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Riskonnected: Social Media, Puberty and Risky Behaviours in Adolescence

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ABSTRACT

Riskonnected: Social Media, Puberty and Risky Behaviours in Adolescence*

We examine the impact of intensive social media use on puberty timing, particularly earlier menarche in girls. Using data from the Millennium Cohort Study (MCS), a nationally representative longitudinal dataset tracking around 19,000 children in the UK, we analyse how digital engagement influences adolescent development. Our results show that intensive social media use significantly accelerates menarche in girls but has no clear effect on male puberty markers. The likely mechanism behind this effect is the negative impact of social media on mental health, particularly stress and anxiety, which have been linked to earlier menarche. Our findings highlight social media use itself as a potential risky behaviour, reinforcing concerns about its effects on adolescent well-being.

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1 Introduction

Late childhood and adolescence is a critical time of life for socio-emotional development. Young people are vulnerable to external factors and their future well-being can be substantially affected by critical experiences and interactions with peers and adults during this key stage of life. Unfortunately, in recent years, there has been a growing evidence of a mental health crisis among adolescents, with increasing rates of depression, anxiety and suicide intentions (see for example Arenas-Alloyo (2025), among many others). The World Health Organization estimates that one in seven teenagers experiences a mental disorder (depression, anxiety and behavioural disorders), conditions that are all linked to experiencing social exclusion, discrimination, stigma, physical ill-health, learning difficulties and risk-taking behaviours (World Health Organization, 2022) .

Social media have become a pervasive presence in the everyday lives of adolescents globally, with platforms such as YouTube, Instagram, WhatsApp, and Snapchat widely used by young people. Recent research from the US Office of the Surgeon General shows that social media use by young people is nearly universal. Up to 95 percent of youth ages 13–17 report using a social media platform, with more than a third saying they use social media "almost constantly" (Office of the Surgeon General, 2023). Notably, social media use among children and adolescents frequently occurs in private spaces—often via mobile devices in bedrooms—without adult oversight (Frith, 2017).

Despite the fact that social media platforms usually require a minimal age of 13 years old to create accounts and use social media, nearly 40 percent of children aged 8-12 use social media Rideout et al. (2022) and the use of social media for this age group has increased steadily in the last 5-10 years. As noticed in OECD (2025), this rapid digital transformation of our societies brings both significant opportunities and serious challenges for children's well-being. Social media and digital environments offer many valuable avenues for learning, play, and social connection. At the same time, these spaces pose emerging risks that can affect children's development and mental health, including cyberbullying, online exploitation, disruptions to sleep, and increased symptoms of anxiety and depression (OECD, 2025).

Social media platforms, have come under growing scrutiny for their possible harmful effects on young users, underscoring the urgent need for stronger safeguards and rigorous research to better understand the nature and extent of these risks (OECD, 2025). Proposals to completely ban screens, digital devices, or platforms—such as smartphones or access to social media—for children below a certain age have emerged in several jurisdictions, including recent debates in

Australia (Leigh, 2024). However, digital technologies are already deeply embedded in children's daily lives from an early age, and reversing these trends poses practical challenges and raises questions about the actual effectiveness of blanket bans (Australian Human Rights Commission, 2024). Further, excluding children entirely from digital environments risks limiting the development of crucial digital competencies that are essential for their personal and professional futures, and such measures overlook the important role of adults in supporting children and adolescence and promoting safe and balanced use of social media (OECD, 2025).

Haidt (2024) defines the current cohort of teenagers as the anxious generation, linking the decline in mental health to parenting changes which have been documented in the parenting styles literature (Doepke and Zilibotti, 2017) amounting to less free time unsupervised by adults outdoors with an incremental exposure to small risks that builds resilience, accompanied by an increase in unsupervised time indoors online (which Haidt labels the online childhood) which instead has lead to exposure to large risks (online harassment and bullying and extreme vulnerability to social comparison and online addiction that platforms rely on to monetize users attention) for which no adequate safeguards are in place. This study also shows that young women are generally more engaged in social media than their male peers (who spend more time gaming), and that the decline in teen mental health appears more marked for females than males.

Research on the link between social media use and mental well-being has increased disproportionately in the recent years, but the evidence on this connection is still conflicting and inconclusive (see for example the meta-analysis by Huang (2017) among many others). An interesting and relatively novel concept developed in recent research is that of problematic social media use (PSMU), which is generally assessed using addiction symptoms, such as loss of control, preoccupation, mood modification, withdrawal symptoms, relapse, conflict when one cannot use social media, (see for example Arrivillaga et al. (2022); Montag et al. (2024) among many others). Recent research has linked PSMU to risks of reduced well-being in several areas, including school, social interactions and emotions (see for example Boer et al. (2020)).

The medical literature has documented the parallel decline in mental health (including self-reported symptoms of depression, major depressive episodes and suicidality) among teenagers in administrative and survey data for North America, Europe and Australia documenting dose effects, that is associate with intensity of use for both smartphones and social media, and a gender effect with girls particularly negatively affected (Abi-Jaoude et al., 2020; Twenge et al., 2022; Kelly et al., 2017).

The mechanisms suggested in this literature are linked to both the way the devices and

platforms function encouraging self scrutiny, social comparison and negative interactions, as well as their content which often involves normalization and even promotion of self-harm and suicidality among youth. Little is known about the relationship between social media and broader concepts of adolescents' health to include physical health and risky health behaviors. Even if it has been established that the use of social media poses important challenges related to the perception of body image and the development of sexual relationships, the relationship with early sexualization is relatively unexplored, a gap that our project aims to fill by investigating the effect of social media on puberty markers of adolescents in the United Kingdom, examining gender differences in the effect of social media use and puberty onset, as well as a range of risky behaviours that are typically associated with puberty.

In the remainder of the paper we review the literature discussing the rise in social media use and correspondent decline in mental health for teenagers and the medical literature linking mental health declines to earlier puberty and associated health and behavioral consequences. We then examine social media use among UK teenagers taking part in the Millennium Cohort Survey survey to document the relationship between intensive social media use and early puberty for girls and boys.

2 Background and Existing Literature

2.1 Social media and mental health

It is important to note that any effects of smartphones and social media use investigated in the literature are always the joint product of the substitution and distraction in time use that takes place when children start using social media, the effect of the addictive features of the platforms themselves (leading to fear of missing out or FOMO), as well as the content seen, and the three cannot be disentangled (Abi-Jaoude et al., 2020; Twenge et al., 2022; Kelly et al., 2017).

Social media has addictive qualities which psychologists identify as salience, mood modification, tolerance, withdrawal symptoms, conflict and relapse Mujica et al. (2022). Using these criteria, studies find that approximately 10 percent of users of social media are addicted, with effects that include depressive symptoms, increased anxiety, and a lowered sense of personal well-being, as well as diminished attention and ability to focus.

It is often the intensive margin (that is prolonged use through the day, typically more than 4 hours) that is found to have detrimental effects on mental health and behavioural

conduct as found for example in McNamee et al. (2021) who show that prolonged use of social media (more than 4 hours per day) is significantly associated with poor emotional health and increased behavioural difficulties, and in particular decreased perception of self-value and increased incidence of hyperactivity, inattention and conduct problems. Studies are very often correlational, although some studies have established causal links between social media use and low mental health exploiting staggered rollouts of social media platforms or availability of high speed internet.

Braghieri et al. (2022) exploit the staggered introduction of Facebook across US colleges and show that data on student mental health shows a negative impact of the rollout of Facebook both on mental health and academic performance, which they attribute to social comparison effects. A meta-analysis of 133 independent samples investigating social media use across platforms conducted by Huang (2022) finds that problematic social media use (that is, high intensity accompanied by symptoms of addiction and dependence, which is very widespread among teens) is always positively associated with markers of mental distress, whether measured with life satisfaction, self-esteem, loneliness, and depression.

McDool et al. (2020) instead focuses specifically on children and shows the effect of the spread of broadband internet in England on well-being outcomes for a representative sample of children in England during the period 2012-2017, and finds that internet use is negatively associated with well-being in feelings about their own appearance, particularly for girls. In what follows, we review the medical literature linking stress to the early onset of puberty, illustrating the health and behavioural consequences of early puberty. Similarly, Arenas-Alloyo (2025) use Spanish data to show that access to high speed internet is associated with a increased mental health diagnoses in hospitals and with a notable rise in adolescent suicide rates, particularly among girls.

2.2 Puberty, Stress and Risky Behaviors

Puberty is the medical term for the biological process where a child's body matures into an adult body capable of sexual reproduction. This period is characterized by physical and hormonal changes, including the development of secondary sex characteristics like pubic hair and breast development in girls, and genital growth and voice changes in boys. Pubertal onset is affected by a range of genetic, behavioral, socio economic and environmental factors with human genetic studies showing that around 50–80 percent of the variation in pubertal onset is geneti-

cally determined (Mancini et al., 2022). [1] Socio economic factors are however important too: Papadimitriou (2016) documents the role of general socio-economic conditions in the evolution of menarcheal age in women, which in the Paleolithic took place between 7 and 13 years of age, to then increase in the classical and middle ages to be around 14 years, with a range from 12 to 15 years. After the industrial revolution a deterioration in living condition led to a further lengthening to 15-16 years and since the second half of the 20th century industrialized countries have witnessed a significant decrease again in age at menarche as a result of the improvement of the socioeconomic conditions, occurring generally at 12-13 years.

However, while the average age may change across countries' levels of development, at the individual level disturbances that affect pubertal timing typically result in adverse health conditions later in life: early puberty has been associated with adverse health outcomes, including breast and endometrial cancer, obesity, type 2 diabetes, cardiovascular disease, short stature, earlier menopause and increased mortality (Mancini et al., 2022). Furthermore, reaching puberty earlier is also associated with earlier ages of first intercourse, higher risk of depression, eating disorders, and substance abuse during adolescence (M. Okasha, P. McCarron, G. Davey Sm, 2001).

It is important to note that for these reasons, the acceleration of puberty is considered a problem in the medical literature and has been the subject of many studies over the past decade. A meta review by (Yermachenko and Dvornyk, 2014) indicates that evironmental factors, which may affect average age at menarche, vary in populations of different ethnicity and that the prenatal, infancy, and early childhood periods are the most susceptible to these factors which include Body weight, high animal protein intake, physical activity and family stressors. Focussing specifically on a subpopulation that is experiencing the fastest rates of decline in menarcheal age in the USA, that of Mexican-American girls, Jean et al. (2011) showed that girls who experienced relatively early menarche had higher risky behaviors, including smoking.

Kaltiala-Heino et al. (2003) specifically investigate the association between early puberty and emotional and behavioural problems in Finland and find that for both girls and boys early puberty was associated with problems but those of girls were internalizing symptoms (like depression, bulimia, and anxiety) while for boys they were externalizing (like drinking, substance use, smoking, bullying and truancy). In the United Kingdom, Kelly et al. (2017)

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[1] Some explanations for early onset of menarche include genetics and body fat (via production fleptin), while others may be related to environmental factors that may impact reproductive hormones, such as growing up in a father-absent home which has been the subject of investigation to disentangle environmental and genetic effects Schlomer and Marceau (2022).

investigates early puberty with the Millennium Cohort Study focussing on the associations between puberty (reported menstruation at age 11) and ethnicity, family income, adiposity and psychosocial stress. She finds that excess adiposity and psychosocial stress were associated with social inequalities in early puberty, while material disadvantage and adiposity were linked to ethnic inequalities in early puberty among girls.

Existing literature has also analysed the relationship between stress and early puberty. For example, Jean et al. (2011) investigates the role of psychosocial factors on age at menarche for Mexican-American girls and shows that the existence of conflicts within the family environment was significantly associated with an earlier age at menarche (lower than 11 years old). Additionally, this study finds a higher risk of early menarche among daughters of mothers who were single parents compared with those who were not. Similarly, several studies in the medical and psychologichal literature have shown that stress exposure during development, socio-economic status and family structure (and in particular father absence) significantly influence age at menarche (see for example Schlomer and Marceau (2020); Richardson et al. (2018) among others).

The link between puberty and the use of social media networks is generally unexplored in the lof theature of the medical and social sciences. Some studies have documented that girls who have developed earlier show more self-disclosive behaviours on social media (posting about personal feelings and romantic experiences)(Swirsky et al., 2022), but the evidence is very scarce and, to the best of our knowledge, our study is the first to analyse the link between early social media use and puberty, mediated to the increased stress induced by social media.

3 Data

The Millennium Cohort Study (MCS) is a UK nationally representative prospective cohort study of children born into 19,244 families between September 2000 and January 2002. The first wave of data was collected when cohort members were around 9 months and the subsequent six sweeps of data were collected at ages 3 years (2004), 5 years (2006), 7 years (2008), 11 years (2012), 14 years (2015) and 17 years (2018). At each wave, data were collected through interviews and anthropometric measurements carried out during home visits. Figure 1 shows the survey construction and the key variables we are interested in as well as when they are measured. Information on social media use and questions about menarche are collected at ages 11, 14 and 17.

Figure 1: Millennium Cohort Survey
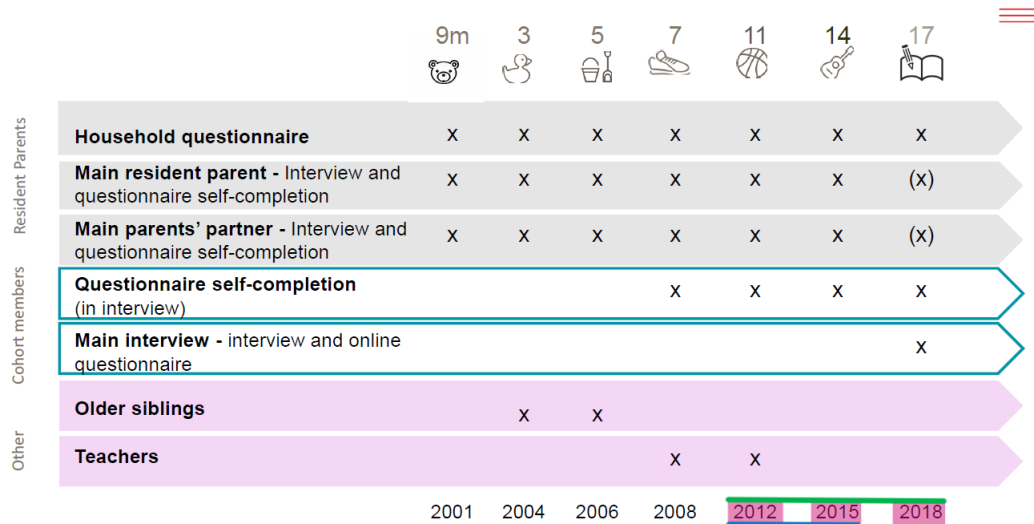
Source: "Introduction to the Millennium Cohort Study" webinar, UCL, Centre for Longitudinal Studies, 2022. *Legend*: Menarche, Facial hair, Social media use.

Our main outcomes focus on markers of female puberty and include: (i) a binary indicator for whether the individual has begun menstruating, (ii) the age at menarche, and (iii) a binary variable equal to 1 if menarche occurred between ages 12 and 13, and 0 if it occurred later. The variable of interest takes the value of 1 if the child uses social media most days at age 11 and 5 or more hours per week at ages 14 and 17.

Inspecting social media use by menarcheal age, as reported in Figure 2, shows that girls who use social media intensively at age 11 are indeed more likely to have experienced menarche by age 14.

Figure 2: Menarche by Social Media Use
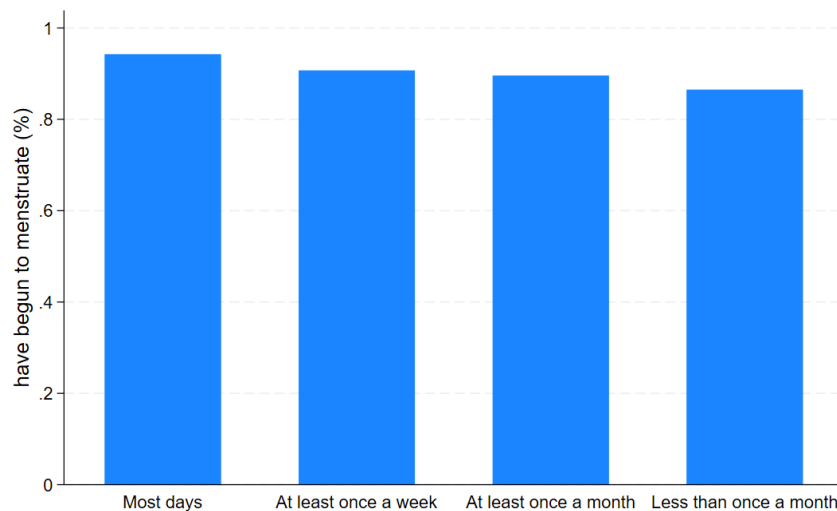
The same pattern is not observed for boys' pubertal development, as illustrated in Figure

Figure 3: Male Puberty by Social Media Use

3, which focuses on facial hair growth as an indicator. For this reason, in the rest of the paper, we focus on the relationship between social media use and puberty for girls.
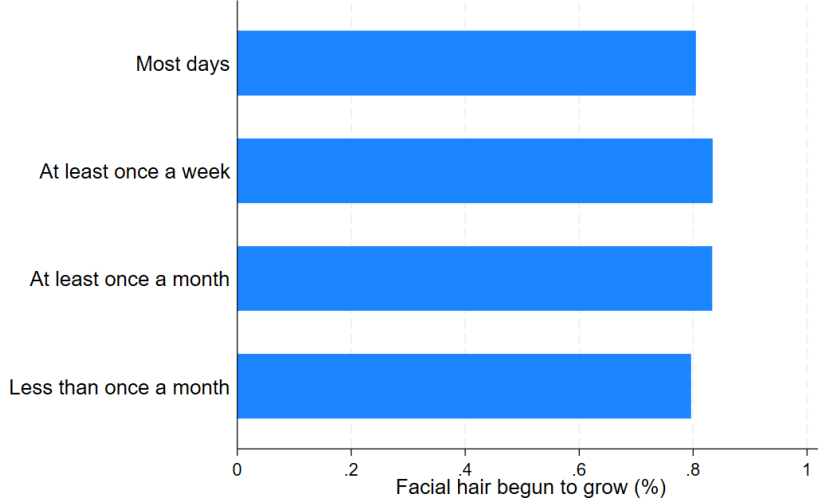
We also want to account for child characteristics such as ethnicity, country of residence, body mass index, time spent on sports, and parental characteristics, including age, marital status, employment-related factors (if employed), and mental health.

Table 1 reports summary statistics for the sample of female adolescents. About 21% of them reported intensive social media use at age 11. The average age in the sample is approximately 14 years. Most participants have at least one sibling, with an average of around 1 to 2 siblings living in the household. The majority of the sample (89%) identify as White. By age 14, 90% of the girls had experienced menarche. Among those who had not reached menarche before age 12, 83% reached it between ages 12 and 13, with the average age at menarche being nearly 13 years.

4 Empirical Strategy

This section outlines the empirical strategy employed to estimate the effect of intensive social media use on puberty timing. We estimate our baseline model using an individual fixed effects approach, specified as follows

$$Puberty_{it} = \beta Social\_Intensive\_Use_{it} + X'_{it}\omega + \alpha_i + \delta_{h(i)} + \epsilon_{it} \qquad (1)$$

where β is the coefficient of interest associated to the binary variable for an intensive use of social media. The vector X_{it} includes time-varying controls, such as child-specific characteristics (e.g., physical development, time spent on sports) and parental characteristics (e.g., marital

Table 1: Descriptive Statistics – Full Sample

Variable	N	Mean	SD	Min	Max
Age (full sample)	9,638	12.87	2.29	10	18
Social media intensive use (full sample)	9,638	0.28	0.45	0	1
Social media intensive use (at age 11)	3,462	0.21	0.41	0	1
Child characteristics (at age 14):					
Has siblings	3,462	0.85	0.36	0	1
Number of siblings in household	2,942	1.68	0.95	1	10
Ethnicity: White	3,462	0.89	0.31	0	1
Ethnicity: Mixed	3,462	0.03	0.16	0	1
Ethnicity: Indian	3,462	0.02	0.13	0	1
Ethnicity: Pakistani or Bangladeshi	3,462	0.04	0.19	0	1
Ethnicity: Black or Black British	3,462	0.02	0.14	0	1
Ethnicity: Other ethnic group	3,462	0.01	0.09	0	1
Body Mass Index (BMI)	3,462	21.89	4.10	7.35	46
Fat Mass Index (FMI)	3,462	26.89	6.95	4.20	56
Birth weight (lbs)	3,462	7.25	4.58	0	15
Months of breastfeeding	3,462	1.19	4.19	0	42
Outcomes:					
Menstruated	9,638	0.56	0.50	0	1
Menstruated at 14	3,462	0.90	0.30	0	1
Menarche at age 12-13 (dummy=0 if after)	2,492	0.83	0.38	0	1
Age at menarche, if >11	2,492	12.82	0.92	12	17

status, employment status, and religion). α_i represents individual fixed effects to account for time-invariant unobservable characteristics of children such as genetic factors and early-life conditions that might influence both the variable of interest and the outcomes. $\delta_{h(i)}$ represents age fixed effects, controlling for age-specific biological trends in puberty onset. ϵ_{it} is the error term. Standard errors are clustered at the individual.

To mitigate concerns that earlier puberty might influence social media use rather than the reverse, we employ a lagged specification where social media use at $t-1$ predicts puberty status at t:

$$Puberty_i = \theta Social\_Intensive\_Use_{i,-1} + \lambda Puberty_{i,-1} + X_i'\phi + \Sigma_i'\rho + \nu_i \qquad (2)$$

In this specification, we restrict the sample to girls who are 14 years old and estimate the effect of intensive social media use in the previous wave on puberty at the current wave (θ). At this stage, 93% have started menstruating, meaning that there is enough variation to estimate the effect of intensive social media use. We exclude age 17 as nearly all girls have reached menarche by that point, making it difficult to identify differences. Additionally, we control for puberty status in the previous wave, which ensures that the estimated effect is not simply capturing the expected biological progression of puberty but rather the influence of social media use in earlier adolescence. Finally, we control for time-varying variables included in X_{it}, as in Equation 1, and time-constant controls in Σ_i such as birth weight and breastfeeding duration. ν_i is the error term.

We then restrict the sample to girls who had not yet reached puberty at age 11, and re-estimate the model using two alternative definitions of the dependent variable. In the first specification, $Puberty_i$ is equal to 1 if the girl reached her period between 12 and 13 years old and 0 if after. In the second specification, $Puberty_i$ is a continuous variable for age of menarche. In both cases, $Social\_Intensive\_Use_{i,-1}$ equals 1 if the girl used social media intensively at 11 and 0 otherwise. We control for time-varying variables included in X_{it}, as in Equation 1, and time-constant controls in Σ_i such as birth weight and breastfeeding duration, which were previously accounted for by individual fixed effects in Equation 1. $\varphi_{h(i)}$ represents age fixed effects, controlling for age-specific biological trends in puberty onset. ν_i is the error term.

5 Effect of Intensive Social Media Use on Menarche

Table 2 presents the baseline results for girls. Intensive social media use is linked to a 4.3 percentage point higher probability of having begun menstruation compared to non-intensive users. When individual fixed effects are introduced, the estimated effect decreases slightly but

remains positive and statistically significant, with intensive social media use increasing the likelihood of having started menstruation by 2.6 percentage points.

Table 2: The effect of social media intensive use on menstruating

	Menstruated	
Social Intensive Use	0.0446***	0.0291***
	(0.00590)	(0.00876)
Individual FE		✓
Observations	9,638	9,638
Individuals		4,885

Standard errors are clustered at the individual level.

*** p<0.01, ** p<0.05, * p<0.1

To further assess the relationship between intensive social media use and menarche timing, we estimate three lagged specification, where social media use in the previous period predicts (i) the likelihood of having started menstruating at time t, (ii) the likelihood of starting menstruation at 12–13 years old rather than after 13 and (iii) the age at which menarche occurs. For these last two specifications, we restrict the sample to girls who had not started menstruating before age 12. This approach helps mitigate concerns about reverse causality, ensuring that the estimated effect captures the influence of earlier social media exposure rather than the possibility that early puberty itself drives increased social media use.

Our results confirm that the effect remains positive and statistically significant (Table 3). Specifically, intensive social media use at $t-1$ is associated with a 2.2 percentage point increase in the probability of having started menstruating at t (Column 1), relative to those with lower social media engagement. It also shows that intensive use of social media at age 11 increases the likelihood of reaching menarche between 12 and 13 years old instead of after 13 (Column 2) and lowers the age of menarche for girls (Column 3). The persistence of a significant effect supports the hypothesis that early digital engagement may accelerate biological maturation through stress-related pathways.

Table 3: The Effect of Social Media Intensive Use at 11 Years Old on Menarche

	(1)	(2)	(3)
	Menstruated at 14 years old	Menarche [12-13]	Menarche age — Not menarche before 12
Social Intensive Use_11	0.0221**	0.0306*	-0.0741*
	(0.0102)	(0.0179)	(0.0432)
	0.0307	0.0884	0.0864
Observations	3,462	2,793	2,793
R-squared	0.128	0.046	0.050

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6   Mediation Analysis of Social Media Use

To investigate the mechanisms through which intensive social media use affects puberty timing, we estimate a mediation model where mental health acts as a mediator in the relationship between social media exposure and age at menarche.

Formally, the identification relies on the following system of equations:

$$\text{MentalHealth}_i = \alpha + \beta_1 \, \text{Social\_Intensive\_Use}_i + \gamma' \mathbf{C}_i + \varepsilon_{1i}$$

$$\text{Puberty}_i = \delta + \theta_1 \, \text{Social\_Intensive\_Use}_i + \theta_2 \, \text{MentalHealth}_i + \phi' \mathbf{C}_i + \varepsilon_{2i}$$

where $Social\_Intensive\_Use_i$ denotes intensive social media use, $MentalHealth_i$ is measured using the Short Mood and Feelings Questionnaire[2], $Puberty_i$ is the outcome variable (measured by age at menarche), and $\mathbf{C}_i$ is a vector of child and parental characteristics. The coefficient β_1 captures the effect of social media use on mental health, θ_2 captures the effect of mental health on puberty timing, and θ_1 captures the direct effect of social media use on puberty, net of mental health.

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[2]Mental health is assessed through the Short Mood and Feelings Questionnaire (SMFQ). The SMFQ is a 13-item self-reported scale that captures emotional difficulties experienced over the past two weeks, such as feeling miserable, tired, or worthless. Each item is rated on a 3-point scale (0 = not true, 1 = sometimes true, 2 = true), resulting in a total score ranging from 0 to 26, with higher scores indicating more severe depressive symptoms.

The total effect of *Social_Intensive_Use* on *Puberty* can be decomposed into (a) a direct effect (θ_1), representing the pathway from *Social_Intensive_Use$_i$* to *Puberty$_i$* not mediated by mental health; and (b) an indirect effect ($\beta_1 \cdot \theta_2$), capturing the pathway from *Social_Intensive_Use$_i$* to *Puberty$_i$* through *MentalHealth$_i$*.

Table 4: Mediation Analysis of Social Media Use on Puberty through Mental Health

	Age of Menarche
Indirect Effect of Social_Intensive_Use (1 vs 0)	-0.011*
	(0.006)
Direct Effect of Social_Intensive_Use (1 vs 0)	-0.095**
	(0.041)
Total Effect of Social_Intensive_Use (1 vs 0)	-0.106***
	(0.040)
Number of observations	2309

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As shown in Table 4, intensive social media use is associated with earlier puberty, both directly and indirectly via deteriorating mental health. The estimated indirect effect indicates that part of the influence of social media on menarche timing operates through its negative impact on girls' emotional well-being.

We also explore whether puberty timing mediates the relationship between social media use and risky behaviour in adolescence. Prior studies have documented positive associations between early puberty and risky behaviours such as smoking and alcohol use in adolescence. Building on this literature, we examine whether earlier menarche, potentially induced by high social media use, partially explains adolescents' propensity to engage in such behaviours. This is specified as:

$$\text{Puberty}_i = \lambda + \kappa_1 \text{ Social\_Intensive\_Use}_i + \psi' \mathbf{C}_i + \varepsilon_{3i}$$

$$\text{RiskyBehaviour}_i = \mu + \rho_1 \text{ Social\_Intensive\_Use}_i + \rho_2 \text{ Puberty}_i + \xi' \mathbf{C}_i + \varepsilon_{4i}$$

where *RiskyBehaviour$_i$* includes measures of smoking, drinking, drug use and early sexual initiation. The indirect effect of social media use on risky behaviour via puberty is given by $\kappa_1 \cdot \rho_2$, and ρ_1 captures the direct effect.

Table 5: Mediation Analysis of Social Media on Risky Behaviours through Earlier Menarche

	Smoking	Drinking	Drugs	Sex
Indirect Effect	0.002**	0.006*	0.002	0.013*
	(0.001)	(0.003)	(0.005)	(0.007)
Direct Effect	0.050***	0.151***	0.039	0.108***
	(0.011)	(0.021)	(0.035)	(0.032)
Total Effect	0.053***	0.157***	0.041	0.121***
	(0.012)	(0.021)	(0.034)	(0.032)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5 presents the mediation results. Intensive social media use is significantly associated with higher probabilities of smoking and drinking, both directly and indirectly through earlier puberty. Although the indirect effect is smaller than the direct one, it remains statistically significant.

For drug use and sexual activity—measured at age 17—we find that intensive social media use is positively associated with early sexual initiation (before age 18), with both the direct and indirect effects being significant. In contrast, while the association with drug use is positive, it does not reach conventional levels of statistical significance.

7 Conclusion

Parents, educators and policy makers have been increasingly concerned with addiction to social media and intensive social media use by the public for a variety of reasons, which include exposure to false information, polarization of views and loss of connection with local communities. In the the case of teenagers, all these concerns are exacerbated by their heightened vulnerability to external pressures and reduced critical abilities at time of exposure which has by and large not been mediated or adequately monitored by adults.

The existing literature has investigated the link between social media use and poor mental health, highlighting mechanisms such as self-critique, social comparison, and negative interactions, whose content frequently reflects a normalization, and sometimes an endorsement, of self-harm and suicidal behaviors among young people. Although existing research has highlighted important challenges associated with the use of social networks, particularly in relation to perception of body image and the formation of sexual relationships, its association with

broader dimensions of adolescent health, including physical health and risky behaviors, remains insufficiently understood. In particular, the potential link between social media exposure and early sexualisation has received limited empirical attention.

This study addresses this gap by examining how the use of social networks is related is related to markers of pubertal development among adolescents in the United Kingdom. We further explore gender differences in the timing of puberty in relation to social media use, as well as a set of risk behaviours commonly associated with pubertal onset.

Our findings suggest that social media use may also affect the age at which puberty occurs and constitute a risky behaviour in itself, reinforcing concerns about its impact on adolescent well-being and underscoring the need for technology and social media education in schools and in the educating community more generally.

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