



Is social media use related to sleep quality, self-esteem, anxiety and depression in adolescence?

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ABSTRACT

Recent evidence is increasingly linking social media use with various aspects of wellbeing, particularly in adolescents. The current study aims to add to this literature by investigating how adolescents' social media use relates to sleep quality, self-esteem, anxiety and depression levels. Furthermore, this study is the first to examine how emotional investment in social media relates to these aspects of wellbeing. 467 adolescents completed questionnaire measures of overall and nighttime social media use, as well as the Pittsburgh Sleep Quality Index, Rosenberg Self-Esteem Scale, Hospital Anxiety and Depression Scale and Social Media Use Integration Scale. Overall social media use, nighttime social media use and emotional investment in social media were each significantly related to poorer sleep quality, lower self-esteem, and higher anxiety and depression levels. Together, social media measures explained 13.5% of the variance in sleep quality, and nighttime social media use was a significant predictor of poor sleep quality after controlling for anxiety, depression and self-esteem. These results highlight both the timing of social media use and emotional investment in social media as important factors that merit further investigation with relation to adolescent wellbeing. The results of this study have the potential to inform interventions aimed at improving adolescents' sleep quality or educating young people and parents about healthy social media use.

KEY WORDS:	SOCIAL MEDIA	ADOLESCENCE	SLEEP	SELF-ESTEEM	MOOD
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Introduction

Social media and wellbeing in adolescence

Social media is a relatively recent phenomenon and as such, has yet to be extensively researched. However, new evidence is increasingly supporting a link between social media use and various aspects of wellbeing, particularly during adolescence. Adolescence is a period of increased vulnerability for the onset of depression and anxiety (McLaughlin & King, 2015). Poor sleep quality is also prevalent in adolescence (Telzer, Fulgini, Lieberman & Galván, 2013), and is associated with depression, anxiety and low self-esteem (Alfano, Zakem, Costa, Taylor & Weems, 2009; Fredriksen, Rhodes, Reddy & Way, 2004). Low self-esteem and depressive symptoms during adolescence prospectively predict low self-esteem and depressive symptoms across the lifespan (Steiger, Fend & Allemand, 2015). Since adolescence is a vulnerable period for problems with sleep, self-esteem, anxiety and depression, it is essential that we understand how adolescents' social media use relates to these factors, with 90% of young people now using social media sites (Duggan & Smith, 2014). The present study examines how adolescents' social media use relates to sleep quality, self-esteem, anxiety and depression.

Social media and sleep

There is a growing body of evidence linking computer and Internet use to poor sleep in adults and adolescents. Suganuma et al. (2007) found that increased electronic media use in adults is associated with shorter sleep duration and poorer perceived sleep quality. In this study, younger participants were more likely to ascribe perceived insufficient sleep to electronic media. The link between electronic media use and poor sleep has been particularly extensively researched in adolescents. Increased Internet use in adolescence is associated with shorter sleep duration (Pea et al., 2012; Garmy, Nyberg & Jakobsson 2012); later bedtimes and rise times (Van den Bulck, 2004; Shochat, Flint-Bretler & Tzischinsky, 2010; Garmy et al., 2012); longer sleep latencies (Shochat et al., 2010); and increased daytime tiredness (Van den Bulck, 2004; Garmy et al., 2012).

In addition to examining electronic media and Internet use in general, a small number of recent studies have investigated how social media use, in particular, relates to sleep. For example, a study by Espinoza (2011) found that 37% of young adolescents reported losing sleep due to social networking sites. However, since social networking sites represent a very recent phenomenon – in the last decade, the percentage of young adults using social media has increased from 9% to 90% (Duggan & Smith, 2014) – relatively few studies have specifically examined social media, as opposed to Internet use in general. To address this gap in the literature, the present study will therefore examine how social media use in adolescence relates to sleep quality. It is expected that greater social media use will be associated with poorer sleep quality, in line with previous findings on Internet and other electronic media use.

Social media represents one particular use of the Internet. Thompson and Loughheed (2012) found that 54% of students' time online was spent using social

media. Previous evidence relating to general Internet use is therefore very relevant when considering social media specifically. However, one important difference is that, unlike other uses of the Internet, social media involves incoming alerts at all times of the day. This is particularly relevant to sleep for two reasons. Firstly, incoming alerts during the night have the potential to disturb sleep. Lenhart, Ling, Campbell and Purcell (2010) reported that 86% of adolescent mobile phone owners slept with their phone in the bedroom (often under their pillow or in their hand). Since Van den Bulck (2003) found that a quarter of adolescents' sleep was interrupted by incoming text messages, it is possible that social media alerts create similar sleep disturbances. Secondly, incoming alerts create considerable pressure to be available 24/7 and contribute to a fear of being disconnected (Thomé, Dellve, Harenstam & Hagberg, 2010). Young adults experience considerable anxiety when their access to texting is restricted (Skierkowski & Wood, 2012). This age group perceives a social pressure to be available at all times and report feeling stressed and guilty when they do not reply to a message immediately (Thomé et al., 2010). Therefore, in addition to sleep disturbances from incoming alerts, it is possible that young people struggle to relax at bedtime due to anxiety at missing messages or new content. These unique aspects of social media use provide further reason to expect a link with poor sleep quality.

Sleep interruptions and difficulty 'switching off' at bedtime are just two examples of the many possible mechanisms underlying a link between social media use and poor sleep. Whilst there is well-established evidence for such a link with Internet use in general – and reason to expect the same with social media in particular – the underlying mechanisms have yet to be understood. Cain and Gradisar (2010) reviewed 36 papers on electronic media use and sleep in adolescence, and outlined a number of possible mechanisms for the observed link. These include the possibility that media use displaces good sleep hygiene practices (e.g. physical activity). Equally, they propose that the bright screen exposure before bedtime may interfere with melatonin production and delay the circadian rhythm. Alternatively, it is possible that poor sleepers use social media as a sleep aid, as adolescents commonly use computers and TV as sleep aids (Eggermont & Van den Bulck, 2006).

An in-depth examination of the underlying mechanisms is beyond the scope of the present study. However, by measuring the timing of social media use and emotional investment in social media, this study has the potential to broadly inform our current understanding of possible mechanisms. For example, a link between poor sleep and nighttime social media use could point towards sleep disturbances from incoming alerts or interrupted melatonin production from bright screen exposure at bedtime (Cain & Gradisar, 2010). In contrast, a stronger link with overall social media use would be in line with the idea that a less physically active lifestyle is involved. Alternatively, a relationship between poor sleep and emotional investment in social media would suggest that anxiety at being unable to view or respond to new content may be involved, by making it difficult to relax at bedtime. Therefore, by measuring not just duration or frequency of social media use, but also its timing and the level of emotional investment in social media, this study aims to inform our current understanding of the mechanisms underlying the link between social media and sleep.

In line with previous findings on Internet use in general, it is expected that greater social media use will be associated with poorer sleep quality. It is also expected that emotional investment in social media – which includes anxiety at being unable to access social media – will be associated with poorer sleep.

Social media and self-esteem

In addition to sleep, another aspect of wellbeing that has been studied in relation to social media is self-esteem. As with the literature on sleep, there have been relatively few studies in this area. The small number of papers that exist on the relationship between social media and self-esteem provide a complex picture, with conflicting results. Vogel, Rose, Roberts and Eckles (2014) found that increased Facebook use was associated with lower self-esteem. Similarly, in a study by Murphy (2013), lower self-esteem was associated with greater Facebook use and larger Facebook network size. However, in contrast to these results, Gonzales and Hancock (2011) found that viewing one's own Facebook profile increased self-esteem. The researchers suggest that selective self-presentation on social networking sites could improve impressions of the self. Studying adolescents in particular, Valkenburg, Peter and Schouten (2006) found that social media use had an indirect effect on self-esteem, through feedback on teenagers' online profiles. Positive feedback increased self-esteem, whereas negative feedback decreased self-esteem. 78% of participants always or predominantly received positive feedback, meaning that in general social media use tended to increase self-esteem. The limited available evidence on self-esteem and social media use is conflicting, and suggests a complex relationship. The current study will therefore investigate whether any association exists between social media use and self-esteem in adolescents, without specifying the expected direction of such a relationship.

A likely mechanism underlying the link between social media use and self-esteem seems to be interpersonal feedback (Valkenburg et al., 2006). Positive or negative interpersonal feedback can also enhance or diminish self-esteem in face-to-face interactions (Hepper & Carnelley, 2011). Hepper and Carnelley (2011) found that feedback had a stronger effect on self-esteem for participants whose self-worth was more invested in others' approval. It is possible that the same is true for social media, such that the feedback received through social networking sites influences self-esteem more strongly for those who are more emotionally invested in social media. Therefore the current study will also explore whether there is an association between self-esteem and levels of emotional investment in social media, again without predicting whether such a relationship will be positive or negative.

Social media and anxiety

Another aspect of psychological wellbeing that has been linked to social media use is anxiety. Farahani, Kazemi, Aghamohamadi, Bakhtiarvand and Ansari (2011) found that adolescents' Facebook use was positively correlated with anxiety levels. Similarly, in a study by Hamburger and Ben-Artzi (2000), participants who used the Internet for social purposes tended to be more neurotic, i.e. more likely to experience anxiety. Facebook use has also been

linked to increased social anxiety (McCord, Rodebaugh & Levinson, 2014; Davidson & Farquhar, 2014). Furthermore, anxiety has been found to predict Facebook addiction (Koc & Gulyagci, 2013). Together, the literature clearly points towards a relationship between social media use and anxiety. The present study will further explore this question with relation to adolescents. It is hypothesised that increased social media use will be associated with higher anxiety levels.

Social media, unlike other Internet or computer use, is unique in the social pressure it creates to be available at all times and respond to messages and new content immediately (Thomé et al., 2010). Young adults, in particular, report considerable anxiety when their access to text-based communication is restricted (Skierkowski & Wood, 2012). This study will therefore investigate whether anxiety is associated with emotional investment in social media, which includes feeling anxious or disconnected when unable to access social networking sites. It is hypothesised that emotional investment in social media will be associated with higher anxiety levels.

Social media and depression

Levels of depression in adolescents have also been linked to electronic media use. Adolescents who spend more time online tend to have more depressive symptoms (Banjanin, Banjanin, Dimitrijevic & Pantic, 2015). In a one-year longitudinal study, Bickham, Hswen and Rich (2015) found that adolescents' mobile phone use and TV viewing contributed to the development of depressive symptoms. Recent evidence also points towards a link between depression and social media, in particular. Pantic et al. (2012) found that daily duration of social media use was associated with increased depression in adolescents. However, relatively little evidence exists concerning this link. The current study will explore this relationship, and based on the existing literature it is expected that greater social media use will be associated with higher depression levels.

If, as recent evidence suggests, social media use is linked to higher depression levels, then it is possible that this effect would be stronger for adolescents who are more emotionally invested in social media, as this includes feelings of attachment to social media sites and distress at being unable to access them. This study will therefore also investigate whether emotional investment in social media relates to depression levels in adolescents. It is expected that greater emotional investment will be associated with higher depression levels.

Hypotheses

Based on the literature reviewed above, the following hypotheses are proposed:

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- Hypothesis 1a: As Overall Social Media Use (SM1) scores increase, Pittsburgh Sleep Quality Index (PSQI) scores will increase.
 - 1b: As Nighttime Social Media Use (SM2) scores increase, PSQI scores will increase.
 - 1c: As Social Integration and Emotional Connection (SMUIS-SIEC) scores increase, PSQI scores will increase.

Hypothesis 2a:	Rosenberg Self Esteem Scale (RSES) scores will be correlated with SM1 scores.*
2b:	RSES scores will be correlated with SM2 scores.*
2c:	RSES scores will be correlated with SMUIS-SIEC scores.*

Hypothesis 3a:	As SM1 scores increase, anxiety (HADS-A) scores will increase.
3b:	As SM2 scores increase, HADS-A scores will increase.
3c:	As SMUIS-SIEC scores increase, HADS-A scores will increase.

Hypothesis 4a:	As SM1 score increase, depression scores (HADS-D) will increase.
4b:	As SM2 scores increase, HADS-D scores will increase.
4c:	As SMUIS-SIEC scores increase, HADS-D scores will increase.

*Note that, in light of conflicting existing literature, Hypotheses 2a, 2b and 2c are not directional.

Methods

Design

This correlational study used a cross-sectional design. The variables were sleep quality (PSQI), overall social media use (SM1), nighttime social media use (SM2), emotional investment in social media (SMUIS-SIEC), anxiety (HADS-A), depression (HADS-D) and self-esteem (RSES).

Participants

Participants were 467 secondary school pupils, aged 11-17 years. Participants were recruited by convenience sampling from Shawlands Academy in Glasgow and did not receive any form of payment for participation.

Measures

Participants completed a questionnaire consisting of the following measures:

Pittsburgh Sleep Quality Index (PSQI)

The PSQI (Buysse, Reynolds, Monk, Berman & Kupfer, 1989) is a self-report measure that provides a global score for sleep quality. Higher scores indicate poorer sleep quality and a score greater than 5 distinguishes poor sleepers from good sleepers. The measure is commonly used with adolescents, as well as adults. Its authors report good reliability, with Cronbach's α of .83 and a test-retest correlation of .85 (Buysse et al., 1989).

Social Media Use Integration Scale (SMUIS)

The SMUIS (Jenkins-Guarnieri, Wright & Johnson, 2013) is a 10-item scale with two subscales: Social Integration and Emotional Connection (SMUIS-SIEC) and Integration into Social Routines (SMUIS-ISR). Jenkins-Guarnieri et al. (2013) report good reliability (Cronbach's α = .921); convergent validity (r = .697) with the Facebook Use Intensity Scale (Ellison, Steinfield & Lampe, 2007); and no significant gender or ethnic differences in scores. The original

scale includes statements relating specifically to Facebook, but was deliberately designed to be easily adapted for other social media. For use in the current study, “social media” replaced “Facebook” in the 10 statements. Items included “I get upset when I can’t log on to social media” and were rated on a 5-point Likert scale from “strongly disagree” to “strongly agree”. Higher scores indicate greater levels of emotional investment or integration into routines.

Hospital Anxiety and Depression Scale (HADS)

The HADS (Zigmond & Snaith, 1983) is a 14-item self-report scale with subscales for anxiety (HADS-A) and depression (HADS-D), each consisting of 7 items. Each item is scored from 0–3, giving a range of 0–21 for possible scores on each subscale, where higher scores indicate higher levels of anxiety or depression. A score of 8 or above indicates ‘caseness’. The HADS has been validated for use with adolescents (White, Leach, Sims, Atkinson & Cottrell, 1999). The scale has good reliability: a review by Bjelland, Haug and Neckelmann (2002) found an average Cronbach’s α of .83 for HADS-A and .82 for HADS-D. Bjelland et al. (2002) also reported convergent validity with the Global Health Questionnaire (Goldberg, 1978), with average correlations of .59 and .58 for anxiety and depression scores, respectively.

Rosenberg Self-Esteem Scale (RSES)

The RSES (Rosenberg, 1965) measures trait self-esteem. For this measure, participants rated 8 statements on a 4-point Likert scale from “strongly disagree” to “strongly agree”. Rosenberg (1965) did not set a cut-off score and the scale is used as a continuous measure, where higher scores indicate higher self-esteem. Items include statements such as “On the whole, I am satisfied with myself” and “At times, I think I am no good at all”. The measure has been found to have high reliability (Cronbach’s α = .86; Tinakon & Nahathai, 2012).

Social Media Questionnaires (SM1 & SM2)

The two social media questionnaires used had been developed and piloted for use with adolescent participants in a previous undergraduate research project. The first (SM1) provides a measure of overall social media use. SM1 consists of 6 questions on: the frequency and duration of social media use; the spread of social media use throughout the day; the number of different social media sites and devices (PC, phone etc.) used. Individual items are scored on scales ranging from 0–1 to 0–9, giving an overall range of 0–31 for total scores. Higher scores indicate greater social media use.

The second questionnaire (SM2) measures nighttime social media use. SM2 consists of 7 questions on: the frequency of social media use shortly before bed, in bed and intending to go to sleep; the duration of social media use after bedtime; perceived sleep delays due to social media; the frequency and duration of sleep disturbances from social media alerts. Individual items are scored on scales ranging from 0–1 to 0–6, with an overall range of 0–31 for possible scores. Higher scores indicate greater nighttime social media use.

Procedure

1st – 4th year pupils (aged 11-15) completed the questionnaires in class. 1st and 2nd year pupils completed the questionnaire online, hosted by qualtrics.com, during ICT classes. 3rd and 4th year pupils completed the same questionnaire in pencil-and-paper form during PSE classes. Participants were briefed and read an information sheet about the study, had the opportunity to ask questions, and completed a consent form either on paper or onscreen. The researcher and class teacher monitored completion of the questionnaires and explained the meaning of questions when necessary. A number of pupils spoke English as a second language and required language support from the researcher or class teacher. Following completion of the questionnaire, pupils were debriefed and encouraged to speak to a member of staff if they had concerns about their mood, self-esteem or sleep. 5th and 6th year pupils (aged 15-17) completed the online questionnaire hosted by qualtrics.com outside of class, via a link circulated by the school on social media.

Pupils and parents had been made aware of the study in advance with a letter from the school. Ethical approval was granted by the University of Glasgow's School of Psychology and Glasgow City Council.

Results

All analyses were carried out using IBM SPSS Statistics version 22 for Macintosh. The final sample included 467 adolescents. 97% of participants indicated that they used social media. Mean scores and standard deviations for each measure are presented in Table 1.

Table 1: Means and standard deviations

Variable	<i>M</i>	<i>SD</i>
Pittsburgh Sleep Quality Index (PSQI)	5.28	3.23
Overall Social Media Use (SM1)	13.64	4.94
Nighttime Social Media Use (SM2)	12.61	7.48
Social Integration and Emotional Connection (SMUIS-SIEC)	16.31	5.01
Integration into Social Routines (SMUIS-ISR)	13.99	3.39
Rosenberg Self-Esteem Scale (RSES)	14.65	4.41
Hospital Anxiety & Depression Scale, Anxiety (HADS-A)	7.48	4.24
Hospital Anxiety & Depression Scale, Depression (HADS-D)	4.38	3.49

The mean PSQI score was 5.28 (SD=3.23). 35% of participants were classed as poor sleepers, with a score greater than 5 (Buysse et al., 1989). Normality assumptions were tested and were not satisfied for PSQI scores. PSQI scores were therefore transformed using logarithm, and the transformed data met normality assumptions. The mean HADS scores were 7.48 for anxiety (SD=4.24) and 4.38 for depression (SD=3.49). 47% of participants were classed as anxious and 21% as depressed, according to the HADS cut-off score of 8 or above (Zigmond & Snaith, 1983). The mean self-esteem score on the RSES was 14.65 (SD=4.41).

For social media measures, the mean score for Overall Social Media Use (SM1) was 13.64 (SD=4.94) and for Nighttime Social Media Use (SM2) was 12.61 (SD=7.48). The mean scores for the Social Media Use Integration Scale were

16.31 (SD=5.01) for the Social Integration and Emotional Connection subscale and 13.99 (SD=3.39) for the Integration into Social Routines subscale.

To test all hypotheses, Pearson correlations were calculated. As indicated in Table 2, 1-tailed tests of significance were carried out to test hypotheses 1, 3 and 4, where the expected direction of associations was predicted. All other tests of significance were 2-tailed. This includes the associations predicted by hypotheses 2a, 2b and 2c – concerning self-esteem scores – since the expected direction of these relationships was not stated. Significant Pearson correlation coefficients are reported in Table 2.

Table 2: Correlation matrix

Variable	1	2	3	4	5	6	7
1. LogPSQI							
2. SM1	.244 [†]						
3. SM2	.337 [†]	.665					
4. SMUIS-SIEC	.275 [†]	.467	.458				
5. SMUIS-ISR	.182 [*]	.584	.508	.570			
6. RSES	-.414	-.170	-.166	-.237	—		
7. HADS-A	.533	.205 [†]	.273 [†]	.318 [†]	.151 [*]	.525	
8. HADS-D	.423	.112 ^{*†}	.213 [†]	.243 ^{*†}	—	-.544	.525

N=467

Notes: All reported coefficients are significant at $p < .001$ unless otherwise specified; * $p < .01$; — indicates non-significant coefficient.

2-tailed tests of significance for all reported correlation coefficients unless otherwise specified; † indicates 1-tailed test of significance.

(LogPSQI = Pittsburgh Sleep Quality Index (transformed by logarithm); SM1 = Overall Social Media Use; SM2 = Nighttime Social Media Use; SMUIS-SIEC = Social Integration and Emotional Connection; SMUIS-ISR = Integration into Social Routines; RSES = Rosenberg Self-Esteem Scale; HADS-A = Hospital Anxiety and Depression, anxiety subscale; HADS-D = Hospital Anxiety and Depression Scale, depression subscale)

Hypothesis 1a – as Overall Social Media Use (SM1) scores increase, PSQI scores will increase – was supported. PSQI scores were positively correlated with SM1 scores, $r = .244$, $p < .001$. Hypothesis 1b – as Nighttime Social Media Use (SM2) scores increase, PSQI scores will increase – was also supported. PSQI scores and SM2 scores were positively correlated, $r = .337$, $p < .001$. In addition, Hypothesis 1c – as Social Integration and Emotional Connection (SMUIS-SIEC) scores increase, PSQI scores will increase – was supported. SMUIS-SIEC and PSQI scores were significantly positively correlated, $r = .275$, $p < .001$.

Hypothesis 2a – self-esteem (RSES) scores will be correlated with SM1 scores – was supported. The relationship was found to be negative, such that self-esteem scores decreased as SM1 scores increased, $r = -.170$, $p < .001$. Similarly, Hypothesis 2b – self-esteem scores will be correlated with SM2 scores – was also supported. Again the relationship was negative, with higher SM2 scores associated with lower self-esteem scores, $r = -.166$, $p < .001$. Hypothesis 2c – self-esteem scores will be correlated with Social Integration

and Emotional Connection (SMUIS-SIEC) scores – was supported. This relationship was also negative, such that self-esteem scores decreased as SMUIS-SIEC scores increased, $r = -.237, p < .001$.

Hypothesis 3a – as SM1 scores increase, anxiety (HADS-A) scores will increase – was supported. Anxiety scores were positively correlated with SM1 scores, $r = .205, p < .001$. Hypothesis 3b – as SM2 scores increase, anxiety scores will increase – was also supported. Higher SM2 scores were associated with higher anxiety scores, $r = .273, p < .001$. In addition, Hypothesis 3c – as Social Integration and Emotional Connection (SMUIS-SIEC) scores increase, anxiety scores will increase – was supported. SMUIS-SIEC and anxiety scores were positively correlated, $r = .318, p < .001$.

Hypothesis 4a – as SM1 scores increase, depression (HADS-D) scores will increase – was supported. Depression scores had a small positive correlation with SM1 scores, $r = .112, p < .01$. Hypothesis 4b – as SM2 scores increase, depression scores will increase – was supported. SM2 and depression scores were positively correlated, $r = .213, p < .001$. Finally, Hypothesis 4c – as Social Integration and Emotional Connection (SMUIS-SIEC) scores increase, depression scores will increase – was also supported. SMUIS-SIEC scores were positively correlated with depression scores, $r = .243, p < .001$.

Additionally, scores on the Integration into Social Routines subscale of the Social Media Use Integration Scale (SMUIS-ISR) were included in analysis to examine the level of association between this measure and the two newly created social media scales. SMUIS-ISR scores were found to have significant moderate positive correlations with both SM1 and SM2 scores, $r = .584, p < .001$; $r = .508, p < .001$, respectively. Integration into Social Routines (SMUIS-ISR) scores also had small positive correlations with PSQI and anxiety scores, $r = .182, p < .01$; $r = .151, p < .01$, respectively.

In addition to these significant correlations, as hypothesised, between social media measures and PSQI, self-esteem, anxiety and depression scores, PSQI scores were also significantly associated with lower self-esteem scores, $r = -.414, p < .001$, and higher anxiety and depression scores, $r = .533, p < .001$; $r = .423, p < .001$. Therefore a hierarchical regression was carried out to investigate whether the social media measures significantly predicted PSQI scores after controlling for anxiety, depression and self-esteem scores (see Table 3).

Table 3: Hierarchical regression on PSQI score

	Step 1			Step 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
SM1	0.001	0.003	.02	0.00	0.003	.01
SM2	0.01	0.002	.28***	0.01	0.002	.18**
SMUIS-SIEC	0.01	0.003	.18**	0.001	0.002	.01
SMUIS-ISR	-0.01	0.004	-.07	0.001	0.004	.02

HADS-A	0.02	0.003	.34***
HADS-D	0.01	0.003	.15**
RSES	-0.01	0.003	-.10

** $p < .01$, *** $p < .001$.

Note $R^2 = .135$ for Step 1; $\Delta R^2 = .219$ for Step 2 ($ps < .001$).

(SM1 = Overall Social Media Use; SM2 = Nighttime Social Media Use; SMUIS-SIEC = Social Integration and Emotional Connection; SMUIS-ISR = Integration into Social Routines; HADS-A = Anxiety subscale of Hospital Anxiety and Depression Scale; HADS-D = Depression subscale of Hospital Anxiety and Depression Scale; RSES = Rosenberg Self-Esteem Scale)

The four measures of social media use (Overall Social Media Use, SM1; Nighttime Social Media Use, SM2; Social Integration and Emotional Connection, SMUIS-SIEC; Integration into Social Routines, SMUIS-ISR) together explained 13.5% of the variance in PSQI scores, $F(4, 424) = 16.52$, $p < .001$. Nighttime Social Media Use (SM2) had a positive and statistically significant moderate effect on PSQI score, $\beta = .28$, $p < .001$, in line with Hypothesis 1b. Social Integration and Emotional Connection (SMUIS-SIEC) also had a small but significant positive effect on PSQI score, $\beta = .18$, $p < .01$, which gives further support to Hypothesis 1c. Overall Social Media Use (SM1) did not significantly predict PSQI scores, $\beta = .02$, $p = .82$. Integration into Social Routines (SMUIS-ISR) was not a significant predictor either, $\beta = -.07$, $p = .24$.

Including anxiety (HADS-A), depression (HADS-D) and self-esteem (RSES) scores in the model explained an additional 21.9% of the variance in PSQI score, $F(3,421) = 47.42$, $p < .001$. In total, this model – including all four social media use measures plus anxiety, depression and self-esteem scores – explained 35.3% of the variance in PSQI scores, $F(7,421) = 32.86$, $p < .001$. The strongest predictor of PSQI score was anxiety score (HADS-A), $\beta = .34$, $p < .001$. Depression score (HADS-D) was also significant, with higher scores predicting higher PSQI scores, $\beta = .15$, $p = .003$. Lower self-esteem scores (RSES) as a predictor of higher PSQI scores reached near-significance, $\beta = -.10$, $p = .051$.

With the inclusion of anxiety, depression and self-esteem scores, Social Integration and Emotional Connection (SMUIS-SIEC) scores no longer significantly predicted PSQI scores, $\beta = .01$, $p = .80$. However, Nighttime Social Media Use (SM2) remained a significant predictor after controlling for anxiety, depression and self-esteem scores, $\beta = .18$, $p < .01$. Overall Social Media Use (SM1) and Integration into Social Routines (SMUIS-ISR) both remained non-significant predictors of PSQI scores, $\beta = .01$, $p = .91$; $\beta = .02$, $p = .75$, respectively.

Discussion

The aim of this study was to examine how social media use relates to sleep quality, self-esteem, anxiety and depression in adolescence. As predicted, greater overall social media use, nighttime social media use and emotional investment in social media were each related to poorer sleep quality, lower self-esteem and higher levels of anxiety and depression. Taking all social media

measures together, nighttime social media use and emotional investment in social media significantly predicted higher PSQI scores, whereas overall use did not. Nighttime social media use significantly predicted higher PSQI scores after controlling for anxiety, depression and self-esteem. Anxiety and depression levels also significantly predicted poorer sleep quality.

Social media and sleep quality

As predicted, greater overall social media use was associated with higher PSQI scores (hypothesis 1a). This result is consistent with previous research that has linked Internet and social media use to poor sleep (Garmy et al., 2012; Pea et al., 2012; Espinoza, 2011; Shochat et al., 2010; Van den Bulck, 2004). As with previous research, these correlational results are not evidence of a causal link between social media use and poor sleep quality. However, this study has extended existing research on sleep by also examining nighttime social media use and emotional investment in social media for the first time. By investigating these particular aspects of social media use – as opposed to simply measuring duration or frequency of use – these findings can inform our understanding of the mechanisms underlying the observed link between social media and sleep, and point towards areas for further investigation.

As predicted, greater nighttime social media use was related to poorer sleep quality (hypothesis 1b). Furthermore, taking all the social media measures together, nighttime social media use significantly predicted PSQI scores, whereas overall social media use did not. This suggests that social media related behaviours around bedtime play a more important role in this relationship than general behaviours throughout the day, such as less physical activity as proposed by Cain and Gradisar (2010). Accordingly, these results are in line with previous suggestions that social media use results in poorer sleep quality by directly displacing sleep, or by interfering with melatonin production via bright screen exposure at bedtime (Cain & Gradisar, 2010). The present findings are also consistent with the idea that social media alerts may interrupt adolescents' sleep, as has been reported with text messages (Van den Bulck, 2003). These proposed explanations assume that social media use impacts on sleep quality, whereas it is equally possible that poor sleep leads to increased social media use as a sleep aid, as adolescents commonly report using computers and TV as sleep aids (Eggermont & Van den Bulck, 2006).

In addition, higher Social Integration and Emotional Connection scores – a measure of emotional investment in social media – were also associated with poorer sleep quality, as expected (hypothesis 1c). Emotional investment, alongside nighttime social media use, also significantly predicted PSQI scores. Previous qualitative research has found that young adults experience considerable pressure to be constantly available and report feeling stressed and guilty when they do not reply to a message immediately (Thomé et al., 2010). In light of this evidence, the current findings suggest that the relationship between social media use and poor sleep quality may result from adolescents' difficulty in relaxing at bedtime due to anxiety at being unable to access new messages or content.

Social media and self-esteem

The current study investigated whether self-esteem was related to social media use, without specifying the expected direction of such a relationship, in light of conflicting existing research. All 3 hypotheses concerning self-esteem scores were supported and it was found that these relationships were negative, such that higher scores on social media measures were associated with lower self-esteem scores.

Firstly, greater overall social media use was found to be associated with lower self-esteem (RSES) scores (hypothesis 2a). This result is consistent with findings that increased Facebook use is related to lower self-esteem (Vogel et al., 2014; Murphy, 2013). The current result confirms these previous findings and extends them from Facebook in particular to apply to social media use in general. This association between greater overall social media use and lower self-esteem could result from upward social comparison. Social media sites allow users to present themselves in the best possible light, by carefully constructing their profile to emphasise their positive characteristics (Gonzales & Hancock, 2011). Social media users tend to engage in more upward than downward social comparison (Vogel et al., 2014), by comparing themselves to people with more desirable characteristics. Social media use may therefore diminish adolescents' feelings of self-worth, by exposing them to profiles that represent unrealistic, idealised versions of other people.

However, the current result does partly conflict with previous findings that social media can have a positive effect on self-esteem. Valkenburg et al. (2006) found that the majority of adolescent participants always or predominantly received positive feedback on their profiles, which was found to increase self-esteem. Similarly, Gonzales and Hancock (2011) reported that viewing one's own Facebook profile increased self-esteem. These two previous studies examined particular aspects of social media use – viewing and receiving feedback on one's profile – which may explain why their results conflict with the present finding concerning overall levels of social media use. This difference in results suggests that the relationship between social media and self-esteem is complex, and it is necessary to examine how various different aspects of social media use relate to self-esteem. The present study contributes to this by examining how nighttime social media use and emotional investment in social media relate to self-esteem.

Greater nighttime social media use was found to be associated with lower self-esteem (hypothesis 2b). Both nighttime and overall social media use had similar correlations with self-esteem – unlike sleep, anxiety and depression, where nighttime use in particular correlated more strongly. This result suggests that the timing of social media use is not an important factor in its relationship with self-esteem. Poor sleep quality has been reported to predict anxiety and depression more strongly than it predicts self-esteem (Wong et al., 2013). In light of this, the present findings may suggest that poor sleep plays a more important role in social media's relationship with anxiety and depression, than with self-esteem. Longitudinal data is required to explore this idea further.

Higher Social Integration and Emotional Connection scores were also related to lower self-esteem scores (hypothesis 2c), which is a new finding. As with

face-to-face interactions (Hepper & Carnelley, 2011), positive or negative feedback through social media has been shown to enhance or diminish self-esteem (Valkenburg et al., 2006). Hepper and Carnelley (2011) found that face-to-face interpersonal feedback had a stronger impact on self-esteem for participants who were more emotionally invested in others' approval. The current finding that greater emotional investment in social media sites is associated with lower self-esteem scores could reflect a similar effect. Whilst the nature of the link between social media use and self-esteem is not yet clear, it is possible that any effect on self-esteem is stronger for adolescents who feel more emotionally connected to social media. Further research is required to better understand this new finding. Qualitative data, in particular, would be valuable to gain a deeper insight into adolescents' emotional connection with social media sites, and how this may relate to aspects of psychological wellbeing such as feelings of self-worth.

Social media and anxiety

As predicted, increased overall social media use was associated with higher anxiety scores (hypothesis 3a). This result is consistent with previous findings that adolescents' Facebook use is positively correlated with anxiety levels (Farahani et al., 2011) and that anxiety sufferers are more likely to be addicted to Facebook (Koc & Gulyagci, 2013). The current study extends these findings to apply to social media sites in general, in a non-clinical population. One explanation for this result comes from Hamburger and Ben-Artzi's (2000) finding that more neurotic participants tended to prefer social uses of the Internet. Therefore adolescents with an increased tendency to experience anxiety may use social media more. Equally, social media could increase anxiety levels, either directly or indirectly through sleep. These two possibilities are discussed below, with reference to results concerning hypotheses 3b and 3c.

Greater nighttime social media use was related to higher anxiety scores, as predicted (hypothesis 3b). One explanation for this relationship is that poor sleep quality may be involved since, of all the social media measures, nighttime use in particular was the strongest predictor of poor sleep quality. It is therefore possible that nighttime social media use leads to poor sleep quality, via the mechanisms discussed above, which in turn has been found to lead to increased symptoms of anxiety (Jackson, Sztendur, Diamond, Byles & Bruck, 2014). Alternatively, it is also possible that high anxiety levels interfere with sleep (Doane, Gress-Smith & Breitenstein, 2015) and lead to increased nighttime social media use as a sleep aid, in line with findings that adolescents frequently use computers and TV as sleep aids (Eggermont & Van den Bulck, 2006). Future longitudinal studies are needed to determine the direction of this relationship.

As expected, higher Social Integration and Emotional Connection scores were associated with higher anxiety scores (hypothesis 3c). This scale measures the level of emotional investment in social media sites, including feeling upset or disconnected when not using social media. Unlike other uses of the Internet, social media involves incoming alerts at all times of the day. Consequently, young people perceive a social pressure to be available 24/7 and report feeling

anxious when they do not reply to messages immediately (Thomé et al., 2010). Similarly, Skierkowski and Wood (2012) found that young adults experience considerable anxiety when their access to text-based communication is restricted. In light of these existing findings, the current results suggest that social media use may increase adolescents' anxiety levels by creating a pressure to be constantly available and a fear of being disconnected. This new finding indicates that emotional investment in social media is an important factor that merits further investigation with relation to links between social media use and anxiety in adolescence.

Social media and depression

As expected, greater overall social media use was associated with higher depression scores (hypothesis 4a). This result is in line with previous research relating adolescents' depressive symptoms to increased Internet use, mobile phone use and TV viewing (Banjanin et al., 2015; Bickham et al., 2015). The current result is also consistent with the limited existing evidence concerning social media use in particular, which links increased use to higher levels of depression in adolescents (Pantic et al., 2012). In contrast, Farahani et al. (2011) did not find a significant association between Facebook use and depression levels. The authors argued that their finding was due to low levels of depression in their sample. However, the current results contradict this, as there was a significant association despite generally low levels of depression in the sample. This relationship between social media use and depression levels has yet to be explained. As with all findings from the current study, these are correlation results that do not indicate causality. Therefore it is not clear whether social media use leads to increased depression levels or vice versa. For example, in light of evidence that children and adults use TV viewing for emotional regulation (Van Der Goot, Beentjes & Van Selm, 2012; Chen & Kennedy, 2005), it is possible that adolescents with greater depressive symptoms tend to use social media more to regulate their low mood.

Whereas Pantic et al.'s (2012) previous study only measured daily duration of social media use, the present study also examined whether depression was related to nighttime social media use or emotional investment in social media. As predicted, greater nighttime social media use was related to higher depression scores (hypothesis 4b). The correlation between depression scores and nighttime social media use, although still small, was stronger than the correlation with overall social media use. This is a new finding and highlights that timing of use is an important factor that may affect how social media impacts on depression levels. As discussed above with reference to anxiety, it is possible that nighttime social media use results in poorer sleep, which has also been shown to increase depressive symptoms over time (Jackson et al., 2014).

Greater Social Integration and Emotional Connection scores were associated with higher depression scores, as expected (hypothesis 4c). This measure includes distress at the prospect of not being able to use social media, including feeling disconnected from friends. This sense of disconnection and isolation could partly explain why participants who were more emotionally connected to social media also had higher levels of depression. This is a new finding and

further research is required to explain this relationship. As with anxiety and self-esteem, depression scores correlated most highly with Social Integration and Emotional Connection out of all social media measures. The current study therefore highlights, for the first time, emotional investment in social media as an important factor that merits further investigation with relation to various aspects of adolescent mental health and wellbeing.

Limitations

One limitation of this study's methodology is that participants' gender was not recorded or included in analysis. The reported significant correlations between social media use, poor sleep quality, anxiety, depression and low self-esteem could mask gender differences in these variables that were not included in the current analysis. For example, female adolescents use social networking sites more than males (Barker, 2009). Poorer sleep quality has also been reported in female adolescents and young adults (Lazaratou, Dikeos, Anagnostopoulos, Sbokou & Soldatos, 2005; Tsai & Li, 2004). Furthermore, Thompson and Loughheed (2012) found that female students were more likely to report losing sleep as a result of Facebook use or feeling addicted to Facebook. Therefore the significant association between social media use and poor sleep quality found in this study could partly reflect higher levels of both variables in female participants, compared to male participants.

As well as sleep quality, researchers have also reported gender differences in other aspects of adolescents' wellbeing. Adolescent girls tend to have lower self-esteem (Bachman, O'Malley, Freedman-Doan, Trzesniewski & Donnellan, 2011), more anxiety symptoms (Van Oort, Greaves-Lord, Verhulst, Ormel & Huizink, 2009) and higher rates of depression than male adolescents (Faravelli, Scarpato, Castellini & Lo Sauro, 2013; Kessler, 2003). As with sleep quality, it is therefore possible that the significant correlations between social media use and anxiety, depression and low self-esteem reflect higher levels of each of these variables in girls than boys.

However, whereas overall social media use has been reported as higher in adolescent girls than boys (Barker, 2009), Jenkins-Guarnieri et al. (2013) found no gender differences in Social Media Use Integration Scale (SMUIS) scores. This suggests that the significant associations between SMUIS scores and sleep, self-esteem, anxiety and depression scores in the current study are unlikely to be the result of gender differences. Nevertheless, there is a clear need for future research to examine gender differences in how social media use relates to sleep quality, anxiety, depression and self-esteem in adolescence.

Similarly, a second limitation of this study is that participants' ages were not recorded or included in analysis. As with gender, there is also evidence of age differences in computer use, sleep, anxiety and depression across adolescence. From age 10 to 16 years, adolescents' computer use increases and sleep duration decreases (Garmy, Nyberg & Jakobsson, 2012). Therefore the significant correlation between social media use and sleep quality does not necessarily indicate a direct link between the two variables, but could mask age as a factor that influences each variable individually. The same could apply to

the relationship between social media use and anxiety and depression levels, which have also been found to increase across adolescence (Kozina, 2014; De Matos et al., 2008). In contrast, self-esteem tends to increase throughout adolescence and adulthood (Orth, Maes & Schmitt, 2015), suggesting that age does not explain the observed relationship between increased social media use and lower self-esteem. Future studies should examine age differences in how social media relates to adolescents' sleep quality and anxiety and depression levels.

Another potential issue with the current methodology is that a number of participants were not native speakers of English and some had poor levels of literacy. Consequently, some participants' poor understanding of the questions may have resulted in inaccurate data. Furthermore, certain non-native speakers required language support from the researcher or teacher, as they were not literate in English. Given the sensitive nature of some measures, concerning self-esteem for example, the presence of a researcher or teacher may have increased social desirability bias in participants' responses (Krumpal, 2013), resulting in less accurate data.

Future directions

As discussed above, future research should examine how both age and gender relate to the links between social media use and sleep quality, anxiety, depression and self-esteem. In addition, the results of this study indicate that nighttime social media use and emotional investment in social media are both important factors that merit further investigation in relation to adolescent sleep quality, self-esteem, anxiety and depression. Moving forward, longitudinal and qualitative studies would be particularly valuable to explain the current, and previous, correlational results.

Longitudinal studies are required to examine causality amongst social media use, sleep quality, self-esteem, anxiety and depression in adolescents. For example, previously proposed mechanisms to explain the observed association between social media use and poor sleep quality have generally assumed that social media use leads to sleep problems (Cain & Gradisar, 2010). However, a longitudinal study of university students found that, in fact, sleep problems predicted greater social media use over time (Tavernier and Willoughby, 2013). Future studies should examine social media use and sleep quality over time in adolescents, including nighttime use and emotional investment, in light of the current results. Such longitudinal data could examine, amongst other research questions, whether nighttime social media use causes poor sleep or is used as a coping mechanism or sleep aid by poor sleepers. In one recent longitudinal study, Bickham et al. (2015) found that adolescents' mobile phone use and TV watching predicted depressive symptoms after one year. Future studies should explore whether the same causal effect exists for social media use – for depression and also anxiety and self-esteem, given the present findings. Such longitudinal research is crucial to improve our understanding of how social media use relates to adolescent mental health, by examining whether this link is causal and if so, whether it is explained by poor sleep.

Qualitative studies could make a unique contribution to future research into the nature of social media use's relationship with sleep, self-esteem, anxiety and depression in adolescence. Such research would provide a deeper insight into the complex experience of growing up in the digital age. For example, Thomée et al. (2010) found that young adults perceived a social pressure to be available via electronic communication at all times of the day. They reported feeling stressed and even guilty when they did not respond to messages immediately, and felt the need to create excuses for not replying straightaway. This qualitative data is unique in the detailed level of insight it gives into the emotional experience of life as a young person in a generation of social media users. To explain the current results, concerning nighttime social media use and emotional investment in particular, future research could employ a qualitative approach. This would provide a deeper understanding of adolescents' attitudes towards social media. Avenues for future qualitative research could include how adolescents may use social media to regulate emotions or cope with poor sleep.

Conclusion

This study contributes to the growing body of evidence linking social media use to sleep quality, self-esteem, anxiety and depression in adolescents. Overall social media use, nighttime social media use and emotional investment in social media were each associated with poorer sleep quality, lower self-esteem, and higher levels of anxiety and depression. Nighttime social media use predicted poor sleep quality after controlling for self-esteem, anxiety and depression levels. The current results add to recent evidence that social media use is negatively related to various aspects of psychological wellbeing in adolescence, and also highlight nighttime social media use and emotional investment as important factors that merit further investigation. Future research could extend these findings with longitudinal and qualitative data, to improve our current understanding and examine the direction of causality of the observed links. As well as guiding future research, these findings can inform educational interventions aimed at adolescents and parents, concerning sleep hygiene and the impact of social media on psychological wellbeing.

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