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ORIGINAL ARTICLE

Adolescent screen time: associations with school stress and school satisfaction across 38 countries

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Abstract

This study examined associations of watching television, electronic games, computer uses with school stress, and satisfaction among adolescents. Nationally representative data from 38 European and North American countries that participated in the 2014 Health Behaviour in School-aged Children (HBSC) survey were analysed. School stress and school satisfaction were each assessed using a 4-point self-reported item and then dichotomised. Participants reported discretional time spent on different screen-based activities. Of the 191,786 participants (age 13.6 [1.6] years; 51% girls), 35% reported high levels of school stress, while 30% reported high satisfaction with their school. Multilevel multivariable logistic regression modelling showed that adolescents reporting watching television > 4 h/day (≤ 1 h/day as reference) had 31% higher odds of school stress (OR 1.31; 95% CI: 1.27–1.35) and 36% less odds of school satisfaction (OR 0.64; 95% CI: 0.62–0.67). Prolonged electronic gaming (> 4 h/day) increased the odds of school stress by 26% (OR 1.26; 95% CI: 1.22–1.30) and decreased the odds of school satisfaction by 37% (OR 0.63; 95% CI: 0.61–0.65). Adolescents with prolonged computer use had 46% higher odds of school stress (OR 1.46; 95% CI: 1.42–1.50) and 39% lower odds of school satisfaction (OR 0.61; 95% CI: 0.59–0.63). Association estimates were more evident among younger adolescents than their older counterparts with no apparent gender differences.

Conclusion: Prolonged screen use, irrespective of type, was positively associated with school stress and inversely associated with school satisfaction with high computer use showing the highest adverse associations. Prospective research is needed to understand directionality and mechanisms of these relationships.

What is Known:
- *Screen-based activities are adversely associated with various health and wellbeing indicators in adolescents..*
- *The relation between screen time and school-related outcomes is yet to understand fully.*

What is New:
- *Prolonged screen time is associated with increased school stress and decreased school satisfaction in adolescents.*
- *Computer use showed higher adverse associations than watching television or playing electronic games.*

Keywords Screen time · School stress · School satisfaction · Adolescent wellbeing · Adolescent health · HBSC

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Abbreviations

BMI	Body mass index
FAS	Family Affluence Scale
HBSC	Health Behaviour in School-Aged Children
MICE	Multiple Imputations by Chained Equations
WHO	World Health Organization

Introduction

Declines in adolescent health and wellbeing have become a global concern over the past decade [1, 2]. Understanding the factors that underpin adolescent wellbeing is becoming increasingly important as the effects of prolonged

home-schooling during coronavirus lockdowns become clearer. Active participation in school-based activities and having a sense of school connectedness is positively associated with better adolescent physical and mental health, as well as intellectual developments [3–5], while experiences of school-related stress are associated with poor psychological wellbeing [5, 6]. One factor that is likely to be related to both adolescent wellbeing and school stress is screen time. Discretional screen time has been found to have negative associations with academic performance [7–11], stress, and depression among adolescents [12–14]. For many adolescents, managing screen time has become a considerable challenge in recent years; however, only a few studies have explored population-level associations between recreational screen time and school stress in adolescents.

Experiences at school are important for adolescent wellbeing. A systematic review found that positive school experiences (e.g., feeling physically and psychologically safe, perceptions of school connectedness) were associated with increased wellbeing and decreased mental health issues [5]. The review also reported that highly demanding academic environments (e.g., expectations of high academic achievements) were associated with increased mental health concerns and risk behaviours. Several studies included in the review found that both age and gender varied in their associations with experiences of stress and wellbeing at school. A five-wave study of European and North American adolescents found that perceived school pressure increased as a function of age and gender but did not vary in any meaningful way over time, with 11-year-olds experiencing the least amount of school pressure, and 15-year-olds experiencing the most [3]. In terms of gender, at age 11, girls reported significantly less perceived school pressure than boys; however, by ages 13 and 15, girls reported significantly more perceived school pressure than boys of the same age and by age 15, girls reported the highest perceived school pressure of all groups.

Similarly, several studies have examined the associations between discretional screen time and adolescent wellbeing. For example, one population-based study of US children and adolescents aged 2–17 years found that after 1 h of screen use per day, increased screen time was associated with decreased wellbeing [15]. Similarly, a longitudinal study found that each additional hour per day of watching television was associated with a 36% higher odds of reporting depressive symptoms [16]. A population-level study also found that adolescents who participated in extracurricular activities (e.g., sports) were less likely to engage in recreational screen-based activities than their peers who did not engage in extracurricular activities [17]. Discretional screen-based activity was also found to be a risk factor for lower satisfaction with life and decreased optimism, with screen time > 2 h/day associated with increased symptoms of anxiety and depression, and decreased wellbeing. This study also found that gender interacted with screen time and wellbeing outcomes [17]. Similar to the associations between school stress and wellbeing, the inverse relationship between screen time and life satisfaction appears to be significantly more pronounced for girls compared to boys [16, 17]. However, these studies are based on a single country and/or use non-representative small samples to investigate wellbeing outcomes without differentiating between different types of screen use. To date, there are no studies that have proposed a directional framework for the specific interaction of screen time, school stress, and mental health in adolescents; however, the available evidence does suggest that screen time may be both a cause and a consequence of school stress and its potential effect on mental health. That is, excessive screen time may lead to poorer grades, decreased school engagement, and subsequently increased depression and anxiety, but an equally plausible pathway model would suggest that the experience of school stress and/or mental health concerns trigger avoidant coping mechanisms such as increased screen time. Using a large-scale nationally representative sample of adolescents across 38 counties, this study aimed to explore the associations of discretional screen time with school stress and school satisfaction.

Materials and methods

Study sample

Data were from 38 countries that participated in the 2014 Health Behaviour in School-aged Children (HBSC) survey, which is a repeated cross-sectional survey aimed at monitoring adolescent health and wellbeing in Europe and North America [18]. The school-based data collection is completed every 4 years from a nationally representative sample of 11-, 13-, and 15-year-old adolescents in participating countries. The HBSC uses a stratified random cluster sampling design. Participants provide self-report data by anonymously completing a questionnaire that includes a range of items on health indicators and related behaviours [18]. Of the 41 countries participated in the 2014 HBSC, three did not collect data on outcomes or study factors, and hence the analytical sample was based on 38 countries. Survey administrators in each country received ethics approval from an appropriate regulatory body, and informed consent was obtained from participants and a parent or guardian.

Outcome measures

School stress was measured by a single item: "How pressured do you feel by schoolwork?" with four response options: (1) not at all, (2) a little, (3) some, and (4) a lot. This measure has been validated in several countries and

included in other validated subscales measuring school pressure [19]. Answers were dichotomised as 'stressed due to school pressure' (responses 3, 4) versus 'not stressed' (responses 1, 2) [20]. School satisfaction was assessed using a single item: "How do you feel about school at present?" with four response options: (1) I like it a lot, (2) I like it a bit, (3) I don't like it very much, and (4) I don't like it at all. Answers were dichotomised as 'highly satisfied with the school' (response 1) and 'not high' (responses 2, 3, 4) [20].

Study factors

Discretional time spent on screen-based activities was assessed using three self-reported items: (i) "About how many hours a day do you usually watch television (including DVDs and videos) in your free time?", (ii) "About how many hours a day do you usually play games on a computer or games console (PlayStation, Xbox, GameCube, etc.) in your free time?", and (iii) "About how many hours a day do you usually use a computer for chatting on-line, internet, emailing, homework etc. in your free time?". Responses included nine options: none at all, 0.5 h/day, 1 h/day, 2 h/day, 3 h/day, 4 h/day, 5 h/day, 6 h/day, and ≥ 7 h/day. These items have acceptable test–retest reliability [21]. For each screen use, response options were collapsed into five categories: ≤ 1 h/day, > 1–2 h/day, > 2–3 h/day, > 3–4 h/day, and > 4 h/day. For sensitivity analyses, each screen time was categorised into three groups: 0–2 h/day, > 2–4 h/day, and > 4 h/day.

Covariates

Sociodemographic covariates included age and gender (girls/boys). Individual-level socioeconomic status was measured with the Family Affluence Scale [FAS; 22], which is a composite score based on items that assess the households' ownership of number of cars and computers, bedroom sharing, and number of family holidays in the past year. Body mass index (BMI) was derived from self-reported height and weight, which was converted into BMI z-scores using the WHO Child Growth Standards. Participants also reported the number of days in the past week that they participated in moderate-to-vigorous physical activities for at least 60 min [23]. These covariates were selected based on their plausible connection to the outcome measures of interest.

Statistical analyses

Missing values for the study factors and covariates ranged from 0.8% (age) to 19% (BMI) (Table 1). To minimise biases due to the missingness, we implemented multiple imputations by chained equations (MICE). We chose 20 imputations based on the rule that the number should be at least as large as the percentage of missing data [24]. The imputed descriptive statistic values closely matched the observed values.

Descriptive statistics of outcome measures and study factors were computed for each participating country. Proportions of adolescents reporting high school stress and school satisfaction were computed for different types of screen use. To estimate the associations, we conducted multilevel logistic regression modelling that considered the nested structure of the data: participating students were nested within schools, and schools were nested within counties. All models were adjusted for age, gender, BMI z-scores, FAS, and physical activity. To avoid issues of multicollinearity among different screen types, separate model was constructed for each screen time. The analyses were replicated across gender and different age groups. Finally, we conducted sensitivity analyses using different categories of each screen type to examine whether different categorisations had any impact on results. We conducted multilevel modelling using the runmlwin command via Stata v17SE (StataCorp, USA). The association estimates are presented in the form of odds ratio (OR) and their 95% confidence interval (CI).

Results

Table 1 presents descriptive statistics of the analytical sample ($n = 191{,}786$). The mean age of study participants was 13.6 (SD 1.6) years and 51% were girls. Over a third (35%) of adolescents reported high level of school stress with more girls reporting that they were stressed than boys (38.0% vs. 32.3%). About 30% of adolescents were highly satisfied with their school with more girls being satisfied than boys (31.8% vs. 27.3%). The percentage of adolescents reporting over 2 h/day of screen time was 54.3% for watching television, 38.4% for electronic games, and 44.6% for computer use. Country-level descriptive statistics of the study sample are presented in Supplementary Table S1.

Proportion of adolescents reporting high levels of school stress increased with the increase of each screen type with computer use showing the most evident upward trend (Fig. 1A). For example, 29% of adolescents with computer use ≤ 1 h/day reported school stress while this percentage was 44% for adolescents with computer use > 4 h/day. Figure 1B shows that school satisfaction decreased monotonically with the increase of each screen type with comparable downward trends. For example, school satisfaction was 34% for adolescents with electronic games ≤ 1 h/day and 22% for electronic games > 4 h/day.

As shown in Table 2, more screen use was likely to increase the odds of reporting school stress and decrease

Table 1 Description of study sample from 38 countries, HBSC 2014 ($n = 191{,}786$)

Characteristics	
	Mean (SD)
Age (years)[a]	13.58 (1.63)
Body mass index (BMI)[b]	19.60 (3.51)
Physical activity ≥ 60 min (days/week)[c]	4.18 (2.06)
	Percentage
Age group	
11-year-olds	28.70
13-year-olds	34.97
15-year-olds	35.57
Missing	0.76
Girls	50.94
Watching television	
≤ 1 h/day	22.63
> 1–2 h/day	23.02
> 2–3 h/day	23.45
> 3–4 h/day	15.02
> 4 h/day	15.87
Missing	0.01
Electronic games	
≤ 1 h/day	42.11
> 1–2 h/day	19.51
> 2–3 h/day	16.03
> 3–4 h/day	8.67
> 4 h/day	13.67
Missing	0.01
Computer use	
≤ 1 h/day	36.25
> 1–2 h/day	19.17
> 2–3 h/day	15.69
> 3–4 h/day	10.29
> 4 h/day	18.59
Missing	0.01
Family Affluence Scale	
Q1	24.60
Q2	33.73
Q3	16.08
Q4	19.14
Missing	6.45
Stressed due to school pressure	35.18
Satisfied with the school	29.58

SD standard deviation, *Qi* i^{th} quartile

Missing values: [a].8%; [b]19.0%; [c]2.2%

the odds of reporting school satisfaction, suggesting some form of dose dependence. Adolescents who reported watching television > 4 h/day (≤ 1 h/day as reference) had 31% higher odds of reporting school stress (OR 1.31; 95% CI 1.27–1.35). Odds of reporting school stress were 26% higher for adolescents who played electronic games > 4 h/day (OR 1.26; 95% CI 1.22–1.30). High computer use was associated with school stress with odds being 32% higher for using computer > 3–4 h/day (OR 1.32; 95% CI 1.28–1.37) and 46% higher for using > 4 h/day (OR 1.46; 95% CI 1.42–1.50). Compared to watching television ≤ 1 h/day, odds of reporting school satisfaction were 36% lower for adolescents who watched television > 4 h/day (OR 0.64; 95% CI 0.62–0.67). Similarly, playing electronic games > 4 h/day had reduced the odds of school satisfaction by 37% (OR 0.63; 95% CI 0.61–0.65) and the odds were reduced by 39% for using computers > 4 h/day (OR 0.61; 95% CI 0.59–0.63).

When examining the associations for school stress across age groups (Fig. 2), the association estimates were evident for adolescents aged 11-year-olds across all screen types with 60% higher odds for watching television > 4 h/day (OR 1.60; 95% CI 1.50–1.71), 68% higher odds for playing electronic games > 4 h/day (OR 1.68; 95% CI 1.57–1.80), and 73% higher for using computers > 4 h/day (OR 1.73; 95% CI 1.61–1.85). The respective estimates for prolonged use (> 4 h/day) were moderate for adolescents aged 13-year-olds with 32% higher odds for watching television (OR 1.32; 95% CI 1.25–1.40), 32% higher odds for playing electronic games (OR 1.32; 95% CI 1.26–1.39), and 50% higher odds for using computers (OR 1.50; 95% CI 1.43–1.57). However, the estimates were marginal for adolescents aged 15-year-olds. Association estimates for school satisfaction were evident for 11- and 13-year-old adolescents, while estimates were moderate for 15-year-olds. Modelling of various screen types across gender showed no notable differences in the association estimates (Fig. 3).

Sensitivity analyses with different thresholds used to define the screen time categories produced similar results without meaningful changes (Table S2). Considering ≤ 2 h/day as reference, each screen type was positively associated with school stress and adversely associated with school satisfaction in a dose-dependent manner.

Discussion

Using a large nationally representative sample of adolescents from 38 European and North American countries, we found that, regardless of the type of screen use (i.e., watching television, electronic gaming, or computer use), higher recreational screen time is associated with increased school stress and decreased school satisfaction among this adolescent population, with some evidence for dose-responsiveness. The results of the present study generally build on the previous findings on the screen use and psychological well-being relationships [12–14]. The unfavourable associations between screen time and school stress or satisfaction among younger adolescents compared to their older counterparts

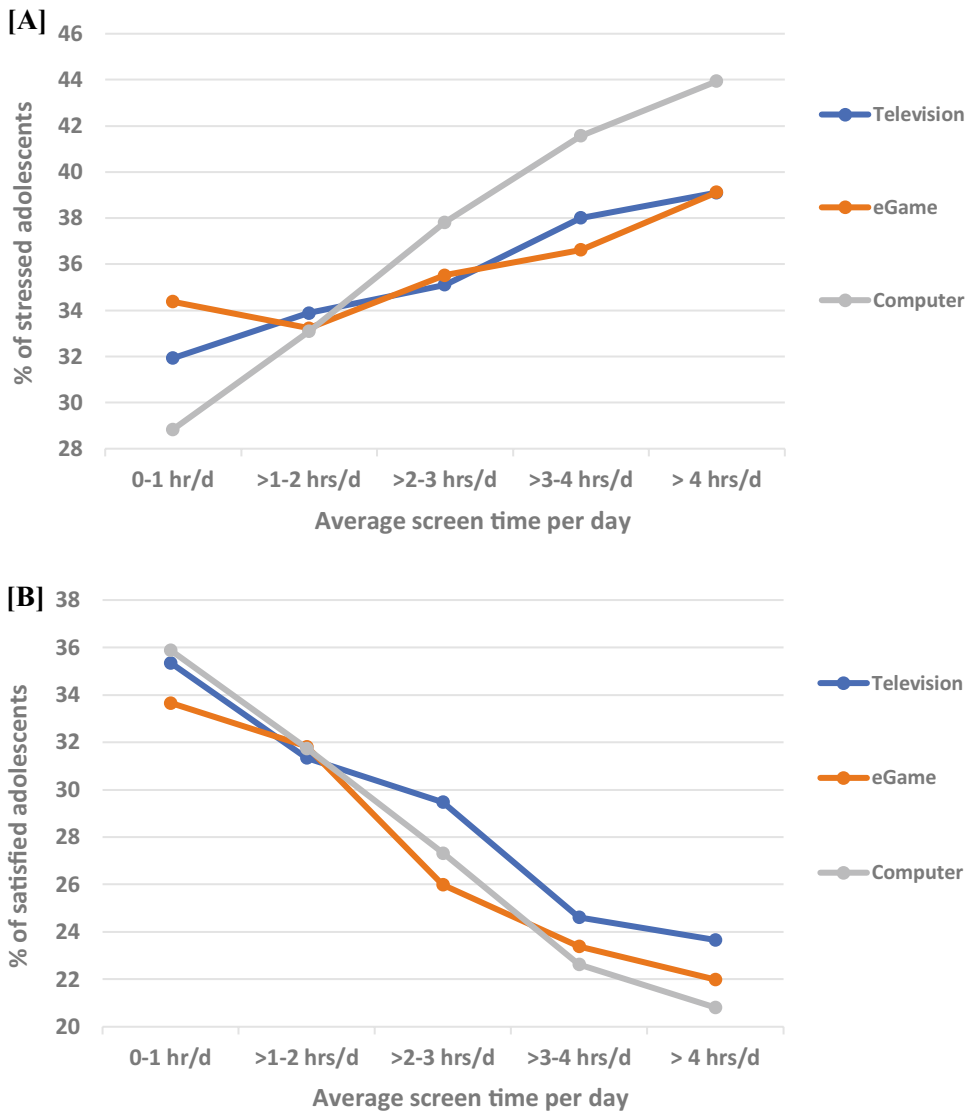

Fig. 1 Percent distribution of adolescents reporting (**A**) school stress and (**B**) school satisfaction by types of screen use in adolescents, HBSC 2014

shown in our study indicate that prolonged screen time may be more detrimental among younger adolescents. However, there were no apparent gender differences in the associations between screen time and school stress or satisfaction.

Our study showed that more time spent in front of a screen, starting from 1 h/day, was positively associated with school stress, and inversely associated with school satisfaction. This study also provides evidence on dose-responsiveness between screen time and school stress or satisfaction, building on the recent evidence between screen time and different health outcomes including life satisfaction and psychosomatic complaints [25]. Our study had a specific emphasis on school-related outcomes (i.e., school stress or satisfaction) given that the age group studied (11–15 years) is a unique period of life where individuals make crucial developmental transitions from childhood to adolescence [26]. During adolescence, schools and peers become major environmental and social constructs as adolescents spend most of their time in schools. Our study showed detrimental associations of different screen types with varying school-related outcomes among adolescents during the formative years developmentally and socially. The proportion of students feeling stressed about school was already high (35%) while feeling satisfied was already low (30%) in our sample, and given the dose-responsiveness between screen time and school-related outcomes, it is important to understand the underlying causal pathway as the relationships could well be bi-directional [27].

In our study, the most apparent association was observed among the youngest group (11-year-olds) and the association became trivial with older age. Just as screen use may vary between age groups, sources for school stress and satisfaction may differ by age groups. For example, typically around age 11 the transition from primary (elementary) school to secondary (high) school occurs, often resulting in a tumultuous upheaval of friendships, habits,

Table 2 Multilevel logistic regression estimates of associations of watching television, electronic gaming, and computer use with *school stress* and *school satisfaction* among adolescents, HBSC 2014

	School stress aOR (95% CI)	School satisfaction aOR (95% CI)
Watching television		
≤ 1 h/day[a]	1.0	1.0
> 1–2 h/day	1.04 (1.01, 1.08)	0.88 (0.86, 0.91)
> 2–3 h/day	1.08 (1.04, 1.11)	0.82 (0.80, 0.85)
3–4 h/day	1.16 (1.12, 1.19)	0.68 (0.66, 0.71)
> 4 h/day	1.31 (1.27, 1.35)	0.64 (0.62, 0.67)
Electronic gaming		
≤ 1 h/day[a]	1.0	1.0
> 1–2 h/day	1.04 (1.01, 1.07)	0.91 (0.89, 0.94)
> 2–3 h/day	1.09 (1.06, 1.13)	0.72 (0.70, 0.75)
> 3–4 h/day	1.14 (1.10, 1.19)	0.67 (0.64, 0.69)
> 4 h/day	1.26 (1.22, 1.30)	0.63 (0.61, 0.65)
Computer use		
≤ 1 h/day[a]	1.0	1.0
> 1–2 h/day	1.09 (1.06, 1.12)	0.88 (0.86, 0.91)
> 2–3 h/day	1.23 (1.19, 1.27)	0.76 (0.74, 0.79)
> 3–4 h/day	1.32 (1.28, 1.37)	0.64 (0.62, 0.67)
> 4 h/day	1.46 (1.42, 1.50)	0.61 (0.59, 0.63)

Adjusted for age, sex, BMI z-scores, physical activity, and Family Affluence Scale

aOR adjusted odds ratio, *CI* confidence interval

[a]Reference category

and school-based self-efficacy [28, 29]. It is possible that young children use screen time to cope with changes and transitions, a way to 'escape' the stress of navigating a new and possibly daunting school climate. As they begin to settle into a new school routine, the need to cope with changes is likely to decrease and, as such, reliance on screen-based escapism may also decrease [30]. Alternatively, adolescence is an important transition phase that connects childhood to adulthood, marked by significant changes in multiple layers of physical, psychological, and social aspects [26]. With increasing age, stress tends to increase [31] and social forces that influence and shape their values and norms also changes from parents and the home environment to peers and teachers within the school environment [32]. Given that older adolescents may experience increasing stress due to forces such as peer pressure, romantic relationships, and school performance [33], their stressors may stem from social and familial sources, with screen time seeming to be less of a source of stress or anxiety as children move into adolescence. Future research could aim to incorporate broad aspects of socio-emotional stress, as well as school stress and discretional screen time when assessing adolescent psychological wellbeing.

The findings of this study can have several public health implications. Given the large proportion of students were being stressed or not satisfied with school, and their links with high screen time, activities during recreational time

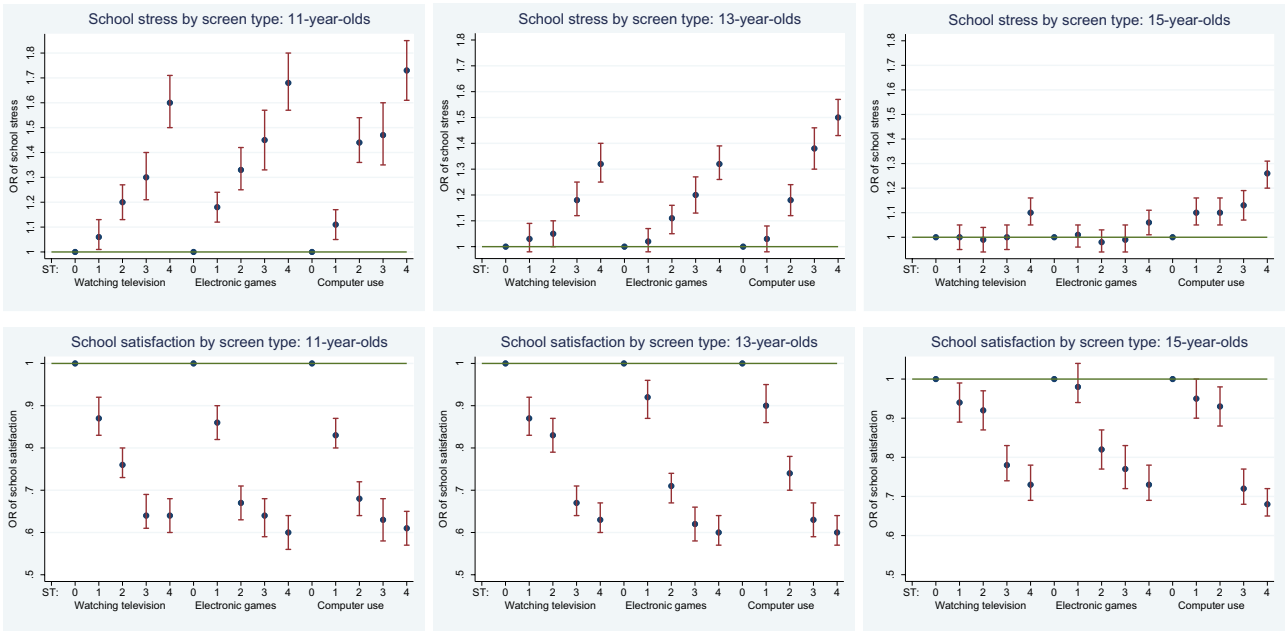

Fig. 2 Multilevel logistic regression estimates of associations of watching television, electronic gaming, and computer use with *school stress* and *satisfaction* among adolescents by *age group*, HBSC 2014. ST: 0 0–1 h/day, 1 > 1–2 h/day, 2 > 2–3 h/day, 3 > 3–4 h/day, 4 > 4 h/day. Each model was adjusted for age, BMI z-scores, physical activity, and Family Affluence Scale

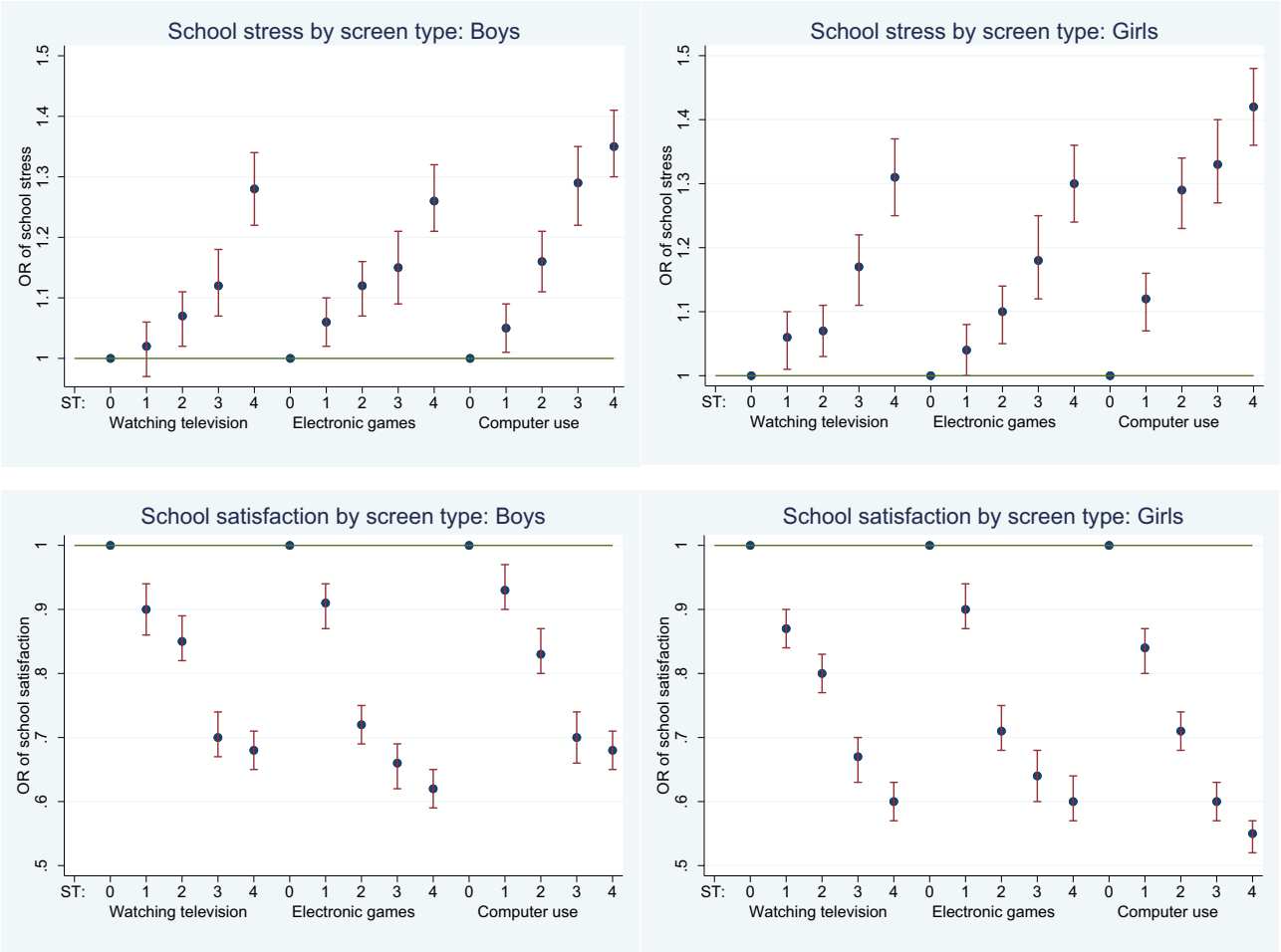

Fig. 3 Multilevel logistic regression estimates of associations of watching television, electronic gaming, and computer use with *school stress* and *satisfaction* among adolescents by *gender*, HBSC 2014. ST: 0 0–1 h/day, 1 > 1–2 h/day, 2 > 2–3 h/day, 3 > 3–4 h/day, 4 > 4 h/day. Each model was adjusted for age, BMI z-scores, physical activity, and Family Affluence Scale

could be effective points of intervention. First, encouraging students to explore healthy activities as alternatives to screen time, especially those that have social, physical, and mental health benefits, could be facilitated, at least in part, by schools [17]. At home, strategies could include collaboration with family members to create a non-screen-based leisure environment. Second, currently existing sedentary behaviour guidelines recommend limiting recreational screen time to no more than 2 h per day. The high recreational time spent on each screen type indicates that participating adolescents far exceed the total screen time recommendation. As digital screens have become an integral part of youth's daily life, revisiting the screen time recommendations for a more balanced approach with current reality is a demand of time. At the global level, mental health issues related to the excessive screen-based activities, colloquially known as technophobia or nomophobia [34], are increasing [35]. As such, public health strategies and recommendations should continuously encourage young people to use screen-based devices in moderation, particularly during their free time, and replace them by physical activity.

Our study includes a large sample of adolescents ($n = 191{,}786$) from 38 countries. We used multilevel regression modelling considering the nested structure of the data; therefore, potential school- and country-level differences in the association estimates are assumed to be appropriately managed for precision. However, some limitations should be noted. Single-item assessment of school stress and satisfaction might not have captured the real constructs. Data used in this study were collected during 2013/2014 and may not reflect rapidly changing contemporary screen media landscape, which may be dominated by increased use of social media and communication technologies. The mechanisms linking adolescent behaviours and psychological wellbeing are likely to be complex and change over time. Future elaboration of the mechanisms between behavioural and

psychological wellbeing indicators beyond associations is warranted. Lastly, we used self-reported, cross-sectional data; therefore, temporality cannot be established. However, given the use of large-scale, nationally representative samples from 38 high-income countries, results could be generalisable to those countries included in the analysis.

Conclusion

The present study found dose-dependent relationships between recreational screen time and both school stress and school satisfaction in adolescents. A strong age difference was found, whereby the associations were stronger for younger children, and decreased gradually with age. Several recommendations for intervention opportunities are noted, particularly within the school and home environments. Prospective research is warranted to evaluate the complex nature of adolescent wellbeing with respect to both school stress and contemporary screen time (e.g., social media) and establish directionality of the relationships.

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Authors' Contributions Asaduzzaman Khan led the conceptualisation, formal analysis, interpretation, and writing and reviewing the manuscript. Eun-Young Lee and Sharon Horwood contributed to interpretation of results and writing and reviewing the manuscript. All authors approved the final manuscript as submitted.

Availability of data and material This study is based on data, publicly available at https://www.uib.no/en/hbscdata (subject to permission from the data custodian).

Code availability Stata code may be available upon request.

Declarations

Ethics approval Analyses for this manuscript were approved by The University of Queensland Human Ethics Committee (2021/HE000671).

Consent to participate Not applicable as the current analysis was based on secondary analyses, publicly available (on request).

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

References

1. Cosma A et al (2020) Cross-national time trends in adolescent mental well-being from 2002 to 2018 and the explanatory role of schoolwork pressure. J Adolesc Health 66(6, Supplement):S50-S58
2. De Looze ME et al (2020) Trends over time in adolescent emotional wellbeing in the Netherlands, 2005–2017: links with perceived schoolwork pressure, parent-adolescent communication and bullying victimization. J Youth Adolesc 49(10):2124–2135
3. Klinger DA et al (2015) Cross-national trends in perceived school pressure by gender and age from 1994 to 2010. Eur J Public Health 25(Suppl 2):51–56
4. Gillander Gadin K, Hammarström A (2003) Do changes in the psychosocial school environment influence pupils' health development? Results from a three-year follow-up study. Scand J Public Health 31(3):169–177.
5. Aldridge JM, McChesney K (2018) The relationships between school climate and adolescent mental health and wellbeing: a systematic literature review. Int J Educ Res 88:121–145
6. Satici B (2020) Social exclusion and adolescent wellbeing: stress, school satisfaction, and academic self-efficacy as multiple mediators. Educational and Developmental Psychologist 37(1):67–74
7. Wentworth DK, Middleton JH (2014) Technology use and academic performance. Comput Educ 78:306–311
8. Samaha M, Hawi NH (2017) "Relationships among smartphone addiction, stress, academic performance, and satisfaction with life": corrigendum
9. Giunchiglia F et al (2018) Mobile social media usage and academic performance. Comput Hum Behav 82:177–185
10. Nayak JK (2018) Relationship among smartphone usage, addiction, academic performance and the moderating role of gender: a study of higher education students in India. Comput Educ 123:164–173
11. Li J, Lepp A, Barkley JE (2015) Locus of control and cell phone use: implications for sleep quality, academic performance, and subjective well-being. Comput Hum Behav 52:450–457
12. Nishida T, Tamura H, Sakakibara H (2019) The association of smartphone use and depression in Japanese adolescents. Psychiatry Res 273:523–527
13. Li X et al (2019) Sleep mediates the association between adolescent screen time and depressive symptoms. Sleep Med 57:51–60
14. Odgers CL, Schueller SM, Ito M (2020) Screen time, social media use, and adolescent development. Annual Review of Developmental Psychology 2:485–502
15. Twenge JM, Campbell WK (2018) Associations between screen time and lower psychological well-being among children and adolescents: evidence from a population-based study. Preventive medicine reports 12:271–283
16. Grøntved A et al (2015) A prospective study of screen time in adolescence and depression symptoms in young adulthood. Prev Med 81:108–113
17. Oberle E et al (2020) Screen time and extracurricular activities as risk and protective factors for mental health in adolescence: a population-level study. Prev Med 141:106291
18. Roberts C et al (2009) The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. Int J Public Health 54(Suppl 2):140–150
19. Torsheim T, Wold B (2001) School-related stress, support, and subjective health complaints among early adolescents: a multilevel approach. J Adolesc 24(6):701–713
20. Löfstedt P et al (2020) School satisfaction and school pressure in the WHO European Region and North America: an analysis of time trends (2002–2018) and patterns of co-occurrence in 32 countries. J Adolesc Health 66(6s):S59-s69

21. Bobakova D et al (2015) Test-retest reliability of selected physical activity and sedentary behaviour HBSC items in the Czech Republic, Slovakia and Poland. Int J Public Health 60(1):59–67
22. Currie C et al (2008) Researching health inequalities in adolescents: the development of the Health Behaviour in School-aged Children (HBSC) Family Affluence Scale. Soc Sci Med 66(6):1429–1436
23. Prochaska JJ, Sallis JF, Long B (2001) A physical activity screening measure for use with adolescents in primary care. Arch Pediatr Adolesc Med 155(5):554–559
24. White IR, Royston P, Wood AM (2011) Multiple imputation using chained equations: issues and guidance for practice. Stat Med 30(4):377–399
25. Khan A et al (2021) Dose-dependent and joint associations between screen time, physical activity, and mental wellbeing in adolescents: an international observational study. Lancet Child Adolesc Health 5:729–738
26. Sawyer SM et al (2012) Adolescence: a foundation for future health. Lancet 379(9826):1630–1640
27. Gunnell KE et al (2016) Examining the bidirectional relationship between physical activity, screen time, and symptoms of anxiety and depression over time during adolescence. Prev Med 88:147–152
28. Bagnall CL, Skipper Y, Fox CL (2020) *'You're in this world now': students', teachers', and parents' experiences of school transition and how they feel it can be improved*. Br J Educ Psychol 90(1):206–226
29. Kiuru N et al (2020) *Associations between adolescents' interpersonal relationships, school well-being, and academic achievement during educational transitions*. J Youth Adolesc 49(5):1057–1072
30. Simonsen I, Rundmo T (2020) The role of school identification and self-efficacy in school satisfaction among Norwegian high-school students. Soc Psychol Educ 23(6):1565–1586
31. Rudolph KD (2002) Gender differences in emotional responses to interpersonal stress during adolescence. J Adolesc Health 30(4 Suppl):3–13
32. Moksnes U et al (2010) The association between stress and emotional states in adolescents: the role of gender and self-esteem. Person Indiv Differences 49(5):430–435
33. Byrne DG, Davenport SC, Mazanov J (2007) Profiles of adolescent stress: the development of the Adolescent Stress Questionnaire (ASQ). J Adolesc 30(3):393–416
34. Anshari M, Alas Y, Sulaiman E (2019) Smartphone addictions and nomophobia among youth. Vulnerable Children and Youth Studies 14(3):242–247
35. Hoffner CA, Lee S (2015) Mobile phone use, emotion regulation, and well-being. Cyberpsychol Behav Soc Netw 18(7):411–416