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Social Networking Site Use in Young Adolescents: Association with Health-Related Quality of Life and Behavioural Difficulties

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Abstract: Despite Social Networking Sites (SNS) having a minimum age of 13, younger adolescents are using them. In this study, we examine self-reported overall SNS use and SNS use if awake at night in relation to Health-Related Quality of Life (HRQOL, measured by KIDSCREEN-10) and behaviour (measured by Strengths and Difficulties Questionnaire, SDQ) in 5,229 adolescents aged 11-12 in the Study of Cognition, Adolescents and Mobile Phones (SCAMP) cohort. Two-thirds of the study population used SNS. Weekday and weekend SNS use on mobile phones and other devices was significantly associated with lower HRQOL in females (all p-values for linear trend < 0.01) but not males. Using SNS if awake at night was also significantly associated with lower HRQOL in females (adjusted β-coefficient - 2.20 (95% CI - 3.18, - 1.22)). Higher SNS use on mobile phones and other devices was associated with increased behavioural difficulties in both genders (p-value for trend < 0.001). Similarly, SNS use if awake at night was associated with greater behavioural difficulties (adjusted β-coefficient 2.54 (95% CI 2.09, 2.98)). We recommend further longitudinal research in this area in order have a better understanding of the direction of relationships between SNS and wellbeing and behaviour in adolescents.

Keywords: Social Networking Sites, Adolescents, Behavior, Wellbeing, Mobile Phones

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1. **Introduction**

With 39% of 8-11 year olds and 83% of 12-15 year olds owning their own smartphone (Ofcom, 2017), Social Networking Sites (SNS) have permeated adolescent life. SNS are websites "designed to help people communicate and share information, photographs etc. with a group" (Cambridge University Press, 2008), such as Facebook, Instagram, Twitter and Snapchat. SNS allow adolescents to talk to friends, share gossip, express themselves and learn new things (Lilley et al., 2014; Science and Technology Committee, 2019). Young people tend to view SNS as having a perceived positive influence on their lives (Frith, 2017). SNS may have particular value in helping introverted adolescents learn to socialise (Rosen, 2011). However, during early adolescence, children undergo a time of social development where they use SNS to facilitate self-expression, test trust, share intimacies and take steps towards the adult world, but where they also may be particularly vulnerable to the risks encountered on SNS (Livingstone, 2014; Peter & Valkenburg, 2013). Such risks include adverts and spam, people being rude or hurtful, strangers, cyberbullying and seeing things they do not want to see (Lilley et al., 2014). Additionally, teens on Facebook may tend to show more narcissistic tendencies and more signs of other psychological disorders including antisocial behaviours, mania and aggressive tendencies, and SNS use may also impact learning at school by providing a distraction (Rosen, 2011). Thus, further research into the effect of SNS on adolescents' wellbeing is needed, especially given the unprecedented speed at which SNS have become ubiquitous.

A number of studies have investigated the relationship between SNS and adolescents' wellbeing (Barry et al., 2017; Beardsmore, 2015; Hanprathet et al., 2015; Kelly et al., 2018; Ra et al., 2018; Roser, Katharina et al., 2016; Woods & Scott, 2016). A higher number of SNS accounts operated by the adolescent is associated with parent-reported inattention, hyperactivity/impulsivity, oppositional defiant disorder and symptoms of depression (Barry et al., 2017; Ra et al., 2018). Frequent use of SNS has been associated with symptoms of behavioural difficulties (Beardsmore, 2015; Booker et al., 2018; Roser, Katharina et al., 2016), an unmet need for mental health support (Sampasa-Kanyinga & Lewis, 2015), high psychosocial distress (Müller et al., 2016), poorer sleep quality, lower self-esteem and higher levels of anxiety and depression (Kelly et al., 2018; Woods & Scott, 2016). In US adolescents aged 12 - 15, high SNS use associated with increased odds of mental health problems, even after adjusting for history of mental health problems (Riehm et al., 2019). Individuals with SNS addiction may be at higher risk of developing mental health symptoms, anxiety, social dysfunction and severe depression (Bányai et al., 2017; Hanprathet et al., 2015). These studies have tended to focus on adolescents aged 13 and above, likely because SNS have a minimum age of 13. However, despite these restrictions, in 2013 it was

reported that 59% of the UK's 11-12 year olds with internet access had a profile on a social networking site (Lilley & Ball, 2013).

Children below the age of 13 tend to view SNS differently to older adolescents (Children's Commissioner, 2017). Focus groups exploring the impact of SNS use on the lives of 8-12 year olds reported that children tended to associate SNS use with a happier mood and positive emotions, and also identified that starting secondary school was a key time of changes in SNS use. After children start secondary school (at age 11), identity and peer approval become more important, with some 11-12 year olds starting to depend on getting 'likes' and 'comments', and using techniques to guarantee obtaining a high number of likes (Children's Commissioner, 2017). However, there is a literature gap with regard to the association of SNS use with behaviour and well-being in young adolescents. Research into the impacts of SNS on wellbeing in this age group has been limited to the exposure to SNS measured as "time spent chatting or interacting with friends on SNS on a normal school day" in the UK Household Longitudinal Survey. The survey found a relationship between interactions on SNS and decreased life satisfaction in females, as well as increased behavioural difficulties over time from age 10 (Booker et al., 2018; Orben et al., 2019). This may not take into account other functions of SNS such as looking at photos and videos. It also does not investigate weekend use or differentiate between SNS use on mobile phones and other devices (such as computers). Thus, further research into the impact of SNS on the wellbeing of 11-12 year olds is needed, as this seems to be a key time in which SNS can affect behaviour and wellbeing.

The impact of SNS use may also differ by gender. In 10-15 year olds, greater interaction with others on SNS at age 10 was associated with lower wellbeing for females but not for males, including greater increases in Total Difficulties Score (from Strengths and Difficulties Questionnaire (SDQ)) over time (Booker et al., 2018). Furthermore, a systematic review and meta-analysis of problematic smartphone use in 10 – 24 year-olds (eg. anxiety when phone was not available, using phone to gain peer acceptance or neglect of other activities), which found that problematic phone users often reported SNS use as the most important or preferred activity on smartphones, also found that females (particularly those aged 17-19) were more likely to exhibit problematic phone use (Sohn et al., 2019). In this systematic review and meta-analysis, problematic phone use was consistently associated with measures of poor mental health, including depression, anxiety, stress and poor sleep quality (Sohn et al., 2019). SNS use is also associated with decreased life satisfaction in females, with less pronounced effects in males (Orben et al., 2019). This suggests that gender may play a role in the relationship between SNS use and behaviour and wellbeing.

If SNS are playing a causal role in altering wellbeing, night-time usage may be especially important. Night-time-specific SNS use is correlated with poorer sleep quality after controlling for anxiety, depression and self-esteem, while adolescents who were more emotionally invested in SNS experienced poorer sleep quality, lower self-esteem and more depression and anxiety (Woods & Scott, 2016). Late night electronic media usage has also been associated with mood disturbances in Korean adolescents (Choi et al., 2017). Inadequate sleep may have a mediating role in the relationship between increasing frequency of SNS use and higher psychological distress in adolescents aged 13 to 16 in England (Viner et al., 2019). Therefore, investigating SNS usage at night is key when examining the association of SNS with behaviour and wellbeing, as less sleep and poorer sleep quality may be a mechanism in the potential relationship between SNS use and behaviour and wellbeing.

The Study of Cognition, Adolescents and Mobile Phones (SCAMP) is a prospective cohort study of adolescents that was set up in 2014 to investigate the use of mobile phones and other devices and cognitive, behavioural, physical and mental health and educational outcomes. The SCAMP cohort is representative of the Greater London school population in the UK, with respect to gender, ethnicity and socio-economic status (SES) (Table 3,Toledano, 2018). In this study, we examined self-reported overall SNS use and SNS use if awake at night in relation to health-related quality of life (HRQOL) and behaviour in 11-12 year olds in the SCAMP cohort. As children and adolescents spend more time on their phones and other devices at the weekend compared to weekdays (as they are at school during the day) (Ofcom, 2017), we examined weekday and weekend use separately in this paper, which is, to the best of our knowledge, a novel and comprehensive approach to examining SNS usage.

Thus the aim of this study was to examine the impact of SNS use on wellbeing and behaviour. We investigated the following hypotheses: H_1: increasing SNS use is associated with lower HRQOL (KIDSCREEN-10 score) and higher behavioural difficulties (from SDQ questionnaire); H_2: SNS use if awake at night is associated with lower HRQOL and more behavioural difficulties; H_3: SNS use has greater impact on HRQOL and behavioural difficulties for female adolescents compared to males.

2. Methods

2.1 Study Population

This study consists of a cross-sectional analysis of SCAMP baseline data. The SCAMP baseline population consists of Year 7 students attending secondary schools in London, UK. The baseline data collection took place between November 2014 and June 2016. Schools

were recruited using invitations to head teachers. More details regarding SCAMP set-up and recruitment can be found elsewhere (Toledano, 2018). During data collection, 111 adolescents opted out of the study and 14 withdrew; excluding these, 6,616 children answered the SCAMP questionnaire. Of these, 5,229 children answered questions on SNS use (SNS use) and the SDQ and KIDSCREEN-10 questionnaires and were included in the present analysis. A comparison of participants included in the present study and those not included can be found in Supplementary Table A.1. SNS use questions were skipped for adolescents who reported not owning a mobile phone or a wireless device (125 reported never owning a mobile phone and 423 reported previously owning a phone but not currently owning one). Thus, while there are significant differences in parental occupation and school type, these may reflect ability of family to purchase a mobile phone or wireless device for the adolescent.

2.2 Questionnaire

Pupils completed a computerised questionnaire, during school hours, conducted via the Psytools software (Delosis Ltd, London) using school computers. The questionnaire included self-reported questions on a variety of exposure measures relating to mobile phone use and a diverse range of outcome measures, as well as covariates including age, gender, ethnicity and parental occupation. Adolescents were also asked whether there had been any extraordinary or life-changing events in the last two weeks, with three possible responses (no; yes, something good happened; yes, something bad happened) to check for proximal factors that might have influenced responses.

2.3 SNS use

We examined self-reported duration of SNS use on mobile phones and use on other devices. This was probed with the questions: "How much time per day do you spend on social network sites (e.g. Facebook, Instagram, Twitter) on your mobile phone?" and "How much time per day do you spend on social network sites (e.g. Facebook, Instagram, Twitter) on other devices (do not include mobile phones)?". Weekday and weekend use were assessed separately for both mobile phones and other devices. Self-reported duration categories were none, 1 – 30 minutes per day, 31 minutes – 2 hours per day, 3 – 4 hours per day and 5 hours or more per day. Night-time use was measured by asking the participants whether they used SNS via their mobile phone if they woke up during the night (yes or no) (hereafter referred to as SNS use if awake at night).

2.4 HRQOL measured by KIDSCREEN-10

KIDSCREEN-10 is a standardised measure of general HQROL in children and adolescents, shortened from the KIDSCREEN-52 and KIDSCREEN-27 instruments (Ravens-Sieberer et al., 2010). It consists of 10 self-reported items, covering physical (eg. "have you felt fit and well in the last week?"), psychological (eg. "have you felt sad in the last week?") and social (eg. "have you had fun with your friends in the last week?) dimensions of wellbeing (The KIDSCREEN Group, 2006). The adolescents indicate the frequency or severity of each item on a 5-point Likert scale (1 = never, 2 = almost never, 3 = sometimes, 4 = almost always and 5 = always; or 1 = not at all, 2 = slightly, 3 = moderately, 4 = very, and 5 = extremely). Sum scores of these 10 items were converted to a score by assigning Rasch person parameters to each possible sum score. The person parameters were transformed into values with a mean of 50 and an SD of approximately 10 (The KIDSCREEN Group, 2006), where a higher value indicates a better HRQOL. The Cronbach's α for KIDSCREEN-10 in our sample was 0.791, indicating an acceptable internal reliability (Cronbach, 1951).

2.5 Behaviour measured by self-reported SDQ

The SDQ consists of five sub-scales assessing Emotional Problems (eg. "I am often unhappy"), Conduct Problems (eg. "I am often accused of lying or cheating"), Hyperactivity (eg. "I am constantly fidgeting"), Peer Problems (eg. "Other people my age generally like me") (with these four subscales together representing difficulties) and Prosocial behaviour (eg. "I try to be nice to other people") (with this subscale representing strengths). Each of the five subscales contains 5 items answered on a three-point Likert scale (0 = not true, 1 = somewhat true, 2 = certainly true). The questions for each sub-scale can be summed to provide a score for each category (with a maximum score of ten). A higher score means more behavioural problems for the four difficulties scales, whereas a higher score represents more strengths for the prosocial behaviour scale. These scores fall into a four-band categorisation: close to average, slightly raised (/slightly lowered), high (/low) and very high (/very low), categories for prosocial behaviours shown in brackets. These categories are defined such that 80% of participants will be as "close to average", 10% "slightly raised", 5% "high" and 5% "very high" (Youth in Mind, 2016). A Total Difficulties Score can be calculated by summing the scores for the emotional problems, conduct, hyperactivity and peer problems subscales. The maximum Total Difficulties Score is 40, with a higher score representing more behavioural difficulties; Total Difficulties Score is also categorised such that 80% of participants will be "close to average" (scoring between 0-14), 10% will be "slightly raised" (scoring 15-17), 5% of participants as "high" (scoring 18-19) and 5% as "very high" (scoring between 20-40) (Youth

in Mind, 2016). Sub-scales of the SDQ have been associated with relevant psychopathology diagnosis in adolescents (Goodman, 2001). The Cronbach's α for SDQ score in our sample was 0.79, indicating an acceptable internal reliability (Cronbach, 1951).

2.6 Socio-demographic characteristics

Ethnicity was categorized as "White", "Black", "Asian", "Mixed" and "Other". Socio-Economic Status (SES) was proxied by parent occupation based on the National Statistics Socio-economic Classification (NS-SEC) level (five group version) for either parent, with the highest NS-SEC level of either parent (or known parent if only one parental occupation given) used for socio-economic status.

2.7 Statistical analyses

The association between duration of SNS use and behaviour (SDQ), and HRQOL (KIDSCREEN-10), were investigated using multi-level linear regression, using both individual and school cohort levels. All models were run separately with weekday SNS use on mobile phone, weekday SNS use on other devices, weekend SNS use on mobile phone, weekend use on other devices, and SNS use if awake at night as separate exposures. Model 1 was an unadjusted model examining relationships between SNS use (weekday or weekend SNS use on mobile phone or other device, or SNS use if awake at night) and SDQ dimensions or KIDSCREEN-10 to examine H_1 and H_2. Model 2 was adjusted for age, gender, SES, ethnicity, school type (independent or state) and self-reported extraordinary events that affected participant's life in the last two weeks. The latter was included to control for any proximal personal factors which may contribute to differences in HRQOL or behaviour. Model 2 also examined H_1 and H_2. We also tested whether the associations varied by gender from the significance of the gender x SNS use interaction term, to investigate H_3. As the Total Difficulties Score can also be categorised into "close to average", "slightly raised", "high" and "very high" (Youth in Mind, 2016), we undertook multi-level logistic regression (Model 3) in order to investigate how using SNS for more than 5 hours a day increases the odds of being in the "very high" group (compared to the other groups, thus as a binary outcome). Similar to Model 2, the logistic regression was adjusted for age, gender, SES, ethnicity, school type (independent or state) and self-reported extraordinary events in the last two weeks.

All statistical analyses were carried out using Stata 13 (StataCorp LP, College Station, TX, USA).

2.8 Ethical Approval

Ethical Approval was obtained from the North West Haydock Research Ethics Committee (ref 14/NW/0347). Head teachers of participating schools signed consent forms to confirm their participation. Parents of all Year 7 pupils were sent an information pack about the study to inform them and give them the opportunity to opt their child out if they did not wish for them to take part. The adolescents could also non-assent on the day of the assessment. The SCAMP study was conducted in accordance with the Declaration of Helsinki.

3. Results

The characteristics of the study participants are shown in Table 1.

(Table 1 here)

3.1 Social Networking Site Use

Two-thirds of participants self-reported using SNS on their mobile phones for at least one minute a day) (Table 2), and 55.18% of male participants and 58.93% of female participants reported SNS use on other devices. Fewer participants reported using SNS on their mobile phones if they woke up during the night (15.63% and 16.94% of males and females, respectively).

(Table 2 here)

3.2 HRQOL

The average KIDSCREEN-10 score was 49.13 (±8.54 (SD)). Higher SNS use on mobile phones or other devices and during weekday and weekend were associated with lower KIDSCREEN-10 in the unadjusted model (Model 1, all p-values for trend < 0.01) (Table 3). However, after adjustment for age, gender, SES, ethnicity, school type and self-reported extraordinary events, these trends were no longer significant (Model 2). SNS use if awake at night was significantly associated with decreased KIDSCREEN-10 score in Models 1 and 2 (β = - 1.56 (95% CI – 2.27, - 0.85)).

(Table 3 here)

Males had a slightly higher average KIDSCREEN-10 score than females (49.6 (±8.7) and 48.6 (±8.5) respectively, p-value for difference <0.001) (Supplementary Table A.2). The association between SNS use (on weekdays and weekends on mobile phones and other devices in Model 2) and KIDSCREEN-10 score were modified by gender (all p-values for interaction <0.05).

Interactions were followed up by running the adjusted analyses (Model 2) stratified by gender (Table 4). For males, SNS use on weekdays or weekends was not significantly associated with KIDSCREEN-10 score on mobile phones or other devices, nor was SNS use if awake at night, after adjustment (Model 2). For females, SNS use was significantly associated with lower KIDSCREEN-10 score. This was true for both use on mobile phones and on other devices, and for weekday and weekend use (all p-values for trend < 0.05). In particular, SNS use for 5 hours or more per day was strongly associated with lower KIDSCREEN-10 score on both mobile phones (weekday: β = - 3.18 (95% CI - 4.99, - 1.37); weekend: β = - 2.12 (95% CI – 3.50, - 0.74)) and other devices (weekday: β = - 3.04 (95% CI - 5.09, - 1.00); weekend: β = - 2.84 (95% CI - 4.44, - 1.24)). SNS use if awake at night was significantly associated with lower KIDSCREEN-10 score (β = - 2.20 (95% CI - 3.18, - 1.22)) in females but not males.

(Table 4 here)

Therefore, H_1 (increasing SNS use is associated with lower HRQOL (KIDSCREEN-10 score) and higher behavioural difficulties (from SDQ questionnaire)) is partially supported, as SNS use on mobile phones and other devices during the weekday and weekend are associated with lower HRQOL, but only in females. H_2 (SNS use if awake at night is associated with lower HRQOL and more behavioural difficulties) was similarly partially supported as SNS use if awake at night was significantly associated with lower HRQOL in females. Thus, H_3 (SNS use has greater impact on HRQOL and behavioural difficulties for female adolescents compared to males) was supported with regard to HRQOL.

3.3 Behaviour

The percentage of participants in the four-fold classification for Total Difficulties Score were similar to the expected distribution of 80% as "close to average", 10% "slightly raised", 5% "high" and 5% "very high" (Youth in Mind, 2016) (Supplementary Table A.2).

Higher use of SNS on both mobile phones and other devices was associated with higher Total Difficulties Scores in both Models 1 and 2 (p-value for trend <0.001 for all general SNS use

categories) (Table 3), especially for 5 hours or more on both mobile phones (weekday: β = 4.59 (95% CI 3.78, 5.40); weekend: β = 3.37 (95% CI 2.72, 4.03)) and other devices (weekday: β = 4.37 (95% CI 3.50, 5.23); weekend: β = 3.60 (95% CI 2.91, 4.30)). From Model 3, SNS use for more than 5 hours per day on mobile phone was associated with higher odds of being in the very high category for Total Difficulties Score compared to no SNS use (weekday: Adjusted Odds Ratio (AOR) 4.11, (95% CI 2.62, 6.43), weekend: AOR 3.06 (95% CI 2.03, 4.59)) (Supplementary Table A.3). SNS use for more than 5 hours per day on other devices also had higher odds of being in the very high category for Total Difficulties Score compared to no SNS use (weekday: AOR 4.41, (95% CI 2.77, 7.03), weekend: AOR 3.86 (95% CI 2.58, 5.79)). Thus, our findings support H_1 (increasing SNS use is associated with lower HRQOL (KIDSCREEN-10 score) and higher behavioural difficulties (from SDQ questionnaire)).

The effect size (β) for 5 hours or more per day was lower for weekend SNS use compared to weekday on both mobile phones and other devices (Table 3).

Of the five SDQ sub-scales (see Table 5), the most pronounced associations were observed for conduct problems (β = 1.82 (95% CI 1.58, 2.07) for 5 hours or more on mobile phones during weekdays, p-value for trend <0.001) and hyperactivity (β = 1.74 (95% CI 1.44, 2.07) for 5 hours or more on mobile phones, p-value for trend <0.001), followed by emotional problems (β = 0.89 (95% CI 0.56, 1.23) for 5 hours or more on mobile phones during weekdays, p-value for trend, < 0.01). The same pattern emerged for SNS use on other devices (Table 5), and weekend use on both mobile phones and other devices (data not shown).

For the peer problems scale, increasing SNS use for up to 4 hours per day on a mobile phone was associated with decreasing peer problems scale score while use of 5 hours or more was associated with increased peer problems, although this association was not significant (Table 5). This pattern was less clear on other devices; similar trends were observed for weekend use (data not shown). Increasing SNS use was associated with lower score for prosocial behaviours (β = - 0.58 (95% CI - 0.87, - 0.30) for 5 hours or more on mobile phones, p-value for trend, <0.001).

 (Table 5 here)

SNS use if awake at night was significantly associated with higher Total Difficulties Score after adjustment (Model 2, β = 2.54 (95% CI 2.09, 2.98)) (Table 3), supporting H_2 (SNS use if awake at night is associated with lower HRQOL and more behavioural difficulties). SNS use if awake at night was most strongly associated with hyperactivity (β = 1.12 (95% CI 0.94, 1.30)), and conduct problems (β = 0.90 (95% CI 0.77, 1.04)), followed by emotional problems (β = 0.43

(95% CI 0.25, 0.61)) (Table 5). SNS use if awake at night was not significantly associated with peer problems but was associated with a lower score for prosocial behaviours (β = - 0.54 (95% CI - 0.70, - 0.39)).

We did not find evidence to suggest that the association between SNS and SDQ was modified by gender, and the associations between SNS use and SDQ score was present in both males and females across SNS measures (Table 4). As such, H_3 (SNS use has greater impact on HRQOL and behavioural difficulties for female adolescents compared to males) is not supported.

4. Discussion

This study has shown that despite an age restriction of 13 years on SNS, a substantial proportion of 11-12 year olds were using SNS. We found that general SNS use and SNS use if awake at night were associated with lower HRQOL in females but not in males. Higher use of SNS on both mobile phones and other devices, and SNS use if awake at night, were associated with increased behavioural difficulties, as measured by the SDQ. There were no gender differences in associations between SNS use and behavioural difficulties. For the individual SDQ subscales, the most pronounced associations were observed for conduct problems and hyperactivity, followed by emotional problems. For peer behaviour, increasing SNS use up to 4 hours per day on a mobile phone was associated with decreasing peer problems scale score; higher SNS use on mobile phones and other devices, as well as SNS use if awake at night, were significantly associated with a lower score for prosocial behaviours. This study contributes further insight to the growing literature on SNS use by adolescents by examining in detail the relationship between time spent on SNS on weekdays and weekends on the HRQOL and behavioural strengths and difficulties in 11-12 year olds.

4.1 SNS use and HQROL

Our findings suggest that high usage of SNS (over 5 hours) and SNS use if awake at night are associated with a poorer HRQOL in females but not in males, thus supporting H_1 and H_2 in females, and supporting H_3 with regard to HRQOL. This is in line with other studies which have seen a stronger magnitude of association between SNS use and depressive symptoms and poorer wellbeing for females compared to males (Booker et al., 2018; Kelly et al., 2018; Orben et al., 2019). Female adolescents may be more likely to be involved in cyberbullying or online harassment, and may also experience dissatisfaction with their appearance or body weight and generally low esteem, which may play a role in this potential relationship (Kelly et

al., 2018). Findings from semi-structured focus groups from female adolescents aged 10 – 18 observed that girls who spent the most time using social media were most likely to say they were sad or depressed nearly every day, want to change their appearance and not participate in sports or arts extra-curricular activities; they were also less likely to trust other girls, have supportive friends and adults to talk through serious issues and enjoy coming to school (Hinkelman, 2017). Research using a cohort of 14-15 year-olds in the UK found that higher SNS use was significantly related to poorer psychological health in females (measured using the GHQ-12 questionnaire) but with a small effect size, with a much larger effect of being bullied, including online bullying and not getting enough sleep (Department for Education, 2019). Similarly, a study of SNS use and personal wellbeing in 13 – 16 year-olds found that the association between very frequent SNS use and later poor mental health in girls was largely mediated by cyberbullying and inadequate sleep, and also to a lesser extent inadequate physical activity(Viner et al., 2019).

In our study, SNS use if awake at night was significantly associated with lower KIDSCREEN-10 score in females– this supports a potential role for inadequate sleep, as sufficient sleep is vital in maintaining physical and mental development (Brand & Kirov, 2011). Adolescents who use SNS more (both in general and if awake at night) may have poorer sleep quality and higher levels of anxiety and depression. Night-time-specific SNS use predicting poorer sleep quality after controlling for anxiety, depression and self-esteem (Woods & Scott, 2016). A separate study of night-time screen-based media use on HRQOL in the SCAMP cohort found that adolescents who used at least one screen-based media device or mobile phones at night had a poorer HRQOL compared to those who did not use any (Mireku, M.; et al., 2018). Adolescents may be using SNS at night because notifications have woken them up if smartphones are not switched off or left on silent. A study in Swiss adolescents aged between 13 and 15 years of age found that being woken up by a mobile phone at night increased odds of problems falling asleep and restless sleep, as well as concentration problems, but were not significantly associated with differences in HRQOL as measured by KIDSCREEN-52 (Foerster et al., 2019). Use of smartphones at night, including use of SNS, leads to exposure to light, including short wavelength ("blue") light, which is more disruptive to circadian rhythms than longer wavelength light (Lockley et al., 2003; Tahkamo et al., 2019). A randomised controlled trial in Dutch adolescents aged 12-17 found that both blue-light blocking glasses and not using screens before bed led to the adolescents going to sleep earlier (Meijden et al., 2019). Exposure to light before bedtime suppresses melatonin production, which can lead to increased alertness and may impair sleep; furthermore, exposure to light during the usual hours of sleep may lead to an even greater suppression of melatonin production, and thus use of SNS if awake during the night may supress melatonin production and prevent the

adolescents from falling back to sleep, which may affect HRQOL (Chang et al., 2015; Gooley et al., 2011). However, as SNS use if awake at night is only associated with lower HRQOL in females, more research may be needed into night-time impacts of SNS and mobile phone. Another explanation may be that lower wellbeing causes the adolescents to wake up in the night more, and they fill time whilst waiting to fall back to sleep by using SNS. Thus, more research is needed to address the mechanisms behind the relationship between HRQOL and SNS use and the differences between males and females, including the role of sleep.

4.2 SNS use and behavioural strengths and difficulties

Higher duration of SNS use on both mobile phones and other devices, and SNS use if awake at night, was associated with self-reports of behavioural difficulties, thus supporting H_1 and H_2. H_3 was not supported as there was no difference by gender. Similarly, a longitudinal study which examined number of hours spent chatting or interacting with friends on SNS during the normal school day found that higher SNS interaction was associated with higher difficulties score at age 10, and, for females, greater SNS interaction was associated with worsening behavioural difficulties with age (Booker et al., 2018). Duration of SNS use was especially associated with conduct problems, hyperactivity and emotional problems. This is in line with findings from the HERMES cohort of Swiss adolescents (Roser, Katharina et al., 2016), which showed strong associations between problematic mobile phone use and hyperactivity and conduct problems. High-frequency engagement with digital media has been found to be positively associated with a significantly higher odds of having symptoms of ADHD in a longitudinal study of Californian adolescents (Ra et al., 2018). SNS are responsible for creating a high number of notifications and alerts which may contribute to inattention and hyperactivity. Smartphone alerts have been found to induce inattention and hyperactivity in an experimental study on adults from the general population (Kushlev, 2018). Additionally, the higher number of SNS accounts and higher self-reported frequency of checking SNS are associated with parent-reported inattention and hyperactivity/impulsivity in adolescents ranging from 14 to 17 (Barry et al., 2017). However, reverse causality must also be considered here, as adolescents who are more prone to inattention/hyperactivity may be those who check their SNS more.

In this study, SNS use was associated with conduct problems. In line with this, children between the ages of 9-16 have reported aggression, such as hitting something or acting aggressively because of slow internet or being disconnected from the internet, and feelings of aggression as a result of other people's behaviour online (e.g. responding to mean comments) or others around them (e.g. siblings distracting them from the internet) (Smahel et al., 2015).

Screen-based media has been positively related to aggression and excessive alcohol use in adolescents from Europe and North America (Iannotti et al., 2009), while conduct problems and aggression have been associated with pathological internet use in European adolescents (Kaess et al., 2014). However, adolescents with conduct problems may use the SNS to distract themselves or escape life's stresses (Kaess et al., 2014; Radovic et al., 2015).

For peer behaviour, low to moderate SNS use (up to 4 hours per day) on a mobile phone was associated with decreasing peer problems, suggesting that SNS may help adolescents connect with their peers and build friendships. This is consistent with other research that recognises the role of SNS for social connection (Radovic et al., 2017), or that not using SNS is detrimental to social connection for 11-12 year olds. Alternatively, adolescents with more friends (because of better prosociality and fewer peer problems) may use SNS more. However, while low-level SNS is correlated with fewer peer problems and higher SNS associated with more peer problems, SNS use is also significantly associated with a reduction in prosocial behaviours, suggesting that while SNS use may help adolescents connect with each other, it may also be associated with a reduction in care for and desire to help others. This potential decrease in prosocial behaviour has been observed in other studies of screen-based sedentary behaviour and mobile phone use (Allen & Vella, 2015; Roser, Katharina et al., 2016). Research has suggested that adult SNS users may be more narcissistic (Andreassen et al., 2017; Brailovskaia & Margraf, 2016; Carpenter, 2012), with lower self-esteem being associated with self-promotion and anti-social behaviours on Facebook (Carpenter, 2012). In adolescents, low self-esteem is associated with high SNS use (Bányai et al., 2017; Woods & Scott, 2016) and SNS addiction (Andreassen et al., 2017). "Fear of Missing Out" (FOMO) may mediate a relationship between increased SNS use and low self-esteem, with low self-esteem motivating a cycle of FOMO-inspired SNS use (Buglass et al., 2017). FOMO may also mediate the pathway between psychopathological symptoms and negative consequences of SNS (Oberst et al., 2017) and the relationship between increased need to belong and need for popularity and Facebook use in adolescents (Beyens et al., 2016). Adolescence is a key time of psychosocial development, where the key tasks are both to stand out (developing an identity and pursuing autonomy) and fit in (gain acceptance from peers) (Brown, 2009). SNS use intersects with these key tasks and differentially relates to adolescents' social connectivity and identity development, with sociability, self-esteem and nature of SNS feedback as important potential moderators (Shapiro & Margolin, 2014). The social environment of adolescents is a complex one, and further research is needed into the different ways in which SNS interact with this, particularly with regard to FOMO.

4.3 Strengths and limitations

The strengths of this research include the large sample size for a narrow age range of pupils in the same academic year at school. The SCAMP cohort is also representative of school age children in London, containing a range of socio-economic and ethnic groups (Table 3,Toledano, 2018). Furthermore, we are able to examine weekday and weekend SNS use separately, and also examine SNS use on mobile phones versus other devices, where little modulation by device type was found. We were also able to investigate SNS use if awake at night alongside general SNS use.

A key limitation of this study is its cross-sectional nature, and as such we are unable to establish directionality and thus draw causal conclusions from this research. Longitudinal studies will provide temporal information between exposures and outcomes that would enable us disentangle this further. Moreover, this study relies on self-reported data about duration of time spent on SNS, which adolescents may overestimate or underestimate; also, adolescents with behavioural problems may be less prone to give socially desired amount of use compared to children without behavioural problems who may underreport their use (Roser, K. et al., 2016). Recall bias may also be a problem. However, an exposure validation study for the SCAMP cohort suggests that self-reported usage adequately distinguishes between true high and low use in SCAMP participants (Mireku, M et al., 2018). Furthermore, the SDQ and KIDSCREEN-10 questionnaires may be open to social desirability bias. Participants might be reluctant to give negative responses, as the questionnaires were done on computers while sitting next to their peers. Additionally, we did not obtain information on which SNS were being used by the study participants. Different SNS have been demonstrated to have different levels of positive and negative impact on the wellbeing of 16-24s (Royal Society of Public Health, 2018), and thus being able to disentangle the impacts of individual SNS would be valuable in understanding the role of SNS in HRQOL and behaviour. Further information on number of friends/followers on SNS, network size, number of SNS accounts (Barry et al., 2017; Buglass et al., 2017; Zhang, 2017) would have also helped to further understand the mechanisms behind the relationship between SNS use and HRQOL and behaviour.

4.4 Future research and implications

Future longitudinal research is recommended to further establish temporal relationships between SNS and wellbeing and behaviour. Furthermore, mediation analysis would provide a deeper insight into potential pathways and mechanisms for these effects. We would also recommend examination of the impacts of different SNS individually, as well as measures of characteristics of SNS use such as connectivity and FOMO. We recommend further guidance

on children's use of SNS by policy-makers and SNS providers following further research, as we have shown that there may be potential relationships between SNS use and HRQOL and behavioural problems in 11-12 year olds, despite current age restrictions on SNS.

5. Conclusion

This study demonstrates that high SNS use on mobile phones and other devices by 11-12 year olds was associated with lower HRQOL (in females) and greater behavioural problems, specifically hyperactivity, conduct problems and emotional problems, and is negatively associated with prosocial behaviours. SNS use for up to 4 hours per day during weekdays on mobile phones was associated with decreasing peer problems. SNS use if awake at night was significantly associated with lower HRQOL and prosocial behaviours and more emotional problems, conduct problems, and hyperactivity, but its relationship with peer problems was not significant.

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Table 1: Descriptive Characteristics of the SCAMP cohort, including potential confounders

	Male (n=2501)		Female (n=2728)	
	n	%	n	%
Age				
10	18	0.72	25	0.92
11	971	38.82	1197	43.88
12	1500	59.98	1497	54.88
13	9	0.36	6	0.22
Missing	3	0.12	3	0.11
School Type				
Independent	455	18.19	565	20.71
State	2046	81.81	2163	79.29
Parental Occupation				
Managerial/professional	1331	53.22	1445	52.97
Intermediate occupational	170	6.80	219	8.03
Small employers/own	404	16.15	403	14.77
Lower supervisory	112	4.48	123	4.51
Semi-routine/routine	262	10.48	322	11.80
Missing	222	8.88	216	7.92
Ethnicity				
White	1078	43.10	1097	40.21
Black	375	14.99	392	14.37
Asian	630	25.19	791	29.00
Mixed	281	11.24	290	10.63
Other/Not interpretable	137	5.48	158	5.79
Mobile Phone Ownership				
No	438	17.51	521	19.10
Yes	2053	82.09	2196	80.50
Missing	10	0.40	11	0.40
Extraordinary events[1]				
No	1409	56.34	1488	54.55
Yes, something good happened	382	15.27	329	12.06
Yes, something bad happened	226	9.04	296	10.85
Missing	484	19.35	615	22.54

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[1] Self-reported extra-ordinary events that affected participant's life in the last two weeks.

Table 2: Social Networking Site use in the SCAMP cohort

	Male (n=2501)		Female (n=2728)	
	n	**%**	**n**	**%**
Mobile Phone SNS Use				
Weekday				
None (reference)	869	34.75	864	31.67
1-30 minutes per day	925	36.99	989	36.25
31 minutes – 2 hours per day	502	20.07	558	20.45
3 – 4 hours per day	99	3.96	186	6.82
5 hours or more per day	106	4.24	131	4.80
Weekend				
None (reference)	820	32.79	822	30.13
1-30 minutes per day	767	30.67	767	28.12
31 minutes – 2 hours per day	584	23.35	636	23.31
3 – 4 hours per day	164	6.56	248	9.09
5 hours or more per day	166	6.64	255	9.35
Other Device SNS Use				
Weekday				
None (reference)	1121	44.82	1148	42.08
1-30 minutes per day	769	30.75	916	33.58
31 minutes – 2 hours per day	420	16.79	461	16.90
3 – 4 hours per day	83	3.32	103	3.78
5 hours or more per day	108	4.32	100	4.67
Weekend				
None (reference)	1016	40.62	988	36.22
1-30 minutes per day	702	28.07	902	33.06
31 minutes – 2 hours per day	485	19.39	526	19.28
3 – 4 hours per day	125	5.00	139	5.10
5 hours or more per day	173	6.92	173	6.34
SNS Use if Awake at Night [2]				
No	2110	84.37	2266	83.06
Yes	391	15.63	462	16.94

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[2] Do you use social network sites via your mobile phone if you wake up during the night?

Table 3: Social Networking Site use with KIDSCREEN-10 and SDQ scores. For KIDSCREEN-10, a negative β coefficient indicates lower HRQOL; for SDQ, a positive β coefficient indicates more behavioural difficulties.

	KIDSCREEN-10 (n = 5229)				SDQ (n = 5229)			
	Model 1 (Unadjusted)		Model 2 (Adjusted[3])		Model 1 (Unadjusted)		Model 2 (Adjusted[3])	
	Co-efficient	95% CI	Co-efficient	95% CI	Co-efficient	95% CI	Co-efficient	95% CI
Mobile Phone SNS Use								
Weekday								
None (reference) (n= 1733)	0	0	0	0	0	0	0	0
1-30 minutes per day (n= 1914)	0.10	- 0.43, 0.63	0.24	- 0.36, 0.86	0.16	- 0.18, 0.51	- 0.03	- 0.41, 0.35
31 minutes – 2 hours per day (n= 1060)	- 0.35	- 0.98, 0.28	- 0.13	- 0.86, 0.59	1.03	0.62, 1.44	0.78	0.33, 1.23
3 – 4 hours per day (n= 285)	- 0.46	- 1.49, 0.58	0.36	- 0.86, 1.58	2.56	1.88, 3.23	2.01	1.25, 2.77
5 hours or more per day (n = 237)	- 2.37	- 3.51, - 1.23	- 1.63	- 2.94, - 0.32	4.94	4.20, 5.67	4.59	3.78, 5.40
P for linear trend		**<0.001**		**0.123**		**<0.001**		**<0.001**
Weekend								
None (reference) (n= 1642)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1914)	0.32	- 0.25, 0.89	0.56	- 0.09, 1.21	- 0.11	- 0.48, 0.25	- 0.30	- 0.71, 0.10
31 minutes – 2 hours per day (n= 1220)	- 0.15	- 0.76, 0.46	0.11	- 0.59, 0.80	0.59	0.19, 0.98	0.32	- 0.12, 0.75
3 – 4 hours per day (n = 412)	- 0.16	- 1.05, 0.73	0.33	- 0.70, 1.35	1.62	1.05, 2.20	1.22	0.58, 1.86
5 hours or more per day (n = 421)	- 1.86	- 2.76, - 0.96	- 1.09	- 2.13, - 0.04	3.87	3.29, 4.45	3.37	2.72, 4.03
P for linear trend		**0.001**		**0.145**		**<0.001**		**<0.001**
Other Device SNS Use								
Weekday								
None (reference) (n = 2269)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1685)	- 0.28	- 0.81, 0.25	- 0.07	- 0.68, 0.54	0.28	- 0.07, 0.62	0.11	- 0.27 0.49
31 minutes – 2 hours per day (n = 881)	- 0.51	- 1.17, 0.15	- 0.27	- 1.03, 0.49	1.25	0.82, 1.68	1.03	0.56, 1.50
3 – 4 hours per day (n= 186)	- 0.15	- 1.40, 1.11	0.39	- 1.08, 1.87	1.94	1.13, 2.76	1.93	1.01 2.85
5 hours or more per day (n = 208)	- 2.35	- 3.54, - 1.16	- 1.73	- 3.11, - 0.34	5.01	4.23, 5.78	4.37	3.50, 5.23
P for linear trend		**0.002**		**0.109**		**<0.001**		**<0.001**
Weekend								
None (reference) (n = 2014)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1604)	- 0.37	- 0.92, 0.19	- 0.19	- 0.82, 0.45	0.38	0.03, 0.74	0.26	- 0.13, 0.66
31 minutes – 2 hours per day (n = 1011)	- 0.10	- 0.74, 0.54	0.16	-0.57, 0.89	0.67	0.26, 1.08	0.50	0.05, 0.96
3 – 4 hours per day (n = 264)	- 0.58	- 1.66, 0.50	- 0.54	- 1.79, 0.70	1.68	0.98, 2.38	1.39	0.62, 2.17
5 hours or more per day (n = 346)	- 1.90	- 2.86, - 0.94	- 1.32	- 2.44, - 0.21	4.06	3.43, 4.69	3.60	2.91, 4.30
P for linear trend		**0.003**		**0.099**		**<0.001**		**<0.001**
SNS Use if Awake at Night								
No (reference) (n=4376)	0	0	0	0	0	0	0	0
Yes (n= 1244)	- 1.63	- 2.24, - 1.02	- 1.56	- 2.27, - 0.85	2.76	2.36, 3.15	2.54	2.09, 2.98

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[3] Adjusted for: sex, age, SES, school type, ethnicity and extraordinary events

Table 4: Social Networking Site use with SDQ and KIDSCREEN-10 scores stratified by gender. For KIDSCREEN-10, a negative β coefficient indicates lower HRQOL; for SDQ, a positive β coefficient indicates more behavioural difficulties.

	KIDSCREEN-10				SDQ			
	Males, adjusted[4] (Model 2) (n=2501)		Females, adjusted[4] (Model 2) (n=2728)		Males, adjusted[4] (Model 2) (n=2501)		Females, adjusted[4] (Model 2) (n=2728)	
	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI
Mobile Phone SNS Use								
Weekday								
None (reference) (n= 1733)	0	0	0	0	0	0	0	0
1-30 minutes per day (n= 1914)	0.60	- 0.25, 1.45	- 0.21	- 1.07, 0.66	- 0.21	- 0.74, 0.32	0.11	- 0.43, 0.65
31 minutes – 2 hours per day (n= 1060)	0.72	- 0.31, 1.74	- 1.04	- 2.07, - 0.00	0.56	- 0.08, 1.20	0.96	0.32, 1.60
3 – 4 hours per day (n= 285)	2.18	0.15, 4.21	- 0.93	- 2.48, 0.62	1.68	0.42, 2.95	2.19	1.23, 3.15
5 hours or more per day (n = 237)	- 0.02	- 0.19, 1.87	- 3.18	- 4.99, - 1.37	4.86	3.68, 6.04	4.33	3.20, 5.45
P for linear trend		**0.177**		**0.001**		**<0.001**		**<0.001**
Weekend								
None (reference) (n= 1642)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1914)	0.47	- 0.43, 1.38	0.62	- 0.31, 1.55	- 0.42	- 0.99, 0.14	- 0.27	- 0.85, 0.31
31 minutes – 2 hours per day (n= 1220)	0.53	- 0.44, 1.51	- 0.35	- 1.34, 0.64	0.23	- 0.38, 0.83	0.38	- 0.24, 1.00
3 – 4 hours per day (n = 412)	0.55	- 1.04, 2.13	0.47	- 1.31, 1.40	1.05	0.07, 2.04	1.25	0.41, 2.09
5 hours or more per day (n = 421)	0.43	- 1.20, 2.06	- 2.12	- 3.50, - 0.74	3.90	2.88, 4.91	3.00	2.14, 3.86
P for linear trend		**0.396**		**0.007**		**<0.001**		**<0.001**
Other Device SNS Use								
Weekday								
None (reference) (n = 2269)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1685)	0.06	- 0.82, 0.94	- 0.23	- 1.07, 0.61	0. 03	- 0.52, 0.58	0.17	- 0.36, 0.70
31 minutes – 2 hours per day (n = 881)	- 0.40	- 1.50, 0.70	- 0.20	- 1.25, 0.85	1.60	0.91, 2.28	0.54	- 0.12, 1.20
3 – 4 hours per day (n= 186)	2.21	0.05, 4.37	- 1.28	- 3.31, 0.74	2.47	1.13, 3.81	1.49	0.22, 2.76
5 hours or more per day (n = 208)	- 0.63	- 2.51, 1.25	- 3.04	- 5.09, - 1.00	4.33	3.17, 5.50	4.34	3.06, 5.62
P for linear trend		**0.954**		**0.017**		**<0.001**		**<0.001**
Weekend								
None (reference) (n = 2014)	0	0	0	0	0	0	0	0
1-30 minutes per day (n = 1604)	- 0.09	- 1.01, 0.82	- 0.28	- 1.16, 0.60	0.30	- 0.270, 0.87	0.22	- 0.32, 0.77
31 minutes – 2 hours per day (n = 1011)	0.68	- 0.37, 1.72	- 0.36	- 1.39, 0.67	0.67	0.02, 1.32	0.32	- 0.32, 0.97
3 – 4 hours per day (n = 264)	- 1.53	- 3.35, 0.30	0.29	- 1.41, 1.99	2.06	0.93, 3.20	0.78	- 0.29, 1.85
5 hours or more per day (n = 346)	0.02	- 1.53, 1.57	-2.84	- 4.44, - 1.24	3.56	2.59, 4.53	3.65	2.65, 4.65
P for linear trend		**0.908**		**0.002**		**<0.001**		**<0.001**
SNS Use if Awake at Night								
No (reference) (n = 4376)	0	0	0	0	0	0	0	0
Yes (n = 1244)	- 0.90	- 1.94, 0.13	- 2.20	- 3.18, - 1.22	2.72	2.08, 3.37	2.34	1.73, 2.95

[4] Adjusted for: age, SES, school type, ethnicity and extraordinary events

Table 5: Social Networking Site use with SDQ subscales. For the Emotional Problems, Conduct Problems, Hyperactivity and Peer Problems scales, a positive β coefficient indicates more behavioural difficulties; for the prosocial scale, a positive β coefficient indicates more prosocial strengths.

	SDQ (n = 5229)				
	Difficulties				Strengths
	Emotional Problems Scale	Conduct Problems Scale	Hyperactivity Scale	Peer Problems Scale	Prosocial Scale
	Adjusted (Model 2) Coefficient[5] (95% CI)	Adjusted (Model 2) Coefficient[5] (95% CI)	Adjusted (Model 2) Coefficient[5] (95% CI)	Adjusted (Model 2) Coefficient[5] (95% CI)	Adjusted (Model 2) Coefficient[5] (95% CI)
Mobile Phone SNS Use per day (weekday)					
None (reference) (n= 1733)	0	0	0	0	0
1-30 minutes per day	- 0.06	0.14	0.07	- 0.18	0.04
(n= 1914)	(- 0.21, 0.01)	(0.02, 0.25)	(- 0.08, 0.23)	(- 0.30, - 0.07)	(- 0.09, 0.17)
31 minutes – 2 hours per day	- 0.04	0.54	0.57	- 0.28	- 0.40
(n= 1060)	(- 0.23, 0.15)	(0.41, 0.68)	(0.39, 0.76)	(- 0.42, - 0.15)	(- 0.56, - 0.24)
3 – 4 hours per day	0.08	1.02	1.34	- 0.41	- 0.53
(n= 285)	(- 0.23, 0.39)	(0.79, 1.25)	(1.03, 1.65)	(- 0.65, - 0.18)	(- 0.79, - 0.26)
5 hours or more per day	0.89	1.82	1.74	0.16	- 0.58
(n = 237)	(0.56, 1.23)	(1.58, 2.07)	(1.41, 2.07)	(- 0.08, 0.41)	(- 0.87, - 0.30)
P for linear trend	**0.001**	**<0.001**	**<0.001**	**0.027**	**<0.001**
Other Device SNS Use per day (weekday)					
None (reference) (n = 2269)	0	0	0	0	0
1-30 minutes per day	0.04	0.10	0.17	- 0.20	- 0.10
(n = 1685)	(- 0.12, 0.19)	(- 0.01, 0.22)	(0.02, 0.33)	(- 0.32, - 0.09)	(- 0.24, 0.03)
31 minutes – 2 hours per day	0.04	0.51	0.60	- 0.10	- 0.24
(n = 881)	(- 0.15, 0.23)	(0.36, 0.65)	(0.41, 0.79)	(- 0.24, 0.05)	(- 0.41, - 0.07)
3 – 4 hours per day	0.20	0.91	0.89	- 0.04	- 0.56
(n= 186)	(- 0.17, 0.58)	(0.63, 1.19)	(0.51, 1.26)	(- 0.32, 0.24)	(- 0.88, - 0.24)
5 hours or more per day	0.99	1.56	1.43	0.40	- 0.48
(n = 208)	(0.64, 1.34)	(1.30, 1.83)	(1.08, 1.79)	(0.14, 0.66)	(- 0.78, - 0.18)
P for linear trend	**<0.001**	**<0.001**	**<0.001**	**0.155**	**<0.001**
SNS Use if Awake at Night					
No (reference) (n=4376)	0	0	0	0	0
Yes (n= 1244)	0.43	0.90	1.12	0.10	- 0.54
	(0.25, 0.61)	(0.77, 1.04)	(0.94, 1.30)	(- 0.04, 0.23)	(- 0.70, - 0.39)

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[5] Adjusted for: age, SES, school type, ethnicity and extraordinary events

Supplementary Tables

Supplementary Table A.1: Differences in characteristics of participants included in study and not included due to missing data on SNS use or outcome measures (SDQ/KIDSCREEN-10)

	Included in study n = 5229 (%)	Not included in study n = 937 (%)	p-value for difference
Age			<0.001
10	0.82	1.31	
11	41.48	49.42	
12	57.34	48.98	
13	0.29	0.22	
Sex			0.406
Male	47.83	46.58	
Female	52.17	53.42	
School Type			<0.001
Independent	19.51	32.80	
State	80.49	67.20	
Parental Occupation			<0.001
Managerial/professional	53.09	35.62	
Intermediate occupational	7.44	6.85	
Small employers/own	15.43	7.43	
Lower supervisory	4.49	2.67	
Semi-routine/routine	11.17	7.86	
Missing	8.38	39.58	
Ethnicity			<0.001
White	41.59	43.41	
Black	14.67	18.01	
Asian	27.18	21.88	
Mixed	10.92	9.84	
Other/Not interpretable	5.64	6.85	
Extraordinary events[1]			<0.001
No	70.15	81.32	
Yes, something good happened	17.22	8.95	
Yes, something bad happened	12.64	9.73	

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[1] Self-reported extra-ordinary events that affected participant's life in the last two weeks.

Supplementary Table A.2: SDQ and KIDSCREEN-10 in the SCAMP cohort

Strengths and Difficulties Questionnaire				
	Male (n=2501)		**Female (n=2728)**	
	Mean	**SD**	**Mean**	**SD**
Total Difficulties Score	10.11	5.59	10.09	5.57
Emotional Problems	2.41	2.10	3.18	2.29
Conduct Problems	2.19	1.83	1.86	1.69
Hyperactivity	3.62	2.26	3.34	2.24
Peer Problems	1.90	1.68	1.71	1.60
Prosocial Behaviour	7.13	1.99	7.80	1.78
	n	**%**	**n**	**%**
By category[2]				
Total Difficulties score				
Close to Average	1968	78.69	2165	79.36
Slightly Raised	264	10.56	270	9.90
High	102	4.08	122	4.47
Very High	167	6.68	171	6.27
Emotional symptoms				
Close to Average	2085	83.37	2012	73.75
Slightly Raised	192	7.68	266	9.75
High	107	4.28	201	7.37
Very High	117	4.68	249	9.13
Conduct problems				
Close to Average	1964	78.53	2298	84.24
Slightly Raised	250	10.00	192	7.04
High	145	5.80	137	5.02
Very High	142	5.68	101	3.70
Hyperactivity/inattention				
Close to Average	2014	80.53	2262	82.92
Slightly Raised	211	8.44	226	8.28
High	128	5.12	126	4.62
Very High	148	5.92	114	4.18
Peer problems				
Close to Average	1738	69.49	2048	75.41
Slightly Raised	330	13.19	327	11.99
High	225	9.00	189	6.93
Very High	208	8.32	164	6.01
Pro-social behaviour				
Close to Average	1642	64.49	2148	77.43
Slightly Raised	388	15.24	309	11.14
High	279	10.96	190	6.85
Very High	237	9.31	127	4.58
Health-related quality of life (HRQOL)				
	Male		**Female**	
	Mean	**SD**	**Mean**	**SD**
KIDSCREEN-10 score	49.57	8.67	48.63	8.54

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[2] Categories as stated in the SDQ Scoring Manual, 2016.

Supplementary Table A.3: Results of multi-level logistic regression investigating relationship SNS use for more than 5 hours per day and odds of being in the "very high" category for Total Difficulties Score (Model 3)

	Total Difficulties Score	
	Adjusted Odds Ratio (Model 3)[3]	95% Confidence Interval
Mobile Phone SNS Use		
Weekday use (more than 5 hours per day)	4.11	2.62, 6.43
Weekend use (more than 5 hours per day)	3.06	2.03, 4.59
Other Device SNS Use		
Weekday use (more than 5 hours per day)	4.41	2.77, 7.03
Weekend use (more than 5 hours per day)	3.86	2.58, 5.79

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[3] Adjusted for age, gender, SES, ethnicity, school type (independent or state) and self-reported extraordinary events that affected participant's life in the last two weeks.