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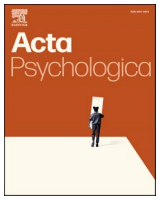

Social media use in female adolescents: Associations with anxiety, loneliness, and sleep disturbances

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ABSTRACT

Social Media Disorder (SMD) is characterised by the intense and excessive use of social media. Although previous studies have shown that SMD was associated with poor mental health, research across types of usage and platforms remain limited. Here, we conducted an initial investigation of social media usage across platforms and its relation to anxiety, sleep and loneliness in female adolescents. Forty one 16- to 19-year-old British female adolescents were administered online questionnaires. Intensity of social media activity across Facebook, Instagram, Snapchat and Twitter was measured with the Social Media Disorder Scale. Anxiety was indicated by the Beck Anxiety Inventory Trait, loneliness was examined via a short three-point questionnaire and sleep quality was measured via both the Pittsburgh Sleep Quality Index and self-reported seven-day sleep diaries. Results showed that, compared to those without SMD, users with SMD experienced elevated levels of loneliness and had less sleep on average, and during the weekdays in particular. Only frequency of posting on Facebook, but not general usage, was associated with poorer sleep quality. These preliminary findings showed that social media disorder across platforms and usage could potentially have different associations to mental health and sleep.

1. Introduction

1.1. Social media usage and disorder

Interpersonal communication within today's modern societies has been radically transformed by the ubiquitous use of social media. The defining aspects of social media which renders it fitting for web-based interactions include the ability for users to generate distinct individual profiles, create, share and receive content, engage with other users and display their social networks (Ellison & Boyd, 2013). Social media usage has been so extensively integrated with our daily lives that nearly 90 % of young adults reported using at least one social media platform to some degree (Perrin, 2015; Smith & Anderson, 2018). This trend has especially risen in younger age groups comprising adolescents and youths, where 95 % of 15- to 24-year-olds reported using social media platforms such as Instagram, TikTok, Twitter and Snapchat on a daily basis and as the primary means for social interaction (Tankovska, 2021). Since adolescents devote a substantial amount of their time to online communication, the repercussions of such frequent social media usage on their subjective mental health has garnered significant attention (Verduyn et al., 2017).

The extant literature presents a mixed body of evidence regarding the positive and negative effects of social media usage (Bettmann et al., 2021; Ellison et al., 2007; Park & Lee, 2012). From a promising perspective, Kalpidou et al. (2011) have shown that the number of connections youths have on Facebook is associated with social adjustment in school, which indicates that social capital from online platforms may be associated with real-world relationships. Social media usage has also been found to have a positive impact on mental health, including alleviating anxiogenic symptoms (Baker & Algorta, 2016; Grieve et al., 2013). However, more recent reviews have demonstrated only a weak correlation between social media and mental health benefits (Appel et al., 2020; Vahedi and Zannella, 2021). By comparison, the relationship between inordinate social media usage and adverse effects on mental health is significantly stronger (Raudsepp & Kais, 2019; Wheatley & Buglass, 2019) which has prompted researchers to distinguish between Social Media Disorder (SMD), characterised by the excessive and intense preoccupation with social media activities, from normative practices (Bányai et al., 2017; Griffiths et al., 2014; Kuss & Griffiths, 2017; Van den Eijnden et al., 2016). SMD is robustly related to

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poorer mental health (Brooks, 2015), including elevated feelings of loneliness, anxiety and sleep disturbances (Alonzo et al., 2021; Hanna et al., 2017; Shensa et al., 2017; O'Day and Heimberg, 2021). The present study aims to examine the associations between SMD and these three aspects of mental health in female adolescents.

1.2. Social media use and anxiety

Mounting evidence points to a positive correlation between social media usage and anxiety in youths, where the duration of time spent on social media is predictive of scoring higher than the clinical benchmark for anxiety-related disorders (Vannucci et al., 2017). Generally, 14- to 24-year-old youths have reported an increase in feelings of anxiety after using social media (The Royal Society of Public Health, 2017). Those exhibiting social media disorder tend to report worse symptoms of anxiety (Andreassen et al., 2016); this effect can be observed across both the number of social media channels used and the duration of social media usage. Concerning the former, individuals who used seven to eleven platforms have been found to be at greater risk for elevated anxiety compared to their counterparts with zero to two platforms (Primack et al., 2017). In regard to the latter, individuals who spent more time on social media daily were shown to be more predisposed to anxiety symptoms and developing anxiety-related disorders (Sampasa-Kanyinga & Lewis, 2015; Woods & Scott, 2016). Supporting this association further, Hanna et al. (2017) demonstrated a dose-response relationship between duration of Facebook usage and anxiety in a large sample of young adults. Generally, individuals with higher baseline anxiety tend to be more drawn to using social media, and are also more likely to experience elevated levels of anxiety afterwards (Kuss & Griffiths, 2017; Shakya & Christakis, 2017).

A prominent theory that has been posited to explain the robust link between social media use and anxiety is Fear of Missing Out (FoMO), which refers to anxiety that stems from not being included in social experiences with others (Przybylski et al., 2013). Perpetual notifications regarding others' lives generate ceaseless social comparisons that leave users in a constant state of anxiety about being excluded from social activities (Steers et al., 2014). FoMO is thus far the strongest predictor of social media usage (Blackwell et al., 2017). Given their heightened attention to negative social evaluations and comparisons, adolescents are especially psychologically liable to FoMO at that age (Jupowicz-Ginalska et al., 2018; Tandoc et al., 2015). For instance, a large-scale study of 16- to 18-year-olds showed that anxiogenic symptoms in that age group predicted FoMO and social media use (Oberst et al., 2017). SMD driven by FoMO, including excessive use of social media during meals, and shortly before and after sleep, could displace essential real-world social interactions and exacerbate anxiety (Przybylski et al., 2013; Turkle, 2017).

1.3. Social media use and loneliness

With greater connectivity accorded by social media, it is ironic that these digital platforms have also been argued to contribute to the loneliness epidemic plaguing the youths of today (Cacioppo & Cacioppo, 2018; Caplan, 2007), with an estimated one-third of respondents of a large survey on adolescents and young adults from the United Kingdom conveying feelings of loneliness (Office for National Statistics [ONS], 2018). Loneliness is described as a subjective emotional state of perceived social seclusion which originates from one's unmet social needs (Hawkley & Cacioppo, 2010; Peplau & Perlman, 1982). While proponents of social media assert that online social connections may provide opportunities for rewarding friendships (McKenna et al., 2002; Valkenburg & Peter, 2009), emerging research has established a strong association between loneliness and SMD (Moretta & Buodo, 2020; Savolainen et al., 2020; Youssef et al., 2020).

Since loneliness arises from a lack of quality and meaning in relationships, it is plausible for an individual to have a vast number of social media connections and still feel lonely (Masi et al., 2011). For instance, a large study on American youths showed that SMD is positively correlated with a heightened sense of social isolation. In another study on SMD specific to Facebook usage and loneliness, Satici (2019) demonstrated that loneliness mediates the detrimental effects of excessive Facebook activity on university students' mental health. Investigating another social media platform, Ponnusamy et al. (2020) showed that disproportionate Instagram usage was linked to loneliness in Malaysian youths. Other researchers have argued for a more nuanced perspective, as individuals who reported unmet social needs and used social media to compensate for existing perceived social isolation were more likely to experience increased loneliness after using social media (Arampatzi et al., 2018; Song et al., 2014; Teppers et al., 2014).

1.4. Social media use and sleep disturbances

Social Media Disorder has been robustly linked to sleep disturbances in adolescents (Arora et al., 2014; Cain & Gradisar, 2010; Espinoza & Juvonen, 2011; Power, Taylor & Horton, 2016; Woods & Scott, 2016). Frequent usage of social media has been shown to affect sleep quality and duration universally, with findings emerging across Europe (e.g., Lam & Peng, 2010), North America (e.g., Demirci et al., 2015) and Asia (e.g., Kadam et al., 2016). Beyond normative social media activities, two studies on 12- to 18-year-old adolescents and youths by Vernon et al. (2015) and Levenson et al. (2016) respectively demonstrated that excessive social media usage, in particular, aggravated the quality of sleep. Being active on social media platforms nearing bedtime was shown to delay the onset of sleep and predict problems with remaining asleep (Thomée et al., 2010). In fact, around one-fifth of 12- to 13-year-olds and nearly a quarter of 14- to 15-year-old adolescents were found to have disrupted sleep, as they would wake during the night to check their social media platforms (Power, Taylor & Horton, 2016). Along the same vein, Woods and Scott (2016) showed that, in addition to SMD, emotionally laden night-time social media usage was correlated with reduced quality of sleep.

Time spent on social media has also been associated with shorter sleep duration among students (Hökby et al., 2016). For instance, Lemola et al. (2015) showed that social media usage at night predicted shorter length of sleep in Swiss students. Moreover, Espinoza and Juvonen (2011) demonstrated that about one-third of American students who used social media platforms experienced one less hour of sleep. Corroborating these findings, Arora et al. (2014) similarly showed that 11- to 13-year-old adolescents who used social networking sites reported sleeping for one less hour compared to their peers. Since sleep is an essential reparative process that is central to mental health (Bey & Hamilton, 2003; Paruthi et al., 2016), the alarming association between social media use and sleep disturbances has galvanised considerable research investigating this phenomenon in relation to mental health outcomes.

1.5. Aims of study

Social media platforms such as Facebook, Instagram, Twitter and Snapchat allow users to consume, create and interact with content albeit in different ways. For instance, Instagram and Snapchat are image-driven platforms, which have been found to decrease loneliness (Pittman & Reich, 2016). In another study, Facebook activity was found to be associated with increased loneliness if the platform was used to offset users' lack of social skills (Teppers et al., 2014). Users may also employ social networking sites differently, with some adopting a more active stance, with frequent social media posts, than others. Thus far, the literature is divided as to the link between anxiety, loneliness and active usage of social media (O'Day and Heimberg, 2021). Collectively, no study has examined platform- and usage-specific social media parameters in association with mental health.

The present study served as a preliminary investigation of social

media activities, including usage across Facebook, Instagram, Twitter and Snapchat platforms, on anxiety, loneliness and sleep quality among 16- to 19-year-old adolescent females. Adolescence represents a developmental stage where individuals are especially vulnerable to FoMO, loneliness and sleep loss, all of which have previously been shown to be independently associated with social media usage. The present study focused on adolescent females in particular due to emerging findings which point to girls being more liable to social media addiction, and the detrimental conditions linked to SMD, than boys. In general, girls were consistently found to be at greater risk for excessive and problematic social media usage than their male counterparts (Demirci et al., 2015; Mérelle et al., 2017; Müller et al., 2016). Adolescent girls have also been shown to be more prone to sleep disturbances (Galland et al., 2017; Sarchiapone et al., 2014). When examining sleep quality in the context of social media usage, Power et al. (2016) showed that nearly a quarter of sampled 12- to 15-year-olds check their social media accounts in the night, with girls more inclined to do so than boys. Finally, adolescent girls were more likely to exhibit heightened anxiogenic disorders than boys (McLean et al., 2011). For instance, in a study on 16- to 18-year-old adolescents in Spain, Oberst et al. (2017) demonstrated that FoMO, anxiety symptoms and SMD occurred more frequently in girls than boys. Taken together, findings from previous research prompted the present study to focus chiefly on female adolescents.

We tested one confirmatory and one exploratory hypothesis for this study. First, in line with the current literature, we hypothesised that SMD would be positively associated with anxiety, loneliness and sleep quality. Second, we expected to observe differences in social media platforms and social media usage according to anxiety, loneliness and sleep scores. Findings from this preliminary study would provide initial insight into anxiety, loneliness and sleep habits and their associations with platform- and usage-specific social media activities.

2. Method

2.1. Participants

A short background questionnaire pertaining to participants' age, ethnicity, education level and medical and psychological conditions was administered to all participants. Five respondents had anxiety while three respondents had asthma and were excluded from the study. In total, forty-one 16- to 19-year-old female adolescents ($M = 17.83$, $SD = 0.83$) from a Further Education College in East Anglia were recruited for this study. Of the participants, 97.6 % were ethnically White Caucasian with English spoken as their native language. The study was approved by the Principal of the college and the [BLINDED] ethics board, and was conducted according to the Declaration of Helsinki.

2.2. Measures[1]

2.2.1. Background questionnaire

Participants were administered a short questionnaire which requested for their demographic information (i.e., age, ethnicity, education level) and existing medical and psychological conditions.

2.2.2. The Social Media Disorder Scale

The Social Media Disorder (SMD) scale is a nine-item instrument that was developed to assess social media addiction (van den Eijnden et al., 2016; see Appendix A). The scale is designed based on the DSM-5 criteria for Internet Gaming Disorder.

Each item of the questionnaire corresponds to one dimension of addiction, namely: Preoccupation, Tolerance, Withdrawal, Persistence, Escape, Problems, Deception, Displacement, and Conflict. Participants respond to each item dichotomously with either a "yes" or "no". A total score of more than five suggests SMD.

2.2.3. Social media questionnaire

A custom social media questionnaire was used to assess participants' usage of various social media sites. Participants reported (1) how many times they visited each of the eleven most commonly used social media platforms per day (PEW Research Centre, 2016), and (2) how many times they posted on each social media platform per day. Participants responded to each question on a 6-point Likert scale, where 'Never' was coded as 0, and "20+ times per day' was coded as 6. For each question, a higher score corresponded to greater social media usage (see Appendix B).

2.2.4. Beck Anxiety Inventory-Trait

To ascertain trait anxiety, participants were administered Beck's Anxiety Inventory-Trait (BAIT; Beck et al., 1988). Compared to Beck Anxiety Inventory (BAI), which assesses more prolonged anxiety, the BAIT measures feelings of dispositional anxiety related to specific problems. Participants responded to each question on a four-point scale, where 0 denotes rarely or never, 1 = occasionally, 2 = often and 3 = almost always. A total score which is lower than 21 indicates low levels of anxiety, whereas a summed score range of 22 to 35 is categorised as moderate anxiety, and a score above 36 signifies high levels of anxiety.

2.2.5. Loneliness

Hughes et al.'s (2004) Short Loneliness scale was employed to determine the extent to which participants experienced feelings of loneliness. The three-item questionnaire posed the following questions: (1) How often do you feel that you lack companionship? (2) How often do you feel left out? (3) How often do you feel isolated from others? Participants indicated their response to each question on a three-item Likert scale, where 1 = hardly ever, 2 = some of the time and 3 = often. A higher total summed score indicated more loneliness.

2.2.6. Pittsburgh Sleep Quality Index (PSQI)

The PSQI is a 19-item self-report questionnaire used to determine participants' sleep quality in the past one month (see Appendix C). The items in this scale form seven dimensional scores which correspond to: (1) subjective sleep quality, (2) sleep latency, (3) sleep duration, (4) habitual sleep efficiency, (5) sleep disturbances, (6) use of sleeping medication and (7) daytime dysfunction. A summed score of 5 and above indicated a poor sleeper.

2.2.7. Sleep diary

To assess daily sleep habits, each participant kept a seven-day sleep diary, where they noted the time they went to sleep, the time they woke up and whether they woke up during the night. As much as possible, the diaries were not given to students during their examination period. At the end of the study all 41 participants returned their sleep diaries (see Appendix D).

2.3. Procedure

Participants' informed and written consent were obtained at the start of the study, and parental consent was gained from participants under 18 years old. However, if a 16- or 17-year-old adolescent was living independently, outside of the family home, their competence was assumed and they were allowed to provide their own consent. Participants were also informed that they could withdraw from the study at any time. All participants were provided with a seven-day sleep diary, which they completed at their own time at home. Finally, questionnaires were administered online at a time which was convenient for the participant. This study was conducted between October 2016 and March 2017, before the global COVID-19 pandemic.

[1] Reliability coefficients were not included in this paper due to loss of access to raw data.

2.4. Analytical plan

Descriptive statistics relating to the various measures would be reported. First, responses across each item in the Social Media Disorder (SMD) scale would be presented. Second, means, standard deviations and results from Mann-Whitney tests would be conducted to ascertain any differences between users with and without SMD across anxiety, loneliness and sleep metrics. Third, descriptive statistics regarding usage and posting on Facebook, Instagram, Twitter and Snapchat platforms would be reported. Finally, means and standard deviations of anxiety, loneliness and sleep parameters would be described.

This study served as a preliminary exploration of the associations between platform- and usage-specific social media habits and anxiety, loneliness and sleep among adolescents. As such, a relatively small sample size was recruited to conduct this initial investigation. The Shapiro-Wilk Normality Test was used to determine normality of this dataset, before deciding on subsequent analyses. Normality can be assumed only for Pittsburgh Sleep Quality Index ($W = 0.957$, p-value $= 0.125$), but not for Beck Anxiety Inventory-Trait scores ($W = 0.938$, p-value $= 0.027$) and Loneliness scores ($W = 0.878$, p-value $= 0.000408$). Therefore, non-parametric analyses would be used to test the hypotheses in this study.

To test the first hypothesis, that SMD was positively associated with anxiety, loneliness and sleep quality, three independent Kruskal-Wallis tests would be conducted. The Social Media Disorder category (i.e., with SMD, without SMD) of users, would be the independent variable, while anxiety, loneliness and sleep quality scores would be the dependent variables, respectively. Post-hoc Mann-Whitney tests would be conducted to determine the directional relationship between variables.

To test the second hypothesis, that social media platforms and usage would differ according to anxiety, loneliness and sleep scores, separate Kruskal-Wallis tests would be conducted, with frequency of usage and active posting on Facebook, Instagram, Twitter and Snapchat as the dependent variables. Participants' anxiety, loneliness and sleep metrics would be included as independent variables. Post-hoc Mann-Whitney tests would be subsequently conducted. To further explore the relationships between social media activities and measures of anxiety, loneliness and sleep, Spearman's rho correlations would be conducted across all variables.

3. Results

3.1. Descriptive statistics

From the Social Media Questionnaire (SMD), 27 % of participants were classified as users with SMD, and 68.3 % of participants reported that they attempted to limit their time spent on social media but failed to do so (see Table 1). As shown in Table 2, users with SMD reported significantly more loneliness, less average hours of sleep, and less average hours of weekday sleep compared to users without SMD. All participants used at least two or more social media platforms, with Snapchat as the most favoured site for both usage and posting (see Table 3). As shown in Table 4, the mean, maximum and minimum duration of sleep differed during weekdays, weekends and throughout the whole week.

In regard to anxiety, 12 % of participants reported moderate levels of anxiety, and only one participant was categorised as having concerning levels of anxiety according to the Beck Anxiety Inventory-Trait questionnaire. With respect to sleep quality, 73 % of participants were categorised as poor sleepers based on their PSQI scores. From this group of poor sleepers, all had low levels of anxiety, 55 % had high levels of loneliness and 27.2 % were classified as users with SMD.

3.2. Social media disorder associated with loneliness and sleep duration

To test the first hypothesis, that social media disorder is positively associated with anxiety, loneliness and sleep parameters, Kruskal-Wallis analyses were conducted. Social media disorder was not significantly associated with anxiety ($H(1) = 2.26$, $p = 0.133$).

SMD classification was significantly associated with loneliness ($H(1)$

Table 1
Number of "yes" responses to each item of the Social Media Disorder (SMD) questionnaire.

Item	Description of item	Number of "yes" responses (%)
Preoccupation	Absorbed about the next time you can use social media again	10 (24.4)
Tolerance	Wanted to spend more time on social media	7 (17.1)
Withdrawal	Felt distressed/upset when you could not use social media	15 (36.6)
Persistence	Attempted to limit time spent on social media but failed	28 (68.3)
Displacement	Disregarded other activities (e.g., hobbies) so that you could use social media	14 (34.1)
Problems	Argued with others about your social media usage	14 (34.1)
Deception	Lied to others about the duration of time you actually spend on social media	10 (24.4)
Escape	Used social media to avoid adverse emotions	24 (58.5)
Conflict	Engaged in severe disagreements with parents and siblings about your social media usage	7 (17.1)

Table 2
Means, standard deviations and results of Mann-Whitney tests of users with and without Social Media Disorder (SMD) across anxiety, loneliness and sleep quality.

Measures	Users with SMD *M* (*SD*)	Users without SMD *M* (*SD*)	W	*p*-Value
Anxiety	15.6 (9.39)	11.0 (7.86)	114	0.137
Loneliness	6.45 (2.38)	4.77 (1.7)	96	0.04*
Sleep quality	8.00 (3.19)	7.53 (3.42)	157	0.824
Average hours of sleep	7.02 (0.896)	7.99 (1.05)	252.5	0.01*
Hours of weekday sleep	7.08 (0.926)	8.11 (1.08)	250.5	0.012*
Hours of weekend sleep	7.14 (1.36)	7.82 (1.48)	206	0.233

* $p < 0.05$.

Table 3
Means and standard deviations of social media usage and posting.

Social media usage	*M* (*SD*)	Daily usage (1+ times per day)	Daily usage (20+ times per day)
Snapchat	4.63 (1.41)	97.6 %	31.7 %
Facebook	4.12 (1.52)	92.7 %	22 %
Instagram	3.68 (1.71)	87.8 %	9.8 %
Twitter	1.85 (2.06)	43.9 %	4.9 %

Social media posting	*M* (*SD*)	Daily posts (1+ times per day)	Daily posts (20+ times per day)
Snapchat	2.68 (1.82)	73.2 %	19.5 %
Facebook	1.05 (0.84)	21.9 %	0 %
Instagram	0.93 (0.41)	4.9 %	0 %
Twitter	0.56 (0.81)	14.7 %	0 %

Table 4
Means and standard deviations of hours of sleep.

Sleep duration (in hours and minutes)	*M* (*SD*)	Minimum	Maximum
Whole week	7:54 (1:03)	5:37	10:38
Week days	8:01 (1:06)	5:48	11:42
Week end	7:46 (1:28)	4:02	11:42

= 4.30, $p = 0.038$), and Mann-Whitney tests showed that participants with SMD displayed significantly greater loneliness than their counterparts without SMD ($W = 96$, p-value = 0.04; see Fig. 1A).

Although SMD was not associated with sleep quality ($H(1) = 0.056$, $p = 0.813$), and duration of sleep on weekends ($H(1) = 1.46$, $p = 0.228$), it was significantly linked to average hours of sleep ($H(1) = 6.63$, $p = 0.01$) and duration of sleep on weekdays ($H(1) = 6.33$, $p = 0.012$). Subsequently, Mann-Whitney tests revealed that SMD was associated with less sleep on average ($W = 252.5$, p-value = 0.01; see Fig. 1B), and less sleep on weekdays ($W = 250.5$, p-value = 0.012; see Fig. 1C).

3.3. Frequent posting on Facebook associated with poorer sleep quality

To test the second hypothesis, that patterns of social media activity, in terms of usage and platform, would differ based on anxiety, loneliness and sleep parameters, Kruskal-Wallis tests were conducted.

Only frequency of Facebook posting was found to be significantly associated with sleep quality ($H(1) = 8.56$, $p = 0.003$). Following that, Mann-Whitney tests showed that poor sleepers engaged in more active posting activity on Facebook ($W = 74.5$, p-value = 0.004; see Fig. 1D). No other significant association emerged between social media usage and anxiety, loneliness and sleep.

Finally, to provide a thorough exploration of associations between social media activities and anxiety, loneliness and sleep, we computed Spearman's rho correlations which showed significant associations between SMD and anxiety, loneliness, and sleep duration (see Table 5).

4. Discussion

This exploratory study commenced with two key hypotheses. The first hypothesis, that Social Media Disorder (SMD) was positively linked to anxiety, loneliness and sleep quality, was partly confirmed. We found that users with SMD displayed more loneliness, fewer hours of average sleep, and fewer hours of sleep during the weekdays. However, no significant association emerged between social media disorder and anxiety. The second hypothesis, that social media usage and platforms would be associated differentially with anxiety, loneliness and sleep, was also partly confirmed, as poorer quality of sleep was found to be linked only

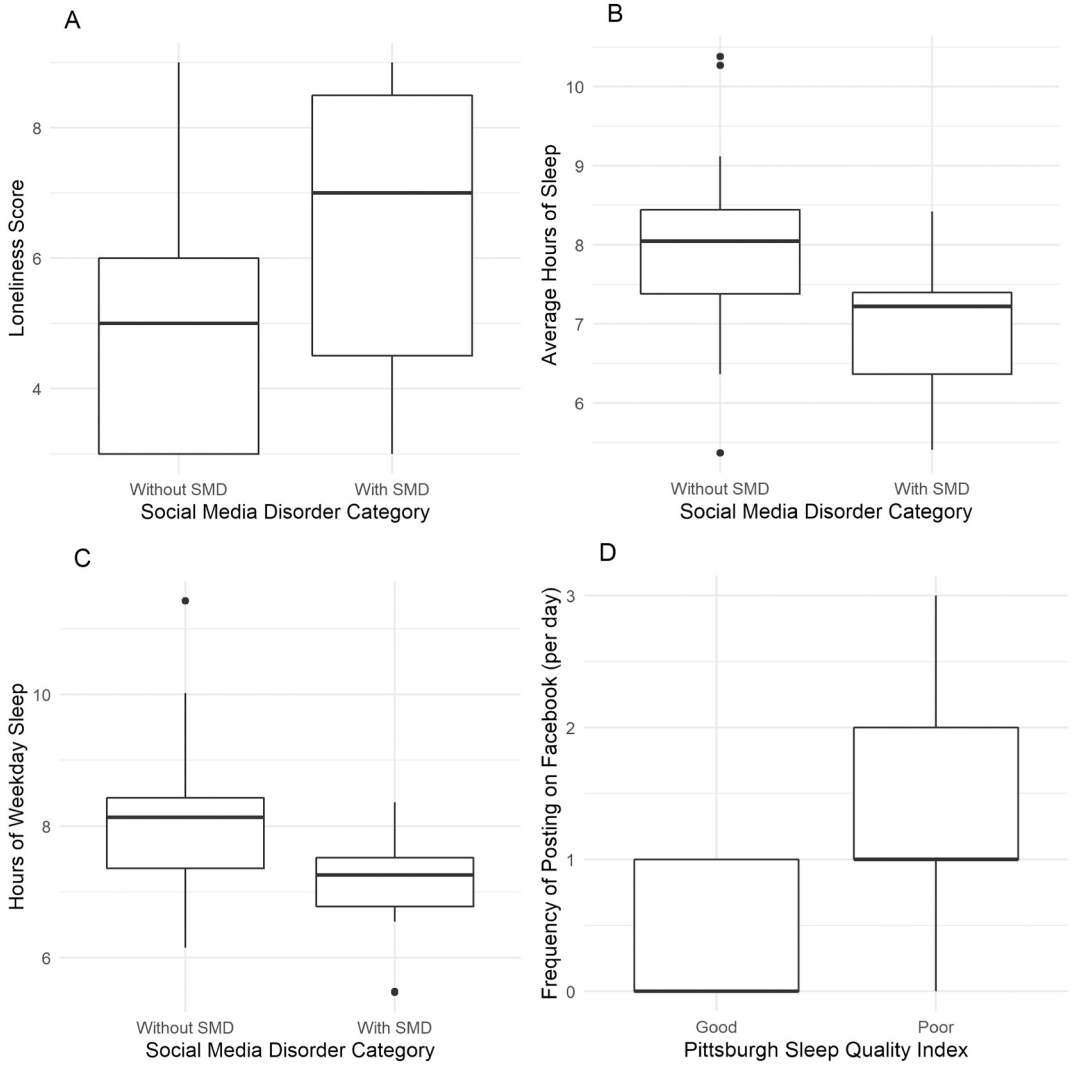

Fig. 1. (A) Users with Social Media Disorder (SMD) reported greater levels of loneliness compared to users without SMD; (B) Users with SMD reported fewer average hours of sleep compared to users without SMD; (C) Users with SMD reported fewer hours of sleep on weekdays compared to users without SMD; (D) Poor sleepers, categorised by the Pittsburgh Sleep Quality Index, reported greater frequency of posting on Facebook.

Table 5
Spearman's rho correlations of social media measures with anxiety, loneliness and sleep metrics.

Measures	Social media disorder	Anxiety	Loneliness	Sleep quality	Average sleep	Weekday sleep	Weekend sleep	Facebook usage	Facebook posting	Instagram usage	Instagram posting	Twitter usage	Twitter posting	Snapchat usage	Snapchat posting
Social media disorder	–														
Anxiety	0.33*	–													
Loneliness	0.45**	0.45**	–												
Sleep quality	0.25	0.44**	0.06	–											
Average sleep	−0.33*	−0.51***	−0.21	−0.49***	–										
Weekday sleep	−0.33*	−0.36*	−0.07	−0.4**	0.88***	–									
Weekend sleep	−0.17	−0.44**	−0.24	−0.39	0.77***	0.41**	–								
Facebook usage	0.32*	0.22	0.27	0.11	−0.23	−0.19	−0.19	–							
Facebook posting	0.28	0.38*	0.19	0.43**	−0.08	−0.09	−0.09	0.39*	–						
Instagram usage	0.09	0.03	−0.03	−0.05	0.05	0.03	0.02	0.4**	0.05	–					
Instagram posting	0.06	0.23	0.08	0.2	−0.07	−0.05	−0.06	0.05	0.16	0.5***	–				
Twitter usage	0.08	0.06	0.01	0.03	0.09	0.19	−0.04	0.28	−0.02	0.55***	0.19	–			
Twitter posting	0.12	0.22	−0.03	0.17	−0.11	0	−0.11	0.29	0.03	0.32*	0.28	0.7***	–		
Snapchat usage	0.29	0.19	0.06	0.14	−0.1	−0.19	−0.01	0.38*	0.16	0.49**	0.25	0.33*	0.26	–	
Snapchat posting	0.3	−0.07	0.13	−0.08	0.26	0.13	0.32*	0.24	0.31	0.07	0.03	−0.06	−0.02	0.53***	–

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

to frequency of posting on Facebook. Since this study was intended as an initial investigation of social media usage and platforms, and their links to mental health, further research would be required to verify these findings.

The significant association between social media disorder and loneliness contributed further evidence to the robustness of this relationship. At its core, loneliness arises when an individual perceives a lack of meaning in relationships (Masi et al., 2011). According to the aetiology of loneliness, individuals who are lonely tend to engage in maladaptive socio-cognitive processes and negative appraisal of their interactions with others, which, as a result, causes them to miss out on opportunities for social activities that worsens their feelings of loneliness (Song et al., 2014). In the context of SMD, individuals who devoted a disproportionate amount of their time on social media might have experienced a greater sense of social isolation through the FOMO effect, where they perceived themselves to be excluded from rewarding social activities with others, thus further amplifying feelings of loneliness. Adolescents are particularly at risk for the adverse effects of social media usage, since they are exceptionally vulnerable to peer pressure and have yet to fully develop their emotion regulation abilities (Vernon et al., 2017).

Adolescents with SMD were found to sleep less than their counterparts without SMD on average, and especially on weekdays. Since adolescents attend school, delays in onset of sleep due to social media activities would likely result in sleep loss during the weekdays (Liu et al., 2019). Night-time use of social media, in particular, could lead to postponed sleep or render individuals cognitively stimulated such that they experience protracted latency before the onset of sleep. Generally, shorter durations of sleep due to social media usage were consistently linked to poorer mental health and difficulties in concentrating (Hökby et al., 2016; Thomée et al., 2010).

When social media usage across platforms was investigated alongside anxiety, loneliness and sleep parameters, individuals who reported poorer sleep quality were found to post on Facebook significantly more than those who experienced better sleep quality. While the reason for this is not clear, we present several hypothetical explanations. Compared to other social media apps such as Instagram, Snapchat and Twitter, Facebook allows users to more conveniently share content through the written medium. For instance, posting on Twitter has a character limit, whereas posting on Instagram and Snapchat are typically image- and video-driven. Hence, users who posted frequently on Facebook could have shared their thoughts and opinions more extensively than those who posted less often. One interpretation would be an indirect link between sleep quality and posting on Facebook, where those who reported poorer sleep quality did so due to cognitive overstimulation of thoughts which were expressed through frequent posts on Facebook. Another reason would be that individuals ruminate about the thoughts and opinions they frequently shared with others on their Facebook posts which could impair their quality of sleep. However, we cautioned that this study represented only an initial investigation and more studies would be required to thoroughly examine the links between social media usage across platforms with anxiety, loneliness and sleep parameters.

4.1. Limitations and future directions

The findings of this study should be noted with its limitations in mind. First, this study used self-reported measures where subjective and biased responses could have increased shared method variance. Objective measures such as the duration of time participants used social media collected from screen time data from their mobile phones could be used in future studies. Actigraphy could also provide more objective metrics of quality of sleep. Second, due to the initial and exploratory nature of this study, a relatively small sample size was used. Future studies could recruit a larger sample size and conduct more extensive analyses which investigate interactions across parameters of social media usage and platforms with mental health. Third, the cross-sectional nature of this study did not examine causal relationships between social media disorder, sleep and loneliness. Future studies could adopt a longitudinal approach which would better disentangle directional relationships.

4.2. Conclusion

The purpose of this study was to conduct an initial investigation of social media disorder across platforms and its relation to anxiety, sleep and loneliness in female adolescents. In line with the current literature, users with SMD reported greater loneliness and had less sleep on average, and during the weekdays. Results also showed that active, frequent posting on Facebook, but not general usage, was associated with poorer quality of sleep. Posting on other platforms such as Instagram, Twitter and Snapchat was not significantly linked to sleep quality. These preliminary findings highlighted the heterogeneity of social media activities and suggested that a deeper understanding of these activities would be needed to elucidate how social media affected health parameters like sleep. Our finding is particularly relevant in today's world, where prolonged periods of reduced face-to-face social activities during the COVID-19 pandemic has led, with alarming alacrity, to an uptick of intensive social media usage (Depoux et al., 2020; Marengo et al., 2022). The accumulated detrimental effects of heavy social media usage during the pandemic have already been shown to aggravate loneliness, anxiety and depression, and could worsen in the next few years (Ashiru et al. (2022); Gao et al., 2020; Hammad & Alqarni, 2021; Helm et al., 2022; Jiang, 2021). An appreciation of the various facets of social media activities would be needed to fully uncover the links between social media usage and mental health.

Declaration of competing interest

One of the authors (Gianluca Esposito) is also the Guest Editor of the Special Issue. The Guest Editor will not handle the submission, that will be handled by the journal EiC.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2022.103706.

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