The Association between Social Media Use and Sleep Disturbance among Young Adults

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Abstract

Introduction—Many factors contribute to sleep disturbance among young adults. Social media (SM) use is increasing rapidly, and little is known regarding its association with sleep disturbance.

Methods—In 2014 we assessed a nationally-representative sample of 1788 U.S. young adults ages 19-32. SM volume and frequency were assessed by self-reported minutes per day spent on SM (volume) and visits per week (frequency) using items adapted from the Pew Internet Research Questionnaire. We assessed sleep disturbance using the brief Patient-Reported Outcomes Measurement Information System (PROMIS®) Sleep Disturbance measure. Analyses performed in Pittsburgh utilized chi-square tests and ordered logistic regression using sample weights in order to estimate effects for the total U.S. population.

Results—In models that adjusted for all sociodemographic covariates, participants with higher SM use volume and frequency had significantly greater odds of having sleep disturbance. For example, compared with those in the lowest quartile of SM use per day, those in the highest quartile had an AOR of 1.95 (95% CI = 1.37-2.79) for sleep disturbance. Similarly, compared with those in the lowest quartile of SM use frequency per week, those in the highest quartile had an AOR of 2.92 (95% CI = 1.97-4.32) for sleep disturbance. Associations all demonstrated a significant linear trend.

Discussion—The strong association between SM use and sleep disturbance has important clinical implications for the health and well-being of young adults. Future work should aim to assess directionality and to better understand the influence of contextual factors associated with SM use.

Keywords

Health; Technology; Sleep Quality; PROMIS; Young Adults; Sleep Disturbance; Social Media; Facebook; Twitter

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INTRODUCTION

Sleep and circadian functioning are essential to promoting good health.[1] While it is recommended that young and midlife adults obtain 7-9 hours of sleep per night,[2] 40% of American adults report getting less than 7 hours of sleep per night on weeknights.[3] Moreover, 38% wake up feeling unrefreshed and 21% have difficulty falling asleep at least a few nights per week. Among young adults ages 19-29, 67% report not getting enough sleep to function properly.[4]

Sleep disturbance and insufficient sleep duration are associated with daytime sleepiness[5;6] and a range of poor health outcomes. For example, insufficient sleep negatively affects cognitive performance, mood, immune function, cardiovascular risk, weight, and metabolism.[7-9] Additionally, a large multiethnic sample of U.S. adults showed that those with sleep duration shorter or longer than 7 hours were more likely to report fair or poor self-rated health,[10] and a worldwide survey of over 16,000 students (ages 17-30) showed a dose-response association between fewer hours of sleep and reporting poor health.[11]

A range of biological, psychosocial, and environmental factors contribute to insufficient sleep and sleep disturbance among adolescents and young adults. This includes biological changes in the accumulation of homeostatic sleep pressure (the likelihood of falling asleep), increasing academic and vocational demands, and use of substances such as alcohol and caffeine.[12-15] However, less is known about associations between use of social media (SM) and sleep quality and quantity. SM has been defined as "a collection of software that enables individuals and communities to gather, communicate, share, and in some cases collaborate or play"[16] and a "group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content."[17] The rapidly growing rate of SM use in recent years[18] raises concern that SM use may adversely affect sleep quality and may displace total amount of sleep.[19]

Prior work that has examined SM use and sleep has yielded inconsistent results. Two recent reviews in this area demonstrated an inverse association between electronic media use and sleep parameters such as longer time to fall asleep, delayed bedtime, and reduced total sleep time.[20;21] However, another study among 11-13 year olds in the Midlands region of the United Kingdom demonstrated that, compared with SM, use of other technologies such as television, music, and video games was more substantially associated with sleep problems.[22] Still, frequent use of social networking sites had the strongest impact on reduced weekday sleep *duration* among this sample. Other studies have suggested associations between SM use and sleep disturbance in countries such as Australia and China,[23;24] but there is a need to explore these findings among large, nationally-representative populations in the U.S.

It will also be valuable to examine associations such as these among young adults. While nearly all research in this area has focused on children and adolescents, 96% of young adults in the 18-30 year-old range use some type of technology—such as cell phones (67%), computers (60%), and electronic music devices (43%)—before bed.[4] Given this high prevalence of devices which could be used for SM, and the deleterious health consequences

of disturbed and insufficient sleep among young adults, studies are needed to explicitly focus on the association of SM and sleep disturbance in young adults.

Thus, we conducted a large, nationally-representative study to assess SM use and sleep among U.S. young adults. Our specific aims were to 1) describe the extent of self-reported SM use in this sample; 2) describe the level of self-reported sleep disturbance among this sample; and 3) determine the association between SM use and sleep disturbance. This will help us to better understand the impact of SM use as these individuals emerge into adulthood, before most chronic illnesses are established. Moreover, we have the unique opportunity to examine the association between SM use and sleep among a group of young adults who are, arguably, the first generation to grow up with social media.

METHODS

Participants

We assessed a nationally-representative sample of U.S. young adults ages 19-32 who were participating in a longitudinal survey assessing multiple health behaviors. Our sample was drawn from a large-scale web-based research panel, which was developed and maintained by Growth from Knowledge (GfK), a survey research company. The research panel, known as the KnowledgePanel®, has been shown to be a statistically valid method for surveying and analyzing health indicators from a nationally-representative sample.[25;26] Participants were recruited via random digit dialing and address-based sampling, which reaches a sampling frame of over 97% of the U.S. population and provides access to people who use a home phone (also known as a "land line") as well as those who use cell phone only.[27;28]

Procedures

From March 2013 to April 2013 (baseline), 3254 GfK panel members completed an Internet-based survey. They were ages 18 to 30 when they completed the baseline assessment. From October 2014 to November 2014, a follow-up survey was sent via email to those who had completed the baseline survey, who were then ages 19 to 32. The data used for this study were collected as part of this 18-month follow-up, during which SM use items were included as part of the survey. Responses were received from 1796 participants (55.2%), of which 1,788 participants (54.9%) had complete sleep data and were included in the analysis. The median time for survey completion was 15 minutes and participants received $15 for their participation. This study was approved by the Institutional Review Board of the University of Pittsburgh and was granted a Certificate of Confidentiality from the National Institutes of Health.

Measures

Participants completed online survey items assessing SM use (independent variable), sleep disturbance (dependent variable), and covariates.

Social Media Use—SM use was assessed with multiple items that were used to create two SM use variables. The first variable reflects *volume* of SM use, as measured by the number of total minutes that participants use SM per day on average for personal, non-work related

use. Participants were asked to estimate using text fields for hours and minutes per day. For analysis, this variable was represented in quartiles: Q1 = 0-30 minutes; Q2 = 31-60 minutes; Q3 = 61-120 minutes; Q4 = 121 minutes or more. The second variable reflects *frequency* of SM use, as measured by the number of visits to SM platforms per week. The frequency variable was adopted from a Pew Internet Research survey asking participants to indicate how frequently they visit or use each of the 11 most popular SM platforms: Facebook, YouTube, Twitter, Google Plus, Instagram, Snapchat, Reddit, Tumblr, Pinterest, Vine, and LinkedIn.[29;30] Response choices included: "I don't use this platform," "Less than once a week," "1-2 days a week," "3-6 days a week," "About once a day," "2-4 times a day," and "5 or more times a day." Summed weighted responses on this scale were used to estimate total site visits per week. We also collapsed these data into quartiles for analyses (Q1 = 0-8; Q2 = 9-30; Q3 = 31-57; Q4 = 58+).

Sleep Disturbance—We assessed sleep disturbance using four items from the Patient-Reported Outcomes Measurement Information System (PROMIS®) Sleep Disturbance measure,[31;32] which assessed problems with sleep, difficulty falling asleep, whether sleep was refreshing, and sleep quality over the past 7 days. PROMIS measures have the advantage of being highly reliable and precise measures of patient-reported health, utilizing short forms of its measures to lessen participant burden while maintaining precision across a range of domains.[33;34] The PROMIS Sleep Disturbance assessment, in particular, reflects a global measure of sleep, rather than focusing on a particular disorder. Previous work has described the development and psychometric testing of the PROMIS sleep disturbance measure among individuals age 18 and older. [31;32] The four items included here were rated on a Likert scale, ranging from not at all (1) to very much (5). Items pertaining to sleep quality and the refreshing nature of sleep were reverse-coded. Because there were 4 items each on a 1-5 scale, raw scores ranged from 4-20. Due to the non-normal distribution of our data, we collapsed the sleep measure into tertiles based upon the raw score distribution, rather than converting to T-scores and treating the score variable as continuous. Low sleep disturbance corresponded to raw scores of 4-8, medium corresponded to raw scores of 9-11, and high corresponded to raw scores of 12-20.

Covariates—We examined associations between our dependent variable and each of the following demographic variables: age, sex, race/ethnicity, relationship status (single vs. committed relationship), living situation, household income, and education level. We divided participants into three age groups (19-23 years; 24-26 years; 27-32 years) and four mutually exclusive groups based on race/ethnicity (White, non-Hispanic; Black, non-Hispanic; Hispanic; or Other non-Hispanic). Categories for living situation, household income, and education level are depicted in Table 1.

Analysis

We included all participants who completed the sleep and SM use items in our analyses. We conducted all primary analyses using survey weights, which were calculated by GfK and applied using a post-stratification adjustment based on socio-demographic benchmark distributions. We used descriptive statistics to characterize the demographic features of the weighted sample and to determine the level of sleep disturbance and SM use frequency and

volume reported by our participants. We used chi-square tests to determine whether participants in each sleep disturbance group (low, medium, high) differed significantly on level of SM use (volume and frequency) and covariates.

We used ordered logistic regression to examine associations among each SM use variable and sleep disturbance, with the lowest level of each social media variable (Q1 for each variable) serving as the reference group. We first conducted this analysis without covariates, and then we conducted multivariable logistic regression including all covariates. The decision to include all covariates in the models was made *a priori* based on their possible impact on sleep disturbance.[35] We first conducted appropriate diagnostics to ensure that the data satisfied the proportional-odds assumption, which is necessary to conduct ordered logistic regression.

We also conducted three sensitivity analyses in order to assess the robustness of our results. First, we included in the multivariable models only covariates with bivariable associations of $P<.15$ or stronger with the outcome (sleep disturbance) to ensure that our models had not over-controlled. Second, we repeated all analyses without using survey weights. Finally, we repeated all analyses using SM use variables as continuous instead of categorical.

Statistical analyses were performed with Stata 12.1 (Stata Corp, College Station, Texas), and two-tailed *P*-values < 0.05 were considered to be significant.

RESULTS

Participants

There were complete data for the independent and dependent variables for 1788 participants. Table 1 depicts demographic characteristics of the weighted sample. As is noted in Table 1, 1768 participants reported SM volume (minutes per day), while 1781 reported SM frequency (visits per week). Thus, missing data accounted for between 0.4-1.6%, depending on the analysis.

Social Media Use

Median volume was 61 minutes of SM use per day (IQR = 30, 135; range = 0-1447), while median frequency was 30 visits per week (IQR=8.5, 56.5; range=0-385).

Sleep

Due to the non-normal distribution of our data, participants were grouped into low, medium, and high sleep disturbance groups based on raw score response distribution. Accounting for survey weights, 42.6% of our sample was in the low sleep disturbance group, 28.0% was in the medium disturbance group, and 29.4% was in the high sleep disturbance group.

Bivariable Analyses

Table 1 demonstrates associations between the two SM use variables and sleep disturbance, as well as covariates and sleep disturbance. SM volume and frequency were significantly associated with sleep disturbance, with greater level of SM use associated with higher levels

of disturbance. Among the demographic variables, sex and level of household income were significantly associated with sleep disturbance. Females were more likely to have high levels of sleep disturbance than males, and lower levels of income were associated with higher levels of sleep disturbance.

Multivariable Analyses

In fully-adjusted models (Table 2), participants with higher SM volume had significantly greater odds of having sleep disturbance. For example, compared with those in the lowest quartile, those in the highest quartile had an AOR of 1.95 (95% CI = 1.37 - 2.79) for having a higher level of sleep disturbance. Similarly, compared with those in the lowest quartile for frequency of use, those in the highest quartile had an AOR of 2.92 (95% CI = 1.97 - 4.32) for having a higher level of sleep disturbance. Post-estimate tests demonstrated linearity of the overall association between each of the independent variables and the dependent variable in both unadjusted and adjusted models (all $P < .001$).

Sensitivity analyses

All sensitivity analyses generated results consistent with the primary results. Analyses which used more parsimonious models, no survey weights, and/or continuous independent variables did not result in differences in terms of either levels of significance or magnitude of findings.

DISCUSSION

We found that young adults ages 19-32 in the U.S. report a median of 61 minutes of SM use per day, and that, consistent with prior research,[4] more than half report medium or high levels of sleep disturbance. We also found that there were consistent, substantial, and progressive associations between SM use and sleep disturbance, whether SM use is operationalized in terms of volume or frequency.

It is interesting that associations with sleep disturbance were higher for the frequency variable than for the volume variable. For example, compared to those in the lowest quartile for frequency, those in the highest quartile had an AOR of about 3 for increased sleep disturbance, while for the volume variable the AOR was about 2. This may indicate that the frequency of visits is a better predictor of sleep difficulty than overall SM time. If this is the case, interventions may focus on SM use behaviors that take on an obsessive "checking" type of quality. However, these analyses should be replicated in other samples before more systematic translation to interventions.

Because the findings presented here are cross-sectional, it is not possible to determine whether SM use contributes to sleep disturbance, sleep disturbance contributes to SM use, or both. Nevertheless, there are several possible mechanisms underlying the association between SM use and sleep disturbance. SM use may directly cause disturbed sleep in three ways.[20] First, SM use may directly displace sleep; for example, if an individual stays up late posting pictures on Instagram, his or her sleep time may be reduced. Second, SM use may promote emotional, cognitive, and/or physiological arousal. For example, watching a provoking video on YouTube or engaging in a contentious discussion on Facebook just

before going to bed may contribute to disturbed sleep. Third, bright light emitted by SM devices may delay circadian rhythms.[36] In each of these cases, sleep may be disturbed as a result of the stimulating and rewarding nature of SM.

Alternatively, those who have difficulty sleeping may subsequently spend more time using SM. In these cases, for example, someone with a pre-existing sleep condition may use SM as a pleasurable way to pass the time while awake or to distract him/herself from the distress of not sleeping. Indeed, there is some evidence that sleep problems predict longer duration of overall technology and media use,[37] and one study reported that using media as a sleep aid is a common practice among adolescents.[38] While that particular study did not assess *social* media use specifically, given the pervasive use of SM there may be good reason to believe that adolescents may also use SM as a sleep aid just as they use television and computer games.

It may also be that both of these hypotheses are true—difficulty sleeping may lead to increased use of SM, which may in turn lead to more problems sleeping. This cycle may be particularly problematic with regard to SM, even compared with traditional media activities. This is because many forms of SM involve interactive screen time, which may be more stimulating and engaging, and thus potentially detrimental to sleep—compared with more passive activities such as watching television and reading books.[21]

Regardless of specific directionality, these associations have meaningful clinical implications for screening and intervention. First, it may be valuable for providers to assess level of SM use in their young adult patients, especially when those patients have difficulty sleeping. Because about two-thirds of young adults report insufficient sleep to function,[4] it may not be unreasonable to assess SM use for problematic patterns as standard practice. Similarly, it may be valuable for school- and clinic-based education programs to address healthy SM use, as has been done for other health behaviors such as obesity and safe driving. Public health programming and SM education can be used to inform the public of the strong associations between SM use and difficulty sleeping, as well as to disseminate information about evidence-based strategies for improving healthy SM use. For example, SM product manuals could include information on the impact of light-emitting devices on melatonin secretion, sleepiness, and circadian rhythms.

As noted above, one important direction for future research will involve determination of directionality of these associations. Longitudinal research may help illuminate this. Additionally, it will be valuable in the future to assess SM use in a more fine-grained manner. It is appropriate at this early stage of research to examine general variables such as overall volume and frequency of SM use. However, it is important to note that there are many different types of interactions that can occur over SM, and thus it will be an important task of future assessments to more comprehensively determine associations between sleep and various types of SM. For example, time on social media may be highly passive (spent primarily viewing others' profiles), or it may be spent as an active participant, and these distinct patterns of use may have different associations with sleep. Similarly, some individuals tend to have highly supportive and pleasant interactions over SM, while others tend to have more contentious interactions that might be more likely to lead to difficulty

sleeping. Thus, questions as to the degree of activity/passivity and character of interactions will be interesting to address in the future.

Strengths and Limitations

This study is unique in its assessment of SM use and sleep disturbance in a nationally-representative sample of young adults. While most work in this area has focused on the effect of media use on sleep among adolescents, it is also highly important to explore SM use as these individuals emerge into adulthood. "Emerging adulthood" has been considered a time of increasing independence and identity exploration, but it is also characterized by instability and a feeling of being "in-between" developmental stages.[39] However, it is also during this period that individuals tend to not only establish but also consolidate behaviors that will last a lifetime.[39] Thus, studying SM use and sleep behaviors of young adults may help us to understand whether SM use in young adulthood promotes SM use later in life, and whether these patterns predict the likelihood of having disturbed sleep as these individuals age. Additionally, this study had the benefit of utilizing a survey measure that allowed us to derive and analyze two different dimensions of SM use: frequency and volume. Both of these measures were significantly associated with sleep disturbance in multivariable models, suggesting that these measures may reflect qualitatively different components of SM use.

As noted above, one important limitation of the cross-sectional nature of the data is that we cannot determine the direction of association between SM use and sleep disturbance, nor can we attribute causality to any effect. Because of the dearth of information on the association of SM use and sleep among young adults, a cross-sectional depiction of these variables was appropriate for this study. Still, a follow-up longitudinal study that allows for the examination of the temporal relationship between these factors would be useful. Moreover, it would be beneficial for future research to examine a broader set of covariates (e.g., mental health status), perhaps within a path analysis, in order to more fully elucidate the nature and directionality of the relationships.

It was a necessary limitation that we relied on participants' retrospective report of their SM use and sleep in completing the survey. For example, in this large population it was not feasible to intensively validate sleep patterns using formal sleep studies or to validate SM use with ecological momentary assessment. However, it may be valuable for future studies to corroborate these findings when SM use and sleep disturbance are assessed in other ways. Additionally, because this study was limited to young adults ages 19 to 32 the results cannot be generalized to other age groups.

Last, PROMIS measures can be administered as Computerized Adaptive Tests within an Item Response Theory framework, which provides the highest level of measurement precision. However, this level of sophistication was unavailable for our survey panel, and we instead utilized the analogous 4-item Sleep Disturbance short form. This may have contributed to the non-normal distribution of our response data, limiting us to treat sleep disturbance as an ordinal-categorical variable.

Conclusion

In summary, this study assessed the association between social media use and sleep disturbance among a large, nationally-representative sample of young adults. The rate of SM use has been growing rapidly in recent years. Additionally, disturbed and insufficient sleep have been associated with poor health outcomes. Thus, the strong association between SM use and sleep disturbance has important clinical implications for the health and well-being of young adults. Future work should focus on longitudinal studies that can determine the direction of effect among these variables, as well as further explore the different types of SM interactions that are associated with sleep disturbance.

Acknowledgments

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Table 1

Weighted Whole Sample Characteristics and Bivariate Associations with Sleep Disturbance (N = 1,788), from a Nationally Representative Sample Assessed in 2014.

Independent Variables	Whole Sample[a]	Sleep Disturbance			P Value[b]
		Low[a] (n = 709)	Medium[a] (n = 489)	High[a] (n = 590)	
Social Media Use					
Minutes Per Day[c]					.004
Q1 (0-30)	29.8	35.7	28.1	22.6	
Q2 (31-60)	20.8	23.4	18.9	18.8	
Q3 (61-120)	24.0	20.5	24.3	28.7	
Q4 (121+)	25.5	20.4	28.7	29.9	
Visits Per Week[d]					<.001
Q1 (0-8)	28.3	35.8	25.2	20.4	
Q2 (9-30)	25.1	24.1	27.4	24.2	
Q3 (31-57)	24.1	23.3	23.2	26.0	
Q4 (58+)	22.5	16.8	24.2	29.4	
Covariates					
Age, y					.08
19-23	33.6	37.5	34.1	27.4	
24-26	24.8	25.2	21.4	27.4	
27-32	41.6	37.3	44.5	45.2	
Sex					.03
Female	50.3	45.5	50.4	57.0	
Male	49.7	54.5	49.6	43.0	
Race					.05
White, non-Hispanic	57.5	63.6	52.8	53.2	
Black, non-Hispanic	13.0	12.8	13.2	13.0	
Hispanic	20.6	17.1	21.2	25.2	
Other[e]	8.9	6.5	12.9	8.6	

Independent Variables	Whole Sample[a]	Sleep Disturbance			P Value[b]
		Low[a] (n = 709)	Medium[a] (n = 489)	High[a] (n = 590)	
Relationship Status[f]					.42
Single[g]	44.4	47.0	41.3	43.5	
Committed relationship[h]	55.6	53.1	58.7	56.5	
Living Situation					.29
Parent/Guardian	33.9	36.5	30.7	33.3	
Significant other	35.7	31.3	39.3	38.5	
Other[i]	30.4	32.2	30.0	28.2	
Household Income					<.001
Low (under $30,000)	22.9	18.6	19.4	32.5	
Medium ($30,000-$74,999)	38.4	38.8	38.2	38.0	
High ($75,000 and above)	38.7	42.6	42.4	29.5	
Education Level					.35
High school or less	35.9	33.6	35.8	39.4	
Some college	38.3	39.1	36.0	39.3	
Bachelor's degree or higher	25.8	27.3	28.2	21.3	

[a]Column percentages. Values may not total 100 due to rounding.

[b]P value derived using Chi-square analyses comparing proportion of users in each category.

[c]n=1768.

[d]n=1781.

[e]Includes Multiracial.

[f]n=1785.

[g]Includes widowed, divorced, and separated.

[h]Includes engaged, married, and in a domestic partnership.

[i]Defined as not living with a parent/guardian or significant other.

Table 2

Weighted Bivariate and Multivariate Associations Between Social Media Use and Sleep Disturbance, from a Nationally Representative Sample Assessed in 2014.

Social Media Use	Sleep Disturbance[a]			
	OR (95% CI)	*P*[c]	AOR (95% CI)[b]	*P*[c]
Minutes Per Day [d,e]		< .001		< .001
Q1 (0-30)	REF		REF	
Q2 (31-60)	1.18 (0.80-1.73)		1.26 (0.86-1.84)	
Q3 (61-120)	1.85 (1.28-2.69)		1.91 (1.31-2.78)	
Q4 (121+)	1.93 (1.37-2.71)		1.95 (1.37-2.79)	
Visits Per Week [f,g]		< .001		< .001
Q1 (0-8)	REF		REF	
Q2 (9-30)	1.60 (1.12-2.30)		1.73 (1.19-2.50)	
Q3 (31-57)	1.70 (1.15-2.50)		1.90 (1.28-2.83)	
Q4 (58+)	2.43 (1.66-3.56)		2.92 (1.97-4.32)	

Abbreviations: OR, odds ratio; CI, confidence interval; AOR, adjusted odds ratio.

[a] Sleep disturbance is divided into low, medium, and high tertiles.

[b] Adjusted for all covariates, including age, sex, race/ethnicity, relationship status, living situation, household income, and education level.

[c] Significance level determined by post-estimate tests for an overall linear effect of the categorical independent variable.

[d] n=1768 in bivariate model.

[e] n=1765 in multivariable model.

[f] n=1781 in bivariate model.

[g] n=1778 in multivariable model.