



Associations between mobile touch screen device use and musculoskeletal and visual symptoms: A cross-sectional study of adolescents in Singapore

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Introduction

The use of technology among adolescents, especially mobile touch screen devices (MTSDs), i.e. smartphones and tablet computers, has grown rapidly in the recent years^{1,2}, and there is concern about its potential negative impact on adolescents' musculoskeletal and visual health^{3,4}. Current evidence on MTSD use have been limited and mostly conducted in adults⁵. There is also limited knowledge on adolescents' contemporary technology use, especially MTSDs, and their associations with musculoskeletal and visual symptoms. Other limitations also include convenience sampling, a focus on Western populations and simple exposure measures of technology use (lack reporting on patterns of use).

This study aimed to examine among a nationally representative group of adolescents in Singapore:

- the amount and patterns of contemporary technology use, particularly mobile touch screen devices (MTSDs),
- and associations with musculoskeletal and visual symptoms.

Methodology

This study recruited adolescents from schools in Singapore (Pri 5, Sec 1 and 3, and JC 1), using a sampling matrix stratified on socioeconomic (types of school and school's local area household income) and academic (educational stream) indicators. Ethics and approval were obtained from Curtin University and Singapore MOE. Written informed consent were obtained from parents.

Participants completed an online questionnaire in class. Questions included weekday/weekend use, duration/frequency and patterns of use including bout length (typical use duration before stopping), types of activities, extent of multitasking, musculoskeletal and visual symptoms (e.g. eye strain, dry eyes), mental health and physical activity. This questionnaire has been developed based on prior studies with high test-retest reliability found⁶ and piloted tested with a group of Singaporean adolescents. Logistic regression analyses adjusted for gender, school level, mental health, physical activity and total technology use of other devices were conducted.

Results

A representative sample of 1884 adolescents (response rate=74%) recruited from 13 schools in Singapore, participated in the survey that was conducted in 2016/2017. Sample demographics:

- 50.4% girls, 49.6% boys
- Pri 5 to JC 1 (10-18 years); mean age (SD): 13.3 (2.0) years
- Race: Chinese (73%), Malay (14%), Indian (6%), others (7%)

Total **technology use** was high, with mean smartphone use (SD) being highest (Fig.1). Mean use on weekends was significantly higher than on weekdays for all the devices.

Gender and school level differences

Mean smartphone use was significantly higher for girls than boys, while desktop, laptop, as well as handheld, non-active and active game consoles were higher for boys. Among Sec 1 & 3 & JC 1, smartphone use dominated, and was much higher than all the other devices (Fig.1). Tablet use was similar among Pri 5, Sec 1 & 3, lowest for JC 1. Laptop use ↑ with increasing school level.

Regarding **patterns of use**, smartphone use dominated for each type of activity among the devices. Social activity had the highest usage on smartphone, while watching videos had the highest usage for tablet, desktop and laptop. Frequent multitasking (some or most of the time) with other devices was highest (69%) for smartphone. Mean bout length of use was also highest for smartphone at 191(221) mins, while that for tablet was 69(127) mins.



Fig. 1 Mean daily use of devices across school levels

Musculoskeletal symptoms in the previous month were most commonly reported in neck/shoulder (42%). Girls had higher prevalence of symptoms at neck/shoulder compared to boys. Prevalence of having symptoms ↑ with increasing school levels for all the body regions.

Number of **visual symptoms** reported during/after using MTSDs was 2.2 (2.0) (out of a list of 9), with tiredness of eyes most commonly reported (56%).

Table 1. Adjusted for gender, school level, mental health^a, physical activity^b and total technology use of other devices

	Smartphone		Tablet	
	N	OR (95% CI)	N	OR (95% CI)
Neck/shoulders	1827	1.04* (1.01-1.07)	1839	1.02 (0.97-1.08)
Upper back	1825	1.07*** (1.03-1.10)	1837	0.97 (0.91-1.03)
Low back	1824	1.01 (0.98-1.04)	1836	1.02 (0.96-1.09)
Arms	1824	1.04** (1.01-1.07)	1836	0.98 (0.93-1.03)
Wrist/hand	1824	1.04* (1.01-1.07)	1836	1.03 (0.98-1.09)
Visual symptoms	1812	1.05*** (1.02-1.08)	1824	1.02 (0.98-1.07a)

^amental health measured using DASS-21 (Depression Stress Anxiety Scale-21), ^bphysical activity measured using PAQ-A (Physical Activity Questionnaire for Adolescents)

Regarding the **associations**, higher daily hours of smartphone use was associated with ↑ risk of last month prevalence of neck/shoulder, upper back, arms and wrist/hand symptoms (OR=1.04 (95%CI=1.01-1.07) to 1.07(1.03-1.10)) and a greater no. of visual symptoms (OR=1.05(1.02-1.08)) (Table 1). No sig. associations were found for tablet use.

Conclusion

There was high technology use, especially smartphones, among Singaporean adolescents. This study also showed that technology was used for various types of school-related and leisure activities, and prevalent multitasking during technology use.

Smartphone use was the most prevalent and its usage dominated among all the devices. Moreover, greater amount of smartphone use was associated with more musculoskeletal and visual symptoms. The high mobile device use exposures are therefore a cause for concern. Further research on the implications of its use are warranted. There is also a need to develop guidelines for wise use to reduce possible negative impact of use on adolescents' health.

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