



Impact of high-frequency email and instant messaging (E/IM) interactions during the hour before bed on self-reported sleep duration and sufficiency in female Australian children and adolescents

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ABSTRACT

Introduction: Social media interactions via email and instant messaging (E/IM) are common in children and adolescents and may lead to insufficient sleep. This study investigated associations between high-frequency E/IM use to interact with peers, perceived insufficient sleep, and reduced time in bed (TIB) in female children and adolescents.

Methods: The Children's Report of Sleep Patterns was completed by 189 female primary and secondary school students (8–16 years old). Responses were categorized as binary variables (high-frequency use vs not high-frequency use; right amount of sleep vs too little sleep), and TIB was calculated from bed and wake times for the previous 24 hours.

Results: High-frequency social media interactions using E/IM during the hour before bed were significantly associated with perceived insufficient sleep (odds ratio [confidence interval]: 2.68 [1.39–5.17]) but not with reduced TIB (−19.07 [−40.02 to 1.89]).

Conclusions: High-frequency social media interactions using E/IM in the hour before bed are a potentially modifiable risk factor for insufficient sleep in female students. Strategies to reduce nighttime usage may improve sleep in children and adolescents.

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Introduction

Mobile electronic devices such as phones, tablets, and laptops provide children and adolescents with immediate and unbound access to social interactions regardless of the time of day. Instant messaging is now the dominant form of peer communication for adolescents.¹

The social and emotional engagement that comes with this unprecedented access to mobile devices can have benefits. For example, instant messaging has been shown to foster friendship quality² and contribute to the well-being of distressed adolescents.³ Online communication can also support a sense of belonging and self-disclosure,

two important mechanisms of identity development during childhood and adolescence.⁴

Being constantly connected, however, may reduce autonomy, and being cut off from online communications can lead to “fear of missing out”⁵ and feelings of anxiety.⁴ This reliance on being constantly connected can result in high-frequency social media use.⁶ Social media use of more than 2 hours per day has been associated with worse mental health in children and adolescents.⁷

High-frequency social media use may also lead to poor sleep. Nighttime Internet use in general is linked to shorter sleep duration and increased daytime tiredness in children and adolescents.^{8–10} In America, 75% of children have at least one electronic device in the bedroom, and 16% report reading or sending emails and messages after initially going to sleep.¹⁰ Few studies have assessed the specific impact of social media use (ie, emailing and messaging) on sleep in

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both children and adolescents. Those that have show that increased duration of nighttime social media use is associated with reduced sleep quality and sleep duration, increased daytime sleepiness, and poor academic performance.^{11–13}

The aims of this study were threefold:

- to investigate the frequency of email/instant messaging (E/IM) use during the hour before bed, perceived sleep sufficiency, and time in bed (TIB);
- to establish how the frequency of E/IM use during the hour before bed, perceived sleep sufficiency, and TIB change with age; and
- to investigate relationships between E/IM, perceived sleep sufficiency, and TIB.

Methods

The study was approved by the University of South Australia's Divisional Human Research Ethics Committee. Written consent to conduct the study was given by schools prior to administration. Information sheets and consent forms were provided to the schools to distribute to all participants in years 3–10 at two schools in the Adelaide metropolitan area. Schools were asked to follow up return of consent forms with parents where possible. Parents provided signed consent for their child to participate; forms were collected by classroom teachers and given to the researcher independently of questionnaires to eliminate any possibility of individual identification of respondents.

The questionnaire was administered to consented participants in the classroom during usual class time. Participants were informed that participation was voluntary and there would be no repercussions for their school grades or general school participation if they did not participate. Participants were told the research was intended to find out more about sleep patterns. As the questionnaire was administered in a group setting, participants were asked to complete the questionnaire independently and not to discuss their responses with fellow students. They were permitted to ask the researcher clarifying questions if unclear.

Measures

The Children's Report of Sleep Patterns (CRSP) measures self-reported sleep patterns, sleep hygiene, and sleep disturbance in children and adolescents ages 8–17 years. The CRSP has good test-retest reliability and validity in child and adolescent populations.^{14,15} Participants self-reported their current age in years, and this was included in analyses because of the relationship with instant messaging frequency and sleep in previous studies.¹⁶

Higher use of social media to interact with peers is linked to poorer well-being in adolescent girls but not boys.¹⁷ However, the relationship between these social interactions before bed and subsequent sleep in girls is not clear. To determine frequency of E/IM use during the hour before bed, participants were asked: "During the hour before bed, how often do you email or instant message with friends?" Response options included never, not often (<once/wk), sometimes (1–2 times/wk), usually (3–5 times/wk), and always (every day); participants were categorized as "high-frequency" users if they indicated usually or always using E/IM during the hour before bed and "low frequency" for the other responses. Sleep sufficiency was determined with the question: "Most nights, do you feel you get..." with response options of "too much sleep," "the right amount of sleep," and "too little sleep." Responses were binned into a binary variable reflecting sufficient (the right amount of sleep) and insufficient (too little sleep). Only two participants indicated they felt they achieved too much sleep. These participants were included in the "sufficient" variable because their reported TIB did not

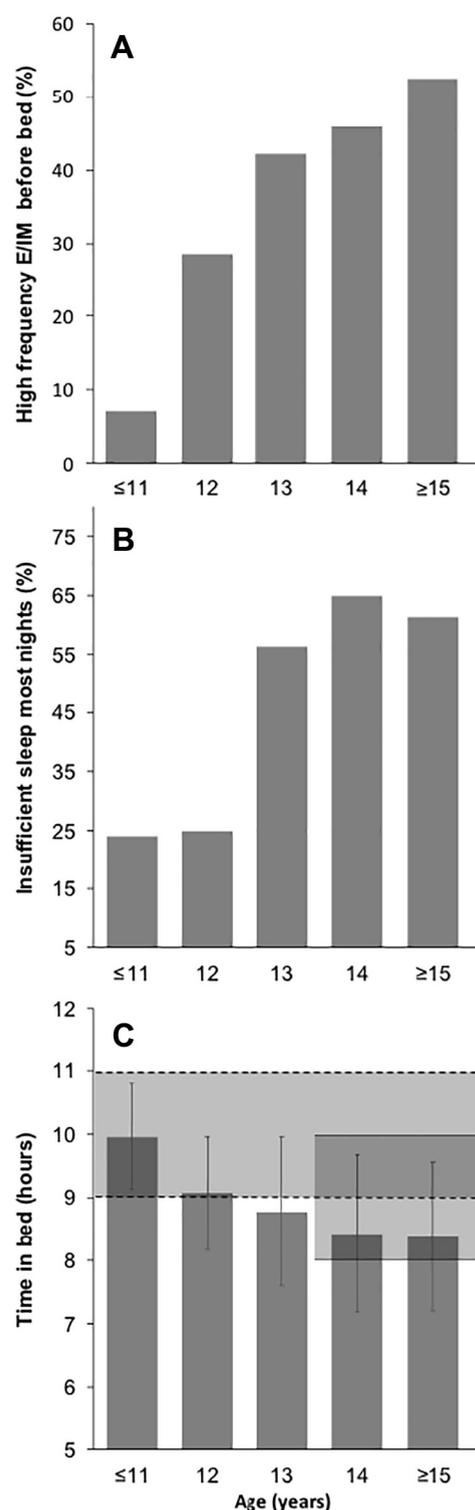


Fig. 1. E/IM use in the hour before bed, insufficient sleep, and TIB by age group (≤11 years, n = 29; 12 years, n = 21; 13 years, n = 39; 14 years, n = 37; ≥15 years, n = 63). A, Proportion of sample reporting high-frequency E/IM in the hour before bed (high frequency defined as usually or almost always, equating to 3 or more nights per week). B, Proportion of sample reporting insufficient sleep (reporting "too little sleep") most nights of the week. C, Mean (±SEM) TIB (hours), with shaded areas delimited by dotted lines reflecting the National Sleep Foundation's recommended sleep duration for 6- to 13-year-old children and shaded areas delimited by solid lines reflecting the recommended sleep duration for 14- to 17-year-old children.

exceed the recommended National Sleep Foundation guidelines. Removing these cases did not change the outcome of the analyses. Participants were asked their bed and wake times in the previous 24 hours which facilitated calculation of TIB in hours, as well as their habitual bed and wake times in half-hourly categorical increments. TIB from last night (continuous) was compared with habitual sleep time calculated from the midpoint of categorical bed and wake times. A positive correlation was found ($r_{187} = 0.27, P < .001$), suggesting use of continuous TIB from the previous night was appropriate to reflect habitual TIB for analyses.

Data analysis

A small quantity of data was missing for insufficient sleep ($n = 2$), TIB ($n = 1$), and E/IM use ($n = 2$). Consequently, a total of four participants were excluded from the final models.

Data were analyzed with IBM SPSS Statistics version 22. To investigate the relationship between self-reported high-frequency E/IM use in the hour before bed and perceived insufficient sleep, a binary logistic regression analysis was conducted specifying perceived sleep insufficiency (1 = too little sleep, 0 = the right amount) as the dependent variable. To determine the relationship between self-reported high-frequency E/IM use and TIB, a linear regression analysis was conducted specifying TIB (in hours) as the dependent variable. Both models specified a predictor of high-frequency E/IM use (1 = usually or always, 0 = never, not often, or sometimes), controlling for age (in years). Initial models included a high-frequency E/IM use by age interaction term; however, the interaction effects did not contribute significantly to the models and are consequently not reported.

Results

Sample descriptives

A total of 189 female Australian children and adolescents aged 8–16 years (mean \pm SD, 13.3 \pm 2.0 years) from two independent South Australian schools completed the questionnaire as part of a larger validity and reliability study for the CRSP. School A was a single-sex education provider (all female, $n = 138$), and school B was a coeducational provider (female, $n = 51$). Across the full sample, 39.6% reported high-frequency E/IM use in the hour before bed, and 51.3% reported insufficient sleep on most nights. Average TIB was 8.8 hours (SEM \pm 1.2 hours).

The proportion of the sample reporting high-frequency E/IM use in the hour before bed increased with age, from 7.1% in those younger than 11 years to more than half of the sample (52.4%) aged 15 years or higher (Fig. 1A). The proportion of the sample who reported

insufficient sleep ranged from approximately one-quarter for those aged 11 years or less to more than half of respondents aged 13 years or more (Fig. 1B). Average TIB (\pm SEM) decreased with age, from 9.96 hours (± 0.15) in respondents aged 11 years or less to 8.39 hours (± 0.15) in those aged 15 years or over (Fig. 1C).

High frequency E/IM use and insufficient sleep

Controlling for age, the odds of reporting insufficient sleep on most nights were aOR = 2.68 (95%CI 1.39–5.17) times higher for those reporting high frequency E/IM. Every increasing year of age was associated with a 24% (95%CI 4%–47%) increase in the odds of reporting insufficient sleep on most nights (Table 1).

High frequency E/IM use and time in bed (TIB)

Controlling for age, there was no significant association between high frequency E/IM in the hour before bed and TIB. Every increasing year of age was associated with a reduction in TIB of nearly 15 minutes ($\beta = -14.52, t_1 = -5.60, P < .001$). Age accounted for nearly 25% of the variance in TIB.

Discussion

These data provide new insight into self-reported high-frequency E/IM use in the hour before bed in female children as young as eight years. High-frequency E/IM was prevalent in female Australian children and adolescents, increasing in frequency with age. Frequency of perceived insufficient sleep on most of nights of the week increased with age, and there was a corresponding decline in time spent in bed, in line with existing literature.^{10,18} These findings suggest that strategies to both reduce the frequency of E/IM usage and provide usage advice specific to times of day may provide a useful approach to improving sleep duration in school-aged children and adolescents.

Social media use in children has received mixed reports with regard to impacts on sleep health, and the more specific role of E/IM which directly facilitates social interaction and engagement has until now not received as much attention. Our findings indicate that not only does usage increase with age as anticipated in female students but E/IM use independently predicts perceived insufficient sleep, with similar odds ratios observed as in a meta-analysis of studies on children who have access to devices at bedtime.¹⁹ No relationship was seen between E/IM use and reduced TIB. It is possible that this may be a consequence of overlap between device usage and bedtime in students, or may be a consequence of the small sample size. This will need to be clarified in future studies.

Table 1

Results of the binary logistic regression for insufficient sleep ($n = 185$, upper rows) and the linear regression for TIB ($n = 185$, lower rows)

| Dependent variable | | aOR | 95% CI LL | 95% CI UL | Wald χ^2 | P | Model R ^{2a} |
|--|------------------------------|---------|-----------|-----------|---------------|-------|-----------------------|
| Insufficient sleep ^b (yes/no) | Age (y) | 1.24 | 1.04 | 1.47 | 6.03 | .014 | 0.11 |
| | High-frequency E/IM (yes/no) | 2.68 | 1.39 | 5.17 | 8.67 | .003 | |
| Dependent variable | | β | 95% CI LL | 95% CI UL | t_1 | P | Model R ² |
| TIB (min) | Age (y) | -14.52 | -19.64 | -9.40 | -5.60 | <.001 | 0.27 |
| | High-frequency E/IM (yes/no) | -19.07 | -40.02 | 1.89 | -1.80 | .074 | |

aOR, adjusted odds ratio; CI, confidence interval; LL, lower limit; UL, upper limit. Insufficient sleep = reporting "too little sleep" on most nights; high-frequency E/IM = usually or almost always = 3 or more nights per week; β = unstandardized regression weights.

^a Cox and Snell estimate.

^b Model $\chi^2 = 22.23, P = .003$.

Given that some social media use is linked to some positive social outcomes in adolescents,^{2–4} it is important that balanced consideration of the impact is a component of public health advice regarding usage. Avoidance of devices entirely is unlikely and potentially unhelpful given the apparent social benefits. However, in light of the high perceived insufficient sleep in these students, particularly in the early teenage respondents, there may be benefit from providing recommendations around E/IM usage time and proximity to bed time.

These preliminary findings should be considered in light of study limitations. The focus on female subjects means that it is not possible to extrapolate findings to male students, and further investigation in larger samples with male participants is required. Younger children (8–10 years, n = 48) were underrepresented in this study. Although sufficiently large to detect a relationship between E/IM and perceived inadequate sleep, the sample size was smaller than anticipated, resulting in concerns of statistical power. With a larger sample, it is anticipated that E/IM would have had a significant impact on TIB. Given that self-reported sleep habits and behaviors have now been validated in children as young as eight, there is a strong case to further investigate these relationships in a larger, and more representative, sample of young school-aged children. Future studies should also consider asking about E/IM usage in bed in children and adolescents, as instant messaging is linked with poor sleep outcomes in American secondary students.¹² Although this study specifically asked about E/IM interactions, it is possible that other sources of online interaction may yield differential findings, and different forms of Internet use for socializing should be considered in future studies. In summary, the present findings support a growing literature that indicates the need for sleep hygiene education and evening management of social media, particularly around interactive technologies like E/IM, in female children as young as eight.

Disclosure Statement

The authors have no conflicts of interest to disclose relevant to this manuscript.

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