group. Previous research on the correlates of SB has

discovered that gender has no relationship with total sitting time and screen time activities in young adults<sup>11</sup>. However, some studies have shown that females are more likely than males to spend more time studying, watching TV, using the internet, and using a mobile phone<sup>12</sup>. Evidence-based information is needed to fill the existing knowledge gaps on this topic within the country and establish the baseline data on SB for better-informed decisions. Thus, the purpose of this study was to investigate the types and patterns of SB among Thai children and youths and the correlates of the participants who meet the screen time guidelines across sociodemographic characteristics.

## Material and Methods

### Survey design and sample

This study obtained data from the Thailand Physical Activity Children Survey (TPACS). A multi-stage stratified cluster sampling was applied to recruit students from 336 schools in 28 provinces (including the Bangkok Metropolitan Area) from 6 regions across the country into the survey. Details on the TPACS can be found elsewhere<sup>13</sup>, and the study protocol was approved by the University of Western Australia (UWA) (RA/4/1/7335) and the Institute for the Development of Human Research Protections (IHRP) in Thailand. This research used a passive parental and active school consent procedure, where recruited students were provided with the study information and was asked to hand over this information to their parents. The children and/or their parents had the option to decline, and they had the right to withdraw from the study at any time. The participants' privacy and confidentiality were ensured via coding, anonymizing, and keeping the individual data obtained strictly confidential. Overall, a total of 4,405 Thai students aged 14–17 years old were eligible for inclusion in our analysis. This sample size was sufficient to determine an estimated prevalence with high precision, having an alpha ( $\alpha$ ) value of 90% and an absolute error (d) value of 5%.

### Measures

Data on the students' participation in SB and PA were concurrently collected across all regions of Thailand between June and August 2015 using a self-reported student questionnaire based on version 14–17 of TPACS (TPACS V14–17)<sup>13</sup>. SB entailed screen time and sitting-down activities, and this survey also collected anthropometry and sociodemographic data. TPACS V14–17 was translated into Thai, pilot-tested, and improved prior to conducting two reliability tests three days apart from each other on the same convenient sampled classrooms. The Thai version of TPACS V14–17 was validated using the 3-axial accelerometer (FeelFit<sup>®</sup>, Faculty of Engineering, Mahidol University, Thailand), and the results demonstrated acceptable validity and reliability. The validity of the questionnaire ranged from very low to high correlation ( $r=0.17$  to  $0.69$ ,  $p\text{-value}<0.05$ ) on the differences in PA intensities, while the test-retest reliability showed low to high correlation ( $r=0.27$  to  $0.76$ ,  $p\text{-value}<0.05$ )<sup>14</sup>.

The body mass index (BMI) was calculated based on weight (kg) divided by height (m) squared, and it was categorized into four groups (“underweight,” “normal,” “overweight,” and “obese”) according to the international childhood BMI unofficial Asian cut-offs<sup>15</sup>.

A single questionnaire item (“Over the last seven days, how many days were you physically active for a combined total of at least 60 minutes per day?”) was used to assess overall PA participation. Children were classified as meeting the WHO PA guidelines if they had achieved 60 min of PA each day for seven days.

The SB investigated in this study was classified into screen time and sitting down. Participation in SB was assessed by providing a list of screen time and sitting-down activities that the students might have engaged in over the previous seven days; the answer option was either a “Yes” or a “No.” If they chose “Yes,” they were asked to indicate the frequency and total amount of time they spent

on that activity during the last seven days. The participants were classified as sedentary if they spent more than 120 minute/day of time doing screen time and sitting-down activities, and they were classified as meeting the screen time guidelines<sup>8</sup> if they spent less than 120 minute/day doing screen time activities. We classified the total sedentary time of <8 hours/day as “low-sedentary” and that of ≥8 hours/day as “high-sedentary” based on previous studies<sup>16</sup>.

Sleep duration was assessed by asking about bedtime and wake-up times. The sleep time per day was stratified into three groups: <7 hours, 7–8 hours, and >8 hours<sup>17</sup>.

### Statistical analysis

The statistical analyses were performed using the IBM Statistical Package for the Social Science (SPSS) Statistics software, version 28.0 for MacOS (IBM Corp., Armonk, NY). Descriptive statistical analyses were conducted to describe the PA and SB characteristics of the samples and prevalence estimates of meeting the screen time guidelines. Meanwhile, chi-square and t-tests were performed to examine differences between the sexes. The backward stepwise logistic regression was used to simultaneously adjust for various independent variables in the model. This analysis also included estimated crude odds ratios (OR) and adjusted OR with corresponding 95% confidence intervals (CI).

## Results

Data from 3,900 students were included in the analysis after removing ineligible cases and cases with missing data on any available key (11.0%). Table 1 shows the distribution of boys and girls, who participated in the study by age, BMI, geographical region of residence, PA, screen time activity, sitting-down activity, number of activities engaged in, total sedentary time, and sleep time. This survey had an almost equal proportion of participating boys (49.5 %) and girls (50.4%), and the distribution by age

was also nearly equal across all age groups. The majority of the participants had a normal BMI (53.6%). There was no significant differences between sexes in terms of age group, BMI, and screen time activity (all p-values>0.05).

Overall, 19.9% of the Thai youths (aged 14–17 years) met the PA guidelines of engaging in an average of at least 60 min of moderate to vigorous intensity of PA daily. A significantly higher proportion of boys met the PA recommendations than girls ( $X^2=148.32$ , p-value<0.001). The majority (69.5%) of the study population spent >120 minute/day engaging in screen time activities and 67.0% engaging in sitting-down activities. Boys had a significantly higher proportion of engaging in ≥5 screen time activities than girls ( $X^2=481.08$ , p-value<0.001). Girls engaged in ≥5 sitting-down activities at a significantly higher proportion than boys ( $X^2=790.70$ , p-value<0.001).

Overall, almost one-third of the participants (30.5%) met the Canadian sedentary behavior guidelines. One-third of our Thai youths (33.7%) were found to be highly sedentary. Moreover, they spent an average of 7.1 hours (431.6±4.6 min) daily on both screen and sitting-down activities.

The top five most common screen time and sitting down activities among our study samples of both sexes are presented in Table 2.

The average length of time of each specific SB activity on weekday and weekend days stratified by sex are shown in Table 3, whereas the multivariate logistic regression findings are presented in Table 4. The youths aged 16 and 17 years old were 28.0% (OR=0.72, p-value <0.05) and 43.0% (OR=0.57, p-value<0.01), respectively less likely to follow the screen time guidelines (≤120 minute/day) compared with their counterparts aged 14 years. Those who lived in regions other than the Bangkok Metropolitan Area and the Central Region had a significantly greater chance of satisfying the screen time guidelines. When a child engaged in 3–4 screen time activities, the probability of meeting the screen time guideline criteria decreased

**Table 1** Descriptive statistics summarizing the characteristics of the samples, stratified by sex

Variable	Overall (n=3,900) n (%)	Boys (n=1,933) n (%)	Girls (n=1,967) n (%)
Age (years)			
14	980 (25.1)	467 (24.2)	513 (26.1)
15	999 (25.6)	503 (26.0)	496 (25.2)
16	967 (24.8)	487 (25.2)	480 (24.4)
17	954 (24.9)	476 (24.6)	478 (24.3)
Body mass index			
Normal	2,091 (53.6)	1,009 (52.2)	1,082 (55.0)
Underweight	562 (14.4)	273 (14.1)	289 (14.7)
Overweight	724 (18.6)	356 (18.4)	368 (18.7)
Obese	523 (13.4)	295 (15.3)	228 (11.6)
Geographical region of residence			
Bangkok metropolitan area	191 (4.9)	105 (5.4)	86 (4.4)
Central region	493 (12.6)	252 (13.0)	241 (12.3)
East	348 (8.9)	179 (9.3)	169 (8.6)
West	252 (6.5)	122 (6.3)	130 (6.6)
North	937 (24.0)	437 (22.6)	500 (25.4)
South	913 (23.4)	454 (23.5)	459 (23.3)
Northeast	766 (19.6)	384 (19.9)	382 (19.4)
Meeting PA guidelines*			
Yes	777 (19.9)	537 (27.8)	240 (12.2)
No	3,123 (80.1)	1,396 (72.2)	1,727 (87.8)
Meeting screen time guidelines (minute/day)			
≤120	1,189 (30.5)	554 (28.7)	635 (32.3)
>120	2,711 (69.5)	1,379 (71.3)	1,332 (67.7)
Number of screen time activities engaged in*			
<3 activities	1,223 (31.4)	585 (30.3)	638 (32.4)
3–4 activities	1,053 (27.0)	467 (24.2)	568 (29.8)
≥5 activities	1,624 (41.6)	881 (45.6)	743 (37.8)
Time spent on sitting–down activities (minute/day)*			
≤120	1,286 (33.0)	773 (40.0)	513 (26.1)
>120	2,614 (67.0)	1,160 (60.0)	1,454 (73.9)
Number of sitting–down activities engaged in*			
<3 activities	1,166 (29.9)	758 (39.2)	408 (20.7)
3–4 activities	1,667 (42.7)	803 (41.5)	864 (43.9)
≥5 activities	1,067 (27.4)	372 (19.2)	695 (35.3)
Total sedentary time			
Low–sedentary (<8 hours/day)	2,585 (66.3)	1,291 (66.8)	1,294 (65.8)
High–sedentary (≥8 hours/day)	1,314 (33.7)	641 (33.2)	673 (34.2)
Sleep time (hours)*			
<7	1,186 (30.4)	524 (27.1)	662 (33.7)
7–8	1,586 (40.7)	800 (41.4)	786 (40.0)
>8	1,128 (28.9)	609 (31.5)	519 (26.4)
	Mean (±SEM)	Mean (±SEM)	Mean (±SEM)
Sedentary behavior (minute/day)			
Total sedentary behavior time	431.6 (4.6)	424.8 (6.6)	438.3 (6.5)
Total screen time activities*	262.4 (26.1)	275.5 (5.5)	249.5 (5.0)
Total sitting–down activities*	166.7 (12.2)	147.1 (2.3)	185.9 (2.5)

\*Significant difference between sexes at p-value<0.001, <sup>a</sup>Percentages may not add to 100% due to rounding, PA=physical activity

by 74.0% (OR=0.26,  $p$ -value<0.01) and 88.0% (OR=0.12,  $p$ -value<0.01) when they engaged in  $\geq 5$  screen time activities compared with those who engaged in less than three screen time activities. Compared to those who slept less than seven hours/day, the youths who slept 7–8 hours/day and more than eight hours/day had a higher chance of meeting the screen time guidelines (26.0% and 89.0%, respectively). Sex, BMI, and meeting the PA guideline criteria were not significant predictors of achieving the screen time guidelines.

## Discussion

This is the first study to investigate the SB prevalence, types, patterns, and associations among Thai youths aged 14–17 years, who met the screen time guideline criteria across sociodemographic characteristics in a nationally representative sample. After removing ineligible cases and cases with missing data on any key variables (11.0%), a total of 3,900 student surveys were included in the analysis.

**Table 2** Top five most common sedentary activities among Thai youths aged 14–17 years, stratified by sex

Rank	Overall (n=3,900)			Boys (n=1,933)			Girls (n=1,967)		
	Activities	n	%	Activities	n	%	Activities	n	%
<b>Screen-time activity</b>									
1	Online social media	3,561	91.3	Online social media	1,703	88.1	Online social media	1,858	94.5
2	Watching TV	3,441	88.2	Watching TV	1,644	85.0	Watching TV	1,797	91.4
3	Watching TV/ listening to music via online platforms	2,885	74.0	Watching TV/listening to music via online platforms	1,368	70.8	Watching TV/listening to music via online platforms	1,517	77.1
4	Using the computer to do homework	2,505	64.2	Playing games on screen devices (on/ offline)	1,316	68.1	Using the computer to do homework	1,295	65.8
5	Playing games on screen devices (on/ offline)	2,293	58.8	Using the computer to do homework	1,210	62.6	Playing games on screen devices (on/ offline)	977	49.7
<b>Sitting-down activity</b>									
1	Doing homework	3,221	82.6	Doing homework	1,476	76.4	Doing homework	1,745	88.7
2	Travelling in motorized vehicles	2,337	59.9	Travelling in motorized vehicles	1,109	57.4	Travelling in motorized vehicles	1,228	62.4
3	Sitting and listening to music via streaming media	2,195	56.3	Sitting and listening to music via streaming media	989	51.2	Sitting and listening to music via streaming media	1,206	61.3
4	Sitting and chatting on the phone	1,841	47.2	Sitting and chatting on the phone	768	39.7	Sitting and chatting on the phone	1,073	54.6
5	Reading books, magazines, or other material	1,825	46.8	Reading books, magazines, or other material	761	39.4	Reading books, magazines, or other material	1,064	54.1

**Table 3** Average time Thai children aged 14–17 years spent on each sedentary activity per day, on weekday and weekend days (mean±SEM)

Sedentary behaviors	Average time per day (mean±SEM) <sup>a</sup>	
	Weekdays	Weekend days
<b>Screen time activities (minute/day)</b>		
Watching TV		
Overall	236.4±4.7	163.3±3.5
Boys	231.4±6.6	152.7±4.7
Girls	241.4±6.8	173.7±5.2
Using the computer to do homework		
Overall	120.7±3.2	77.5±2.1
Boys	125.1±4.8	79.3±3.1
Girls	116.3±4.3	75.6±2.9
Playing games on screen devices (on/offline)		
Overall	153.8±4.3	117.5±3.5
Boys	204.0±6.9	157.4±5.7
Girls	104.4±4.9	78.3±4.0
Playing handheld video games		
Overall	57.3±2.8	46.4±2.2
Boys	93.2±5.0	77.8±4.1
Girls	21.9±2.5	15.6±1.6
Using online social media		
Overall	326.6±6.1	224.1±4.9
Boys	301.9±8.4	195.6±6.4
Girls	351.0±9.0	252.0±7.5
Watching TV/listening to music via online platforms		
Overall	166.8±4.0	119.5±2.9
Boys	168.0±5.7	112.6±4.0
Girls	165.6±5.5	126.3±4.2
<b>Sitting-down activities (minute/day)</b>		
Sitting and chatting on the phone		
Overall	77.7±3.0	45.1±1.6
Boys	63.6±3.9	35.9±2.1
Girls	91.5±4.5	54.0±2.5
Doing homework		
Overall	166.1±3.2	456.4±5.5
Boys	104.2±4.1	412.1±8.0
Girls	191.5±4.8	499.8±7.4
Reading books, magazines, or other material		
Overall	60.3±1.8	36.6±1.2
Boys	49.2±2.3	27.9±1.5
Girls	71.2±2.7	45.1±1.9
Travelling in motorized vehicles		
Overall	98.2±2.2	30.4±1.9
Boys	89.9±3.0	29.1±1.2
Girls	106.2±3.3	31.6±1.2
Sitting for praying or meditation		
Overall	20.8±0.7	8.9±0.3
Boys	18.8±1.0	7.9±0.5
Girls	22.7±1.0	9.9±0.5
Doing hobbies or crafts		
Overall	14.2±0.7	11.4±0.6
Boys	12.9±1.0	10.5±0.9
Girls	15.6±0.9	12.2±0.9
Sitting and listening to music on streaming media		
Overall	86.1±2.5	54.6±1.6
Boys	80.1±3.6	51.4±2.3
Girls	92.1±3.4	57.8±2.2

<sup>a</sup>Cells in bold represent a significant difference between sexes at a p-value of <0.05

**Table 4** Regression results of factors associated with meeting the screen time guidelines

Factor	Meeting screen time guidelines ( $\leq 120$ minute/day)		
	%	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex			
Boys	28.7	1	1
Girls	32.3	1.18 (1.03–1.36)**	1.13 (0.97–1.32)
Age (years)			
14	36.8	1	1
15	30.6	0.75 (0.62–0.91)**	0.81 (0.66–1.00)
16	28.9	0.69 (0.57–0.84)*	0.72 (0.58–0.89)**
17	25.5	0.58 (0.48–0.71)*	0.57 (0.46–0.70)*
Body mass index			
Normal	32.0	1	1
Underweight	28.3	0.83 (0.68–1.03)	0.84 (0.67–1.05)
Overweight	30.0	0.91 (0.75–1.09)	0.87 (0.71–1.07)
Obese	27.5	0.80 (0.65–0.99)**	0.86 (0.68–1.08)
Geographical region of residence			
Bangkok metropolitan area	12.0	1	1
Central region	18.1	1.60 (0.98–2.63)	1.53 (0.91–2.57)
East	34.5	3.84 (2.35–6.26)*	3.45 (2.06–5.77)*
West	45.6	6.13 (3.71–10.12)*	4.73 (2.78–8.04)*
North	31.2	3.30 (2.09–5.22)*	2.84 (1.76–4.59)*
South	30.3	3.18 (2.01–5.03)*	2.91 (1.80–4.70)*
Northeast	35.6	4.04 (2.55–6.40)*	2.96 (1.82–4.79)*
Meeting PA guidelines			
Yes	28.4	1	1
No	31.0	1.13 (0.95–1.34)	0.89 (0.74–1.08)
Number of screen activities engaged in			
<3 activities	53.8	1	1
3–4 activities	22.3	0.24 (0.21–0.28)*	0.26 (0.22–0.30)*
$\geq 5$ activities	12.1	0.11 (0.91–0.15)*	0.12 (0.99–0.16)*
Sleep time (hours)			
<7	23.7	1	1
7–8	28.4	1.28 (1.07–1.52)**	1.26 (1.04–1.52)**
>8	40.5	2.19 (1.83–2.62)*	1.89 (1.55–2.30)*

\*p-value<0.01; \*\*p-value<0.05; Reference categories, Sex: Boys, Age: 14 years old, BMI: normal, Geographical region: Bangkok Metropolitan Area, Meeting PA guidelines: yes, Number of activities engaged in: <3 activities, and Sleep time:<7 hours  
OR=odds ratio, CI=confidence interval, PA=physical activity

### Prevalence of sedentary behavior

Overall, 30.5% of our Thai youth population aged 14–17 years met the Canadian sedentary behaviour guideline criteria (i.e., no more than 2 hours of recreational screen time per day). This prevalence estimate was consistent with the international estimate reported in a systematic review where one-third of children ( $\leq 18$  years old) were found to satisfy the guidelines. Compared to other Asian countries, the prevalence estimated by our study was lower than

those found in Japan (43.0%)<sup>18</sup> and South Korea (32.7%)<sup>19</sup>. We also found that 33.0% of Thai youths spent less than 2 hours on sitting down activities. However, for the sitting down activities, unlike for screen time ones, there are no recommendations for children and youths. Therefore, it was not possible to determine the proportion of Thai youths that followed the guidelines satisfactorily. Our results suggested that attention should be paid to reducing screen time among this population group and replacing screen activities with



PA of any intensity as recommended by WHO<sup>1</sup>. Efforts to regularly monitor SB in children should also be established for Thailand so as to determine trends related to this behavior.

### **Time spent on sedentary behaviors**

One-third of Thai youths (33.7%) were highly sedentary (spent  $\geq 8$  hours/day doing both screen time and sitting-down activities). The average time our participants spent on both screen and sitting-down activities daily was 7.1 h ( $431.6 \pm 4.6$  min). This estimate was lower than that found in Canadian youths (8.2 hours/day)<sup>20</sup>. Considering it by domain and average, the Thai youths spent 4.3 hours/day ( $262.4 \pm 26.1$  minute/day) on screen time activities and 2.7 hours/day ( $166.7 \pm 12.2$  minute/day) on sitting-down activities.

### **Most common sedentary activities among the Thai youth**

The most common screen time activity the youths of both genders engaged in was using online social media or chatting via social media applications on a personal computer, tablet, or mobile phone (91.3%). Watching TV programs/movies on a TV set was the second most popular activity (88.2%), followed by watching TV/listening to music through online platforms (74.0%). Considering its popularity by gender, using a computer for homework ranked fourth among girls, while it ranked fifth among boys. In Thailand, the number of social media users was approximately 42.2 million in 2017, and it was expected to increase to 56.3 million in 2022<sup>21</sup>. Therefore, it is not surprising that online social media was the most common screen activity the Thai youth engages in. This finding is consistent with that reported in a USA study on a nationally-representative sample of youths, which found that social media (such as Instagram, Snapchat, or Facebook) is used by 81.0% of youths aged 13–17 years<sup>22</sup>. However, using the computer

for homework was more favored among girls than among boys, whereas playing games on screen devices was more prevalent among boys.

The most common sitting-down activities among the Thai youth were doing homework, reports, or group work (82.6%); traveling in motorized vehicles or public transport (59.9%); and sitting and listening to music via streaming media (56.3%). The ranking of the most common sitting-down activities was the same in both sexes. Some sitting-down activities such as reading and doing homework were productive in nature. Doing homework is not an unexpected sitting-down activity to be reported in a population such as that of Thailand; it has been especially commonly found in Asian countries, e.g., Taiwan and Singapore, where academic achievement is highly valued<sup>23</sup>. Our findings are also in line with those reported in China. Academic-related SB, such as doing homework, is a significant component of Chinese middle school students' sitting-down activities<sup>24</sup>. Moreover, female students may prioritize academic studies more than their male counterparts; they tend to put in more effort and outperform boys on academic success indicators<sup>25</sup>.

### **Time spent on sedentary behavior on both weekday and weekend days**

Overall, our Thai youths spent the longest period of time, approximately 5.5 hours/day ( $326.6 \pm 6.1$  minute/day), using online social media on a weekday and approximately 3.7 hours/day ( $224.1 \pm 4.9$  minute/day) on a weekend day. When exploring gender differences in terms of average screen time, a significantly higher time was spent by boys compared to girls on screen time activities like watching movies, using computers to do homework, playing games (on/offline) on screen devices, and playing handheld video games. In terms of sitting-down activities, our participants spent the longest time doing homework, approximately 7.6 hours/day ( $456.4 \pm 5.5$  minute/day) on a weekend day and

2.7 hours/day (166.1±3.2 minute/day) on a weekday. Girls had a higher chance of participating in all the sitting-down activity types than boys.

It is noticeable that SB patterns differed between boys and girls. Boys tended to engage more in using a computer, playing games on screen devices, and playing handheld video games, while girls spend more time on social media, sitting and chatting on the phone, doing traditional paper-and-pencil homework, and reading books/magazines or other reading material. The Thai youth of both genders, but particularly girls, spent more time on social media than on academic-related screen activities such as using a computer for doing homework and doing traditional paper-and-pencil homework. These findings are similar to those of an earlier study on Singaporean students, which showed that boys tend to spend more time on computers/internet and video games, while girls spend more time on homework, reading, sitting and talking, talking on the phone, and watching TV<sup>26</sup>.

When considering sedentary patterns on weekday and weekend days, the Thai youth were found to be more sedentary during weekdays. A similar pattern was discovered in a cross-sectional study conducted in 56 public schools in Brazil using a self-report instrument to assess SB<sup>27</sup>. In the Czech Republic, more overall sedentary time was evident on school days than on weekends. In the case of screen time, however, weekend daily screen time was significantly greater than weekday daily screen time<sup>28</sup>. Regarding gender, boys have been reported to spend three times more hours on weekdays and four times more hours on weekends, even on extended weekends, than girls on screen time activities<sup>29</sup>. Our results suggest that any efforts in trying to reduce SB among youths should consider the different patterns of this behavior that occur during weekday and weekend days. Doing homework was the sitting-down activity that the Thai youth spent the highest amount of time doing on both weekday and

weekend days, and these results are similar to those reported in American<sup>30</sup> and Chinese students<sup>24</sup>. Clearly, Thai youth spent a significant amount of time doing homework on weekends, approximately three times higher than on weekdays. However, a large amount of homework might prevent children from getting enough sleep or engaging in non-academic and out-of-school PA that could benefit their overall well-being<sup>30</sup>. In our case, this might again be related to the value given to academic performance in the Thai context, which in turn, puts pressure on the youth to focus on studies rather than spending time on recreation or PA on weekends. Moreover, it is essential to note that boys tend to have much higher screen time than girls. Valtonen et al. (2021) have hypothesized that boys prefer screen games to physically active hobbies or screen-free play with friends<sup>29</sup>.

#### **Sociodemographic factors associated with meeting screen time guidelines**

Our study suggests that gender is not associated with meeting the screen time guideline criteria, and this result is consistent with those reported in a previous systematic review<sup>31</sup>. Previous research has highlighted the importance of gender differences in the development of SB guidelines or the design of interventions to reduce SB because girls and boys frequently engage in different sedentary activities; moreover, there are sex physiology differences in health outcomes associated with SB<sup>32</sup>. According to our results, however, gender might not be a predictor for SB when considering specific SB domains; nevertheless, more research is needed to verify this assumption.

Age was negatively associated with meeting the screen time guidelines in our study. As children grew older, sedentariness increased, and they were less likely to meet the screen time guideline criteria. The negative relationship between age and meeting the screen time guideline criteria could be attributed to the increased amount

of homework requiring computer use as children advance in their education<sup>33</sup>. A previous systematic review supports the positive association between age and SB identified in our study, especially related to screen time<sup>31,33</sup>.

The geographical area of residence was found to be significantly associated with meeting the screen time guidelines. Compared with the Bangkok Metropolitan Area and the Central Region, Thai youths living in other regions were significantly more likely to meet the screen time guideline criteria. This might be due to the differences in terms of socioeconomics, urbanization, family lifestyle, and regional culture across the regions of our country. Although previous research in Western countries has found screen time to be higher in urban areas<sup>34</sup>, it is difficult to apply such findings to Asian populations. Further research is warranted to clarify the relationship between cultural geography and meeting the screen time guidelines.

The number of screen time activities the Thai youth engaged in is another important factor that was negatively associated with meeting the screen time guideline criteria. Our results were in line with previous literature showing a similar relationship between the number of media devices at home and children's screen time, especially in urban areas<sup>35</sup>. Hence, when designing interventions to prevent excessive screen use among Thai youths, limiting access to media devices should be considered.

Our study showed that sleep time was positively associated with following the screen time guidelines satisfactorily. In other words, higher screen time could disrupt the sleep time of the Thai youth. Previous research has indicated that adolescents in the United Kingdom had significantly shorter weekday sleep durations when using their mobile phones frequently before bed<sup>36</sup>. Many other studies have also underscored the negative impacts of screen time activities on reduced sleep duration, poor sleep quality, and daytime drowsiness among adolescents<sup>37</sup>. Therefore, our study recommends the consideration of

integrating sufficient sleep duration into interventions aimed at reducing SB among the Thai youth population.

### Limitations

This study has some limitations that must be considered when interpreting its results. First, our study presents results based on data collected from a previous population-level survey (TPACS), which was conducted in 2015. Therefore, the information presented in our study might not represent the current SB among the Thai youth. Nonetheless, due to a lack of information at the national level, our results provide an important baseline for the country. Second, the SB prevalence estimates were based on a self-reporting instrument that may or may not accurately indicate the engagement of the youths in screen and sitting-down activities. In addition, self-reported sedentary time measures have a recall bias, poor precision due to item misinterpretation, and low correlation with a gold standard sedentary time objective monitor, all of which are possible weaknesses, particularly in younger age groups<sup>38</sup>. Third, the comparisons between the prevalence and duration of SB reported in our investigation and those reported in other studies might have some limitations due to differences in the terminology and measurement of "sedentary behavior" employed in each study. In other studies, SB is collectively referred to as "screen time" rather than it being separated and classified as screen time and sitting-down activities. Even though screen time activity primarily involves sitting, it should not be assumed that someone is engaging in it while primarily seated or in a stationary position due to the nature of portable screen-based devices<sup>39</sup>. Furthermore, there is strong evidence that watching screen media differs physiologically from other forms of SB such as reading<sup>40</sup>. Finally, this study's cross-sectional design does not allow for the identification of a causal relationship, so the interpretations of its results should be made with caution.

## Conclusion

This is the first study to investigate the prevalence, types, and patterns of SB, including the factors associated with meeting the screen time guideline criteria, across sociodemographic variables in a nationally representative sample of Thai children aged 14 to 17 years. The results showed that nearly two-fifths of Thai youths were highly sedentary. Overall, the Thai youth spent more time on SB during weekdays than on weekends—except for doing homework, to which they devoted a longer amount of time on weekends. The prevalence estimates of Thai youths meeting the screen time guidelines were low. Age, geographical region of residence, number of screen time activities one engaged in, and sleep time were associated with meeting the screen time guideline criteria. Limiting access to screen devices and promoting sufficient sleep time might be helpful to the efforts aimed at reducing SB among the Thai youth.

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## Conflict of interest

The authors declare that they have no conflict of interest.

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