

'There's more to life than staring at a small screen': a mixed methods cohort study of problematic smartphone use and the relationship to anxiety, depression and sleep in students aged 13–16 years old in the UK

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ABSTRACT

Background Depression and anxiety are common in adolescents and have increased over the last decade. During that period, smartphone usage has become ubiquitous.

Objectives The study aim was to assess the association between problematic smartphone usage (PSU) and anxiety.

Methods Using a prospective mixed methods cohort study design, students aged 13–16 year old from two schools were enrolled regarding their smartphone use, mood and sleep via a semistructured questionnaire at baseline and week 4. The primary outcome was symptoms of anxiety (Generalised Anxiety Disorder Questionnaire, GAD-7) and exposure was PSU (Smartphone Addiction Scale Short Version). A linear regression was fitted to assess the change in anxiety. Thematic analysis of free-text responses was conducted.

Findings The sample included 69 participants that were enrolled and followed up between 28 March and 3 June 2022. Of those with PSU, 44.4% exhibited symptoms of moderate to severe anxiety compared with 26.4% of those without PSU. There was a linear association between change in symptoms of anxiety and PSU $\beta=0.18$ (95% CI 0.04 to 0.32, $p=0.013$). Several themes were found: both positive and negative effects of smartphones on relationships; negative effects on school performance and productivity; mixed effects on mood; a desire to reduce the amount of time spent on smartphones.

Conclusions Increased anxiety, depression and inability to sleep were seen in participants as their PSU score increased over time. Participants reported both positive and negative effects of smartphones and almost all used strategies to reduce use.

Clinical implications Interventions need to be developed and evaluated for those seeking support.

BACKGROUND

Mental illness is one of the leading causes of disability in the UK.¹ There has been an increase in anxiety symptoms in adolescents over the last decade by 40% in the USA and most rapidly in teenage girls in the UK.^{2 3} In parallel, there has also been an expansion to ubiquity in smartphone

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ There is mixed evidence about the role of screentime linked to anxiety and depression.

WHAT THIS STUDY ADDS

⇒ Few prospective studies exist on teenagers, reporting changes in screentime and symptoms of anxiety and depression and none in the UK.
⇒ There is little evidence reporting the views and experiences of adolescents on their smartphone use.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The qualitative findings suggest that adolescents are typically managing their usage well, with quantitative data supporting that almost all students using reduction strategies to manage their usage.
⇒ However, interventions need to be developed and evaluated for those seeking support.

use in this population,^{4 5} leading to the question of whether smartphone use per se is related to poor mental health outcomes. While there is little debate of the role of smartphones on poor sleep,^{6 7} there is limited evidence in longitudinal studies of the role in other mental health outcomes.^{8–11} This may be explained by the phenomenon of problematic smartphone use (PSU), a pattern of behaviour towards smartphones similar to other behavioural addictions.^{12 13} We might expect adverse health outcomes to relate to addictive behaviour towards smartphones rather than smartphone use, or screentime, in general.

PSU as a form of addiction is a contested idea.^{14–16} One argument is that smartphone use is normative in children and young people and that ordinary intensive social behaviour in this age group is being pathologised. Further, while associations with self-reported depression, anxiety and poor sleep abound in the literature, the majority of existing research is cross sectional in design, raising the question of direction of causality.^{10 17} The handful of longitudinal studies published in university students in

Table 1 Demographic and clinical covariates by PSU

	No PSU (N=53)	PSU (N=9)	Missing (N=7)	Total (N=69)
Age, mean (SD)	15.0 (1.07)	15.4 (1.27)	15.6 (1.06)	15.0 (1.09)
Gender				
Male	31 (88.5%)	4 (44.4%)	3 (42.9%)	38 (55.1%)
Female	22 (41.5%)	5 (55.6%)	3 (42.9%)	30 (43.5%)
Missing	0 (0.0%)	0 (0.0%)	1 (14.3%)	1 (1.4%)
Ethnicity				
White	36 (67.9%)	4 (44.4%)	1 (14.3%)	41 (59.4%)
Asian/mixed	9 (16.9%)	3 (33.3%)	3 (42.9%)	15 (21.7%)
Black/other	8 (15.1%)	2 (22.2%)	3 (42.9%)	13 (18.8%)
History of ASD or ADHD				
Yes	5 (9.4%)	1 (11.1%)	0 (0.0%)	6 (8.7%)
No	48 (90.6%)	8 (88.9%)	5 (71.4%)	61 (88.4%)
Missing	0 (0.0%)	0 (0.0%)	2 (28.6%)	2 (2.9%)

PSU, problematic smartphone usage.

South East Asia demonstrate a complex relationship between depression and PSU, with pre-existing mental health difficulties raising the likelihood of problematic smartphone use at a later date and vice versa.^{18 19} However, a single longitudinal study in children and adolescents found that psychosocial adjustment rather than comorbid depression or anxiety at baseline influenced recovery or persistence of PSU at follow-up.²⁰

Objectives

This is a mixed methods study in high school students aged 13–16 years old in the UK. The primary aim was to elucidate the relationship between self-reported problematic smartphone use and self-reported anxiety, depressed mood and sleep quality over time, using widely used clinical screening tools. The secondary aims were to explore how adolescents understood their smartphone use and the associated advantages and disadvantages, and what steps, if any, they took to moderate their use.

METHODS

Study design

This was a prospective, longitudinal cohort study in secondary schools to students aged 13–16 year old over a 4-week period. Ethical approval was granted by the King's College London Research Ethics panel (LRU/DP-21/22-28340) on 22 February 2022.

Participants

Participants were recruited from a convenience sample of consenting secondary schools in London. Schools approved the study and circulated the participants' information sheet and consent forms prior to the baseline visit. Researchers attended the school, and the students were invited to take part in the research. The researchers attended the school assembly and introduced the study and invited participants to take part during the lunchtime break, where interested participants returned a consent form, and those under 16 alongside a parental consent form.

Assessments

To ensure the questionnaire was age appropriate, it was co-designed with a group of female students for this study incorporating measurement of both the exposure and the outcomes. The group explored the students' use of, and attitudes to, smartphone

more generally, including any reduction strategies that they had used to reduce their smartphone use. Open questions to capture qualitative data about participants own views on their interaction with their smartphone were also included. The assessments were measured at baseline and again at week 4 to determine the short-term change in anxiety, depression and sleep compared with short-term change in smartphone usage. To reduce bias and encourage follow-up, students were provided a £5 love to shop voucher after completing both assessment time points.

The primary outcome was changes in the symptoms of anxiety over a 4-week period, measured using the Generalised Anxiety Disorder Questionnaire (GAD-7).²¹ The GAD-7 is a screening questionnaire commonly used in primary care in the UK, where total scores of under 5 is no symptoms of anxiety, 5–9 mild symptoms of anxiety, 10–14 moderate symptoms of anxiety, and 15 or greater severe symptoms of anxiety.

Secondary outcomes were changes in the symptoms of depression, measured using the Patient Health Questionnaire (PHQ-9).²² PHQ-9 total scores of under 5 indicate no symptoms of depression, 5–9 mild symptoms of depression, 10–14 moderate symptoms of depression, and 15 or greater severe symptoms of depression. Finally, the severity of insomnia using the Insomnia Severity Index (ISI), for which total scores of 0–7 indicates 'no clinically significant insomnia,' 8–14 'subthreshold insomnia,' 15–21 'clinical insomnia (moderate severity)' and 22–28 'clinical insomnia (severe).'²³ Internal reliability of the primary and secondary outcomes at baseline will be reported using Cronbach's alpha.

Primary smartphone exposure

The exposure was PSU measured using the change from baseline to week 4 in the Smartphone Addiction Scale Short Version (SAS-SV).²⁴ The SAS-SV is a widely used self-report 10-item scale validated for use in young people,²⁵ considered the tool of choice for measuring problematic smartphone use which maps onto the constructs related to behavioural addiction.¹² Scores of 31 and 33 for girls and boys, respectively, may be used as diagnostic cut-off values for the presence of PSU.

Sample size justification

In order to detect a slope of 0.3 (an approximation of the linear association) in a linear regression model with 80% power and a type 1 error=0.05,²⁶ 90 participants would need to be followed up. Assuming an attrition rate of 10% over the 4-week period, we estimated that 100 participants would need to be enrolled from the schools.

Quantitative statistical analysis

The demographics, outcomes and smartphone usage characteristics were summarised. The primary outcome was analysed as the change from baseline to 4 weeks in symptoms of anxiety (using GAD-7) compared with the change in PSU using the SAS-SV. This was analysed as a linear regression using the *regress* command in Stata V.18. Age and gender were adjusted for as covariates in the analysis as they have previously been found to explain anxiety in other work.²⁶ Secondary outcomes, PHQ-9 and ISI, were analysed in a similar manner. Crude and adjusted analyses were fitted and the slope parameter (β) for the change in SAS-SV reported from the regression model with 95% CIs. Statistical analyses were conducted using Stata V18.

Missing data were explored using pattern missingness and the analysis was used a complete case approach.

Table 3 App usage by PSU

	Mean (SD)			Adjusted mean difference* (95% CI)	P value
	No PSU (N=53)	PSU (N=9)	Total (N=62)		
App usage (hours/day)					
Instagram	0.5 (0.8)	0.5 (0.6)	0.5 (0.7)	-0.08 (-0.62 to 0.46)	0.762
TikTok	1 (1.3)	1.4 (0.8)	1.0 (1.2)	0.33 (-0.57 to 1.24)	0.463
Snapchat	0.8 (1.2)	1.5 (0.8)	0.9 (1.1)	0.69 (-0.17 to 1.55)	0.115
WhatsApp/messaging	0.5 (0.8)	0.3 (0.2)	0.5 (0.8)	-0.34 (-0.97 to 0.28)	0.277
YouTube/Netflix	1.3 (1.3)	0.8 (1.3)	1.2 (1.3)	-0.35 (-1.39 to 0.69)	0.505
Games	0.5 (0.9)	0.4 (0.4)	0.5 (0.9)	-0.11 (-0.8 to 0.58)	0.752
Internet	0.8 (1.1)	0.3 (0.2)	0.7 (1.1)	-0.59 (-1.42 to 0.24)	0.157
Facebook	0.2 (0.6)	0.1 (0.1)	0.1 (0.6)	-0.11 (-0.55 to 0.34)	0.634
Music apps	1.1 (1.2)	1.8 (1)	1.2 (1.2)	0.56 (-0.37 to 1.49)	0.235

*Analysed using a linear regression, adjusting for age and gender.
PSU, problematic smartphone usage.

Qualitative analysis

The free-text box comments (online supplemental figure 1) were extracted and uploaded to NVivo (release V.1.3) where they were coded independently by MC and NJK. The two independent coding frames were compared. There was high agreement between coders, with differences only in the label given to some codes, while the meaning of the labels were very similar. Thematic analysis was conducted to derive common themes of respondents' experiences of smartphone use.²⁷

FINDINGS

Demographics

Schools were consented in March 2022. The baseline measures completed between 28 March and 5 April 2022, and 4-week measures between 5 May and 3 June 2022. Of the 49 schools approached, 2 consented to take part, and 69 participants were enrolled. One school was an independent boy's school based in a deprived area (index of multiple deprivation, quintile two) where 18 boys were enrolled. The second school was a mixed

gender independent school based on the highest quintile of affluence where 51 students were enrolled.

The median age of participants was 14.9 years (IQR 14.1–16.2), and 30 (43.5%) were female (table 1). The majority of participants were white (59.4%). The prevalence of self-reported problematic smartphone use was 14.5% overall, and higher in females (M: 10.53%; F: 16.67%).

At baseline, there were 27.5% with moderate or severe symptoms of anxiety, and 44.4% with PSU, compared with 26.4% without PSU (table 2). There were 36.2% with moderate or severe symptoms of depression, and 55.6% with PSU, compared with 35.8% without PSU. Similarly, there were 21.2% with moderate to severe insomnia, 22.2% with PSU and 22.6% without PSU. Internal reliability of the GAD-7 at baseline was $\alpha=0.90$, PHQ-9 $\alpha=0.87$ and ISI $\alpha=0.83$, indicating good reliability of the primary and secondary outcomes.

App usage

There were no significant differences between PSU and non-PSU groups in the use of any particular apps (see table 3). The most used applications differed by group: while in these PSU group, these were music Apps, Snapchat and TikTok (weekday mean use of 1.8 (SD=1.0), 1.5 (0.8) and 1.4 (0.8) hour per day) (table 3), in the non-PSU group, these were YouTube, music apps and TikTok (weekday mean use of 1.3 (1.3), 1.1 (1.2) and 1.0 (1.3)). Of those adolescents with PSU, late night usage (>11 pm) was carried out by 55.6% and 44.4% on Snapchat and TikTok (online supplemental table 1), whereas late night use for those without PSU was 34.0% using YouTube 18.9% for TikTok.

Statistical analysis

Primary outcome

Of the 69 participants that were enrolled, 62 (89.9%) were followed up at week 4. There was a strong positive linear association between change in symptoms of anxiety and change in PSU during the 4 week study period. There was a positive slope (β) between anxiety and PSU $\beta=0.18$ (95% CI 0.04 to 0.32, $p=0.01$) (table 4, online supplemental figure 2). Similar findings were reported from the unadjusted crude analysis. Therefore, an increase over the 4-week period in PSU by 10 would estimate an increase in symptoms of anxiety of 2.2 (approximately half a clinical category).

Table 2 Clinical characteristics at baseline

	Frequency N (%)			
	No PSU (N=53)	PSU (N=9)	Missing (N=7)	Total (N=69)
GAD-7				
Minimal to mild anxiety	39 (73.6)	5 (55.6)	3 (42.9)	47 (68.1)
Moderate to severe anxiety	14 (26.4)	4 (44.4)	1 (14.3)	19 (27.5)
Missing	0 (0.0)	0 (0.0)	3 (42.9)	3 (4.3)
PHQ				
Minimal to mild depression	34 (64.2)	4 (44.4)	3 (42.9)	41 (59.4)
Moderate to severe depression	19 (35.8)	5 (55.6)	1 (14.3)	25 (36.2)
Missing	0 (0.0)	0 (0.0)	3 (42.9)	3 (4.3)
ISI				
Minimal to mild insomnia	41 (77.4)	7 (77.8)	3 (42.9)	51 (73.9)
Moderate to severe insomnia	12 (22.6)	2 (22.2)	1 (14.3)	15 (21.7)
Missing	0 (0.0)	0 (0.0)	3 (42.9)	3 (4.3)

GAD-7, Generalised Anxiety Disorder Questionnaire; ISI, Insomnia Severity Index; PHQ-9, Patient Health Questionnaire; PSU, problematic smartphone usage.

Table 4 Changes in symptoms of anxiety, depression and insomnia

Outcome	Variable	Crude slope (β) (95% CI)	P value	Adjusted slope (β) (95% CI)	P value
Primary outcome					
Symptoms of anxiety (GAD-7)	SAS-SV	0.22 (0.08 to 0.36)	0.002	0.18 (0.04 to 0.32)	0.013
	Age	-0.04 (-1.05 to 0.98)	0.945	0.29 (-0.72 to 1.3)	0.563
	Gender	-0.12 (-2.42 to 2.17)	0.913	-5.34 (-20.7 to 10.1)	0.488
Secondary outcomes					
Symptoms of depression (PHQ-9)	SAS-SV	0.12 (0.00 to 0.25)	0.047	0.14 (0.00 to 0.27)	0.045
	Age	-0.16 (-1.10 to 0.78)	0.731	0.21 (-0.83 to 1.25)	0.685
	Gender	0.38 (-1.56 to 2.32)	0.694	0.27 (-1.9 to 2.44)	0.804
Symptoms of insomnia (ISI)	SAS-SV	0.21 (0.06 to 0.36)	0.008	0.21 (0.06 to 0.37)	0.008
	Age	0.85 (-0.32 to 2.01)	0.149	0.81 (-0.34 to 1.96)	0.164
	Gender	-0.91 (-3.4 to 1.58)	0.466	-12.12 (-29.82 to 5.58)	0.174

GAD-7, Generalised Anxiety Disorder Questionnaire; ISI, Insomnia Severity Index; PHQ-9, Patient Health Questionnaire; SAS-SV, Smartphone Addiction Scale Short Version.

Secondary outcomes

There was a positive association between the change in symptoms of depression and change in PSU in the adjusted analysis $\beta=0.14$ (95% CI 0.004 to 0.27, $p=0.045$) (table 4, online supplemental figure 3); similar findings were exhibited in the crude analysis. Thus, an increase of 10 over the study period in SAS-SV would estimate an increase in symptoms of depression of 1.4 (approximately a third of a clinical category).

There was a strong evidence of a positive association between symptoms of insomnia and PSU in the adjusted analysis $\beta=0.21$ (95% CI 0.06 to 0.37, $p=0.008$; table 4, online supplemental figure 4). The same findings were repeated in the unadjusted analysis. So an increase in PSU of 10 would estimate an increase in symptoms of inability to sleep of 2.1.

Smartphone usage reduction strategies

A majority of participants (89.9%) attempted at least one strategy to limit their smartphone use. Putting smartphone on silent was the most common, used by 83.0% of those in the non-PSU group, who, on average, found it to be effective, and 100.0% of those in the PSU group, who found it to be slightly effective (online supplemental table 2). Another widely used strategy was turning off notifications, used by 71.7% of those in the non-PSU group, who, on average, found it to be effective, and 77.8% of those in the PSU group, who found it to be slightly effective.

Thematic analysis

Theme 1: effects on relationships

Twenty-one respondents mentioned that smartphone use had an impact on their relationships. Most of these ($n=21$) were positive, describing how smartphones helped them communicate more easily with friends and family, particularly those who do not live locally or in the same country.

A smaller number of respondents ($n=7$) mentioned negative effects of smartphone use on their relationships, such as distancing themselves from family due to being on the phone talking to friends, feeling more irritable towards family or affecting how they interact socially in general:

I think it slowly takes away your social behaviour so it becomes harder to hang out and talk to people. (R38)

My phone sometimes makes me anxious, and usually isolate myself from my family and friends. (R31)

Theme 2: effects on school performance and productivity

Fifteen respondents described smartphones as distracting, and 11 reported an impact of using a smartphone on schoolwork. Most statements were negative with, a reduction in productivity and time that should have been dedicated to schoolwork:

I feel like so many apps I use on my phone occupy precious time that I could be using to work on school and doing other things that really interest me I think it takes up useful time that I could be using to read, learn, study etc. (R53)

If I wasn't on my phone I would have more energy to do homework, revise and more important things. (R68)

Four respondents described a positive impact on studying due to the availability of educational resources online, and one respondent mentioned how smartphones can have both positive and negative impacts on studying.

For the 12 respondents, the effect of smartphone used on school performance varied depending on a number of factors, such as how much time is spent using a smartphone (and whether the user is able to control the time spent) and whether the user has other urgent priorities such as examinations:

Can make you anxious, and can lead to a certain laziness. But if you knew how to control yourself and have your priorities straight, it won't happen. (R6)

If you have no school or exams, I don't see the problem in using smartphones for hours on end. (R10)

Theme 3: effects on mood

Forty-one respondents commented on the effect of smartphone use in their mood. Positive effects were identified by 23 respondents and included the ability to entertain and reduce stress and boredom:

Makes me less bored, lets me interact with people It makes me more entertained as I always have something to do. (R40)

It makes me happy when I speak to my friends and it's my escape from the world—especially music. (R2)

Other respondents mentioned how using their smartphone helps them cope with difficult emotions:

I love my phone, [it] help[s] me distract myself when I am sad or self harm. (R29)

I don't like being away from my phone, its presence is comforting. (R34)

One respondent seemed neutral about the effects of smartphone use in their mood:

I do my own thing on my phone, it doesn't affect my mood that much. (R36)

Negative effects were highlighted by 33 respondents and included comparing oneself to others, being involved in cyberbullying, and seeing content that is 'scary'. Adverse effects described on mood could be extreme including suicidal thinking:

If I am getting cyberbullied or seeing something sad it makes me sad. (R2)

Sometimes it makes me very depressed because I see people who are better than me and I sometimes start to cry and feel very suicidal. (R18)

Sometimes I see things on Instagram that scare me and then I can't stop thinking about them and I am scared that something like that will happen even though it will never happen. (R32)

Smartphones increased stress for some respondents, particularly when used for too long:

Makes you feel more stressed, feel worried and over exaggerating things. (R3)

Smartphones make me feel tired and anxious, I feel that I have been feeling tired very quickly. (R32)

It tires me out when I am on it for a certain amount of time, draining my motivation. Negatively affects my will to work. (R5)

I wish I spent less time on my phone as being on a smartphone for way too long and seeing the wrong content can decrease mental health. (R3)

The topic of self-control was mentioned, with some respondents describing that if a user knows how to manage the time spent on smartphone use, they can avoid some of the negative effects:

Can make you anxious, and can lead to a certain laziness. But if you knew how to control yourself and have your priorities straight, it won't happen. (R6)

Ambivalence was apparent in some responses, with respondents describing unwanted effects of smartphone use but appearing to minimise or contradict those effects:

I don't like being away from my phone, its presence is comforting. But it doesn't affect my mood. (R34)

It gives me a temper sometimes I think it has an impact but not a massive one. (R69)

Sometimes it makes me very depressed because I see people who are better than me and I sometimes start to cry and feel very suicidal. The more I use, I feel more mentally stable, and without it, I may consider suicide. [It has] Many uses, avoids depression, helps me cool off. (R18)

Mostly negative effects were described by 33 respondents. In addition to a generally negative impact on mood and productivity as already described, some respondents feel smartphone use, in particular social media, can lead to time wasted with no significant benefits:

I want to spend less time on my smartphone because it is a massive waste of time and doesn't benefit me in any way. I deleted TikTok a few months ago, and my quality of life improved almost instantly. (R55)

I do want to spend less time because one can become so glued to the screen that they lose sense of what is actually important in your life and what truly matters. (R6)

It could make you feel insecure because of looking at others on Instagram. (R62)

Theme 4: time spent on smartphone and a desire to reduce usage
Time spent using a smartphone was mentioned by 28 respondents. Half of those (n=14) explicitly said they wish they spent less time on their phones:

I want to spend less time as I can do other more productive things such as studying and being with my [family]. (R18)

I feel like so many apps I use on my phone occupy precious time that I could be using to work on school and doing other things that really interest me. (R53)

It is a HUGE waste of time, and benefits me in no way. (R55)

Others felt they were on their smartphones too much but were ambivalent towards the idea of reducing their use:

To an extent I'm on it too much. I know it's bad for my health but I go on it too much, I don't think I need help to stop—if it was the most important thing for me right now when I could stop. (R45)

My smartphone does lead me to getting sidetracked and controlling phone usage is a huge challenge for me. However, there are many educational applications which are beneficial for school. (R7)

I can't decide [if I'd like to spend less time on my smartphone], because I use my phone for work purposes and it does help, but there is temptation. (R69)

Twelve respondents commented on how they find it difficult to control how much time they spend on their smartphones:

I don't know how much is too much. (R18)

I keep scrolling even though I know I have other things to do. (R35)

Only one respondent mentioned using strategies such as apps to set time limits on their smartphone use in the free text boxes:

I have a time limit app that I use to only spend 1.5 hours per day on the app of use. (R42)

Some believe that reducing one's smartphone use needs to be an initiative from the user themselves rather than something imposed by others:

Nobody can stop you excessively using your smartphone except for yourself, as the will has to come from you. (R6)

(...) I feel it is something I should control on my own. (R5)

However, others felt that they would need external support to reduce their smartphone use:

Need help with more time limits and putting it away some days. (R33)

I need some help to restrain me from my phone. (R69)

While others justified their phone use by mentioning positive effects:

I don't think I spend too much time because it can be a creative outlet. (R47)

I like to read on my phone, so don't think I want to use it any less. (R61)

DISCUSSION

Summary of results

This mixed methods study investigated the associations between PSU and anxiety, sleep and depression using a prospective cohort study. We found a linear relationship between changes in PSU over time and anxiety, depression and sleep quality. These findings suggest that adolescents who demonstrate greater symptoms of PSU have greater symptoms of anxiety, depression and poor sleep. A majority (89.9%) of teenagers used one or more smartphone reduction strategies to limit their smartphone time. Qualitative analysis of free-text fields in the questionnaire revealed

that teenagers had an awareness of both positive and negative aspects of smartphone use, reported nuanced effects on mood and relationships, but an awareness of an adverse impact on productivity.

How do our findings relate to other research: quantitative

We found the prevalence of PSU to be 14.5%, which is consistent with other studies suggesting prevalence between 10% and 30%.^{12 28 29} Furthermore, there is a growing body of evidence which supports our findings and demonstrates a comorbidity between PSU and common psychiatric disorders such as depression, anxiety and OCD.³⁰ Of all the mental health disorders, depression is the one which is most consistently related to PSU with greatest effect sizes and repeatability.^{31 32} Similarly, there are significant association between PSU and anxiety,³² and PSU and sleep.^{6 33 34} Some studies have found no association or very small negative association between smartphone usage defined in terms of time spent and mental health outcomes.^{9 35} Both the quantitative and qualitative data shown here reflect the importance of considering the relationship people have with their smartphone and whether they use it in an adaptive way.²⁸ Participants in our study reported multiple benefits of smartphone use. Similarly, other studies have found they can relieve stress and improve socialisation with family and friends,³⁶ improve productivity³⁷ and improve academic learning.³⁸

Furthermore, 83% participants had tried several reduction strategies to cut down time spent on smartphones. A recent randomised controlled trial using two reduction strategies were successfully used as an intervention for PSU.¹¹

In contrast to the wealth of quantitative research regarding problematic smartphone use, there is a relative paucity of qualitative research in teenagers.^{39–42} Our qualitative findings are consistent with findings elsewhere with respect to reporting of social and mental health benefits as well as harms connected with smartphone use, concerns around addictive potential, impact on schoolwork and desire to limit use.^{39 41 42} Despite early concerns that findings about smartphone use in East Asia would not translate to the UK setting, there are striking consistencies between our findings and those from Singapore and Spain.^{42 43} Our findings extend current qualitative research by focussing on a tighter age range—young teenagers aged 13–16 years old, studying the relationship to sleep which is not explored in other qualitative research, and by combining a qualitative approach with quantitative description of types of apps used by participants and strategies for harm reduction.

This study has several strengths. Its prospective mixed methods cohort study design allowed for examination of the relationship between PSU and anxiety, depression and sleep over time, as well as using qualitative methods. However, weaknesses of the study include the observational nature, which prevented causality from being established; and the use of self-reported questionnaires which may have introduced possible reverse causation and biases in the analysis of the results. A key limitation was low power due to a smaller sample size than expected.

Clinical implications

These findings suggest that most adolescents understand the impact of maladaptive use and are typically managing their use well. However, a small number are aware of negative consequence and need help in implementing reduction strategies to manage their usage. Interventions need to be developed and evaluated for those seeking support.

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