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Say “GDNT”: Frequency of Adolescent Texting at Night

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Abstract

Objective—Electronic media use is pervasive among adolescents. However, prior studies of media use have not specifically focused on texting behavior, and current estimates of teen texting -- a primary form of communication among adolescents -- are based on teens’ self-reported use. Evaluating the frequency of nighttime texting is crucial, given evidence that such behaviors may contribute to epidemic levels of insufficient sleep among adolescents.

Methods—Descriptive analysis of objectively recorded outgoing text message data in a sample of adolescents (N=43; M=16.06, SD 1.29 years of age; 63% females).

Results—The current study found that texting behavior was ubiquitous in the pre-bedtime period with 98% of adolescents sending at least one text after 8:00 pm. Texting was also very prevalent at night: 70% of participating teens sent at least one text between 10:00 pm and 5:59 am.

Conclusions—These findings add to a growing body of literature highlighting the potential role of mobile electronic devices in adolescent sleep disturbances.

Keywords

Adolescents; media use; texting; nighttime; mobile technology

Electronic media use is pervasive among American adolescents, and it has become a fundamental aspect of contemporary adolescent development and communication(1). Given the rapidly evolving nature of modern day electronic media use and given numerous research and popular press articles documenting the adverse consequences of excessive media use on indicators of adolescent mental and physical health(2-4), including sleep specifically(5, 6), there has been increasing awareness of the importance of studying the usage prevalence and impact of their use among youth.

Regarding sleep, nighttime media use could contribute to sleep disturbance via exposure to stimulating content which can lead to hyperarousal in the prebedtime period, or via exposure to device-emitted light prior to bedtime that can disrupt circadian rhythms (7). Given that adolescence is a period of intense neurobiological, psychosocial, and physical development (8), it is critical to identify factors, such as electronic media use, that are contributing to the rising rates of sleep disturbance in this vulnerable group.

Several recent studies have examined nighttime media use, broadly defined (which may include television “screen time” as well as screen time from other types of technology, including cell phones), and adolescent sleep(1, 7, 9-11). For instance, Hale and Guan (7) found that among the 67 studies identified in a review of the literature on screen time and sleep among children and adolescents, 90% showed a significant inverse association between screen time and sleep duration. However, of the 67 studies reviewed, only 18 (27%) specifically focused on mobile devices.

Importantly, research suggests that trends in the types of technology being used by adolescents are changing at a rapid rate, with increasing “screen time” related to mobile device use(9). In particular, the use of “texting” as a means of communication has risen dramatically among teens. For instance, a Pew Research survey(12) found that 63% of all teens say they exchange text messages every day with people in their lives, a rate that far surpasses the frequency with which they pick other forms of daily communication, including phone calling by cell phone (39% do that with others every day), face-to-face socializing outside of school (35%), social network site messaging (29%), instant messaging (22%), talking on landlines (19%) and emailing (6%). Such forms of rapid and immediate communication may also directly interfere with adolescents’ sleep, as teens are essentially “available” at all times of the day and night.

Despite the increasing prevalence of mobile phone use among teens and the particular salience for sleep, only a handful of studies have specifically focused on nighttime mobile phone use and the implications for adolescent sleep (13-17). For instance, in a study of Belgian adolescents, 62% of adolescents reported using their cell phones after “lights out” and such use was associated with significantly increased risk of self-reported “tiredness” one year later (16). Results of a recent meta-analysis suggest that the use of mobile devices is associated with increased sleep disruption and curtailed total sleep time among teenagers; however, the magnitude of the effect is relatively small (6). The small effect size for the impact of mobile device use on adolescent sleep may reflect the limited number of available studies that were included in the meta-analysis (N=3) as well as methodological limitations of the existing studies. Furthermore, few studies have examined texting behavior, specifically, in adolescent populations, despite the fact that this is a primary means of communication for this age group, and the specific implications for sleep.

In particular, the extant literature has relied exclusively on self-report methods to measure the frequency and timing of cell phone use. Self-reports are subject to a number of inherent biases, including forgetting and recall bias (18). Adolescents may also intentionally misreport their texting behavior, for example, if they perceive that it is socially desirable to receive or send more texts since higher use may be considered a sign of status or popularity within this age group. In fact, in a validity study of self-reported texting behavior as compared to phone bill-derived categorical number of outgoing daily text messages among college students (ages 18-24), Gold and colleagues (19) found only 26% agreement between self-reported number of texts and phone bill-derived texting frequency. Furthermore, there was a systematic tendency to over-report texting frequency; among those who did not accurately report their texting frequency, 81% overestimated.

Recognizing these limitations, this report describes a secondary analysis of data collected from a study in which a smartphone application ('app') automatically recorded and time-stamped approximately one week's worth of text communications as they occurred in real-time and in teens' natural environments. Data were collected across the 24-hour period and classified as occurring pre-bedtime (8:00 pm-9:59 pm) and at night (10:00 pm-5:59 am). We also examined whether texting frequency during each of these time intervals differed according to adolescents' gender or age.

Methods

Design Overview

Data are from a study investigating differences in teen communications about health risk behaviors through speech and text messaging. Teens carried a study-issued smartphone and an application (or 'app') on the device recorded the time and content of all outgoing text messages. Participants were required to use the study smartphone to ensure adequate protection of study-related information and standard functioning of the data collection app. (See (20) for additional data about the study methods).

Sample

Participants were recruited through advertisements in local print media, websites (craigslist.org), and flyers. Parents or guardians provided screening information on behalf of 62 teens, all of whom were eligible for the study based on the following criteria: adolescents between the ages of 14 and 18 years, with their own cell phones who send text messages at least four days per week. Of those invited to participate, 69% (N=43) attended the baseline session and are included in the analytic sample.

Protocol

Data collection took place from April through September, 2013, either during teens' school spring break or summer vacation. We collected data during these times to circumvent challenges of collecting voice data (collected as part of the parent study) while teens were in school. Parents provided written informed consent and teens provided assent. All procedures were approved by the RAND Human Subjects Protections Committee (HSPC).

At the first study session, teens completed a baseline questionnaire (see Measures). Teens then exchanged their own cellphone (stored securely by study staff) for a study smartphone to be used for all calls and texts during the study period. Teens received training on the functionality of the phones and how they should be used. Specifically, teens were told to send/receive all of their text messages (including Twitter) and phone calls using the study phones, and that they could use the default applications stored on the phone (i.e., select games) as they liked.

After training, researchers transferred all of teens' contacts from their regular phone to the study phone. Participants then sent a "text blast" (group text) to all selected contacts indicating that they could now be reached by text and by phone at a new number for the study period. Teens then left the study site to use the phones in the field. Teens returned to

the study site on the third day of the study to ensure that the app was working as expected and to answer any outstanding questions about the protocol or device. On day 9, teens returned to the study site to return the study equipment, complete a follow-up survey (see Measures) and semi-structured debriefing interview, have their own phones returned and to receive payment. Teens who completed all of the study procedures earned \$180.

Measures

Texting Data included only outgoing text messages (including Twitter) so as to avoid collecting data from non-consented secondary subjects (i.e., persons not in the study sending messages to participants). This was a requirement of RAND's HSPC.

Pre-bedtime Texts were defined as outgoing text messages sent between the hours of 8:00 pm and 9:59 pm each day of the study, averaged within participants, across days.

Nighttime Texts were defined as outgoing text messages sent between the hours of 10:00 pm and 5:59 am each day of the study, averaged within participants, across days.

Total Texts was defined as the number of texts sent by participants in a 24 hour period averaged across the study recording period.

Demographics items included age, gender, race and ethnicity, and parental employment and education.

Results

Participants were $n=43$ adolescents ($M=16.06$, $SD=1.29$ years of age; 63% female). Participants were predominantly White (74.19%) and of moderate SES: 62% of fathers and 48% of mothers had bachelor's degrees or more education. Participants' BMIs were generally in the normal range ($M=22.69$, $SD=4.36$) (21).

On average, texting data was collected for 6.63 days per participant. As shown in Table 1, pre-bedtime or nighttime text messaging was ubiquitous: 98% of participants sent at least one text after 8:00 pm and 70% sent a text between 10pm-5:59 am. When asked about how "typical" their texting behavior during the recording period was relative to habitual texting, the majority (71%) said that they did not change the way they texted or talked during the study. Overall, one participant (2%) reported sending more texts than normal while one other (2%) reported sending fewer texts, but only at the beginning of the study while acclimating to the new phone. The remainder of changes to texting behavior (25%) was related to the length and/or content of the text messages. Figure 1 displays the average number of texts per individual, per day in 2-hour time blocks over a 24-hour period. The figure shows that texting is most frequent in the hours between 2:00 pm-9:00 pm. There was no relationship between texting frequency and gender or age.

Discussion

The current study is the first to demonstrate, using objectively recorded outgoing text messages, that teen texting is frequent, with the highest number of texts occurring in the

afternoon/evening hours of the day. These results validate previous studies whose data has been largely self-report and subject to biases (19). Participants in this sample sent approximately 36 texts per day, although the upper range of texting in a 24 period was 155 texts. The average daily texting rate reported in this study is lower than in prior surveys, which have reported that teens send approximately 100 texts per day (22). This discrepancy may reflect a tendency for teens to over-report texting behavior as it may be considered a sign of status or popularity to be texting frequently throughout the day. In fact, a validity study which compared self-reported texting frequency to phone bill-derived frequency of texts, suggests a systematic tendency to over-report the number of outgoing texts (19). There may also be seasonal differences in teen texting, with fewer texts sent during the summer and/or holiday periods (when these data were collected). Our lower texting rate may also be due to the fact that we recorded outgoing text messages only, while the Pew survey(12), for example, included self-reported text messages *sent and received*. Furthermore, it is possible that the lower frequency of texting during the study period was due to the use of a study device; however, the majority of teens (71%) reported that their texting behavior did not change during the course of the study. Of the 29% that reported a change in texting behavior, 25% reported changing the content or length of their texts during the course of the study, whereas only 4% reported an increase or decrease. We did not observe any differences by gender or age; however our sample was small and may have been underpowered to detect differences across groups.

Limitations of the design are that recording was done on study phones with study phone numbers, that data included only outgoing (and not incoming) texts, that data come from a small, convenience sample, and that data collection occurred during the summer or spring break. Further, while the sample was recruited because they responded to an advertisement looking for a “teen who texts”, national data show that 78% of youth age 12-17 own a cell phone (22). Therefore, we believe that in terms of cell phone use, our sample is broadly generalizable to community samples of adolescents that participate in research. Notably, however, the sample was relatively small and findings should be replicated in larger, adolescent samples, to determine the generalizability of the current findings. Furthermore, the data included text messages (including twitter messages) but did not include other forms of private messaging or other communications apps (e.g., snapchat). Given that this was a secondary analysis and the original study did not incorporate sleep measures, we cannot determine whether texting behavior in this study impacted sleep. Nevertheless, in conjunction with prior research, the findings suggest that the combination of teen social pressures, circadian biology, and the immediacy of texting as a means of communication, may become mutually reinforcing factors which make it exceedingly difficult for teens to “disconnect” at bedtime, provide a sufficient time to unwind prior to bedtime, potentially setting the stage for poor quality or insufficient sleep. Moreover, the exposure to backlit displays which are common to mobile devices may have direct effects on sleep by disrupting circadian function and melatonin expression(13).

Given the importance of sleep to teenagers’ healthy development(23) and the epidemic of insufficient sleep in American teens(24), it is critical that researchers, clinicians, families, and policymakers identify and develop prevention or intervention strategies to mitigate

modifiable factors that contribute to sleep problems in teens. Findings from the current study demonstrate that texting behavior is ubiquitous in teens, and is particularly prevalent in the hours before bedtime. Prior research has shown that use of cellular devices immediately prior to bedtime can delay sleep onset, disrupt sleep, and result in curtailed sleep (13, 15-17, 25). Thus, clinicians should encourage families to keep technology out of the bedroom, as research further shows that adults are also frequently using technology in the bedroom (14). Education efforts should also be aimed at teen social groups so that they can provide support for each other to mutually agree to disconnect at bedtime. Establishing “buy-in” at the peer group level is critical, so that teens who choose not to send or receive texts at night do not have to fear “missing out” on critical social information and potentially face social rejection. At a policy-level, it is also important as new technologies and platforms for communication emerge, that policymakers are knowledgeable about the potential implications for teens’ health and safety.

These results are important as they validate previous studies which have used self-report methods of texting behavior, which may be subject to reporting biases. Further research is needed to examine objectively recorded texting frequency and the impact on adolescents’ sleep, in order to identify prevention and intervention efforts to reduce the epidemic levels of insufficient sleep duration among teens.

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References

1. Gradisar M, Wolfson AR, Harvey AG, Hale L, Rosenberg R, Czeisler CA. The Sleep and Technology Use of Americans: Findings from the National Sleep Foundation's 2011 Sleep in America Poll. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine*. 2013; 9(12):1291–9. [PubMed: 24340291]
2. Mathers M, Canterford L, Olds T, Hesketh K, Ridley K, Wake M. Electronic Media Use and Adolescent Health and Well-Being: Cross-Sectional Community Study. *Academic Pediatrics*. 2009; 9(5):307–14. [PubMed: 19592322]
3. Kappos AD. The impact of electronic media on mental and somatic children's health. *International Journal of Hygiene and Environmental Health*. 2007; 210(5):555–62. [PubMed: 17869577]
4. Thomee S, Harenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--a prospective cohort study. *BMC public health*. 2011; 11:66. [PubMed: 21281471]
5. Peiró-Velert C, Valencia-Peris A, González LM, García-Massó X, Serra-Añó P, Devís-Devís J. Screen Media Usage, Sleep Time and Academic Performance in Adolescents: Clustering a Self-Organizing Maps Analysis. *PLoS ONE*. 2014; 9(6):e99478. [PubMed: 24941009]
6. Bartel KA, Gradisar M, Williamson P. Protective and risk factors for adolescent sleep: A meta-analytic review. *Sleep Medicine Reviews*. 2015; 21:72–85. [PubMed: 25444442]
7. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep medicine reviews*. 2015; 21:50–8. [PubMed: 25193149]

8. Dahl RE. The regulation of sleep and arousal: Development and psychopathology. *Development & Psychopathology*. 1996; 8:3–27.
9. Adams SK, Daly JF, Williford DN. Adolescent Sleep and Cellular Phone Use: Recent Trends and Implications for Research. *Health Services Insights*. 2013; 6:99–103. [PubMed: 25114565]
10. Russ SA, Larson K, Franke TM, Halfon N. Associations Between Media Use and Health in US Children. *Academic Pediatrics*. 2009; 9(5):300–6. [PubMed: 19592321]
11. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Med*. 2010; 11(8):735–42. [PubMed: 20673649]
12. Lenhart A. Teens, smartphones & texting. Pew Internet & American Life Project. 2012
13. Arora T, Broglia E, Thomas GN, Taheri S. Associations between specific technologies and adolescent sleep quantity, sleep quality, and parasomnias. *Sleep Medicine*. 2014; 15(2):240–7. [PubMed: 24394730]
14. Gradisar M, Wolfson AR, Harvey AG, Hale L, Rosenberg R, Czeisler CA. The sleep and technology use of Americans: findings from the National Sleep Foundation's 2011 Sleep in America poll. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine*. 2013; 9(12):1291–9. [PubMed: 24340291]
15. Munezawa T, Kaneita Y, Osaki Y, Kanda H, Minowa M, Suzuki K, et al. The Association between Use of Mobile Phones after Lights Out and Sleep Disturbances among Japanese Adolescents: A Nationwide Cross-Sectional Survey. *Sleep*. 2011; 34(8):1013–20. [PubMed: 21804663]
16. Van den Bulck J. Adolescent use of mobile phones for calling and for sending text messages after lights out: Results from a prospective cohort study with a one-year follow-up. *Sleep*. 2007; 30(9):1220–3. [PubMed: 17910394]
17. Honda M, Genba M, Kawakami J, Nishizono-Maher A. A sleep and life-style survey of Japanese high school boys: Factors associated with frequent exposure to bright nocturnal light. *Sleep and Biological Rhythms*. 2008; 6(2):110–9.
18. Shiffman S, Hufford M, Hickcox M, Paty JA, Gnys M, Kassel JD. Remember That? A Comparison of Real-Time Versus Retrospective Recall of Smoking Lapses. *Journal of Consulting and Clinical Psychology*. 1997; 65(2):292–300. [PubMed: 9086693]
19. Gold JE, Rauscher KJ, Zhu M. A validity study of self-reported daily texting frequency, cell phone characteristics, and texting styles among young adults. *BMC research notes*. 2015; 8:120. [PubMed: 25890089]
20. Fillo J, Staplefoote BL, Martinez A, Sontag-Padilla L, Shadel WG, Martino SC, et al. Simplified Novel Application (SNAApp) Framework: A Guide to Developing and Implementing Second-Generation Mobile Applications for Behavioral Health Research. *Translational Behavioral Medicine: Practice, Policy, Research*. in press.
21. Body Mass Index: Considerations for Practitioners. Centers for Disease Control and Prevention; Washington, DC:
22. Lenhart, A. Teens, Smartphones & Texting. Pew Internet & American Life Project; Washington, DC: 2012.
23. Carskadon MA, Acebo C, Jenni OG. Regulation of adolescent sleep: Implications for behavior. *Annals of the New York Academy of Sciences*. 2004; 1021:276–91. [PubMed: 15251897]
24. National Sleep Foundation. Adolescent sleep needs and patterns: Research report and resource guide. National Sleep Foundation; 2000.
25. Hysing M, Pallesen S, Stormark KM, Jakobsen R, Lundervold AJ, Sivertsen B. Sleep and use of electronic devices in adolescence: results from a large population-based study. *BMJ Open*. 2015; 5(1):e006748.

Figure 1.

Distribution of average number of texts per 2h time block across the 24-hour period, averaged across days of recording.

Table 1

Texting Frequency and Distribution over Time (n=43)

Texting Interval	Mean	SD	Min	Max
Average # Texts per day over 24-hour period	36.50	27.07	3.43	154.71
Average # Texts Pre-Bedtime (8PM – 10 PM per day)	5.73	4.91	0	20.57
Average # Texts Between 10PM – 6AM per day	4.44	7.11	0	39.14
Texted at least once over period after 8pm	0.98	0	0	1.00
Texted at least once over period after 10pm	0.70	0.46	0	1.00