



RESEARCH ARTICLE

Association Between Social Media or Internet Exposure and Age at Menarche Among State Junior High School Girl Students in Padang

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Submitted: October 25, 2025

Accepted: July 28, 2026

Published: August 13, 2026

DOI: <https://doi.org/10.25077/aoj.10.2.271-281.2026>

Abstract

Objective: To examine the association between social media or internet exposure and age at menarche among state junior high school students in Padang, Indonesia.

Method: This analytical cross-sectional study was conducted from April to June 2025 among second-grade female students from selected state junior high schools in Padang. Eligible participants were girl students aged ≥ 12 years who had experienced menarche. Data were collected through structured interviews using questionnaires. Variables included age at menarche, age at first exposure to social media, daily duration of use, and pornography exposure. Statistical analysis was performed using Kruskal-Wallis and Chi-square tests with a significance level of $p < 0.05$.

Result: A total of 97 participants were included in the final analysis. Most respondents experienced normal menarche at 12–14 years (69.07%), while 29.90% had early menarche (< 12 years). The mean age at first social media exposure was 9.85 ± 1.48 years. Earlier first exposure to social media was significantly associated with earlier menarche (8.00 ± 0.73 vs 10.45 ± 0.78 years; $p < 0.001$). Longer daily social media use was also significantly associated with early menarche ($p < 0.001$). Pornography exposure showed a strong association with early menarche, with 96.3% of girl students in the early menarche group reporting prior exposure ($p < 0.001$).

Conclusion: Earlier onset of social media exposure, longer daily use, and pornography exposure were significantly associated with earlier age at menarche. These findings highlight the importance of parental supervision and healthy digital media use among adolescents.

Keywords: menarche, social media, internet exposure, adolescence, puberty

INTRODUCTION

Puberty is a critical developmental stage in girls, marked by the transition from childhood to reproductive maturity through hormonal, physical, psychological, and social changes. In females, one of the main indicators of pubertal onset is menarche, defined as the first menstrual period resulting from activation of the hypothalamic-pituitary-ovarian axis. This process begins with gonadotropin-releasing hormone (GnRH) secretion from the hypothalamus, followed by stimulation of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which induce ovarian estrogen production and menstrual function.^{1–3}

Globally, adolescents represent a substantial proportion of the population. According to the World Health Organization (WHO), approximately one-fifth of the world's population is aged 10–19 years, with around 900 million living in developing countries. In Indonesia, adolescents account for 26.67% of the total population, and nearly half are female.⁴

The age at menarche varies across populations and is influenced by multiple biological and environmental factors. In Indonesia, menarche commonly occurs between 10 and 16 years, with an average age of 13 years. National data from Riskesdas 2010 also reported a mean menarcheal age of 13 years. Earlier menarche is more frequently observed among girls living in urban areas than in rural settings.⁴

Several internal and external factors have been associated with earlier menarche, including nutritional status, genetics, socioeconomic conditions, environmental influences, high-calorie and high-fat diets, lifestyle, sexual behavior, and media exposure.^{5,6} Among these, increasing attention has been directed toward the role of social media and internet use, particularly exposure to age-inappropriate or sexually explicit content.⁷

Social networking platforms provide adolescents with opportunities for communication, self-expression, and relationship building beyond geographical boundaries. However, excessive use may also expose them to inappropriate content and contribute to adverse behavioral, psychological, and physiological outcomes affecting family life, school performance, and social functioning.^{8,9}

A proposed biological mechanism linking digital media exposure to earlier puberty involves psychological stimulation from visual and auditory sexual content, which may activate the hypothalamus and increase GnRH secretion. This hormonal cascade subsequently stimulates FSH, LH, and estrogen production, potentially accelerating pubertal onset.^{10,11} In addition, prolonged gadget use may increase blue-light exposure, suppressing melatonin secretion. Because melatonin normally inhibits GnRH release before puberty, reduced melatonin levels may remove this inhibitory effect and contribute to earlier pubertal initiation.¹¹

Early menarche has important health and social implications. It has been associated with earlier sexual debut, increased risk of unintended pregnancy and sexually transmitted infections, early marriage, reduced educational attainment, and psychosocial stress.^{8,9} Girls who mature earlier may perceive themselves as more physically and emotionally mature, which can influence decision-

making and social expectations.

Despite growing internet access among adolescents, evidence regarding the association between social media or internet exposure and age at menarche remains limited in many Indonesian settings. Understanding this relationship is important for developing preventive strategies, promoting healthy digital behavior, and supporting adolescent reproductive health. Therefore, this study aims to examine the association between social media or internet exposure and age at menarche among state junior high school girl students in Padang City.

METHODS

This analytical cross-sectional study was conducted to assess the association between social media or internet exposure and age at menarche among female state junior high school students in Padang, Indonesia. The study was carried out from April to June 2025 in selected state junior high schools located in urban, mountainous, and border areas of the city.

The target population consisted of second-grade female students enrolled in state junior high schools in Padang. Eligible participants were girls aged ≥ 12 years who had experienced menarche and agreed to participate in the study. Exclusion criteria included current hormonal therapy; comorbid conditions such as thyroid disease, thrombocytopenia, leukemia, pituitary tumor, diabetes mellitus, adrenal disease, HIV with enteropathy, or sexually transmitted infections; body mass index classified as underweight or obese; and use of glasses with blue-light filters.

The minimum sample size was calculated using the Lemeshow formula for cross-sectional studies with an unknown population size. Using a 95% confidence level ($Z = 1.96$), estimated proportion of 0.66, and precision of 10%, the required minimum sample size was 85 participants. After adding 10% to account for possible dropout, the final minimum sample size was 95 participants.

Participants were recruited using proportional sampling from selected schools. All eligible students who had experienced menarche were invited to participate and underwent interview-based data collection after informed consent was obtained.

The dependent variable was age at menarche. It was categorized as early (< 12 years), normal (12–14 years), and late (> 14 years). Independent variables included exposure to social media or the internet, consisting of type of platform used, age at first exposure (onset of exposure), daily duration of exposure, and pornography exposure. Pornography exposure was defined as exposure to sexually explicit visual, audio, written, or interactive content that violates prevailing moral norms.

Data were collected through structured interviews using a questionnaire. Baseline information included age, body weight, height, menstrual history, and digital media exposure characteristics. Questionnaires and stationery were used as study instruments.

Data processing was performed using SPSS. The process included data editing, coding, entry, and cleaning to ensure completeness and accuracy before analysis.

Univariate analysis was conducted to describe the distribution of each variable. Categorical variables were presented as frequencies and percentages, while numerical variables were summarized as mean $\pm$ standard deviation or minimum–maximum range.

Bivariate analysis was used to examine associations between exposure variables and age at menarche. Normality was assessed using the Shapiro-Wilk test. If normally distributed, one-way ANOVA was used to analyze the relationship between onset or duration of exposure and menarche age categories. If data were not normally distributed, transformation was attempted; if normality was still not achieved, the Kruskal-Wallis test was applied. The association between pornography exposure and age at menarche was analyzed using the Chi-square test. Statistical significance was defined as $p < 0.05$ with a 95% confidence interval.

Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Andalas/Dr. M. Djamil General Hospital, Padang. Written informed consent was obtained from all participants prior to enrollment.

RESULTS

A total of 105 female students from several state junior high schools in Padang were initially recruited. After screening based on the predefined inclusion and exclusion criteria, 8 participants were excluded: one due to asthma, one due to the use of blue-light filter glasses, and six because of extreme nutritional status (four underweight and two obese). The final analytic sample consisted of 97 participants.

Participant Characteristics

Table 1. Characteristics of Study Subjects

Characteristics	Category	Mean $\pm$ SD (Min–Max) / n (%)
Age at menarche	Early (<12 years)	29 (29.90%)
	Normal (12–14 years)	67 (69.07%)
	Late (>14 years)	1 (1.03%)
Age at onset of social media exposure (years)		9.85 $\pm$ 1.48 (7–13)
Duration of social media exposure (hours/day)	4–6 hours	31 (31.96%)
	6–8 hours	47 (48.45%)
	8–10 hours	19 (19.59%)
Pornography exposure	Yes	28 (28.87%)
	No	69 (71.13%)

Most respondents experienced menarche at a normal age (12–14 years), accounting for 67 participants (69.07%). Early menarche (<12 years) was observed in 29 participants (29.90%), while only one participant (1.03%) reported late menarche (>14 years).

The mean age at first exposure to social media was 9.85 ± 1.48 years, with a range of 7 to 13 years. Regarding daily duration of social media use, 31 participants (31.96%) reported 4–6 hours/day, 47 participants (48.45%) reported 6–8 hours/day, and 19 participants (19.59%) reported 8–10 hours/day.

Most respondents reported no pornography exposure (69 participants; 71.13%), whereas 28 participants (28.87%) stated they had been exposed.

Association Between Age at First Social Media Exposure and Menarche Age

Table 2. Comparison of Age at Onset of Social Media Exposure by Menarche Age Category

Menarche Age Category	N	Mean $\pm$ SD Age at Exposure Onset (years)	<i>p</i> -value
Early (<12 years)	27	8.00 ± 0.73	<0.001
Normal (12–14 years)	69	10.45 ± 0.78	

The relationship between onset of social media exposure and age at menarche was analyzed using the Kruskal-Wallis test. A statistically significant difference was found between menarche groups ($p < 0.001$).

Participants with early menarche had a significantly younger mean age at first social media exposure compared with those with normal menarche. Girls with early menarche were first exposed at a mean age of 8.00 ± 0.73 years, whereas those with normal menarche reported first exposure at 10.45 ± 0.78 years.

These findings indicate that earlier initiation of social media use was associated with earlier onset of menarche.

Association Between Daily Duration of Social Media Exposure and Menarche Age

Table 3. Association Between Daily Duration of Social Media Exposure and Menarche Age Category

Menarche Age Category	Duration 4–6 h n (%)	Duration 6–8 h n (%)	Duration 8–10 h n (%)	Total
Early (<12 years)	0 (0%)	14 (51.9%)	13 (48.1%)	27
Normal (12–14 years)	38 (43.3%)	28 (47.8%)	3 (8.9%)	69
Late (>14 years)	1 (100%)	0 (0%)	0 (0.0%)	1
Total	39 (40.2%)	42 (43.3%)	16 (16.5%)	97
<i>p</i> -value	<0.001			

Daily duration of social media exposure was also significantly associated with age at menarche

(Kruskal-Wallis, $p < 0.001$).

Among participants with early menarche (<12 years), none reported social media use of only 4–6 hours/day. Instead, 14 participants (51.9%) reported 6–8 hours/day, and 13 participants (48.1%) reported 8–10 hours/day.

In contrast, among those with normal menarche (12–14 years), the majority reported lower or moderate exposure duration: 38 participants (43.3%) used social media for 4–6 hours/day, 28 participants (47.8%) for 6–8 hours/day, and only 3 participants (8.9%) for 8–10 hours/day.

The single participant with late menarche (>14 years) reported using social media for 4–6 hours/day.

Overall, longer daily social media use appeared more common among participants with early menarche, suggesting a dose-related relationship between screen exposure duration and pubertal timing.

Association Between Pornography Exposure and Menarche Age

Table 4. Association Between Pornography Exposure and Menarche Age Category

Menarche Age Category	Pornography Exposure	
	Yes n (%)	No n (%)
Early (<12 years)	26 (96.3%)	1 (3.7%)
Normal/Late (≥ 12 years)	5 (7.1%)	65 (92.9%)
Total	31	66
<i>p-value</i>	<0.001	

The association between pornography exposure and age at menarche was assessed using the Chi-square test. Because only one participant belonged to the late menarche group, the normal and late menarche categories were combined into a single group (≥ 12 years) for analysis.

A statistically significant association was observed between pornography exposure and age at menarche ($p < 0.001$). Among participants with early menarche, 26 girls (96.3%) reported prior pornography exposure, while only 1 participant (3.7%) reported no exposure.

Conversely, among participants with normal or late menarche (≥ 12 years), the majority had never been exposed to pornography (65 participants; 92.9%), while only 5 participants (7.1%) reported exposure.

These results suggest that pornography exposure was markedly more prevalent among girls with early menarche than among those with menarche at age 12 years or older.

DISCUSSION

This study aimed to analyze the association between social media or internet exposure and age at menarche among female students of state junior high schools in Padang City. The mean age at menarche in this study population was 11.8 ± 1.1 years. This figure is substantially lower than the Indonesian national average of 13 years reported in Riskesdas 2010.⁴ These findings provide local empirical evidence supporting the global secular trend toward accelerated puberty onset. A large analysis published in *JAMA Pediatrics* also confirmed a worldwide trend of earlier puberty in girls, with an average advancement of approximately three months per decade since the 1970s.¹²

Variables reflecting the intensity of social media exposure, namely earlier onset of exposure and longer daily duration of use, showed significant associations with earlier menarche ($p < 0.001$). Students who experienced early menarche (<12 years) started using social media at a mean age of 8 years, nearly two years earlier than those with normal menarche timing. In addition, pornography exposure was also statistically associated with early menarche. The strength of this relationship highlights psychosexual content as a potentially important risk factor.

Collectively, these findings indicate that the modern digital environment, characterized by intense artificial light exposure, sedentary behavior, and psychosocial or psychosexual stimulation, may contribute to modulation of pubertal timing. This environment may be viewed as a form of non-chemical endocrine disruptor. Traditionally, endocrine-disrupting compounds are exogenous chemicals that interfere with hormone synthesis, secretion, transport, metabolism, or elimination.¹³ However, when defined functionally as environmental factors that disturb neuroendocrine homeostasis, several aspects of digital exposure identified in this study may act through similar biological pathways and alter pubertal timing.

Association Between Onset and Duration of Social Media Exposure and Age at Menarche

One possible mechanism explaining the relationship between prolonged screen exposure and accelerated puberty is the light–melatonin–hypothalamic-pituitary-gonadal (HPG) axis pathway. Extensive use of smartphones and tablets, particularly at night, results in substantial exposure to blue light (approximately 446–477 nm). This wavelength is known to be the most potent suppressor of melatonin secretion by the pineal gland.¹⁴

Melatonin is not only a sleep-regulating hormone but also plays an important role as a natural inhibitor of pubertal onset. High melatonin levels during the prepubertal period are believed to suppress the gonadotropin-releasing hormone (GnRH) pulse generator in the hypothalamus. GnRH is the key hormone initiating the entire pubertal cascade.^{14,15}

Chronic melatonin suppression caused by prolonged blue-light exposure may effectively remove this inhibitory brake from the HPG axis. This disinhibition allows premature activation of GnRH pulsatility, stimulating pituitary release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), followed by ovarian estradiol production. Increased estradiol levels then promote secondary sexual development and eventually menarche.¹⁶

This hypothesis is supported by experimental evidence from animal studies. Kiliç Uğurlu et al. demonstrated that female rats exposed to blue light for 6 or 12 hours daily entered puberty significantly earlier than controls. This acceleration was accompanied by reduced melatonin levels and significantly increased LH and estradiol concentrations.¹⁵

The effect of exposure may be stronger because it occurs during the prepubertal period. Children are physiologically more sensitive to the suppressive effect of light than adults. One study found that nighttime light exposure reduced melatonin secretion by 88% in children compared with 46% in adults under identical lighting conditions.¹⁷ Larger pupils and clearer ocular lenses in children allow more blue-spectrum light to reach the retina. Furthermore, prepubertal children appear more sensitive than pubertal adolescents. This combination of earlier exposure and greater biological sensitivity may amplify pubertal acceleration.

In addition to neuroendocrine pathways, behavioral factors may also contribute. Longer social media use often reflects a sedentary lifestyle. Wu et al. reported that excessive sedentary behavior, rather than screen time alone, was significantly associated with increased risk of precocious puberty in girls.¹⁸ Sedentary behavior may increase adiposity, and adipose tissue functions as an endocrine organ secreting leptin. Elevated leptin levels signal sufficient energy reserves and stimulate the kisspeptin-GnRH pathway, thereby facilitating pubertal onset.¹⁹

Another possible pathway is psychosocial stress. Social media can expose adolescents to continuous social comparison, feedback-seeking behavior, fear of missing out (FoMO), and cyberbullying.²⁰ Chronic exposure to these stressors may be interpreted through the Psychosocial Acceleration Theory, which proposes that early adversity or stressful environments may trigger a faster life-history strategy, including earlier maturation and reproduction.²¹

Association Between Pornography Exposure and Age at Menarche

This study also found a significant association between pornography exposure and early menarche. Literature in developmental psychopathology suggests that early exposure to sexual content may trigger “accelerated cognitive maturation,” whereby children are prematurely introduced to sociosexual paradigms before they possess adequate emotional and cognitive capacity to process them.²²

Intense psychosexual stimulation that is inappropriate for developmental stage may function as a strong environmental signal to the kisspeptin system. The brain may interpret repeated sexual content exposure as an indication that earlier reproductive readiness is required. This psychological input may then be translated into neurobiological signaling that activates kisspeptin neurons and stimulates GnRH pulsatility, triggering the pubertal cascade earlier than expected.²²

Although direct evidence for this mechanism remains limited, several indirect findings support its plausibility. Longitudinal studies have shown that high pornography use among adolescent girls is associated with more rapid progression of sexual behaviors, including masturbation and other sexual activity.²³ The present study suggests that such acceleration may occur not only at the behavioral level but also at a more fundamental physiological level, namely

pubertal timing itself.

Pornographic exposure may also be conceptualized as a form of early life adversity. Feelings of confusion, stress, and cognitive dissonance resulting from age-inappropriate sexual content may act as psychological stressors, which, as previously discussed, may accelerate maturation as an adaptive but potentially harmful response.²¹

CONCLUSION

The findings showed that most second-grade female students at state junior high schools in Padang experienced menarche at a relatively early age, indicating a shift in pubertal timing toward younger ages compared with normal developmental patterns. Most respondents had already been introduced to and started using social media during elementary school, suggesting that digital exposure began during early developmental stages before full adolescence. In addition, daily social media use was generally high, with many students spending substantial time accessing various platforms for entertainment, communication, and other activities. A large proportion of respondents had also been exposed to pornographic content, either unintentionally or out of curiosity.

This study found significant associations between media exposure variables and age at menarche. Earlier onset of social media exposure was correlated with younger age at menarche, while longer daily duration of social media use was also associated with earlier menarche. Furthermore, exposure to pornographic content was significantly related to a greater likelihood of experiencing menarche at a younger age. Overall, these results suggest that social media and internet exposure, particularly intensive use and access to adult-oriented content, may contribute to the tendency toward early menarche. The findings highlight the importance of parental supervision of digital media use and early reproductive health education for adolescents.

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