



Original article

Gendered Mechanisms Underlie the Relation Between Pubertal Timing and Adult Depressive Symptoms



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ABSTRACT

Purpose: Sex differences in depression emerge in adolescence, in concert with puberty. Off-time maturers, especially early-maturing girls, report more depressive symptoms than their same-sex peers. Recent evidence shows that these pubertal timing effects persist into adulthood, but the underlying mechanisms are unclear.

Methods: Participants were 318 young adults (201 women, 117 men) who rated their depressive symptoms in the past 2 weeks and provided valid retrospective reports of their pubertal timing. Controlling for age, regression analyses were used to examine effects of sex, linear and quadratic pubertal timing, and their interaction on depressive symptoms. (Non)linear indirect effects analyses were used to identify psychological mechanisms (self-perceived masculinity, positive affect, and negative affect) underlying persisting effects, separately for men and women.

Results: For young men, pubertal timing effects on depression were linear, with later maturers reporting more symptoms. Effects were partially explained by late maturers' low self-perceptions of masculinity and low positive affect. For young women, pubertal timing effects on depression were quadratic, with early and late maturers reporting more symptoms than on-time maturers. Effects were partially explained by off-time maturers' high negative affect.

Conclusions: Pubertal timing is related to adult depressive symptoms, but the nature of the link and the mechanisms underlying it differ for men and women. This increases understanding of the long-term consequences of gendered adolescent experiences and may have downstream implications for individualized prevention and intervention through gender-related individual differences that contribute to heterogeneity in depression etiology.

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IMPLICATIONS AND CONTRIBUTIONS

This research contributes to understanding mental health consequences of gendered adolescent experiences. Pubertal timing is related to adult depressive symptoms in different ways and for different reasons in the sexes. This has implications for tailoring prevention and intervention efforts to the unique needs of adolescent and adult males and females.

Adolescence is a critical developmental period for sex differences in mental health [1,2]. Depression is a marked example. Boys and girls do not differ in depression in childhood, but a 2-to-1 female-to-male preponderance emerges in adolescence, coin-

ceding with the onset of puberty, and this disparity persists into adulthood [3–5].

Pubertal timing (when puberty occurs for an individual compared with same-sex peers) is related to depression diagnoses and symptomatology. This is especially true for early-maturing girls, but off-time (early and late) maturers of both sexes are at risk [6–8]. There are several explanations for this (reviewed in [7,9,10]). First, depression is related to increases in gonadal hormones and related factors, such as neural sensitivity to hormones [11]. Second, off-time puberty reflects a disparity in physical and psychological development. Early maturers are more physically

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than psychologically mature, whereas the reverse is true for late maturers. Third, early maturers, especially girls, are the first among their peers to undergo puberty and its social sequelae (e.g., attracting attention from older peers). Fourth, puberty intensifies childhood adjustment problems, which might be context dependent more common in those who subsequently have off-time puberty [12].

Most work on pubertal timing and depression is limited to adolescence, but there is emerging evidence that effects persist into adulthood, particularly for women who matured early and for men who matured late [13–15]. These findings converge across methods and measures. Although there have been some failures to replicate [16,17], they were restricted to age at menarche measures, which are not especially reliable [18], and they had substantial missing data. All studies (whether they detected significant effects or not) created categorical pubertal timing groups (i.e., early, on-time, late) for analyses. Although this has some benefits, it reduces the dimensionality of the data, instituting strict cutoffs between similar scores and potentially obscuring effects. Further research is needed.

Biological explanations for persisting pubertal timing effects on adult depression come from experimental evidence in rodents. Puberty may be a second (following the prenatal) period of organizational (i.e., permanent) sex hormone effects on the brain, which has decreasing sensitivity to hormones throughout adolescence [11]. If this occurs in human beings, then the timing of exposure to pubertal hormones (androgens for boys, estrogens for girls) is important, resulting in greater masculinization of the brain for earlier maturing men and greater feminization for earlier maturing women. Thus, in adulthood, individuals with early timing should be more sex-typed than individuals with late timing. Findings of increased female-typed depression in early maturing women and late maturing men are consistent with this notion.

Persisting effects of pubertal timing on adult depression might also be downstream psychosocial consequences of adolescent behavior problems associated with puberty. There are several ways in which these effects could occur. For example, compared with on-time and late maturers, early maturing girls spend more time with older peers, have more sexual partners, and have more tumultuous relationships with their parents, and as adults, might be less likely to have satisfying relationships and more likely to suffer from depression [13,14,19]. Furthermore, compared with early and on-time maturers, late maturing boys are more likely to have a low body mass index (BMI) and to be self-conscious with low self-esteem, and as adults, might be more likely to be depressed [14,15,20].

There is some speculation, but limited empirical investigation of the psychological mechanisms underlying pubertal timing links to adult depression [21]. Positive and negative affect are possible mechanisms that are uniquely related to depression [22,23]. This can be seen in the diagnostic criteria for major depressive disorder, with some symptoms reflecting low positive affect (e.g., anhedonia) and others high negative affect (e.g., feelings of worthlessness [24]). Psychometric work, however, shows stronger associations of high negative than low positive affect with depression [25]. Clinical work supports this, with depressed pubertal girls reporting the highest rates of negative affect (compared with controls, boys, and prepubertal girls [23]).

Self-perceived masculinity is another possible mechanism. Regardless of biological sex, high psychological masculinity is associated with high self-esteem and with low depression [26,27].

Among men, early maturers display more dominance and less succorance (e.g., seeking of encouragement) than late maturers [28]. Also, the association between late pubertal timing and adult depression was partially accounted for by boyhood BMI, suggesting that late maturers are depressed in part because they are smaller and perceive themselves to be less masculine than their early maturing peers [15].

Current study

The aim of the current study was to examine the association between pubertal timing (measured and modeled continuously) on adult depressive symptoms, and to explore the potentially sex-specific psychological mechanisms underlying the relation. To accomplish this, a sample of young adults varying in pubertal timing were studied. Women were hypothesized to report more depressive symptoms than men. Furthermore, early maturing women, but late maturing men were hypothesized to report higher levels of depressive symptoms than their same-sex peers. Finally, psychological mechanisms were hypothesized to be indirect effects, underlying associations between pubertal timing and depressive symptoms, separately for men and women. Past work is limited, but affect was expected to be important for women, and masculinity to be important for men.

Method

Participants and procedure

Three hundred twenty young adults (203 women and 117 men) completed a supervised 1-hour online survey in a research laboratory for course credit. They were undergraduate students recruited from a university subject pool based on their age and responses to the pubertal timing measure described later, which was administered in a screening questionnaire. Participants had to be at least 18 years old, and those with early and late puberty were oversampled to avoid range restriction, since on-time maturers were predominant in the population. Of those who completed the screening questionnaire, 38% of early and late maturers, but only 18% of on-time maturers ultimately participated in the study.¹ The study was approved by the university's institutional review board.

Participants in the final sample were between 18 and 32 years old ($M = 19.48$, standard deviation [SD] = 1.54); data from two women, who were distracted or did not understand directions, were excluded. Men ($M = 20.05$, $SD = 1.96$) were older than women ($M = 19.14$, $SD = 1.12$), $t(316) = 5.27$, $p < .001$, $d = .57$. Most were Caucasian (91%) and in their first year of college (74%). Pubertal timing and cognition data from this sample are reported elsewhere [29].

Measures

Retrospective pubertal timing was assessed using a self-report measure [29]. Female participants indicated on a scale from 1 (*much earlier than peers*) to 5 (*much later than peers*) when they had their first period, noticeable breast development, teenage growth spurt, and bra purchase. Male participants indicated on the same scale when they had their first wet dream, beard growth, teenage growth spurt, and voice cracking. A composite score was

¹ Not all screened students (about 1,500) had the opportunity to participate.

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