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Sleepless due to social media? Investigating problematic sleep due to social media and social media sleep hygiene

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ABSTRACT

Emergent research suggests that “fear of missing out” (FoMO)-driven nocturnal use of social media may result in sleep disturbances and adversely influence quality of sleep. Previous research in this area primarily focused on adolescents. Therefore, knowledge of these occurrences in young adults is limited. This study addresses this knowledge gap by investigating the associations of FoMO, psychological well-being (anxiety, depression), compulsive social media use (CSMU), and sleep hygiene (habits that promote/inhibit sleep) with problematic sleep adults in both academic and employment settings. Cross-sectional surveys were conducted to collect data from two cohorts including (i) full-time students (N = 1398), and (ii) full-time working professionals (N = 472). Data were analyzed with structural equation modeling. The results indicated that psychological well-being influences CSMU, which in concurrence with sleep habits, influences the association between FoMO and problematic sleep. Significant differences existed in the strength of the association between CSMU and FoMO between the two cohorts. Interestingly, FoMO is more strongly associated with CSMU among working professionals. This study provides novel insights into the differential effects of CSMU and FoMO on sleep behaviors in young adult students versus working professionals.

1. Introduction

Social media platforms and smartphones have a global base of approximately 2.5 billion users (Clement, 2019). A growing number of these users engage in nocturnal, i.e. night-time, social media use (Adams et al., 2017; Deloitte, 2017), which may be attributed to the convenience and mobility of smartphones (Adams et al., 2017). Subsequently, scholarly attention is now focused on understanding the impact of excessive, as well as nocturnal use of social media and technological devices on users' well-being (e.g. Gradisar et al., 2013; Wolniewicz et al., 2018). Appleton et al. (2020) found nocturnal use of technological devices, such as smartphones, to be associated with work errors and vehicular accidents in Australia. In addition, a report on young adults in the U.K. estimated that about 20% of respondents frequently awoke at night to check social media notifications which caused them to experience more exhaustion than their peers (Royal Society for Public Health & Young Health Movement, 2017).

Individuals' maladaptive use of smartphones and compulsive social media use (CSMU hereafter) can result in negative consequences in their daily lives, such as social media fatigue (Bright & Logan, 2018), a “fear of missing out” (FoMO) (Apaolaza et al., 2019; Dhir et al., 2018), and sleep disturbances. In fact, FoMO has also been found to manifest as a distinct workplace phenomenon, independent of its generalized conceptualization (Przybylski et al., 2013), which can result in work-related burnout among employees (Budnick et al., 2020).

In a systematic review of literature, Alonzo et al. (2019) concluded that poor sleep quality, anxiety, and depression occur in young individuals who are excessively active on social media. However, the association of CSMU and FoMO with problematic sleep patterns is poorly understood (Milyavskaya et al., 2018; Royant-Parola et al., 2018; Rzewnicki et al., 2020), which may be attributed to certain limitations of prior research. A review of empirical studies that investigated these associations suggested that previous studies primarily focused on adolescents (e.g. Hale et al., 2018; Scott et al., 2019; Scott & Woods, 2018).

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Comparatively, fewer studies have examined this association in emerging or young adults (Adams et al., 2017; Rogers & Barber, 2019).

Secondly, research investigating associations between psychopathological traits (e.g. anxiety and depression), FoMO, CSMU, and sleep problems experienced by employed young adults has been limited (Exelmans & Van den Bulck, 2016; Levenson et al., 2016). This is a distinct gap because the work performance of young adults may be affected by maladaptive use of smartphones and social media. For example, Miksch and Schulz (2018) suggested that young, employed adults who use smartphones nocturnally for work-related communication exhibit lower work efficiency the following day. Subsequently, knowledge of how sleep hygiene and work quality among employed young adults is influenced by CSMU, or associated phenomena, such as FoMO, is needed (e.g. Budnick et al., 2020). Sleep hygiene may be understood as the degree of individual adoption of specific behaviors (or habits) that promote sleep, in concurrence with avoidance of habits that inhibit sleep (Mastin et al., 2006).

Third, information about the role of CSMU in poor sleep quality has been inconsistent (Levenson et al., 2016; Scott & Woods, 2018). For example, some studies suggest CSMU as a coping strategy for insomnia (Tavernier & Willoughby, 2014), whereas others discuss its adverse influence on problematic smartphone usage and sleep hygiene (Xanidis & Brignell, 2016). Nocturnal access of social media through smartphones may affect users' sleep hygiene by elongating periods of sleep onset latency (time taken to fall asleep) and decreasing sleep duration (Hale et al., 2018). This can potentially cause problematic sleep patterns through negative effects on sleep quality and quantity (Johansson et al., 2016; Levenson et al., 2016).

Subsequently, cohort-based studies examining the influence of CSMU and other social media experiences have been suggested (Rzewnicki et al., 2020), especially in terms of their effect on users' sleep quality, patterns, and directionality of such associations (e.g. Alonzo et al., 2019; Ciarrochi et al., 2016; Dhir et al., 2019). Consequently, this study focuses on answering three primary research questions:

RQ1. What is the association between anxiety, depression, and CSMU?

RQ2. Is there an association between FoMO, CSMU, sleep hygiene, and problematic sleep due to social media use?

RQ3. Do the associations between FoMO, CSMU, sleep hygiene, and problematic sleep due to social media use differ for young adults who are employed versus in academic pursuit?

The current study presents a two-fold contribution to existing knowledge. Firstly, we studied the associations between CSMU, FoMO, and sleep related problems in young adults, a cohort which has been less studied previously. We conducted a concurrent examination of these associations for two cohorts of young adults: (i) full-time students (N1 = 1398), and (ii) full-time working professionals (N2 = 472). Furthermore, since CSMU has been suggested as a coping strategy (e.g. Hatchel et al., 2018), users may self-determine sleep hygiene for engaging in CSMU or avoiding FoMO. These actions may represent a deficiency in self-regulation for fulfilling individual needs. Thus, the second contribution of this study rests in the utilization of two theoretical lenses – the theory of compensatory internet use (TCIU) (Kardefelt-Winther, 2014) and self-determination theory (SDT) (Ryan & Deci, 2000), to conceptualize and investigate the aforementioned associations. The aim of this study is to contribute to the existing knowledge on potential effects of FoMO and CSMU on individuals' sleep behavior. The findings may help to generate public awareness about the adverse effects of social media use on sleep and may also be used to create optimal interventions.

2. Research background

2.1. Compulsive and nocturnal use of social media

Research suggests that individuals who manifest indicators of diminished well-being, such as anxiety (Gezgin et al., 2017) and

depression (Elhai et al., 2016), may exhibit consumption patterns that reflect generally addictive behaviours (Blackwell et al., 2017; Wolniwicz et al., 2018). Individuals with these traits may exhibit a predilection toward problematic use of technological platforms, e.g. social media or smartphones (Elhai et al., 2017).

Social media has been suggested as potentially more addictive than cigarettes or alcohol (Royal Society for Public Health & Young Health Movement, 2017). CSMU may encourage individuals to use social media during periods of sleep latency to stay socially connected and/or avoid FoMO (Exelmans & Van den Bulck, 2016; Scott & Woods, 2018; Xanidis & Brignell, 2016). Concurrently, emergent research has examined the impact of nocturnal social media use on individuals' performance in different areas of life (Benson et al., 2019), e.g. job-related burnout (Zivnuska et al., 2019) and physiological consequences, such as fluctuations in blood pressure (Elhai et al., 2016).

Nocturnal social media use may contribute to incidents of disturbed or problematic sleep (Adams et al., 2017; Xanidis & Brignell, 2016). For instance, Levenson et al. (2017) reported that 30% of respondents used social media in the 30 min preceding their bed time and subsequently experienced disturbed sleep. Due to evidentiary, yet limited, knowledge on such adverse impacts, researchers have suggested the need for further exploration of associations between social media use and sleep patterns (e.g. Royant-Parola et al., 2018; Rzewnicki et al., 2020).

2.2. Differential impact of social media across user cohorts

Excessive integration of social media (i.e. CSMU) in daily routines can affect users' psychological well-being (Apaolaza et al., 2019; Wiesner, 2017). However, this affect has been primarily investigated in adolescents (Beyens et al., 2016; Tavernier & Willoughby, 2014) or teenagers (Royant-Parola et al., 2018). Few studies have also examined these associations among university students (Rogers & Barber, 2019). However, limited studies have focused on exploring whether similar effects of CSMU occur in other user cohorts, such as young employed adults (Faranda & Roberts, 2019) and the elderly (van der Velden et al., 2019). This is a distinct gap in knowledge, as users' individual characteristics may have a significant influence on their social media usage and behavioral patterns, e.g. demographics (Andreassen et al., 2017). Social media usage patterns also differ among student and non-student users (Diffley et al., 2011). Barber and Santuzzi (2017) found that students who are concurrently employed may experience increased pressure of maintaining social media connectivity and, subsequently, potential consequences, such as poor sleep hygiene, burnout, and stress.

While the aforementioned studies seem to reflect differential behavior between student and non-student (employed) social media users, others suggest a certain degree of similarity. For example, Milyavskaya et al. (2018) reported a small, but significant effect of FoMO on non-student users, whereas the same effect was significantly greater for students. Steenackers et al. (2016) confirmed that CSMU also affected adult and non-student users, albeit for a specific platform, i. e. Facebook. Furthermore, Browne et al. (2018) argued for the need to include non-student samples in future studies to develop generalized conceptual frameworks for investigating FoMO, social media use, and its consequences. Therefore, based on prior studies, it may be said that the existing literature offers limited insight into the differential effects of CSMU and FoMO on sleep hygiene and problematic sleep for student versus non-student (employed) users. This study attempts to address this by conducting a comparative study with two separate datasets for (i) full-time students (sample A, N = 1398) and (ii) full-time working professionals also involved in part-time studies (referred to as working professionals hereafter) (sample B, N = 472).

3. Theory and hypothesis development

Continual social media connectivity can create a series of cues that induce users to act, regarding responding to notifications and messages

(Osatuyi & Turel, 2018). Such actions may be either prompt or delayed, contingent on users' perceived social pressure to respond and ability to self-regulate responses during appropriate times (Osatuyi & Turel, 2018; Verheij, 2018). Low self-regulation in responding to social media communication at relatively inappropriate times, such as periods of sleep latency, may lead to development of problematic sleep (Verheij, 2018). Prior studies postulate a link between an individual's self-regulation and social media engagement, which suggests the need to explore the processes and motivations underlying individuals' social media usage. Therefore, TCIU (Kardefelt-Winther, 2014) and SDT (Ryan & Deci, 2000) may be appropriate theoretical lenses for examining these relationships, as these theories pertain to the rationale, i.e. motivations and psychological processes, for specific actions which relate to social media use in the present context.

3.1. Theoretical framework

Prior research suggests that individuals may be driven to spend a greater amount of time on social media in an effort to feel socially connected and to avoid experiencing FoMO (Browne et al., 2018; Elhai et al., 2016; Przybylski et al., 2013). These findings align with the tenets of SDT (Ryan & Deci, 2000), which postulate that individuals may positively self-regulate their behaviors to experience a sense of personal well-being. According to SDT, this may be achieved through fulfillment of three psychological needs – autonomy (need for endorsement of own behavior), competence (need for achievement of personal goals), and relatedness (need for connection with others) (Ryan & Deci, 2000). SDT has been previously used to study consequences of CSMU (Beyens et al., 2016; Przybylski et al., 2013), FoMO (Przybylski et al., 2013), and social media-induced sleep issues (Vollmer et al., 2014). SDT is an appropriate theoretical lens to examine the current associations, as prior research indicates that individuals may regulate their sleep patterns to nocturnally engage with social media (e.g. Adams et al., 2017), and avoid FoMO (Rosen et al., 2016), which can lead to a shorter sleep duration (Scott & Woods, 2018). Therefore, social media may act as a platform for users to self-regulate their desires for maintaining social connections.

TCIU was proposed by Kardefelt-Winther (2014) as a way to explain

an individual's over-engagement with internet/social media as a mechanism to compensate for their own feelings of negativity or psychopathy (Wolniewicz et al., 2018). This theory may be used to link the traits of psychopathology and diminished well-being to amount of social media/internet use (Kardefelt-Winther, 2014; Wolniewicz et al., 2018) by students (Ohno, 2016), as well as working professionals (Grover et al., 2019). Thus, TCIU paves the way for understanding the reasons or motives for which individuals allow technology to pervade their lives (Kardefelt-Winther, 2014). It may also help to understand reasons for maladaptive engagement with social media, internet, and smartphones (e.g. Dempsey et al., 2019; Elhai et al., 2018). Such reasons may relate to coping with, or escaping from indicators of psychological distress, such as FoMO (Ohno, 2016) and depression (Grover et al., 2019; Ohno, 2016).

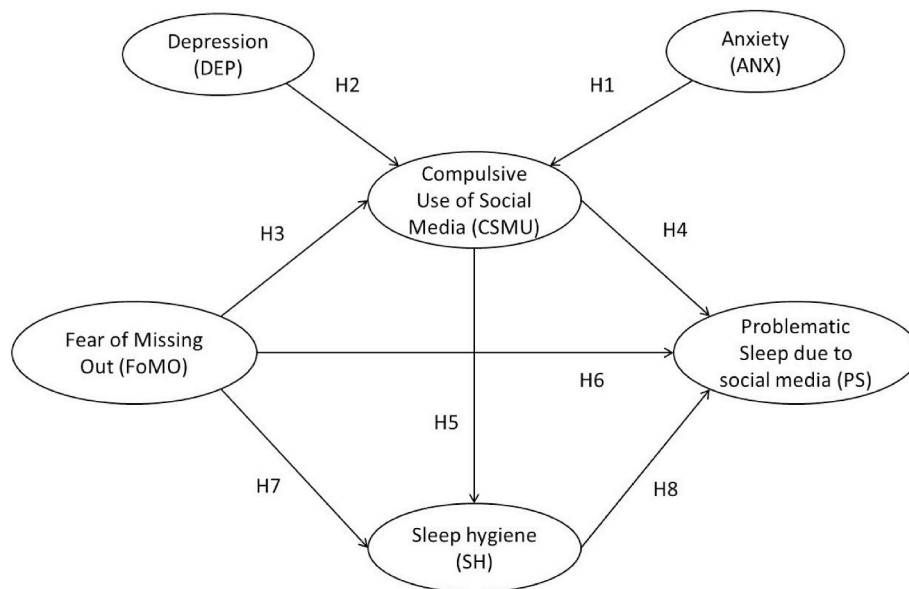
3.2. Research model

The present study investigated the associations between psychological well-being (i.e. anxiety and depression) with CSMU. Furthermore, associations between FoMO, CSMU, sleep hygiene, and problematic sleep due to social media were examined. The study framework also tested the mediating influence of CSMU and poor sleep hygiene on association between FoMO and problematic sleep due to social media. Fig. 1 presents the proposed research framework and the hypothesized relationships described in the subsequent sections.

3.3. Psychological well-being and compulsive social media usage

Although the term 'compulsive use' is usually applied to addictive behaviors related to drug use or gambling (Dhir et al., 2018), Meerkerk et al. (2009) suggest that the term can also relate to a specific set of activities related to social media usage, e.g. excessive checking of messages or notifications.

Several scholars have tried to understand the impact of problematic use or CSMU on mental health and psychological well-being (Aladwani & Almarzouq, 2016; Benson et al., 2019). According to Wegmann et al. (2015), self-regulation may mediate the effects of depression, anxiety,



Note: Sleep hygiene = poor social media Sleep Hygiene

Fig. 1. Proposed conceptual model.

and CSMU on individuals. However, the directionality of relationships between these variables remains unclear. Some studies have suggested that negative well-being indicators, such as depression and anxiety, are significant influencers of CSMU (Lin et al., 2016). For example, Aladwani and Almarzouq (2016) found anxiousness to be an antecedent of CSMU. Bright and Logan (2018) found that depression triggered CSMU in female adolescents, whereas anxiety was a more significant predictor in males. Similarly, Vannucci et al. (2017) suggested that increased social media use may lead to higher likelihood of experiencing anxiety disorders. However, few studies have indicated that individuals engage in CSMU as a way to alleviate symptoms of anxiety (Billieux et al., 2015) and depression (Meerkerk et al., 2009). Therefore, we theorize that anxiety and depression are associated with CSMU and propose the following hypotheses:

- H1. Anxiety has a positive association with CSMU.
- H2. Depression has a positive association with CSMU.

3.4. Compulsive social media usage and FoMO

Anderson and Jiang (2018) found that approximately 95% of teenagers in the U.S. owned a smartphone, of which 45% remained continuously online and 44% checked their social media several times a day. These statistics indicate the degree to which individuals experience the need to ensure a continual connection with social media. According to SDT, individuals may regulate their own behavior to achieve a sense of accomplishment for their own needs. We argue that CSMU may be a mechanism for avoiding FoMO and may also be encouraged by the desire to sustain a sense of relatedness with others. Existing studies offer some insight into the association between FoMO and CSMU, but present contrary evidence regarding the directionality of the relationship. For example, Blackwell et al. (2017) found FoMO to be a predictor for CSMU, whereas Gezgin et al. (2017) suggested that CSMU can lead to the development of FoMO. Wiesner (2017) also suggested that FoMO can lead to CSMU, as individuals may maintain continual social media connectivity to avoid missing new information or updates by social groups. Recognizing such uncertainties in knowledge pertaining to FoMO, Blackwell et al. (2017) suggested a need for further research into the associations between FoMO and addictive or compulsive behavior related to social media. Therefore, we propose the following hypothesis:

- H3. FoMO has a positive association with CSMU.

3.5. Compulsive social media usage and sleep

Research suggests a relationship between social media use and poor sleep hygiene (Scott et al., 2019; Scott & Woods, 2018), as well as poor sleep quality due to high levels of emotional attachment to smartphones and nocturnal use of social media (Woods & Scott, 2016). Smartphones generate blue light emission which may suppress melatonin production and negatively affect circadian rhythms (sleep-wake cycles) (Christensen et al., 2016). Consequently, such usage may cause problematic sleep due to decreased drowsiness, longer sleep latency periods, and enervating sleep quality (Christensen et al., 2016).

Research has linked CSMU to problematic sleep (Adams et al., 2017; Ciarrochi et al., 2016; Woods & Scott, 2016), and sleep hygiene (Christensen et al., 2016; Scott & Woods, 2018). For example, Xanidis and Brignell (2016) found problematic sleep to be contingent upon users' level of reliance on social media, wherein sleep quality mediated the relationship between social media use and cognitive failures in a user's daily life. In contrast, Tavernier and Willoughby (2014) found that users engaged in nocturnal social media use to cope with sleep problems. However, prior studies have focused primarily on adolescents (Adams et al., 2017; Scott & Woods, 2018; Woods & Scott, 2016). Furthermore, few studies have specifically studied cause-effect relationships between social media use and sleep (Scott & Woods, 2018). Therefore, we argue that current knowledge on the associations between CSMU and sleep is inconsistent, and there is a need to study whether

similar associations exist for adult users. Thus, we propose the following hypotheses:

- H4 CSMU has a positive association with problematic sleep due to social media.
- H5 CSMU has positive association with poor social media sleep hygiene.

3.6. FoMO and sleep

According to SDT, individuals may regulate their own behaviors to avoid negative emotions, such as anxiety, stress, or guilt (Ryan & Deci, 2000). In the context of social media, this may result from psychological distress (e.g. anxiety, frustration) created from FoMO, due to a perceived delay or temporary disconnect with social media (Gezgin et al., 2017). Dahl and Lewin (2002) suggested that self-determined times for sleeping, coupled with the desire to stay awake to engage in social activities may contribute to sleep problems. For example, users, especially youth and adolescents, may prefer to keep their phones within reach during the night to continue their perceived connection with social media and avoid FoMO induced distress (Scott & Woods, 2018). Furthermore, Adams and Kisler (2013) reported that students repeatedly woke during sleep latency periods to answer texts or calls and experience lower sleep quality. In another study, Adams et al. (2017) reported that students often compromised sleep quality to continually maintain connectivity with peer and familial groups on social media.

Since social media provides opportunities to engage in social activities, we theorize that the desire to not miss such opportunities may result in individuals' adoption of problematic sleep hygiene which can adversely affect sleep quality. Although studies have indicated that greater use of technology and social media can affect sleep patterns (Adams et al., 2017; Woods & Scott, 2016), the mechanism behind this effect is not well understood (Scott & Woods, 2018). The present study is an attempt to address this gap through the following hypotheses:

- H6 FoMO has positive association with problematic sleep due to social media.
- H7 FoMO has positive association with poor social media sleep hygiene.

3.7. Sleep hygiene and problematic sleep due to social media

Previous research suggests that social media use exerts a negative influence on sleeping habits (Vorderer et al., 2016; Xu et al., 2015). According to Vorderer et al. (2016), individuals desire to stay connected to social media and habitually prefer to keep their smartphones in proximity, even during the night, to ensure quick responses to social media communication. Gradisar et al. (2013) found that a majority of respondents used technological devices within an hour of self-reported bedtimes, which suggests a deficiency in self-regulation (Ryan & Deci, 2000). Furthermore, Gradisar et al. (2013) found evidence of sleep-related complaints from excessive use of technology to be more prevalent in younger (<30 years), rather than mature individuals (>30 years). Johansson et al. (2016) also found evidence that individuals' use of technological devices, such as smartphones, prior to sleep could influence circadian rhythms leading to poorer sleep quality, and problematic sleep. Similar findings were also reported by Adams and Kisler (2013) for users engaging in social media use during sleep latency periods. However, prior studies have called for further investigation into the associations between the use of technology (e.g. smartphones, social media), sleep hygiene, and problematic sleep (Adams et al., 2017; Adams & Kisler, 2013). Therefore, based on prior research, the current study aims to test the following hypothesis:

- H8. Poor social media sleep hygiene has a positive association with problematic sleep due to social media.

4. Materials & methods

4.1. Survey and data collection

A survey was conducted on a large university campus in Northern India to collect two sets of cross-sectional data. Potential participants were identified with support from the university which advertised information related to the study through notice boards in several departments. Individuals targeted for the survey were aged 18–27 years and included full-time students and working professionals. Individuals who responded to the advertisement were informed of the voluntary and confidential nature of participation. Prior to participation, individuals were asked to confirm their use of Facebook, which is among the most popular social media platforms in India with an estimated network of approximately 269 million active users (Statista, 2019). Upon receipt of oral confirmation and consent to participate, individuals were asked to respond to a paper-based questionnaire designed to record responses on a 5-point Likert scale. It contained previously tested scale items to measure CSMU (Andreassen et al., 2012), FoMO (Przybylski et al., 2013), anxiety (La Greca & Lopez, 1998), and depression (Salokangas et al., 1995). The items for variables of sleep hygiene and problematic sleep were developed by the authors following a mixed-method approach. Young adult users were first interviewed about their social media use, sleep hygiene, and experience of problematic sleep, followed by the subsequent development and testing of scale items. Our study on the validation and development of these scale items is currently under review.

4.2. Participant profile

Two cross-sectional datasets were generated for two groups. The first group, Sample A (students), consisted of 1398 Facebook users aged between 19 and 27 years. This group was comprised of full-time students in Masters (post-graduate) programs, of which 57.4% were female. The second group, sample B (working professionals), was comprised of 472 respondents, of which 63.1% were female. The respondents in this group were 18–23 years old and enrolled in part-time Bachelors and Masters programs while being simultaneously employed in full-time jobs.

4.3. Common method bias

Due to use of self-reported data, it was important to address the potential occurrence of common method bias (CMB) (Podsakoff et al., 2003). To eliminate potential CMB, the following steps were taken: (a) scale items for different variables were disjointedly distributed throughout the questionnaire, (b) anonymity for respondents was emphasized and, (c) respondents were encouraged to respond truthfully by emphasizing the purely academic nature of enquiry. Furthermore, Harman's single factor test (Harman, 1976) was conducted which determined variance for the single factor to be <50%. The results determined that the present research was not affected by CMB (Podsakoff et al., 2003).

5. Analysis

IBM SPSS 25.0 and AMOS 25.0 were used for statistical analyses. Structural Equation Modeling (SEM) was conducted using a two-step approach (Anderson & Gerbing, 1988). The reliability and validity of the study constructs were confirmed by the measurement model, whereas the structural model was used for hypotheses testing. Descriptive statistics for the sample and participants were performed via SPSS.

5.1. Reliability and validity

The convergent validity of the study measures for both studies was determined first by examining the factor loadings which were above the

threshold value of 0.5 (Anderson & Gerbing, 1988). Following, the average variance extracted (AVE) and composite reliability (CR) values were assessed for meeting the threshold values of 0.50 and 0.70, respectively (Fornell & Larcker, 1981). The CR values for problematic sleep due to social media (PS) (0.68) in study A and CSMU (0.69) in study B were slightly lower than the recommended threshold value (see Tables 1 and 2). However, reliability values slightly less than the recommended threshold values are acceptable while exploring less extensively investigated constructs (Hulland, 1999).

CSMU and PS were measured with two items. Two and three item constructs can be reliable if they can be interpreted in a meaningful way (Worthington & Whittaker, 2006; Wübben, 2009), and the items are highly correlated, while uncorrelated with other variables (Worthington & Whittaker, 2006; Yong & Pearce, 2013). These conditions are valid in both CSMU and PS. Both measures possess sufficient Spearman-Brown reliability values (Eisinga et al., 2013).

Discriminant validity of the studies was tested by examining correlations between the latent constructs (Fornell & Larcker, 1981). The inter-construct correlations were <0.80 for both studies. Furthermore, the AVE values were higher than the average shared variance (ASV) and maximum shared variance (MSV), which suggests that both studies meet the conditions for establishing the criteria for discriminant validity (Fornell & Larcker, 1981) (Tables 1 and 2).

5.2. Measurement model

The results suggested a good model fit for both the studies (Study A: $X^2/df = 4.46$, GFI = 0.9, AGFI = 0.94, CFI = 0.96, TLI = 0.94, RMSEA = 0.05 and study B: $X^2/df = 2.342$, GFI = 0.93, AGFI = 0.90, CFI = 0.94, TLI = 0.93, RMSEA = 0.05). Factor loadings were also found to be satisfactory with individual values of each scale item meeting the recommended threshold value of 0.60 (Hair et al., 2006) (Table 3).

5.3. Structural model

The structural models of both studies exhibited a good model fit (Study A: $X^2/df = 4.49$, GFI = 0.95, AGFI = 0.94, CFI = 0.95, TLI = 0.94, RMSEA = 0.05 and Study B: $X^2/df = 2.35$, GFI = 0.93, AGFI = 0.90, CFI = 0.94, TLI = 0.93, RMSEA = 0.05). R^2 and β values were used to evaluate the predictive power of the model across the two studies.

The Study A model tested the hypothesized relationships in students. For Study A, a 36% variance in data is explained for problematic sleep (see Fig. 2). The following hypotheses were supported: H1 ($\beta = 0.16$, $p < .001$), H2 ($\beta = 0.25$, $p < .001$), H3 ($\beta = 0.10$, $p < .05$), H4 ($\beta = 0.20$, $p < .001$), H5 ($\beta = 0.43$, $p < .001$), H7 ($\beta = 0.07$, $p < .05$) and H8 ($\beta = 0.47$, $p < .001$). However, hypothesis H6 was insignificant ($\beta = 0.05$, $p > .05$) (Table 4).

The Study B model predicted a 25.1% variance for problematic sleep in working professionals (Fig. 3). The following hypotheses were supported: H1 ($\beta = 0.19$, $p < .05$), H2 ($\beta = 0.16$, $p < .05$), H3 ($\beta = 0.17$, $p < .05$), H5 ($\beta = 0.41$, $p < .001$) and H8 ($\beta = 0.45$, $p < .001$). However, hypotheses H4 ($\beta = 0.07$), H6 ($\beta = 0.05$) and H7 ($\beta = 0.06$) were insignificant (Table 4). Therefore, in both studies, the relationship between FoMO and problematic sleep was insignificant, whereas the strongest correlations existed between CSMU, sleep hygiene, and problematic sleep.

5.4. Mediation analysis

Mediation analysis was carried out using process macro in SPSS. Model 4 in process macro was used to conduct the mediation analysis where confidence intervals were bootstrapped 5000 times. The mediation analysis examined the mediating influence of CSMU and sleep hygiene among different study variables. The direct association between FoMO and sleep hygiene was significant for both studies. Upon the addition of CSMU as the mediator, the main effect among FoMO and

Table 1
Reliability and validity results (Study sample A).

Variables	M	SD	Alpha	CR	AVE	MSV	ASV	CSMU	FoMO	ANX	PS	SH	DEP
CSMU	1.81	.94	0.71	0.71	0.55	0.19	0.14	0.74					
FoMO	2.25	.93	0.74	0.76	0.53	0.26	0.13	0.31	0.73				
ANX	2.07	.87	0.89	0.89	0.58	0.26	0.15	0.32	0.51	0.76			
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PS	1.75	.99	0.68	0.68	0.52	0.32	0.13	0.41	0.19	0.22	0.72		
SH	1.52	.79	0.82	0.84	0.58	0.32	0.14	0.43	0.19	0.26	0.57	0.76	
DEP	2.07	.92	0.77	0.77	0.53	0.26	0.15	0.36	0.48	0.51	0.26	0.26	0.73

Note: Cronbach’s alpha (Alpha), Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), Average Shared Variance (ASV), Mean (M), Standard Deviation (SD), Compulsive use of Social media (CSMU), Anxiety (ANX), Depression (DEP), Fear of Missing Out (FoMO), poor social media Sleep Hygiene (SH), Problematic Sleep due to social media (PS).

Table 2
Reliability and validity results (Study sample B).

Variables	M	SD	Alpha	CR	AVE	MSV	ASV	CSMU	FoMO	ANX	PS	SH	DEP
CSMU	1.79	.93	0.68	0.69	0.53	0.18	0.12	0.73					
FoMO	2.20	.92	0.73	0.75	0.51	0.31	0.16	0.37	0.72				
ANX	2.12	.94	0.85	0.85	0.50	0.31	0.15	0.34	0.55	0.70			
Paste Correlations Table into A1 and Standardized Regression Weights Table into F1, then click me.													
PS	1.67	.94	0.69	0.73	0.58	0.25	0.09	0.27	0.15	0.24	0.76		
SH	1.42	.70	0.82	0.83	0.56	0.25	0.11	0.42	0.20	0.25	0.50	0.75	
DEP	2.09	.93	0.75	0.75	0.50	0.30	0.14	0.33	0.55	0.46	0.21	0.19	0.71

sleep hygiene remained significant. Therefore, CSMU partially mediated the association between FoMO and sleep hygiene for both the samples. Similarly, sleep hygiene also partially mediated the association between CSMU and problematic sleep for Study A and B. The main effect among CSMU and problematic sleep was found to be significant irrespective of the presence or absence of the mediator. Finally, the direct association of problematic sleep and FoMO was found to be significant. However, the direct effect vanished with the addition of CSMU and sleep hygiene as mediators. Therefore, CSMU and sleep hygiene were found to fully mediate the association of FoMO and problematic sleep. Tables 5 and 6 present the details of the conducted mediation analysis.

6. Discussion

H1 and H2 tested the positive association of anxiety and depression with CSMU. These hypotheses were supported for both sample groups with slightly stronger relationships present for students. The findings support prior research that suggested an association between CSMU and anxiety and depression among adolescents and students (e.g. Bettmann et al., 2020; Lin et al., 2016). Furthermore, the significance of H1 and H2 for working professionals contradicts the findings of Osatuyi and Turel (2018) who found younger adults exhibit a higher propensity toward social media addiction, compared to older adults. This difference may arise due to the influence of contextual factors, and in the present study, it may be attributed to the geographical region of India wherein depression is a viable concern among working professionals (James, 2019). Thus, we contend that for such working professionals, CSMU may be a form of coping strategy for self-alleviation of deficiencies in psychological well-being, as has been suggested by prior studies (Billieux et al., 2015; Khang et al., 2011).

The positive correlation of FoMO with CSMU for both students and working professionals was tested by H3. This correlation was found to be significant for both the groups and results support findings from past studies (Blackwell et al., 2017). Additionally, the findings present a novel insight for FoMO as a stronger predictor of CSMU among working professionals rather than students. This may be attributed to the fact that working professionals, especially those concurrently engaged with academic studies, may have limited opportunities for tangible social interactions. Such individuals may perceive social media to be a platform

which can provide a continued and temporally-stable means of social connectivity and, subsequently, alleviate persistent, as well as transient feelings of loneliness (Deters & Mehl, 2013) or depression (James, 2019).

H4 tested the correlation of CSMU with problematic sleep. This correlation was found to be significant among students, but insignificant among working professionals. The significance of H4 among students supports the theories of prior studies that social media engagement takes precedence over sleep quality or duration for students (Adams et al., 2017). Additionally, the current study presents fresh insight into social media-induced sleep behavior for working professionals. Contrary to the results of Gradisar et al. (2013), this study found no direct correlation between CSMU and problematic sleep among working professionals. This supports our theory that for working professionals, CSMU may be an indirect way to cope with psychological deficits, such as anxiety or depression. However, the findings also suggest that working professionals may self-regulate their social media use to some degree and their decrease of sleep quality or duration may be attributed to other causes, such as stress due to familial or educational commitments.

H5 tested the association between CSMU and sleep hygiene and was found to be significant for both students and working professionals. The findings are consistent with previous studies which suggest that CSMU may adversely influence users’ sleep behaviors (or sleep hygiene) (e.g. Johansson et al., 2016; Vorderer et al., 2016). However, this influence may manifest due to different causal factors, such as motivations and socio-demographic indicators, for students versus working professionals, as CSMU was not associated with problematic sleep for working professionals. Further, this variance may be attributed to differential levels of self-regulation for an individual’s sleep hygiene and impulsive tendencies to respond to social media notifications during periods of sleep latency (Exelmans & Scott, 2019).

H6 tested the association between FoMO and problematic sleep. No significant association existed for both samples. This finding may be attributed to disparate motivational, personal, or contextual factors that may drive FoMO. For instance, working professionals may utilize periods of sleep latency to engage with social media to maintain perceived social connectivity, fulfill needs for relatedness, and avoid FoMO (Kim & Drumwright, 2016). Such working professionals may be able to self-regulate social media use because of multiple commitments.

Table 3
Study measures and factor loadings for the measurement and structural model.

Construct	Measurement items	Study A (N = 1398)		Study B (N = 472)	
		CFA	SEM	CFA	SEM
Depression (DEP) Depression may be described as a psychological condition affecting mental and cognitive abilities of an individual through experience of negative emotions, such as sadness and loss of interest in regular activities (Parekh, 2017a)	DEP1: I have not enjoyed my life	0.67	0.67	0.68	0.68
	DEP2: I have felt unworthy	0.76	0.75	0.75	0.75
	DEP3: I have felt all joy disappear from my life	0.75	0.75	0.69	0.69
Anxiety (ANX) Excessive amounts of fear or stress over anticipated concerns pertaining to future occurrences (Parekh, 2017b), such as prospective evaluations made by others during interactions (La, Greca, & Lopez, 1998)	ANX1: I worry about what others say about me	0.73	0.73	0.65	0.65
	ANX2: I worry that others don't like me	0.86	0.86	0.77	0.77
	ANX3: I'm afraid that others will not like me	0.86	0.86	0.82	0.82
	ANX4: I worry about what others think of me	0.85	0.85	0.79	0.79
	ANX5: I feel that others make fun of me	0.65	0.65	0.61	0.61
	ANX6: I feel that peers talk about me behind my back	0.57	0.57	0.55	0.55
Compulsive Use of Social media (CSMU) Overt attachment to use of specific activities on social media that mirror general behaviors associated with other forms of addictions (Andreassen et al., 2012; Meerkerk et al., 2009)	CSMU1: I've spent a large amount of time thinking about FB or planned use of FB	0.73	0.73	0.67	0.67
	CSMU2: I've felt an urge to use FB more and more?	0.76	0.75	0.78	0.77
Fear of Missing Out (FoMO) Pervasive concerns of an individual about missing out on experiences that others might be having (Przybylski et al., 2013).	FoMO1: I fear others have more rewarding experiences than me	0.78	0.78	0.75	0.75
	FoMO2: I fear my friends have more rewarding experiences than me	0.83	0.83	0.84	0.84
	FoMO3: I get anxious when I don't know what my friends are doing	0.52	0.52	0.52	0.52
Poor social media sleep hygiene (SH) Defined as degree to which an individual exhibits specific social media-related behaviors and habits that may promote sleep as well as concurrent avoidance of habits that inhibit sleep (Mastin et al., 2006). This construct refers to users' sleep habits, awareness about nocturnal use of social media in a non-harmful manner, and the potential	SH1: How often do you wake up in the night to check your Facebook Wall?	0.81	0.80	0.76	0.76
	SH2: How often do you wake up in the night to check Facebook notifications?	0.87	0.88	0.89	0.89
	SH3: How often do you wake up in the night to check likes/comments on a Facebook post?	0.78	0.79	0.78	0.78
	SH4: How often do you use Facebook before sleeping?	0.53	0.53	0.53	0.53

Table 3 (continued)

Construct	Measurement items	Study A (N = 1398)		Study B (N = 472)	
		CFA	SEM	CFA	SEM
Problematic Sleep due to social media (PS) Disruptions in sleeping patterns due to excessive usage of social media during periods of sleep latency that may result in negative impacts on sleep quality and duration (Johansson et al., 2016; Levenson et al., 2016). This construct refers to disturbances in terms of delays, insufficiency, and lower quality sleep experienced due to social media use.	PS1: How often is your sleep disturbed due to Facebook notifications?	0.75	0.76	0.92	0.93
	PS2: How often is your sleep reduced due to Facebook use before sleeping?	0.69	0.69	0.57	0.56

Therefore, their sleep quality or duration may not be directly affected by FoMO. In contrast, students may be driven by perceived social pressure to engage in nocturnal social media use to emulate their peers (Adams et al., 2017) and may not consider a delayed bed-time as problematic. Furthermore, we theorized that the association between FoMO and problematic sleep may be moderated or mediated by other variables (Elhai et al., 2016). Thus, CSMU and sleep hygiene were examined as potential mediators for FoMO and problematic sleep.

The mediation analysis confirmed that CSMU partially mediated the association between FoMO and sleep hygiene for both samples, whereas sleep hygiene partially mediated the relationship between CSMU and problematic sleep for both sample groups. Furthermore, CSMU and sleep hygiene fully mediated the association of FoMO and problematic sleep, as the direct effect of FoMO on problematic sleep became insignificant on addition of mediators. These results suggest that sleep hygiene plays a definitive role in the development of problematic sleep patterns among working professionals and students. In accordance with these findings, we theorize that although working professionals may engage in CSMU to avoid FoMO, their experience of problematic sleep is contingent upon the effect of their sleeping habits, i.e. sleep hygiene.

H7 tested the association between FoMO and sleep hygiene. This association was significant for students, which is supported by prior research on effects of FoMO on young social media users (e.g. Alonzo et al., 2019; Scott et al., 2019). This suggests that students give considerable value to FoMO and may consequently experience higher levels of nomophobia. In contrast the association between FoMO and sleep hygiene was insignificant for working professionals in the final structural model. This suggests that FoMO may not have enough significance to induce a change in sleep hygiene for working professionals, and supports our proposition that social media may only be a compensatory or coping mechanism for meeting psychological needs. These individuals may pay significant attention to healthy regulation of their sleep hygiene to ensure accomplishment of their work and study commitments.

Finally, H8 determined that sleep hygiene was positively associated with problematic sleep due to social media use for both students and working professionals. This finding is consistent with prior studies which suggest that sleep hygiene can influence the quality and duration

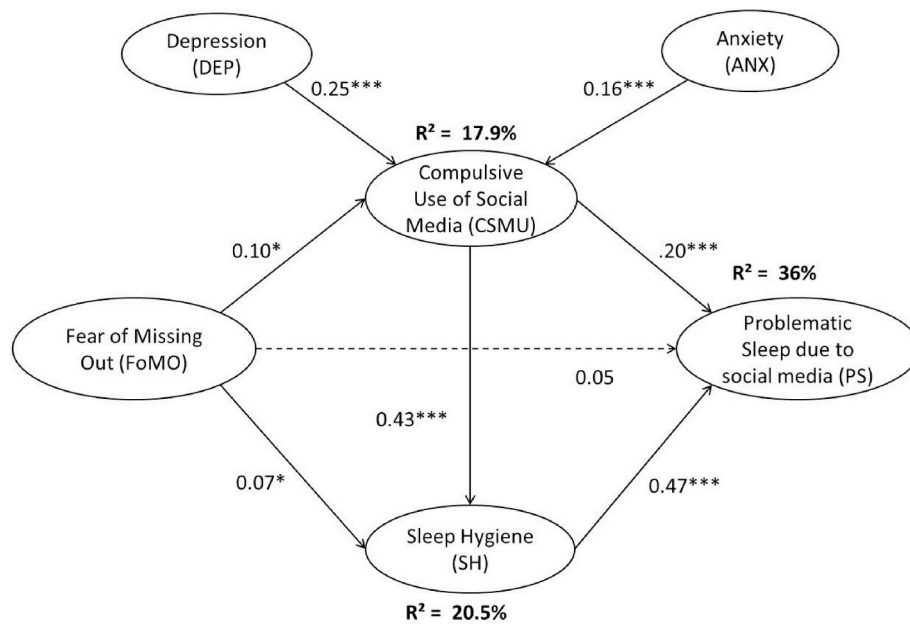


Fig. 2. Structural model results (Study A).

Table 4
Confirmation of hypotheses.

Hypothesis	Path	Study A (N = 1398)		Study B (N = 472)		Supported (Yes/No/ partially)
		β	p	B	p	
H1	ANX → CSMU	0.16	<0.001	0.19	<0.05	Yes
H2	DEP → CSMU	0.25	<0.001	0.16	<0.05	Yes
H3	FoMO → CSMU	0.10	<0.05	0.17	<0.05	Yes
H4	CSMU → PS	0.20	<0.001	0.07	n.s.	Partially
H5	CSMU → SH	0.43	<0.001	0.41	<0.001	Yes
H6	FoMO → PS	0.05	n.s.	0.05	n.s.	No
H7	FoMO → SH	0.07	<0.05	0.06	n.s.	Partially
H8	SH → PS	0.47	<0.001	0.45	<0.001	Yes

Note: Compulsive use of Social media (CSMU), Anxiety (ANX), Depression (DEP), Fear of Missing Out (FoMO), poor social media Sleep Hygiene (SH), Problematic Sleep due to social media (PS), not significant (n.s.).

of sleep experienced by social media users (Adams & Kisler, 2013; Levenson et al., 2016). This means that individuals who use social media during periods of sleep latency may be at risk of experiencing adverse changes in physiological functions, or other probable health-related issues that can arise due to problematic sleep patterns. This finding indicates that maintaining appropriate sleep hygiene practices, despite nocturnal social media use, is critical for young adults (both students and working professionals) to avoid experiencing problematic sleep.

7. Conclusions

Concerns about negative influences of CSMU and FoMO on users' sleep patterns have been gaining traction in academic research (Levenson et al., 2016; Scott & Woods, 2018). Prior investigations have focused on effects of excessive engagement with social media on sleep behavioral patterns of adolescents and students. Existing academic knowledge is limited in its understanding of the same phenomena in

working professionals. This study attempted to address these current gaps by using TCIU and SDT theories to develop a comprehensive framework. Eight hypotheses were proposed and tested to examine the correlations between FoMO, CSMU, psychological well-being (anxiety and depression), poor sleep hygiene, and problematic sleep due to social media. By analyzing two sets of responses received from students and working professionals, the current study provided novel insights about the differential effects of FoMO and CSMU on sleep related behaviors, e.g. the lack of a direct effect of FoMO on problematic sleep for both groups of social media users (H6). Members of both user groups may engage in CSMU due to anxiety (H1) and/or depression (H2) and FoMO (H3). In students, CSMU was positively associated with both problematic sleep (H4), and poor sleep hygiene (H5). CSMU was also positively associated with sleep hygiene in working professionals, but the strength of the relationship was slightly lower in comparison with students. Additionally, for working professionals, CSMU was not associated with problematic sleep (H4) and FoMO was not directly associated with poor social media sleep hygiene (H7).

7.1. Implications

The present study has provided several contributions to current theoretical and practical knowledge in this field.

7.1.1. Theoretical contributions

Firstly, to bridge the gap in current understanding pertaining to CSMU and its impact on sleep related behavior, the study incorporated concepts from two motivational theories – TCIU and SDT. The findings, such as the mediational role of CSMU and sleep hygiene on the association between FoMO and problematic sleep, advance current understanding of the effects of these variables on individuals' essential activities. Additionally, the differential influence of these variables on sleep behaviors of different types of social media users also adds to the current body of knowledge.

Secondly, this study significantly contributed to knowledge on FoMO and its interactivity with other negative aspects of social media use, such as CSMU, as few studies have investigated FoMO as an antecedent (Elhai et al., 2018). Furthermore, few studies have investigated the association between FoMO and sleep (Scott & Woods, 2018; Woods & Scott, 2016). These findings also offer new insight into the pathways and interactions

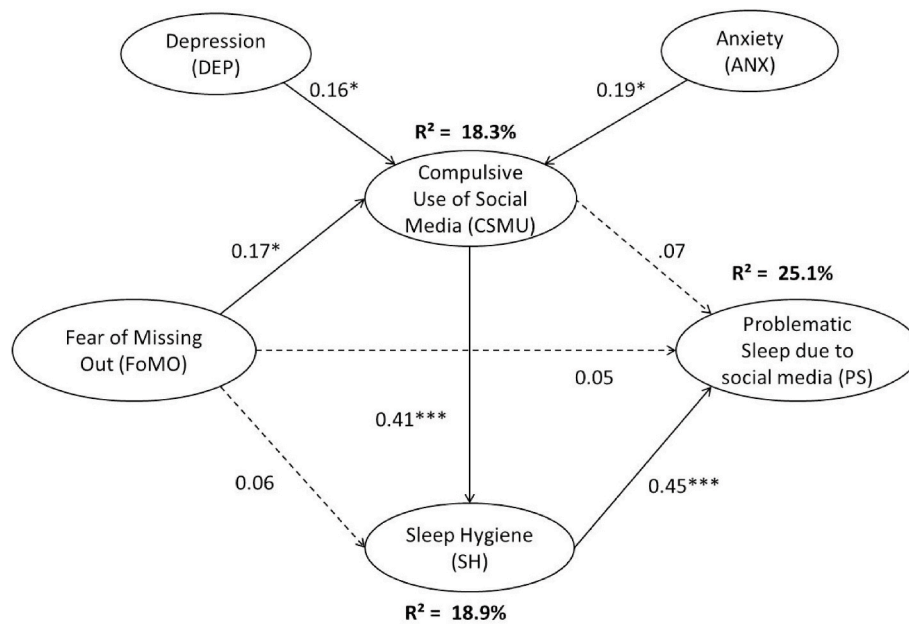


Fig. 3. Structural model results (Study B).

Table 5
Mediation analysis results.

Study sample A (students)						
FoMO → CSMU → SH						
	β	se	t	P	LLCI	ULCI
FoMO → CSMU	.25	.03	9.58	.00	.1983	.3004
CSMU → SH	.25	.02	12.68	.00	.2077	.2837
FoMO → SH	.08	.02	3.95	.00	.0388	.1151
Total effect of FoMO → SH	.14	.02	6.94	.00	.0992	.1772
FoMO → CSMU/SH → PS						
	β	se	t	P	LLCI	ULCI
FoMO → CSMU	.25	.03	9.58	.00	.1983	.3004
FoMO → SH	.14	.02	6.94	.00	.0992	.1772
FoMO → PS	.05	.02	1.83	.07	-.0032	.0938
CSMU → PS	.14	.03	5.43	.00	.0898	.1913
SH → PS	.56	.03	16.57	.00	.4944	.6272
Total effect of FoMO → PS	.16	.03	5.84	.00	.1048	.2109
CSMU → SH → PS						
	β	se	t	P	LLCI	ULCI
CSMU → SH	.26	.02	14.03	.00	.2277	.3018
SH → PS	.57	.03	16.84	.00	.5013	.6334
CSMU → PS	.15	.03	5.91	.00	.1003	.1998
Total effect of CSMU → PS	.30	.03	11.53	.00	.2491	.3513
Study sample B (working professionals)						
FoMO → CSMU → SH						
	β	se	T	P	LLCI	ULCI
FoMO → CSMU	.30	.04	6.62	.00	.2078	.3832
CSMU → SH	.25	.04	6.60	.00	.1758	.3247
FoMO → SH	.11	.04	2.79	.01	.0317	.1824
Total effect of FoMO → SH	.18	.04	4.73	.00	.1057	.2562
FoMO → SH → PS						
	β	se	t	P	LLCI	ULCI
FoMO → CSMU	.30	.04	6.62	.00	.2078	.3832
FoMO → SH	.18	.04	4.73	.00	.1057	.2562
FoMO → PS	.03	.05	.55	.59	-.0662	.1171
CSMU → PS	.12	.05	2.53	.01	.0270	.2149
SH → PS	.46	.06	8.26	.00	.3505	.5695
Total effect of FoMO → PS	.14	.05	2.98	.00	.0493	.2396
CSMU → SH → PS						
	β	se	t	P	LLCI	ULCI
CSMU → SH	.28	.04	7.70	.00	.2094	.3528
SH → PS	.46	.06	8.40	.00	.3554	.5724
CSMU → PS	.13	.05	2.74	.01	.0361	.2183
Total effect of CSMU → PS	.26	.05	5.50	.00	.1656	.3496

Table 6
Indirect effects between dependent and independent variables.

Study sample A (students)				
	Effect	se	LLCI	ULCI
FoMO → CSMU → SH	.06	.01	.0440	.0802
FoMO → CSMU → PS	.04	.01	.0198	.0528
FoMO → SH → PS	.09	.02	.0527	.1129
CSMU → SH → PS	.15	.02	.1189	.1866
Study sample B (working professionals)				
	Effect	se	LLCI	ULCI
FoMO → CSMU → SH	.07	.02	.0402	.1166
FoMO → CSMU → PS	.04	.02	.0037	.0741
FoMO → SH → PS	.08	.02	.0466	.1263
CSMU → SH → PS	.13	.02	.0865	.1826

through which FoMO may induce adverse effects on psychological and physiological well-being, such as delayed circadian rhythms, increased stress, and diminished cognitive abilities of users engaged in CSMU.

Thirdly, results of model testing for the two social media user groups of students and working professionals offer insights into differences in how users may process and experience consequences of CSMU. This affords a significant contribution to the current body of knowledge wherein the primary focus has previously focused on adolescents (Beyens et al., 2016). These findings imply alternative pathways in which effects of CSMU and associated phenomenon may adversely affect social media users' well-being.

Lastly, the results contribute to the existing knowledge on the impact of CSMU on sleep related behaviors and habits (Adams et al., 2017; Adams & Kisler, 2013; Exelmans & Scott, 2019; Exelmans & Van den Bulck, 2016). Investigation of this relationship is limited in the existing literature, and the present study contributes to identification of mechanisms through which CSMU may result in problematic sleep.

7.1.2. Implications to practice

Firstly, the results suggest that CSMU during the period of sleep latency can induce problematic sleep patterns among a considerable number of users, especially in the presence of innate psychological issues, such as anxiety and depression. However, for sleep patterns to be influenced, a significant and concurrent change in sleep hygiene or habits must occur. Thus, the findings imply the need for generating

awareness among civic stakeholders, such as parents and educators, about the implications of integrating smartphones or social media into night-time routines, i.e. sleep hygiene.

Secondly, there is a need to create targeted awareness among parents, therapists, and educators about psychopathological antecedents of CSMU, such as anxiety or depression. Such awareness may help the guardians of young students, as well as professionals, to facilitate interventions that may mitigate the effects of such traits. Concurrently, parents or guardians may also create appropriate times for nocturnal social media or smartphone use to avoid any negative effect on students' sleep routines and hygiene. Working professionals, however, may be motivated to create self-checks to restrict CSMU and maladaptive smartphone use. Concurrently, close peers and family members, such as spouses or siblings, may also motivate individuals to disengage with technology use during periods of sleep latency.

Lastly, social media service providers may also be encouraged to create specific features that may allow users to monitor their own usage of social media, especially during the night. Creation of such features would allow providers to encourage optimal usage of their services and could potentially lessen chances of users experiencing ill-effects of CSMU, such as fatigue and FoMO. Consequently, such service providers may be able to deliver a sustainable and pleasant usage experience that may help them in maintaining a loyal customer base.

7.2. Limitations and future work

Despite the valuable contributions of this study, the findings are constrained due to six limitations which affect its generalizability. Firstly, self-reported data has been used for analysis which introduces some elements of bias. Log data or experiments may be employed to further validate the results of this study. Secondly, the data collection occurred in a specific region of a single country which may limit the applicability of this study. Further validation across different geographical or culturally diverse regions is required to extend the scope of these findings. Thirdly, majority of respondents in both datasets were female. Therefore, the responses may not fully reflect perceptions of male social media users. Fourth, we used convenience sampling for data collection. Therefore, the findings may not be applicable for generalization to the general populace. Fifth, due to our use of a self-reported cross-sectional survey, the validity of the findings may be affected by social desirability bias due to lack of respondents' truthfulness or hesitation in reporting personal sleep-related habits. Lastly, the generalizability of this study and its findings are currently limited to the insights gained from a single social media platform and therefore may not be representative of effects created by other, substantially different social media platforms.

Future studies may confirm the validity of these findings by addressing the limitations of the present research. In addition, these findings suggest the need to consider individual characteristics and psychopathological traits of social media users during development of conceptual frameworks. Socio-demographic variables, such as gender, family life-cycle stage, education, occupation, etc. may be incorporated into future studies to gain an understanding of whether these variables have the potential to influence existing relationships between FoMO, CSMU, sleep hygiene, and problematic sleep. Furthermore, there is a need to investigate the effects of CSMU and FoMO among social media users from different age cohorts. Insights derived from such studies may be employed to devise optimal strategies that could help social media service providers to engage users in a sustainable manner. Also, because these findings imply that proposed relationships are processed differentially by different consumer groups, future studies may test the viability of other latent variables that may affect sleep hygiene and problematic sleep for both young and mature consumers. Future studies may also incorporate the dark personality traits, such as narcissism or Machiavellianism, in their frameworks to understand their influence on CSMU and, consequently, on other variables included in this study. To

increase the generalizability of this study, future investigations may be conducted for other social media platforms, such as YouTube, to investigate if social media content has any impact on the proposed relationships.

CRedit authorship contribution statement

Anushree Tandon: Conceptualization, Investigation, Methodology, Writing - original draft, Writing - review & editing. **Puneet Kaur:** Conceptualization, Data curation, Formal analysis, Writing - original draft. **Amandeep Dhir:** Conceptualization, Project administration, Supervision, Validation, Writing - review & editing. **Matti Mäntymäki:** Conceptualization, Project administration, Supervision, Validation, Writing - review & editing.

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