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Adolescent use of social media and associations with sleep patterns across 18 European and North American countries

Meyran Boniel-Nissim, PhD[a], Jorma Tynjälä, PhD[b], Inese Gobiņa, PhD[c], Jana Furstova, MSc[d], Regina J.J.M. van den Eijnden, PhD[e], Claudia Marino, PhD[f], Helena Jeriček Klanšček, PhD[g], Solvita Klavina-Makrecka, MSc[h], Anita Villeruša, MD[c], Henri Lahti, MSc[b], Alessio Vieno, PhD[f], Suzy L. Wong, PhD[i], Jari Villberg, MSc[b], Joanna Inchley, PhD[j], Geneviève Gariépy, PhD[i,k*]

[a] Department of Educational Counselling, The Max Stern Academic College of Emek Yezreel, Emek Yezreel, Israel
[b] Faculty of Sport and Health Sciences, University of Jyvaskyla, Jyvaskyla, Finland
[c] Department of Public Health and Epidemiology, Institute of Public Health, Riga Stradins University, Riga, Latvia
[d] Olomouc University Social Health Institute, Palacky University Olomouc, Olomouc, Czech Republic
[e] Interdisciplinary Social Science, Utrecht University, Utrecht, The Netherlands
[f] Department of Developmental and Social Psychology, University of Padova, Padova, Italy
[g] National Institute of Public Health, Ljubljana, Slovenia
[h] Department of Public Health and Epidemiology, Riga Stradins University, Riga, Latvia
[i] Public Health Agency of Canada, Ottawa, Canada
[j] MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Glasgow, UK
[k] Department of Social and Preventive Medicine, School of Public Health, University of Montreal, Montreal, Canada

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ABSTRACT

Objective: Over the past decade, concurrent with increasing social media use (SMU), there has been a shift toward poorer sleep among adolescents in many countries. The purpose of this study was to examine the cross-national associations between adolescent SMU and sleep patterns, by comparing 4 different categories of SMU (nonactive, active, intense, and problematic use).
Design, setting, and participants: Data were from 86,542 adolescents in 18 European and North American countries that participated in the 2017/18 Health Behaviour in School-aged study.
Measurements: Mixed-effects linear regression models were used to examine cross-national associations between 4 SMU categories and adolescent sleep duration, bedtime and social jetlag derived from self-reported data.
Results: For all countries combined, nonactive SMU was associated with longer sleep, earlier bedtimes, and less social jetlag, compared to active SMU, although the differences were minor. By comparison, intense and problematic SMU were associated with less sleep and later bedtimes on both school and nonschool days, and greater social jetlag, compared to active SMU. While findings were relatively consistent between countries, some differences were observed, suggesting that the national and cultural context may be important in interpreting results.
Conclusions: These findings suggest that both intense and problematic SMU are associated with poorer sleep patterns in adolescents across most countries. Further research is needed to identify effective policies, programs, and messaging to promote the healthy use of social media and prevent potential negative impacts on adolescent sleep.

Introduction

The use of electronic media has increased rapidly over the past decade among adolescents,[1,2] with social media becoming an important platform for social connection.[3] Social media is an umbrella term

*Corresponding author: Geneviève Gariépy, PhD, Department of Social and Preventive Medicine, School of Public Health, University of Montreal, Montreal, Canada. Tel.: +1-514-294-5025.
E-mail address: genevieve.gariepy@umontreal.ca (G. Gariépy).

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covering both social networking sites (such as Instagram) and instant messaging apps (such as WhatsApp). Data from 2018 indicate that approximately one-third of adolescents in Europe and North America used social media almost all the time throughout the day,[4] although current figures are likely higher given the rise in use during the COVID-19 pandemic.[5,6]

As SMU is now common, its potential negative impacts are increasingly concerning. SMU may encompass 2 distinct but related concepts—intense and problematic SMU. The intensity of SMU indicates the frequency with which an individual uses social media, whereas problematic SMU refers to a loss of control over one's use and the presence of other addiction-like symptoms (eg, withdrawal, neglect of other activities) that are accompanied by significant impairments in daily functioning.[7] Thus, problematic SMU indicates a potentially addictive behavior with negative consequences, but intense SMU may not necessarily lead to negative outcomes.[8,9] Data from representative samples of adolescents from 29 countries showed that the prevalence of intense SMU (defined as having online contacts through social media almost all the time) varied between 17.4% in Switzerland and 49.9% in Italy, and the prevalence of problematic SMU varied from 3.2% in the Netherlands to 14.2% in Spain.[8]

Alongside the increasing use of social media, there has been a shift among adolescents toward poorer sleep, including shorter sleep duration, later bedtime, and greater social jetlag.[10,11] Insufficient sleep is widespread, affecting 30%-70% of adolescents in Europe and North America,[11] and emerging evidence suggests that other sleep patterns, such as social jetlag, also affect health.[10] Social jetlag is the inconsistent timing of sleep across the week, whereby, due to a shift toward a later chronotype during adolescence and early school start times, adolescents tend to sleep less and wake up earlier during the week but sleep more and wake up later on weekends.[12] Insufficient and poor sleep patterns have been associated with lower cognitive performance and negative health consequences such as cardiometabolic problems, obesity, and depressive and anxiety symptoms.[13-15]

Across countries, the use of electronic devices has been linked to shorter and poorer sleep among adolescents.[16,17] SMU may negatively affect adolescent sleep through multiple pathways. First, the use of electronic devices may delay sleep onset through blue light emission and increased cognitive arousal before bedtime; displace sleep-promoting activities, such as physical activity; and interrupt sleep (eg, receiving late text messages),[18,19] Second, beyond the effects of using a device itself, SMU may delay or disrupt sleep through psychosocial pathways.[18,20-25] For instance, Scott and colleagues[22] have suggested that fear of missing out (FoMO) and social norms may be key explanatory factors. Adolescents might be more prone to bedtime SMU if they fear losing social status because of missing important online interactions, or are concerned about social disapproval if they are not continuously available online. Accordingly, Kater and Schlarb[23] suggest that sleep disturbance might be related to the personal meaning of SMU for adolescents rather than only the duration of SMU.

Despite emerging studies linking SMU to poor sleep,[20,24,26-28] the evidence is still sparse, specifically with regard to different types of SMU, such as intense and problematic use. One study examined the association between intense and problematic SMU and sleep among Dutch adolescents and found that both were associated with later bedtimes and low quality of sleep.[20] Moreover, the relationship between SMU and sleep patterns may vary by age, as older adolescents tend to sleep less during the week, go to bed later, and experience greater social jetlag,[11] while also using online communication more often than younger adolescents.[4] Finally, knowledge mostly comes from studies conducted in individual regions or countries, using different measures and sampling strategies, thereby limiting cross-national comparison and challenging the generalizability of findings across different contexts. Cross-national differences can provide insights into potential social and cultural influences of adolescent SMU and sleep, and can also serve to inform country-specific discussions and actions regarding adolescent SMU and sleep.

The following study investigated the associations between SMU and sleep patterns in adolescents across 18 European and North American countries and by age group. We examined a gradient of SMU behaviors, including nonactive use, active use, intense use, and problematic use. These 4 SMU categories represent a continuum of exposures to social media with the potential for varying harms in terms of sleep problems. We hypothesized that intense and problematic SMU would be associated with poorer sleep patterns as compared to nonactive and active use and that the associations would be stronger for older than younger adolescents.

Methods

Data and participants

Data were from the 2017-2018 Health Behaviour in School-aged Children (HBSC) study, an international repeated cross-sectional survey on adolescent health in collaboration with the World Health Organisation. The survey collects data every 4 years from representative samples of 11-, 13- and 15-year-old students following a standardized international protocol.[29] The survey uses cluster sampling with schools as the primary sampling units. Study participation is voluntary and anonymous. Active informed consent was obtained from schools and participants. Depending on the country, passive or active informed consent was obtained from parents. Each participating country obtained ethical approval for their national survey.

The 2017-2018 HBSC was conducted in 48 European and North American countries and regions. For this study, we included 18 HBSC participating countries/regions that collected data on both the SMU questionnaire and sleep items (n = 94,693 total participants). We excluded participants with missing data on SMU (n = 8151). The final sample size was 86,542 in the following 18 countries/regions: Flemish Belgium (n = 3761), French Belgium (n = 3285), Canada (n = 9122), Czech Republic (n = 10,612), Denmark (n = 2823), Estonia (n = 4461), Finland (n = 2899), Greece (n = 3633), Hungary (n = 3561), Iceland (n = 6198), Latvia (n = 3985), Netherlands (n = 4540), Norway (n = 2572), Poland (n = 4828), Portugal (n = 5413), Republic of Moldova (n = 4325), Scotland (n = 4541), and Ukraine (n = 5983).

Measures

Social media use

The questionnaire included a preliminary explanation of the meaning of social media: "We are interested in your experiences with social media. The term social media refers to social network sites (eg, Facebook, [add other local examples]) and instant messengers (eg, [insert local examples], WhatsApp, Snapchat, Facebook messenger)."

Intense SMU. Using 4 items adapted from the EU Kids Online Survey,[30] adolescents identified how often they had online contact through social media with the following categories of people: close friends, friends from a larger friend group, friends they met through the internet, and other people (such as classmates, siblings, or teachers). Five frequency options ranged from "never or almost never" to "almost all the time throughout the day." Data analysis included individuals who provided information for at least one category of people. The highest frequency reported across the 4 categories of people was used to establish 3 levels of intense SMU: (1) nonactive (never/at most weekly); (2) active (daily/several times a day); and (3) intense (almost all the time). The items on the scale were not expected to have high intercorrelations (eg, adolescents with intense contact with close friends were not necessarily expected to have intense

contact with friends met through social media). Therefore, the internal consistency of the items was not assessed.[31]

Problematic SMU. The Social Media Disorder Scale[7,32] was used to identify adolescents exhibiting signs of problematic SMU. The scale asked participants if they experienced 9 items related to addictive behaviors during the past year, such as regularly neglecting other activities and lying about the amount of time spent on social media. Adolescents who reported 6 or more symptoms were classified as problematic users, independent of their intensity of SMU.

Four categories of SMU. Following the method used by Boniel-Nissim and colleagues,[9] we combined the intense and the problematic SMU scales into 4 mutually exclusive categories: (i) nonactive user (online contact with others not at all or at most weekly AND nonproblematic user,); (ii) active user (online contact with others daily but not all time AND nonproblematic user); (iii) intense user (online contact almost all the time throughout the day with at least one of the groups above AND nonproblematic user); and (iv) problematic user (6 or more symptoms regardless of the intensity of SMU).

Sleep patterns

Four items asked about sleep times: "When do you usually go to bed?" and "When do you usually wake up?" separately on school and nonschool days. Responses were in 30-minute intervals. Bedtime ranged from "No later than 21:00" to "02:00 or later" on school days, and "No later than 21:00" to "04:00 or later" on nonschool days. Wake-up time ranged from "No later than 05:00" to "08:00 or later" on school days and "No later than 07:00" and "14:00 or later" on nonschool days. Sleep duration was computed by subtracting bedtime from wake time separately on school and nonschool days. Social jetlag was estimated by calculating the difference in bedtimes on nonschool and school days.[33] In Finland, Portugal, and Scotland, sleep data were not collected in the youngest age group (11-year-olds).

Sociodemographic variables

The survey collected data on age (age groups: 11-year-olds, representing ≥10.5 to ≤12.5 years; 13-year-olds, >12.5 to ≤14.5 years; 15-year-olds, >14.5 to ≤16.5 years), gender (boy/girl), and family affluence. The latter was measured using the Family Affluence Scale (FAS),[29] a reliable and valid measure of socioeconomic status[34] that estimates affluence based on 6 items (number of cars, bathrooms, computers, and family holidays, ownership of a dishwasher, and having own bedroom) during the past year. The FAS score was categorized into tertiles (low, medium, high) with respect to gender, age, and country.

Statistical analysis

We first conducted descriptive analyses of the sample across the 4 SMU categories. We examined the overall associations between the 4 SMU categories and sleep by fitting mixed-effects linear regression models to the full sample, separately for each of the 5 sleep measures (sleep duration on school and nonschool days; bedtime on school and nonschool days; social jetlag), accounting for school-level and country-level clustering. We then examined cross-national associations by running the same mixed-effects linear regression models for each country. The intraclass correlation was calculated from each model to estimate the proportion of variation attributable to differences between countries or schools. All models were adjusted for gender, age, and family affluence. All covariates had less than 5% missing values. For the figures, we calculated the predicted sleep duration, bedtime, and social jetlag by SMU categories from the regression models using the margins commands in Stata. Statistical analyses were conducted in Stata/SE 15 (Stata Corp, College Station, TX). All analyses incorporated sampling weights where relevant to ensure results were representative of participating countries.

Results

Table 1 presents the characteristics of the full sample by SMU categories. Across the sample, 15.5% of adolescents reported nonactive SMU, 48.1% active SMU, 30.2% intense SMU, and 6.3% problematic SMU. Nonactive users were more likely to be boys than girls, younger, and from lower family affluence than their peers. Active social media users were evenly distributed across gender, age, and family affluence groups. Both intense and problematic users were more likely to be girls, older, and relatively evenly distributed across family affluence groups.

SMU and sleep duration

Table 2 and Supplementary Table 1 show the associations between the 4 SMU categories and sleep indicators across all

Table 1
Description of the study sample overall and by social media use categories

		Social media use			
	Full sample (%)	Nonactive user (%)	Active user (%)	Intense user (%)	Problematic user (%)
Proportion of sample	100% (*n* = 86,542)	15.5% (*n* = 13,311)	48.1% (*n* = 41,229)	30.2% (*n* = 26,536)	6.3% (*n* = 5466)
Gender					
Boys	49.1%	56.7%	48.6%	44.2%	42.2%
Girls	50.9%	43.3%	51.4%	55.8%	57.8%
Age group					
11 years	33.9%	51.8%	31.5%	25.2%	22.9%
13 years	34.5%	29.8%	35.9%	35.7%	31.2%
15 years	31.6%	18.5%	32.6%	39.1%	38.0%
Relative family affluence					
Low	34.4%	39.5%	33.1%	31.8%	36.0%
Medium	33.4%	33.6%	34.4%	32.7%	34.5%
High	32.2%	26.8%	32.5%	35.6%	31.9%
Sleep duration (mean, hh:mm)					
School days	8:19	8:45	8:22	8:05	7:47
Nonschool days	9:47	10:02	9:48	9:39	9:27
Bedtime (mean, hh:mm)					
School days	22:31	22:04	22:28	22:46	23:04
Nonschool days	00:01	23:18	23:54	00:28	00:50
Social jetlag (mean, hh:mm)	1:27	1:11	1:24	1:38	1:44

Note: All values are weighted.

Table 2
Associations between social media use categories and sleep indicators, all countries combined (HBSC 2017/2018)

	Sleep duration on school days Coefficient (95% CI)	Sleep duration on nonschool days Coefficient (95% CI)	Bedtime on school days Coefficient (95% CI)	Bedtime on nonschool days Coefficient (95% CI)	Social jetlag Coefficient (95% CI)
Social media use					
Nonactive use	0.13 (0.08, 0.17)	0.13 (0.09, 0.16)	−0.16 (−0.19, −0.12)	−0.34 (−0.40, −0.28)	−0.19 (−0.21, −0.16)
Active use	Reference	Reference	Reference	Reference	Reference
Intense use	−0.25 (−0.29, −0.22)	−0.18 (−0.21, −0.15)	0.25 (0.21, 0.28)	0.51 (0.45, 0.57)	0.25 (0.20, 0.31)
Problematic use	−0.51 (−0.57, −0.46)	−0.35 (−0.41, −0.28)	0.50 (0.45, 0.55)	0.84 (0.74, 0.93)	0.33 (0.24, 0.42)

Note: All regression models are adjusted for age, gender, and relative family affluence categories and weighted using survey weights. See Supplementary Table 1 for full model estimates.

countries combined, adjusted for gender, age, and family affluence. Nonactive SMU was associated with longer sleep on school days (+7.8 minutes) and nonschool days (+7.8 minutes), compared with active SMU, while intense and problematic SMU were associated with substantially less sleep on school days (−15.0 and −30.6 minutes, respectively) and nonschool days (−10.8 and −21.0 minutes, respectively). Approximately 15% of the variance in sleep duration on school days was attributable to differences between schools (intraclass correlation 0.15, 95% CI 0.10, 0.21) (Supplementary Table 1).

Country-specific associations between SMU categories and sleep duration on school days are presented in Fig. 1a and Supplementary Tables 2 and 4. In most countries, nonactive SMU was associated with slightly longer sleep on school days relative to active SMU. Differences were minor, ranging from less than + 1.0 minute in Denmark to +13.2 minutes in the Czech Republic and Portugal. Finland was the exception, with nonactive SMU being associated with shorter sleep (−22.2 minutes). Conversely, intense SMU was associated with shorter sleep on school days across all countries, ranging from −5.4 minutes in Flemish Belgium to −22.8 minutes in Latvia. Problematic SMU was associated with an even shorter sleep relative to active SMU, ranging from −17.4 minutes in Flemish Belgium to −49.8 minutes in Estonia.

The results on nonschool days followed similar patterns (Fig. 1b and Supplementary Tables 3 and 5). Nonactive SMU was associated with slightly longer sleep duration, ranging from +1.2 minutes in Norway to +13.2 minutes in Estonia, but associations were not statistically significant in most countries and were reversed in Finland (−6.0 minutes). Intense SMU was associated with shorter sleep in most countries, ranging from −4.8 minutes in Flemish Belgium to −19.8 minutes in Latvia. Problematic SMU was associated with even shorter sleep across most countries, ranging from −9.0 minutes in Hungary to approximately −30 minutes across Ukraine (−27.6 minutes), Scotland (−28.2 minutes), Finland (−30.0 minutes) and Estonia (−33.0 minutes).

SMU and bedtime

Across all countries combined (Table 2 and Supplementary Table 1), nonactive SMU was associated with earlier bedtimes on school days (−9.6 minutes) and nonschool days (−20.4 minutes), relative to active SMU, whereas intense and problematic SMU were related to substantially later bedtimes both on school days (+15.0 and +30.0 minutes, respectively) and nonschool days (+30.6 and +50.4 minutes, respectively).

Country-specific associations between SMU categories and bedtimes on school days are presented in Fig. 2 and Supplementary Tables 6-9. Nonactive SMU was associated with earlier bedtimes relative to active SMU across most countries, ranging from −4.2 minutes in Iceland to −16.2 minutes in Portugal. Finland was an exception where nonactive SMU was associated with a later bedtime of +15.6 minutes. Meanwhile, intense SMU was related to later bedtimes across every country, ranging from +4.8 minutes in Flemish Belgium to +21.0 minutes in Finland and Iceland. Similarly, problematic SMU was associated with later bedtimes in all countries, ranging from +14.4 minutes in Flemish Belgium to +45.0 minutes in Estonia.

The same pattern emerged on nonschool days (Fig. 2b and Supplementary Tables 7 and 9). Nonactive SMU was associated with earlier bedtimes relative to active SMU across all countries, ranging from −12.6 minutes in Norway and Iceland to −33.0 minutes in Estonia, except in Finland, where the association was inversed (+18.0 minutes) and not statistically significant. Conversely, intense SMU was associated with later bedtimes, ranging from +16.2 minutes in Flemish Belgium to +41.1 minutes in Latvia, while problematic SMU was associated with even later bedtime across countries, ranging from +31.2 minutes in the Republic of Moldova to +70.8 minutes in Estonia and Finland.

SMU and social jetlag by country

Across countries (Table 2 and Supplementary Table 1), nonactive SMU was linked with less social jetlag (−11.4 minutes), while intense and problematic SMU were associated with greater social jetlag (+15.0 and +19.8 minutes, respectively) than active SMU.

Country-specific results for SMU categories and social jetlag are presented in Fig. 3 and in Supplementary Tables 10 and 11. Nonactive SMU was associated with less social jetlag relative to active SMU in almost all countries except in Finland, ranging from −6.6 minutes in Poland and Greece to −18.6 minutes in Estonia. On the other hand, intense SMU was associated with greater social jetlag in every participating country, ranging from +6.6 minutes in Iceland to +21.0 minutes in Canada. Finally, problematic SMU was associated with greater jetlag in most countries except Hungary, Iceland, and the Republic of Moldova, ranging from +13.2 minutes in Norway to over 30 minutes in Finland (+31.8 minutes) and Scotland (+35.4 minutes).

SMU and sleep patterns by age

Table 3 presents the associations between SMU categories and sleep indicators by age for all countries combined. Overall, we found few differences across age groups. The most notable difference was in bedtime on nonschool days, where problematic SMU was associated with a bedtime almost an hour (+58 minutes) later relative to active SMU in 13-year-olds compared to differences of +50 minutes in 11-year-olds and +43 minutes in 15-year-olds. The results across countries are available in Supplementary Tables 12-29.

Discussion

This study examined the associations between SMU and sleep patterns among adolescents across 18 European and North American countries. Given the widespread of SMU in adolescents and the importance of sleep to their development and well-being, increasing our understanding of SMU and sleep is imperative to mitigate

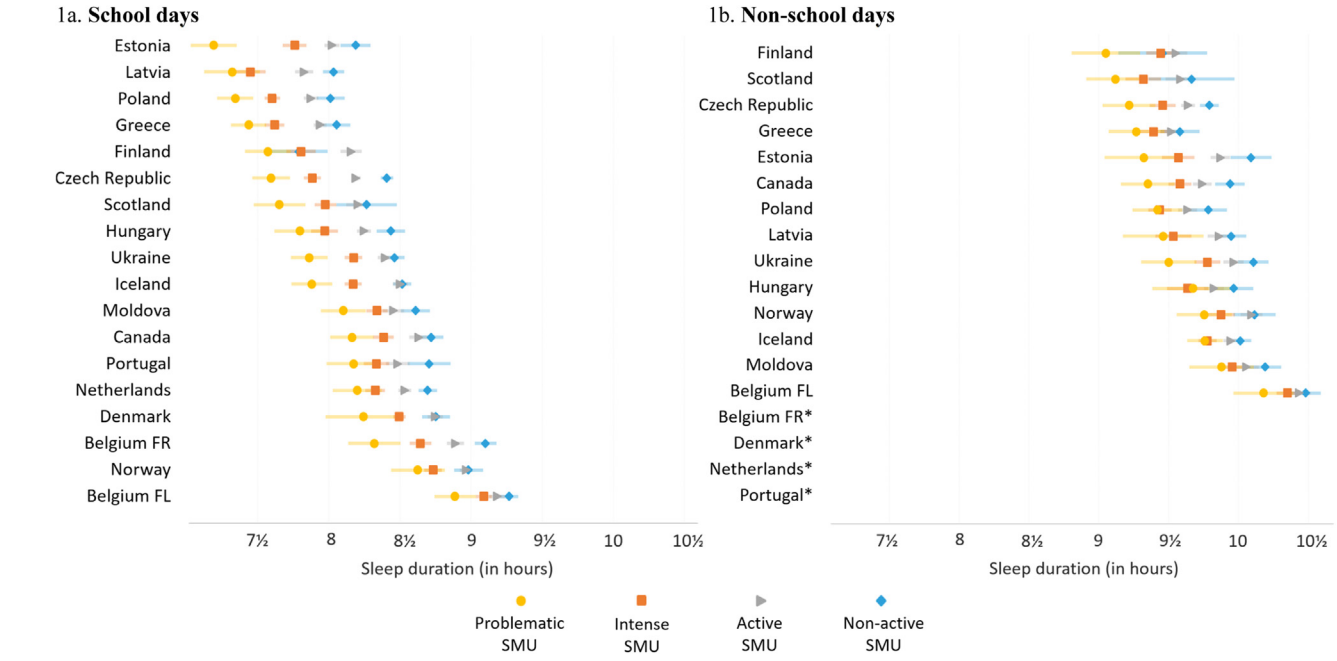

Fig. 1. Predicted sleep duration (in hours with 95% CI) on school and nonschool days by social media use categories across countries. *Data unavailable. Belgium FL, Flemish Belgium; Belgium FR, French Belgium; SMU, social media use. Bars indicate 95% confidence intervals. All estimates were adjusted for age, gender, and relative family affluence categories and weighted using survey weights. Data from Finland, Portugal, and Scotland excluded the youngest age group (11-year-olds). See Supplementary Tables 4 and 5 for detailed estimates.

negative impacts. In line with our expectations, our findings show that, across countries, intense and problematic SMU were consistently associated with shorter sleep durations, later bedtimes and greater social jetlag. The largest associations were observed for problematic SMU. In keeping with other cross-sectional[21,26,28] and longitudinal research,[20,24] our results support the hypothesis that both intense and problematic SMU may impede healthy sleep patterns in adolescents. Our study extends the literature by showing a similar and consistent pattern of associations that expands across European and North American countries.

Our findings point to both problematic and intense SMU as factors associated with poor adolescent sleep. This is interesting because previous cross-sectional and longitudinal studies have shown that while problematic SMU was negatively related to mental, school, and social domains of adolescent well-being, intense SMU was not.[8,9] As our study operationalized intense SMU as online contact all the time,

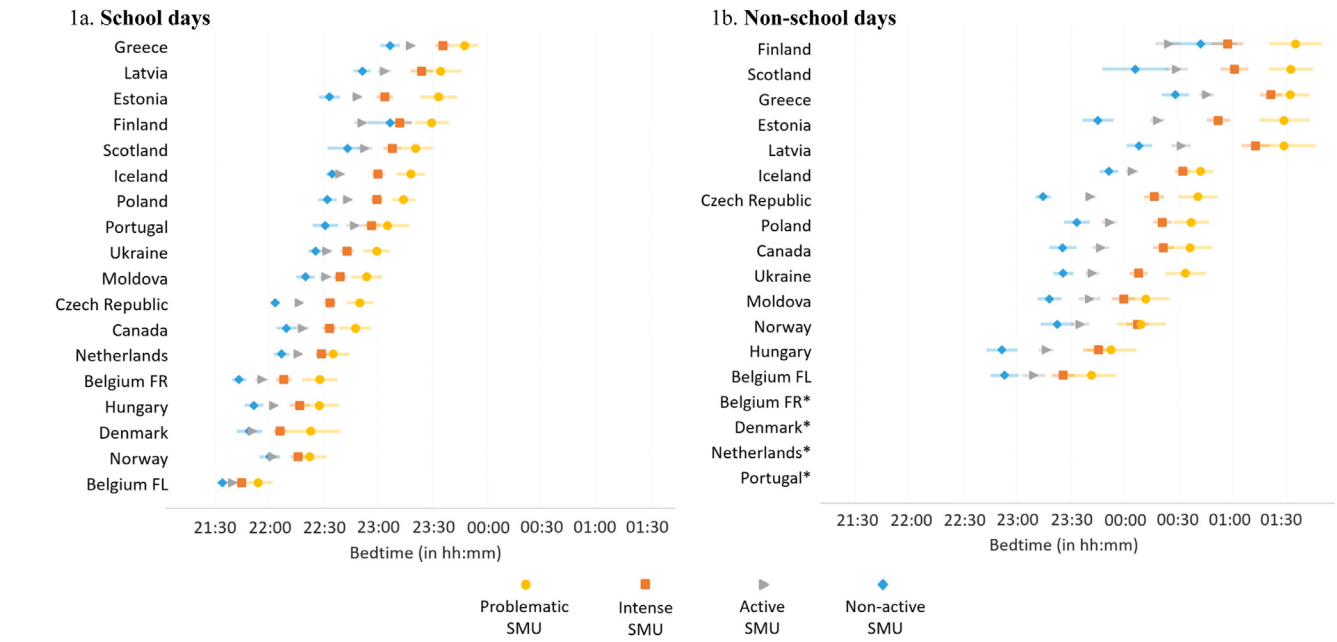

Fig. 2. Predicted bedtime (in hh:mm with 95% CI) on school and nonschool days by social media use categories across countries. *Data unavailable. Belgium FL, Flemish Belgium; Belgium FR, French Belgium; SMU, social media use. Bars indicate 95% confidence intervals. All estimates were adjusted for age, gender, and relative family affluence categories and weighted using survey weights. Data from Finland, Portugal, and Scotland excluded the youngest age group (11-year-olds). See Supplementary Tables 8 and 9 for detailed estimates.

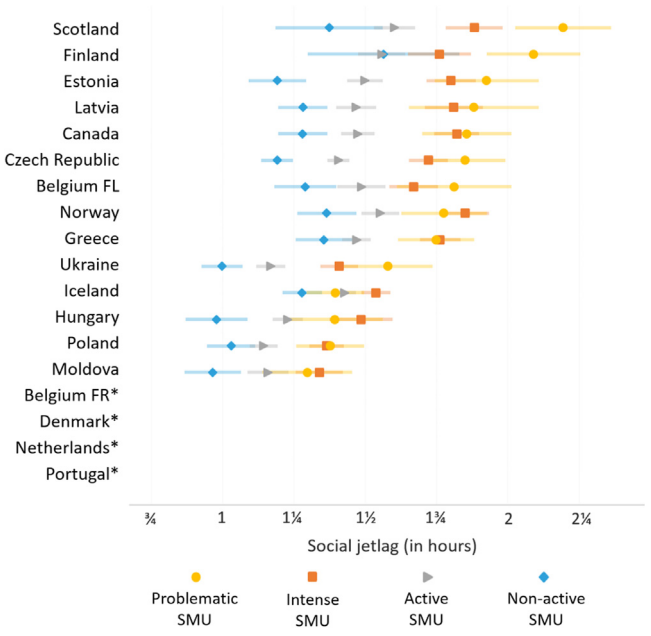

Fig. 3. Predicted social jetlag (hours with 95% CI) by social media use categories across countries. *Data unavailable. Belgium FL, Flemish Belgium; Belgium FR, French Belgium; SMU, social media use.

Bars indicate 95% confidence intervals. All estimates were adjusted for age, gender, and relative family affluence categories and weighted using survey weights. Data from Finland, Portugal, and Scotland excluded the youngest age group (11-year-olds). See Supplementary Table 11 for detailed estimates.

our results indicate that high frequency of SMU, even if not problematic, negatively relates to healthy sleeping patterns, supporting similar longitudinal findings.[20] As well as the direct effects of electronic devices on sleep (eg, blue light exposure, cognitive arousal), other psychosocial mechanisms may explain the relationships between intense and problematic SMU and sleep problems, and differences between each. For instance, adolescents who are in constant online contact with others may have social commitments that overflow into the night or engage in co-rumination about problems with others that can keep them up.[35] The Theory of Media Multitasking Intensity[36] points to adolescents as the most vulnerable to intense media multitasking, mainly SMU, as part of their need to establish their memberships in the physical and virtual worlds, and thus experience negative implications such as sleep problems.[37]

Meanwhile, adolescents with problematic SMU experience addiction-like symptoms, such as a desire to spend more time on social media and feeling bad when being offline, making it more difficult to disconnect from social media at night. A qualitative study among Scottish adolescents found that adolescent night-time SMU was driven by concerns over negative consequences for real-world relationships if they disconnected from social media, resulting in delayed bedtimes, insufficient sleep, and daytime tiredness.[27] These concerns included the risk of offline peer exclusion from missing out on online interactions and fear of social disapproval from violating norms around online availability.[22,27] Previous studies have demonstrated a link between SMU, FoMO and sleep problems,[25] but further research is needed to examine whether these associations are more prone in problematic or intense users, and whether they vary across countries.

Our findings suggest that active SMU (characterized as daily online contact with others and nonproblematic use) is generally linked with minor differences in sleep patterns relative to nonactive SMU across most countries. The only exception was in Finland, where nonactive users reported shorter sleep duration and later bedtimes compared with active users. These results point to the fine line between being active through social media and maintaining a healthy sleep pattern. These findings also add to our understanding of the Goldilocks hypothesis,[38] which posits that moderate SMU, typically measured using frequency of use, is associated with the highest level of well-being. In contrast, our results show a monotonic relationship between gradients of SMU and sleep, with the healthiest sleep patterns generally found for nonactive SMU and the unhealthiest, for problematic SMU. However, further research is warranted to inform healthy SMU recommendations, particularly as SMU continues to grow.

The associations between SMU and sleep were relatively consistent across age groups in most countries, except for some differences in bedtimes on nonschool days. The associations between problematic SMU and later bedtimes on nonschool days were greater in 13-year-olds than in 11- and 15-year-olds. Oshima and colleagues[39] reported that mobile phone use after lights were turned off at night

Table 3
Associations between social media use categories and sleep indicators in different age categories, all countries combined (HBSC 2017/2018)

Social media use	Sleep duration on school days Coefficient (95% CI)	Sleep duration on nonschool days Coefficient (95% CI)	Bedtime on school days Coefficient (95% CI)	Bedtime on nonschool days Coefficient (95% CI)	Social jetlag Coefficient (95% CI)
11 years old					
Nonactive use	0.11 (0.07, 0.14)	0.09 (0.05, 0.13)	−0.12 (−0.15, −0.09)	−0.28 (−0.34, −0.23)	−0.16 (−0.20, −0.12)
Active use	Reference	Reference	Reference	Reference	Reference
Intense use	−0.18 (−0.23, −0.12)	−0.11 (−0.19, −0.04)	0.15 (0.11, 0.20)	0.40 (0.35, 0.46)	0.25 (0.21, 0.30)
Problematic use	−0.47 (−0.58, −0.36)	−0.43 (−0.60, −0.27)	0.45 (0.36, 0.54)	0.83 (0.64, 1.02)	0.39 (0.26, 0.52)
13 years old					
Nonactive use	0.16 (0.08, 0.23)	0.22 (0.16, 0.28)	−0.18 (−0.23, −0.12)	−0.40 (−0.52, −0.29)	−0.23 (−0.29, −0.17)
Active use	Reference	Reference	Reference	Reference	Reference
Intense use	−0.27 (−0.31, −0.24)	−0.20 (−0.27, −0.13)	0.28 (0.25, 0.31)	0.59 (0.52, 0.67)	0.30 (0.24, 0.37)
Problematic use	−0.58 (−0.68, −0.49)	−0.43 (−0.53, −0.33)	0.55 (0.47, 0.64)	0.96 (0.84, 1.08)	0.38 (0.29, 0.48)
15 years old					
Nonactive use	0.14 (0.07, 0.22)	0.09 (0.03, 0.14)	−0.22 (−0.28, −0.15)	−0.39 (−0.47, −0.31)	−0.20 (−0.24, −0.15)
Active use	Reference	Reference	Reference	Reference	Reference
Intense use	−0.27 (−0.31, −0.23)	−0.19 (−0.26, −0.13)	0.27 (0.22, 0.31)	0.50 (0.42, 0.58)	0.22 (0.17, 0.28)
Problematic use	−0.47 (−0.54, −0.39)	−0.20 (−0.29, −0.12)	0.47 (0.40, 0.54)	0.72 (0.59, 0.85)	0.25 (0.11, 0.39)

Note: All regression models are adjusted for gender and relative family affluence categories and weighted using survey weights.

was negatively related to sleep duration only in younger adolescents (13-15 years), but not in older adolescents (16-18 years). Because older adolescents tend to go to bed later,[11] in part because of their changing biology, problematic SMU may not affect their bedtime to the same extent. Nevertheless, insufficient sleep and social jetlag are more common among older adolescents and intense and problematic SMU are also more prevalent in this age group.[8,11] This has important implications for adolescent functioning across a range of contexts, including schools, family, and leisure time.

While the findings were relatively consistent between countries, differences were observed, suggesting that the national and cultural context may be important in interpreting results. These differences may be explained by the broader context of the social and school environment in these countries. For instance, the relationship between SMU and sleep can be affected by school start times. The delayed bedtime associated with intense or problematic SMU may have a greater negative impact on sleep duration among students who start school early than those who start school later. Country-level differences in parental rules around sleep may provide another explanation. A recent Dutch study found that strict parental rules about restricting internet use in the hour before going to sleep and leaving the smartphone out of the bedroom were related to earlier bedtimes and better sleep quality among adolescents.[20] However, this protective effect was not observed among adolescents reporting problematic intense and SMU.

Study strengths and limitations

The present study has several strengths, including a large representative cross-national sample and validated variables that enabled country-level comparisons. In addition, the current study adds to the literature by investigating a range of sleep indicators and 4 different patterns of SMU.

Several study limitations should be acknowledged. First, data were collected in 2017/18 before the start of the COVID-19 pandemic. Recent studies conducted during the pandemic suggested an increase in SMU[5,6] and changes in sleep patterns[40] among adolescents. Therefore, we recommend taking our result as relevant for prepandemic and as a base to compare to postpandemic results. Second, the cross-sectional data do not allow for causal inferences. Longitudinal research on SMU and sleep is required to determine the direction of causality. Third, all measures were based on self-report instruments that may deviate from adolescents' actual time using social media and sleep patterns. Notably, the intensity of SMU was a measure of active (ie, communicating with others) and not passive SMU (eg, scrolling through the feed). Additionally, SMU was categorized based on intensity of use and problematic use; however, other measures of SMU, such as duration, timing, and content, may also contribute to sleep problems. Future studies could use objective measurements of frequency and time spent on social media, such as smartphone tracking applications. Finally, other measures can shed light on SMU, as suggested in previous work,[27] such as social anxiety and self-consciousness.

Conclusions

This study found that, across 18 countries, both intense and problematic SMU were associated with shorter sleep duration, later bedtimes, and greater social jetlag in adolescents. Given the high prevalence of intense and problematic SMU and the importance of sleep to adolescent health and well-being, these findings have important public health and research implications and help identify potential harms associated with certain types of SMU. Further research is required to identify effective policies, programs, and messages to promote healthy SMU and prevent potential negative impacts on adolescent sleep patterns.

Declaration of conflict of interest

The authors have declared no conflicts of interest.

Disclosures

HBSC is an international study carried out in collaboration with WHO/EURO. The International Coordinator is Jo Inchley (University of Glasgow) for the 2017/18 survey. The Data Bank Manager was Oddrun Samdal (University of Bergen). The 2017/18 survey included in this study was conducted by the following Principal Investigators in the 18 countries: Flemish Belgium (Bart De Clercq, Anne Hublet), French Belgium (Katia Castetbon), Canada (William Pickett, Wendy Craig), Czech Republic (Michal Kalman), Denmark (Katrine Rich Madsen), Estonia (Leila Oja, Jaanika Piksööt), Finland (Jorma Tynjälä), Greece (Anna Kokkevi), Hungary (Ágnes Németh), Iceland (Arsaell M. Arnarsson), Latvia (Iveta Pudule), the Netherlands (Gonneke Stevens, Saskia van Dorsselaer), Norway (Oddrun Samdal), Poland (Anna Dzielska, Agnieszka Malkowska-Szkutnik), Portugal (Tania Gaspar), Republic of Moldova (Galina Lesco), Scotland (Jo Inchley), Slovakia (Andrea Madarasova Geckova), Slovenia (Helena Jeriček Klanšček), Spain (Carmen Moreno, Francisco Rivera), Sweden (Petra Lofstedt), Switzerland (Marina Delgrande), Ukraine (Olga Balakireva), Wales (Chris Roberts).

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.sleh.2023.01.005.

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