

# Sleep problems: predictor or outcome of media use among emerging adults at university?

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## SUMMARY

The pervasiveness of media use in our society has raised concerns about its potential impact on important lifestyle behaviours, including sleep. Although a number of studies have modelled poor sleep as a negative outcome of media use, a critical assessment of the literature indicates two important gaps: (i) studies have almost exclusively relied on concurrent data, and thus have not been able to assess the direction of effects; and (ii) studies have largely been conducted with children and adolescents. The purpose of the present 3-year longitudinal study, therefore, was to examine whether both sleep duration and sleep problems would be predictors or outcomes of two forms of media use (i.e. television and online social networking) among a sample of emerging adults. Participants were 942 (71.5% female) university students ( $M = 19.01$  years,  $SD = 0.90$ ) at Time 1. Survey measures, which were assessed for three consecutive years starting in the first year of university, included demographics, sleep duration, sleep problems, television and online social networking use. Results of a cross-lagged model indicated that the association between sleep problems and media use was statistically significant: sleep problems predicted longer time spent watching television and on social networking websites, but not *vice versa*. Contrary to our hypotheses, sleep duration was not associated with media use. Our findings indicate no negative effects of media use on sleep among emerging adults, but instead suggest that emerging adults appear to seek out media as a means of coping with their sleep problems.

## INTRODUCTION

In 2010, over 75% of Canadians and Americans (Statistics Canada, 2010a; U.S. Census Bureau, 2010) reported having internet access in their homes. Among adolescents, prevalence rates of daily television and computer use are as high as 85 and 95%, respectively (Milde-Busch *et al.*, 2010). Moreover, 72% of all internet users report using online social networking (Brenner, 2013). These high prevalence rates have led to increased concern that media use may be displacing important lifestyle behaviours, such as sleep (Zimmerman, 2008). This is an important issue, given the pivotal role that sleep is thought to play in psychosocial functioning across the lifespan (Galambos *et al.*, 2009). Higher media use has been consistently associated with more irregular sleep patterns, shorter sleep duration, as well as more sleep problems (Chahal *et al.*, 2013; Choi *et al.*,

2009; Oka *et al.*, 2008; Punamäki *et al.*, 2007). Researchers have proposed that increased media use may be linked to poor sleep because time spent engaged in media use may directly displace sleep (Li *et al.*, 2007; Oka *et al.*, 2008; Owens *et al.*, 1999; Van den Bulck, 2004; Zimmerman, 2008). Highly arousing media content (e.g. a violent movie) also may lead to nightmares and poor overall sleep quality (Li *et al.*, 2007; Owens *et al.*, 1999; Zimmerman, 2008), particularly among individuals whose emotion regulation strategies are not yet fully developed.

There are two important gaps, however, within the literature: (i) a lack of studies examining bidirectional associations between sleep and media use; and (ii) a lack of studies examining these associations among emerging adults. Researchers generally have inferred that longer media use precedes poor sleep, but have based this interpretation on concurrent findings (Chahal *et al.*, 2013; Punamäki *et al.*,

2007; Wang *et al.*, 2012) and thus are not able to determine whether poor sleep, in fact, may precede media use or whether the nature of the association is bidirectional (but see Johnson *et al.*, 2004; for an exception). Poor sleep may predict increased media use over time, for example, as individuals with sleep problems (who generally have been found to report more negative emotional adjustment) may seek out media as a way to cope. In fact, negative emotional adjustment has been linked to media use in both children and older adults (Chen and Kennedy, 2005; Van der Goot *et al.*, 2012). Additionally, given that technological advances have led to increased ease of accessing media (e.g. through cell phones; Jacobsen and Forste, 2011), poor sleep quality also may lead to greater media use over time as individuals now can more easily engage in media use when they have difficulty initiating or maintaining sleep (Kubey, 1986).

Furthermore, studies examining the link between sleep and media use have largely been based on children and adolescents (Chahal *et al.*, 2013; Choi *et al.*, 2009; Li *et al.*, 2007; Oka *et al.*, 2008; Van den Bulck, 2004), while little attention has been paid to emerging adults. Importantly, university students have been found to report higher prevalence rates of media use relative to both junior and senior high school adolescents (Wang *et al.*, 2012). Moreover, in both Canada (Statistics Canada, 2010b) and the USA (U.S. Census Bureau, 2010), use of online social networking has been found to be most prevalent among emerging adults, relative to any other age group. As an extension of the literature, therefore, the purpose of the present 3-year longitudinal study was to examine whether both sleep duration and sleep problems would be predictors or outcomes of two forms of media use (i.e. television and online social networking) among a sample of emerging adults.

## MATERIALS AND METHODS

### Participants

Participants were 942 (71.5% female) first-year university students at Time 1 (17–25 years;  $M = 19.01$  years,  $SD = 0.90$ ), who remained enrolled at a mid-sized university in Southern Ontario, Canada across three consecutive academic years. Parental education was used as a proxy for socioeconomic status, and averaged between 'some college, university or apprenticeship program' and 'completed a college/apprenticeship and/or technical diploma'. The majority of participants were domestic-Canadian (88%).

### Procedure

We recruited first-year university students from various academic disciplines to participate in a longitudinal survey study on stress, coping and adjustment to university by way of posters, classroom announcements, website postings and visits to on-campus student residences. Participants were given either 1-h course credit or monetary compensation

(CAD \$10.00) at Time 1, and monetary compensation at Time 2 (CAD \$20.00) and Time 3 (CAD \$30.00). Three assessments were conducted, each one year apart. Each year, assessments took place between January and March. The study was approved by the University Ethics board prior to survey administration at all three assessments, and participants provided informed active consent prior to participation.

### Missing data analysis

Missing data occurred within each assessment time point because some students did not finish the entire questionnaire (average missing data = 1.5%). In addition, not all participants completed each of the three survey waves – that is, some participants completed the survey in Years 1 and 3, and others completed the survey in Years 1 and 2. Specifically, out of the original sample that completed the survey in Year 1, 82% completed the survey in at least 2 of the 3 years (i.e. 63% completed it in all 3 years; 10% completed it only in years 1 and 2; and 9% completed it only in years 1 and 3). Missing data analyses revealed that the probability of missingness on a given variable was not related to scores on that particular variable (i.e. data were missing at random; Enders, 2010), and thus missing data for the main model were estimated using the full information maximum likelihood (FIML) estimation method. FIML retains cases that have missing data, thus avoiding the biased parameter estimates that can occur with pair-wise or list-wise deletion (Schafer and Graham, 2002).

## Measures

### Demographics

Age, gender and parental education were assessed at Time 1, and were used as covariates in the model. For parental education, scores (1 = did not finish high school to 6 = professional degree,  $r = 0.40$ ) were averaged for participants who reported on both parents.

### Sleep problems

An adapted version of the Insomnia Severity Index (Morin, 1993) was used to assess the severity of sleep problems (e.g. difficulty falling asleep, staying asleep, waking up too early, and staying awake), with responses ranging from 1 = no problem to 5 = very severe problems. An assessment of participants' overall satisfaction with their subjective sleep quality, as well as perceived daytime functioning as a result of sleep patterns, was also included in the sleep problems index. Higher scores indicate more sleep problems.

### Sleep duration

Sleep duration was calculated from participants' bed times ('What time do you normally fall asleep?') and wake times

('What time do you normally wake up?'), averaged across the week and weekend. Higher scores indicate longer sleep duration (in hours).

### Media use

Two indices of media use were assessed. (i) Television: (a) 'On an average WEEK day, how many hours do you spend watching TV shows/movies either on TV or computer?' (b) 'On an average day on the WEEKEND, how many hours do you spend watching TV shows/movies either on TV or computer?' (ii) Online social networking: (a) 'On an average WEEK day, how many hours do you spend going on Facebook/My Space/Twitter/E-mail/Messenger?' (b) 'On an average day on the WEEKEND, how many hours do you spend going on Facebook/My Space/Twitter/E-mail/Messenger?' Responses to these four items ranged from 1 = not at all to 5 = 5 or more hours. Two separate composite scores were created (i.e. for television and for online social networking) based on scores averaged across the week and weekend. Higher scores indicate longer media use.

### Plan of analyses

The primary statistical analyses were carried out using path analysis in AMOS 20.0. Model fit was evaluated using the comparative fit index (CFI) and the root mean squared error of approximation (RMSEA). CFI values greater than 0.95 and a RMSEA value of less than 0.06 (simultaneously) were used as the criteria for determining a well-specified or close-fitting model (Hu and Bentler, 1999). We note that both media use variables (i.e. time spent watching television and time spent engaged in online social networking) were modelled as continuous variables instead of categorical variables as this approach was in keeping with the research question at hand (i.e. an examination of the nature of the association between media use and sleep quality, and not on how the specific amount of time spent engaged in media use relates to sleep quality). Descriptive analyses (e.g. histograms; skewness and kurtosis values) indicated that scores on the two media use variables were normally distributed.

The cross-lagged model was comprised of four variables assessed at three time points: sleep problems, sleep duration, time spent watching television, and online social networking. Across the three time points we included lag-1 cross-lag paths, as well as lag-1 and lag-2 autoregressive/stability paths. We also accounted for concurrent associations among all the study variables within each wave. Age, gender and parental education were included as covariates, with correlations specified between these three covariates and each of the four variables assessed at Time 1. Finally, paths were estimated between each covariate and each of the four variables assessed at Time 2 and Time 3.

## RESULTS

### Descriptive statistics

Descriptive statistics (i.e. means, standard deviations, ranges and Cronbach's alpha values) for all study variables are presented in Table 1. Average sleep problems for the sample ranged from 13.81 to 14.16, suggesting that participants reported few sleep problems across the three assessments. Average sleep duration ranged from 8 h, 18 min to 8 h, 36 min, across the three assessments. Overall, participants reported spending, on average, between '1 and 2 h' and '3–4 h' a day on both online social networking and watching television across all three assessments.

### Primary analyses

In terms of the main cross-lagged model, results of a chi-square difference test of relative fit,  $\chi^2_{\text{diff}}(12) = 11.75$ ,  $P > 0.05$ , indicated that the patterns of associations among the variables were the same from Time 1 to Time 2 and from Time 2 to Time 3. Thus, subsequent analyses of our research questions were based on the model that was constrained over time, and we report below only the regression coefficients for Time 1–Time 2 (note that the pattern of results among the variables is the same from Time 2 to Time 3). Results of the path analysis indicated that the associations between sleep duration and television, as well as between sleep duration and online social networking, were not statistically significant (Table 2). The associations between sleep problems and television, as well as between sleep problems and online social networking, however, were both statistically significant, such that more sleep problems predicted both longer time spent watching television ( $\beta = 0.070$ ,  $P = 0.005$ ), as well as more time spent engaged in online social networking ( $\beta = 0.054$ ,  $P = 0.013$ ; Fig. 1), but not *vice versa*. Both time spent watching television and online social networking did not predict sleep duration and sleep problems.

## DISCUSSION

As an important extension of the literature, the present 3-year longitudinal study was the first to examine the direction of effects between two important sleep characteristics (i.e. sleep duration and sleep problems) and two indices of media use (i.e. television and online social networking) among a sample of emerging adults at university. In the present study, sleep problems predicted both time spent watching television, as well as time spent on social networking websites. On the other hand, neither time spent watching television nor time spent on social networking websites predicted sleep problems. Thus, sleep problems was a predictor and not an outcome of media use among our sample of emerging adults. Contrary to our hypothesis, sleep duration was not associated with time spent watching television or engaged in online

**Table 1** Correlations, means, standard deviations, scale ranges and Cronbach's alpha values for all key study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. SPROB1	–														
2. SPROB2	0.57	–													
3. SPROB3	0.53	0.63	–												
4. SDUR1	-0.24	-0.16	-0.14	–											
5. SDUR2	-0.19	-0.25	-0.18	0.46	–										
6. SDUR3	-0.17	-0.22	-0.27	0.39	0.48	–									
7. OSN1	0.08	0.07	0.06	0.02	0.02	0.01	–								
8. OSN2	0.12	0.10	0.10	-0.01	0.02	0.00	0.54	–							
9. OSN3	0.12	0.13	0.14	-0.02	-0.01	-0.04	0.48	0.57	–						
10. TV1	0.03	0.06	0.05	0.05	0.03	0.02	0.26	0.18	0.16	–					
11. TV2	0.08	0.10	0.11	0.04	0.06	0.03	0.16	0.28	0.20	0.37	–				
12. TV3	0.08	0.12	0.14	0.02	0.04	0.07	0.15	0.21	0.24	0.35	0.46	–			
13. AGE	0.02	0.00	-0.01	-0.05	-0.07	-0.06	-0.08	-0.06	0.03	-0.02	-0.09	-0.05	–		
14. GEN	0.18	0.09	0.06	-0.05	0.00	-0.02	0.21	0.22	0.20	0.03	0.04	0.09	-0.07	–	
15. PEDU	-0.12	-0.07	-0.06	-0.01	0.01	0.06	-0.03	-0.09	-0.04	-0.06	-0.01	0.01	-0.11	-0.12	–
M	13.81	14.16	13.92	8.60	8.31	8.27	3.47	3.29	3.20	3.28	3.29	3.24	19.01	1.72	3.68
SD	4.26	4.20	4.42	1.22	1.19	1.17	0.97	0.98	0.93	0.98	1.00	1.05	0.90	0.45	1.29
Range	6–28	6–29	6–29	4–15	4–12	4–12	1–5	1–5	1–5	1–5	1–5	1–5	17–25	1–2	1–6
$\alpha$	0.76	0.76	0.79	NA	NA	NA	0.85	0.85	0.82	0.74	0.79	0.80	NA	NA	NA

AGE, age at Time 1; GEN, gender; OSN, online social networking; PEDU, parental education at Time 1; SDUR, sleep duration; SPROB, sleep problems; TV, television. Numbers 1, 2 and 3 represent Time 1, Time 2 and Time 3, respectively.

**Table 2** Beta weights and standard errors for all cross-lagged and stability paths

Path	B	$\beta$	SE	P
Sleep problems 1 → Sleep problems 2	0.561	0.565	0.031	0.000
Sleep problems 1 → Sleep duration 2	-0.024	-0.088	0.007	0.000
Sleep problems 1 → Online social networking 2	0.012	0.054	0.005	0.013
Sleep problems 1 → Television 2	0.017	0.070	0.006	0.005
Sleep duration 1 → Sleep duration 2	0.423	0.435	0.032	0.000
Sleep duration 1 → Sleep problems 2	-0.090	-0.026	0.077	0.240
Sleep duration 1 → Online social networking 2	-0.004	-0.006	0.017	0.799
Sleep duration 1 → Television 2	0.023	0.028	0.021	0.259
Online social networking 1 → Online social networking 2	0.508	0.505	0.031	0.000
Online social networking 1 → Sleep problems 2	0.101	0.023	0.097	0.298
Online social networking 1 → Sleep duration 2	0.003	0.003	0.029	0.909
Online social networking 1 → Television 2	0.058	0.057	0.026	0.025
Television 1 → Television 2	0.361	0.356	0.034	0.000
Television 1 → Sleep problems 2	0.153	0.036	0.094	0.104
Television 1 → Sleep duration 2	0.006	0.005	0.028	0.839
Television 1 → Online social networking 2	0.044	0.045	0.021	0.038

$\beta$ , standardized beta; B, unstandardized beta; SE, standard error.

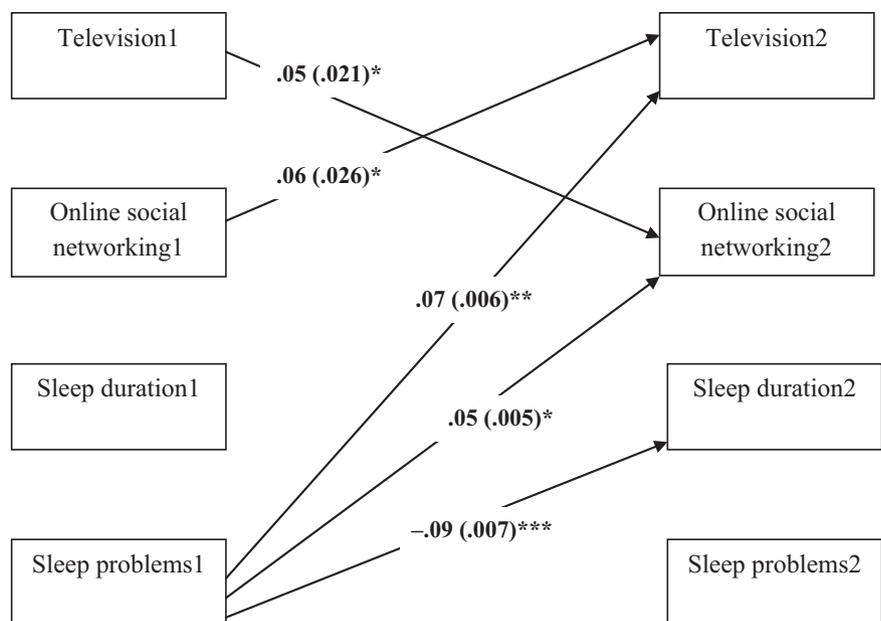
Numbers 1 and 2 after variable names indicate Time 1 and Time 2, respectively – only two time points are shown as cross-lagged paths were invariant across the three waves. Results for covariates (age, gender and parental education) are not shown, but can be obtained from first author.

social networking over time. These results provide an important insight into the nature of the associations between sleep and media use among emerging adults at university.

In contrast to findings in the present study, theoretical models of sleep and media use have traditionally modelled sleep problems as the outcome of media use (Cain and Gradisar, 2010). Moreover, few studies have specifically examined the direction of effects between sleep problems and media use (but see Johnson *et al.*, 2004), particularly among emerging adults at university. The unidirectional finding from sleep to time spent watching television in the

present study is in contrast to the Johnson *et al.* (2004) study, which found that time spent watching television predicted more sleep problems over time but sleep problems did not predict time spent watching television. One reason for this discrepant finding is that Johnson and colleagues assessed the association between watching television in adolescence and subsequent sleep problems in emerging adulthood, whereas the present study assessed the association between watching television and sleep problems ‘within’ the emerging adulthood period. As has been proposed by Johnson *et al.* (2004) perhaps the nature of the association

**Figure 1.** Significant cross-lagged paths. Note. \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ . Values indicate standardized beta weights (standard errors are in parenthesis). For simplicity, only two time points are shown as cross-lagged paths were invariant across the three waves (i.e., pattern of significant cross-lagged paths for Time 1–Time 2 are the same for Time 2–Time 3). Numbers 1 and 2 after variable names indicate Time 1 and Time 2, respectively. Results for stability paths for each variable (all of which were significant) as well as covariates (age, gender, and parental education) are not shown but can be obtained from first author.



between television and sleep problems changes across the lifespan. Indeed, Johnson *et al.* (2004) found that a reduction in time spent watching television at 14 years was associated with a reduced risk for sleep problems at 16 years but, interestingly, a reduction in the amount of time spent watching television at 16 years was 'not' associated with a reduced risk for sleep problems at 22 years. Also the data for the Johnson study were collected between 1983 and 1993 – a period of time when the ease of accessing television other than from a television set was not as prevalent as it is today (Brown, 2006). The current ease of accessing television (e.g. through mobile devices such as iPads and tablets) may have facilitated the use of television as a sleep aid as it has become easier to watch television in the bedroom.

Higher media use (both watching television and online social networking) may be one way in which emerging adults cope with sleep problems. Indeed, Eggermont and Van den Bulck (2006) found that 36.7% of individuals surveyed reported that they watched television specifically as a way to help them fall asleep. Given that sleep problems have been associated with negative affect (Galambos *et al.*, 2009) and poor overall emotional adjustment (Tavernier and Willoughby, 2013), emerging adults who report more sleep problems may seek out media as a coping mechanism to help regulate their emotions (Chen and Kennedy, 2005; Van der Goot *et al.*, 2012). Additionally, as an activity that requires little physical and mental effort, both television viewing (Kubey, 1986) as well as passive browsing on online social networking websites (Tosun, 2012) are prime candidates for individuals with sleep problems (e.g. difficulty falling asleep) wishing to fill in their time spent trying to fall asleep.

Importantly, in the present study, sleep problems at one point in time predicted longer time spent on media use 1 year later. This long-term association between sleep quality and media use lends itself to intriguing questions regarding possible mechanisms (e.g. emotion regulation) that may explain this link. Furthermore, given that findings from the present study differ from other studies with regard to the direction of effects between sleep quality and media use (e.g. longer media use was associated with an increased risk of developing sleep problems 1 year later in Thomée *et al.*, 2012), it is critical that future studies explore possible factors (e.g. personality traits such as neuroticism, conscientiousness, etc.) that might moderate the link between sleep characteristics and media use.

Moreover, in contrast to studies with children and adolescents that have reported a link between sleep duration and media use, we found that sleep duration was unrelated to television or online social networking among our sample of emerging adults. First, it is important to note the relatively adequate sleep duration reported among our sample (i.e. more than 8 h of sleep per night across all three assessments). As class start times have been shown to be predictive of sleep–wake timing among university students, increased flexibility in selecting class schedules may facilitate longer sleep duration among emerging adults at university

(Onyper *et al.*, 2012). Although past studies have found that shorter sleep duration is associated with longer media use, some of these studies did not assess sleep problems (Chahal *et al.*, 2013; Oka *et al.*, 2008; Van den Bulck, 2004). Past studies based on emerging adults that have assessed both sleep duration and sleep problems often have found that sleep duration tends to be a weaker predictor of psychosocial outcomes relative to sleep problems (Galambos *et al.*, 2009).

Although the present study makes a significant contribution to the literature by addressing two important gaps, findings must be interpreted against the study's limitations. First, our measure of online social networking was based on time spent across a number of different social networking websites, lumped together (e.g. Facebook/MySpace/Twitter). As these websites have slightly different components (e.g. options for video chat), we were not able to distinguish 'how' individuals spent their time. Additionally, our measure of television use did not assess the content of television programmes. Future research should examine, therefore, the direction of effects between sleep problems and time spent on particular activities on social networking websites, and should include an assessment of television content (e.g. degree of violence). Second, our assessments of television and online social networking were based on only two items per type of media activity. Future research should verify the associations found in the present study using multi-item, validated scales of media use in order to account for different aspects of media use (e.g. social context of media use – whether alone or with friends) and how they might relate to sleep characteristics.

Third, our assessment of sleep problems and sleep duration was based on participants' subjective self-reports. A worthwhile avenue for future research would be to assess the associations found in the present study using objective sleep measures (e.g. actigraph recordings). Fourth, it must be noted that although our sample was comprised of both domestic-Canadian and international students from a variety of different ethnic backgrounds, these students all came from the same university and thus results of our study may not be generalizable to other samples. Importantly, given the increased flexibility that university students have in scheduling sleep–wake timing and daytime activities (Zimmermann, 2011), participants in this sample may not be representative of emerging adults in general, including those who are not enrolled at university and have full-time jobs with different scheduling constraints. Thus, it would be worthwhile for future studies to examine the nature of the association between sleep and media use among non-university emerging adult samples. Fifth, as the present study was based on a select sample of university students who generally reported few sleep problems and adequate sleep duration, it is crucial that future studies also examine the nature of the association between sleep and media use among clinical samples, including individuals diagnosed with insomnia. Sixth, although findings in the present study support a unidirectional association from sleep to media use, it remains to be

determined whether the nature of the association between these two constructs may be reversed (i.e. from media use to sleep), or possibly bidirectional, given a different sample – such as clinically sleep-deprived individuals or individuals diagnosed with internet addiction.

A final noteworthy point concerns the fact that although the effect sizes (i.e. standardized beta weights) reported in the present study are deemed ‘small’ by traditional standards (Cohen, 1992), it is important to highlight that a strength of the present study was the use of a conservative model, which controlled for autoregressive/stability paths, associations among all variables within a wave, as well as the effect of age, gender and parental education, while also simultaneously controlling for the effect of the other predictors in the model. Importantly, the present study has addressed two important gaps in the literature: (i) the need to assess bidirectional associations between sleep and media use; and (ii) the need to examine these associations among emerging adults. Our results provide evidence for a unidirectional association between sleep problems and media use, such that more sleep problems predicted both time spent watching television and engaged in online social networking. Sleep problems, therefore, was the predictor and not the outcome of media use among this sample. Establishing the direction of effects between sleep problems and media use holds important implications for the effective design and execution of intervention programmes aimed at targeting both sleep and waking behaviours among university students. Our findings indicate that it may be worthwhile to promote more effective sleep habits to assist university students in getting good quality sleep given the pivotal role that sleep plays across the lifespan. It will, therefore, be imperative for researchers to examine the effectiveness of media use as a sleep aid among university students.

## CONFLICT OF INTEREST

No conflicts of interest declared.

## AUTHORS CONTRIBUTIONS

RT and TW have contributed significantly to the manuscript and consent to their names on the paper. The second author acknowledges funding received from the Social Sciences and Humanities Research Council of Canada.

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