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## Age at menarche and onset of suicide ideation among high-risk girls

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Early adolescence is the developmental period with the highest incidence of suicide ideation (SI), especially among girls, and it is also the time of development when most girls reach menarche, the final stage of puberty. Substantial evidence from community samples shows that younger age at menarche increases risk for developing psychopathology. Fewer studies have examined its relationship with age at onset of psychopathology. These studies suggest that younger age at menarche is associated with younger age at onset of mood and anxiety disorders (Tondo et al., 2017) and substance use (Lanza and Collins, 2002). In one of the few studies on SI, girls with younger age at menarche reported a higher prevalence of past-year SI than girls with normative age at menarche (Lee et al., 2019).

The present study examined the relationship between age at menarche and onset of SI in a clinical sample of adolescents, describing their sequential order, latency, and relationship. Information on physiological markers that signal heightened suicide risk may facilitate the identification of high-risk girls.

Our sample was drawn from a larger study of adolescents, ages 12–19, who presented with SI or a suicide attempt in pediatric emergency departments or a child psychiatry outpatient department from two hospitals between 2012–2014 (Hospital 1) and 2018–2020 (Hospital 2). Hospital 1 was a private hospital in the Washington Heights neighborhood of New York City. Hospital 2 was a public hospital in the Bronx, New York. The study sample included 109 girls (36.7% Hospital 1), mean age (SD) = 15.2 (2.1), who completed two study sessions, 0.5–3 months apart. Racial/ethnic distribution was Latina (68.8%), Black (18.3%), Mixed-race (7.3%), Asian (2.8%), and White (2.8%). An additional 25 girls did not complete the second session and did not differ in demographics or age at SI onset from the study sample.

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CRediT authorship contribution statement

Ana Ortin: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Visualization, Project administration. Regina Miranda: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - review & editing, Visualization, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

None.

In the first session, girls reported their age at SI onset during a semi-structured interview inquiring about their most recent SI. Age at onset of non-suicidal self-injury (NSSI) was assessed via the Self-Injurious Thoughts and Behaviors Interview (Nock et al., 2007). We computed a variable indicating if NSSI onset preceded or occurred in the same year as SI onset ( $n = 45$ ) or whether it occurred after or never ( $n = 64$ ). In the second session, parents ( $n = 74$ ) and girls ( $n = 100$ ) reported on the girls' age at menarche ( $\kappa = 0.85$ ). Eight girls skipped this question, and we used parental report, instead. One girl had not had her period yet.

Age at SI onset ranged from 5–19 years ( $M = 12.4$ ,  $SD = 2.6$ ). Two thirds of the sample had SI by age 13. Age at menarche ranged between 9–16 years ( $M = 11.5$ ,  $SD = 1.5$ ). Twenty-seven girls (24.8%) had SI onset before menarche, an average of 3.9 years earlier than girls with post-menarche SI [9.4 (1.9) vs. 13.4 (2.0);  $t = 8.97$ ,  $p < .001$ ]. Among girls with post-menarche SI ( $n=82$ ), average latency from menarche to SI onset was 2.0 years ( $SD = 1.8$ , range 0–8), with 16 girls reporting SI onset in the same year as menarche. Age at menarche was dichotomized via median split ( $Med = 11$ ). Average age ( $SD$ ) at SI onset among girls with early menarche ( $n = 42$ , 11 years old) was 12.5 (1.9) years, and among girls with normative menarche ( $n = 40$ , > 11 years old), it was 14.3 (1.7) years. In a regression model that adjusted for prior/concurrent NSSI, current age, race/ethnicity, income (below vs. above poverty line), and hospital, girls with earlier menarche had an onset of SI earlier than girls with normative menarche,  $b = -1.19$ ,  $SE = 0.38$ ,  $p = .003$ . This association remained significant after adjusting for current depressive symptoms (Patient Health Questionnaire-Adolescents, PHQ-A),  $b = -1.23$ ;  $SE = 0.38$ ,  $p = .002$ .

Our findings point towards early menarche as a critical time for the development of SI, with most girls starting to think about suicide within two years of menarche. The maturation disparity hypothesis suggests that girls who mature earlier are at higher risk for psychopathology, because they have less time to acquire the cognitive and emotional skills necessary to navigate the expectations and experiences associated with sexual maturity (Ge and Natsuaki, 2009). Additionally, hormonal fluctuations starting around menarche have been linked to increases in negative affect and depressive symptoms (Martel et al., 2009), which could place girls at higher suicide risk. Finally, exposure to early adversity may accelerate the brain and body's maturation, which may account for both the early onset of menarche and SI. A substantial percentage of our sample had SI onset before menarche, which could reflect a genetic predisposition to onset of suicidal behavior in childhood.

Our study is limited by retrospective report of SI and menarche onset. Most measures included in the larger study assessed current state, which, for most girls, did not coincide with either the onset of SI or menarche. Findings require replication with a larger sample that includes measures of the pubertal milestones that precede menarche.

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