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Association between early menarche and suicidal behaviors in Korean girl adolescents

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Abstract

Early menarche can be the socio-psychological problems. We studied the association between early menarche and suicidal risk behaviors among South Korean girl adolescents using national-wide data.

Web-based self-report data from 2006 to 2015 the Korea Youth Risk Behavior Web-based Survey data were used in this study. Menarche status was divided into an "early menarche" group (at <12 years of age) versus "not early" menarche group (at ≥12 years of age).

Participants with adolescent girls with early menarche group showed a higher prevalence of substance use, higher levels of stress, poorer self-rated health status, unhappier perceiveness, more frequent depressed mood, inter-sexual kissing or petting, inter-sexual intercourse, homosexual kissing or petting, being the victim or the assailant of sexual assaults, sexual transmitted diseases experience, pregnancy, and abortion experience than the not early menarche group. Adolescent girls with early menarche who had suicidal ideation (25.4% vs 22.2%, $P < .001$), suicidal plans (4.1% vs 2.6%, $P < .001$), and suicidal attempts (6.8% vs 5.2%, $P < .001$) were higher than that in the adolescent girls with not early menarche. A multivariate analysis after adjusting revealed that the odds ratios for suicidal ideation, plans, and attempts were 1.07 (95% confidence interval [CI]: 1.05–1.10), 1.35 (95% CI: 1.28–1.41), and 1.13 (95% CI: 1.09–1.18), respectively.

Adolescent girl with early menarche was associated with suicidal behaviors.

Abbreviations: CI = confidence interval, KYRBWS = Korea Youth Risk Behavior Web-based Survey.

Keywords: adolescent, early menarche, suicide

1. Introduction

Suicide is a common death problem worldwide including South Korea. Suicidal behaviors were prevalent among especially in female adolescents, and is a significant predictor of future suicide attempt and suicidal death.[1]

Adolescents experience that situational critical period with both physiological and psychological changes.[2] Therefore, girls with menarche exhibit psychological instability and a change in social responses.[3] Menarche is the most important female reproductive system changes happening during adolescence for the females.[4] Early menarche may impact on adolescents girl psychopathology such as depression and anxiety, than other girls with average menarche.[5,6] Eventually, these psychiatric symptoms could cause more serious results, such as suicidal ideation, plans, and attempts. Studies on suicidal ideation, early menarche girls reported a higher prevalence of suicidal ideation than not early menarche girls.[3,7] Previous Korean study showed that early menarche girls with earlier menarche than average have a higher risk for suicidal ideation,[3] but this study adjusting age, stress, depression only, and only showed suicidal ideation. So this study investigated whether there are associations between early menarche and suicidal behaviors (ideation, plans, and attempts) among Korean girl adolescents using multiple confounding variables which may affect suicidal behaviors.

2. Methods

2.1. Study participants

The study data were gained from the 2006 to 2015 Korea Youth Risk Behavior Web-based Survey (KYRBWS), which was a national-wide survey that investigated various health-related behaviors of 12 to 18-year-old Korean adolescents. KYRBWS survey procedures were anonymous and voluntary, and informed consent was provided by the parents or legal guardian of each participant. The KYRBWS received the Korea Centers for Disease Control and Prevention IRB approval from 2006 to 2014. From 2015, the ethics approval for the KYRBWS was waived by the Korea Centers for Disease Control and Prevention IRB under the Bioethics & Safety Act and opened to the public for academic use.

Editor: Wen-Jun Tu.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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How to cite this article: Kim SR, Lee S, Chung JH. Association between early menarche and suicidal behaviors in Korean girl adolescents. Medicine 2021;100:38(e27301).

Received: 5 April 2021 / Received in final form: 18 June 2021 / Accepted: 2 September 2021

http://dx.doi.org/10.1097/MD.0000000000027301

Adolescents girls who did not provide menarche records and adolescents girls who had not undergone menarche at the time of the investigations were excluded. Ultimately, 367,314 adolescents girls with early menarche (n = 81,120) and not early menarche adolescents girls (n = 286,194) were included in the final analyses.

2.2. Socioeconomic and demographic factors

The self-reported KYRBWS questionnaires data were used to gain information on socioeconomic variables (age, school type [middle, high, vocational high], residence area, living with parents, subjective academic achievements, parental education level, and household income), health behavioral factors (smoking, alcohol, and exercise), psychological factors (substance use, self-rated stress, health status, happiness, weekday sleep duration, sleep satisfaction, depression, and suicidal behaviors [ideations, plans, and attempts]), and sexual behaviors (inter-sexual and homosexual kissing, petting, intercourse, being the victims or assailants, pregnancy, sexual transmitted diseases experience, and abortion experience). The residence area was categorized as urban or rural. Suicidal behavior is associated with some health behavioral factors, such as smoking,[8] alcohol,[9] and exercise status.[10] Thus, this study investigated and adjusted above health behavioral factors. Socioeconomic status might be another important risk factor for suicidal behavior.[11] Residential area was divided into "urban" and "rural". Smoking status was determined by smoking cigarette more than 1 day in the last month.[12] Alcohol drinking was determined by the drink alcohol more than 1 day in the last month were classified into the alcohol group.[12] Regular exercise was defined as <3 times/week or ≥3 times/week activity that increases heart rate or respiration rate at least 1 hour per day in the last 7 days.[13] Father's and mother's educational status were defined as "less than high school" and "more than university". The student's academic achievements status was categorized as "poor", "average", and "well", and the family income was classified as "low", "moderate", and "high". The timing of sexual intercourse was categorized as sexual intercourse experiences occurring during elementary school (grades 1–6) or during middle/high school (grades 7–12), as described previously.[14] Sexually transmitted diseases (gonorrhea, syphilis, genital warts, urethritis, pelvic inflammatory disease, AIDS, etc) experiences were based on whether the student's self-reports survey.

2.2.1. Menarche measures. Based on the cutoff value of previous studies,[15,16] our study menarche groups were divided into an early menarche (at <12 years of age) group versus "not early" menarche (at ≥12 years of age) group. Adolescents girls who had not undergone menarche at the time of the survey were excluded from the study.

2.2.2. Mental health measures. Mental health status was obtained in all participants. Self-rated stress status, health status, and happiness were categorized. Illicit drug experience (glue, butane gas, stimulants, marijuana, amphetamine, heroin, high-dose cold medicine or anxiolytics for mood elevation, hallucinations, or excessive dieting) was categorized as "never experienced" or "ever experienced".[17]

Depression was defined with Korean version World Health Organization Composite International Diagnostic Interview-short Form question ("In your lifetime, have you ever had more than 2 weeks where you felt sad, blue, or depressed during the previous year?"), which has been validated as a cost-effective screening tools for health surveys.[18] Suicidal ideation was defined as thinking about committing suicide in the last 12 months. This indicator is a well-validated predictor of suicide attempts that has been used in other surveys.[19] Suicidal plans were defined as planning to commit suicide in the last 12 months and suicidal attempts were defined as trying to commit suicide in the last 12 months.

2.3. Data analysis

All sampling and weighted variables were surveyed using SPSS statistics programs (SPSS Inc., Chicago, IL). Descriptive statistical methods were used to describe the basic characteristics of the study adolescents; the numbers and percentages are reported for each variable. Multiple logistic regression analysis with complex sampling adjusted for age, school type, residence area, family structure, family affluence scale, smoking, alcohol, regular exercise, sleep duration and satisfaction, substance use, sexual experience, perceived stress and health status, and depressive mood. P values $<.05$ were considered statistically significant.

3. Results

The baseline characteristics of the study population (N = 367,314) are presented in Table 1. Adolescents girl with early menarche (n = 81,120) and not early menarche (n = 286,194). Adolescent girls with early menarche group showed more living in urban area, more living with both parents, more alcohol and smoking habits, and higher household income than adolescent girls with not early menarche group. Differences in mental health status between the adolescents with early and not early menarche are presented in Table 2. The adolescent girls with early menarche reported less sleep, lower sleep satisfaction, more substance use, higher levels of moderate to severe stress, poorer perceived health status, unhappier perceiveness, and a more frequent depressed mood compared to the adolescent girls with not early menarche group. The proportion of adolescent girls with early menarche who had suicidal ideation (early menarche, 25.4%) was higher than that in the adolescent girls with not early menarche (22.2%; $P < .001$). The proportion of adolescent girls with early menarche who had suicidal attempts (early menarche, 6.8%) was higher than that in the adolescent girls with not early menarche (5.2%; $P < .001$). The proportion of adolescent girls with early menarche who had suicidal plans (early menarche, 4.1%) was higher than that in the adolescent girls with not early menarche (2.6%; $P < .001$). Differences in sexual behaviors between the adolescents with early and not early menarche are presented in Table 3. The early menarche group showed significantly higher inter-sexual kissing or petting, inter-sexual intercourse, homosexual kissing or petting, being the victim or the assailant of sexual assaults, sexual transmitted diseases experience, pregnancy, and abortion experience than the not early menarche group. The odds ratios of suicidal ideation, plans, and attempts among the adolescent girls with early menarche compared to those adolescent girls with not early menarche are shown in Table 4. A multivariate analysis after adjusting revealed that the odds ratios for suicidal ideation, plans, and attempts were 1.07 (95% confidence interval [CI]: 1.05–1.10), 1.35 (95% CI: 1.28–1.41), and 1.13 (95% CI: 1.09–1.18), respectively.

Table 1

Clinical, socioeconomic and demographic characteristics of study populations.

	Not early menarche (n = 286,194)	Early menarche (n = 81,120)	*P* value
Age	15.1 ± 1.7	15.1 ± 1.8	.027
School			<.001
Middle school	135,566 (47.4)	41,184 (50.8)	
Academic high school	112,459 (39.3)	30,394 (37.5)	
Vocational high school	38,169 (13.3)	9542 (11.7)	
School type			<.001
Girl school	109,808 (38.4)	30,142 (37.2)	
Coeducation	177,386 (61.6)	50,978 (62.8)	
Residence			<.001
Rural	35,277 (12.3)	8886 (11.0)	
Urban	250,917 (87.7)	72,234 (89.0)	
Living with both parents			<.001
No	12,418 (4.3)	4373 (5.4)	
Yes	273,776 (95.7)	76,747 (94.6)	
Subjective academic achievement			<.001
Poor	105,476 (36.9)	28,839 (35.6)	
Average	80,850 (28.3)	21,574 (26.6)	
Well	99,868 (34.9)	30,707 (37.9)	
Alcohol	56,734 (19.8)	16,628 (20.5)	<.001
Smoking	19,167 (6.7)	6244 (7.7)	<.001
Exercise	62,941 (22.0)	19,803 (24.4)	<.001
BMI	20.1 ± 2.6	21.2 ± 2.6	<.001
Father education level			.725
Less than high school	169,709 (59.3)	48,159 (59.4)	
More than university	116,485 (40.7)	32,961 (40.6)	
Mother education level			<.001
Less than high school	200,324 (70.0)	56,262 (69.4)	
More than university	85,870 (30.0)	24,858 (30.6)	
Household income			<.001
Low	66,341 (23.2)	20,538 (25.3)	
Moderate	145,033 (50.7)	38,987 (48.1)	
High	74,820 (26.1)	21,595 (26.6)	

BMI = body mass index.

4. Discussion

The aim of this study was to investigate the relationship between early menarche and suicidal behaviors among girls. In our study, early menarche was associated with suicidal behaviors even after adjusting for multiple confounding variables, including depression. This might support the connection between early menarche and suicidality. In our study, early menarche was positively associated with suicidal ideations, plans, and attempts among Korean adolescent girls. Compared with not early menarche group, the likelihood for suicidality increased approximately 1.07 (suicidal ideations), 1.35 (suicidal plans), and 1.13 (suicidal attempts) times among early menarche group after adjustment, respectively. Our study also showed on the relationship between early menarche and sexual behaviors.

Our study results could explain whether early menarche might be a critical time for suicidal behaviors. The maturation disparity hypothesis suggests that early menarche girls are at higher risk for psychopathology because they have less time to get the cognitive insights and emotional experiences necessary to cope with sexual maturity.[20] The present study is more meaningful because the data were obtained from a representative consecutive survey throughout Korea from 2006 to 2015.

Our study showed that early menarche group showed more depressive traits compatible with other study that early menarche was a risk factor for psychological symptoms such as depression, disruptive behavior, and self-harming behaviors.[21] Study based on UK cohort also suggests that female adolescents who have early menarche group were more likely to have increased level of depressive symptoms.[22] Psychological symptoms associated with early menarche are mediators that can increase the risk of suicide in female adolescence.[21,23,24] Besides, sex hormone fluctuations from menarche initiation have been associated with increases in negative effect and depressive symptoms,[25] which could place girls at higher suicide risk.

Our study results indicate that an independent relationship exists between early menarche and suicidal ideation after adjusting for multiple confounding factors, including depression. A review of the relationship between early menarche and psychopathology suggested that early menarche induced gonadal hormone may affect adolescent neural development, increasing the vulnerability to psychopathology.[26] These results suggest that the factors, such as the increment of biological vulnerability to suicidal ideation due to early exposure of sexual hormone, are associated. Girls with early menarche experience a rapid change in body shape in preparation for sexual activity. Due to these changes, they may feel more pressure to change their lifestyle as well as more fear and embarrassment than their peers.[27] Although girls with early menarche have reached physical maturation, it may not be accompanied by emotional maturation; therefore, they are likely to feel negative effects, for example,

Table 2

Psychosocial characteristics of patients.

	Not early menarche (n = 286,194)	Early menarche (n = 81,120)	*P* value
Substance use	2019 (0.7)	1134 (1.4)	<.001
Perceived stress			<.001
Severe to very severe	141,098 (49.3)	42,646 (52.6)	
Moderate	111,107 (38.8)	29,761 (36.7)	
None to mild	33,989 (11.9)	8713 (10.7)	
Perceived health status			<.001
Good	176,249 (61.6)	47,459 (58.5)	
Fair	85,173 (29.8)	25,024 (39.8)	
Poor	24,772 (8.7)	8637 (10.6)	
Sleep duration	5.7 ± 1.3	5.6 ± 1.3	<.001
Sleep satisfaction			<.001
Not enough	127,817 (44.7)	38,101 (47.0)	
Moderate	94,172 (32.9)	25,912 (31.9)	
Enough	64,205 (22.4)	17,107 (21.1)	
Perceived happiness			<.001
Happy	152,633 (53.3)	41,935 (51.7)	
Moderate	95,010 (33.2)	26,904 (33.2)	
Unhappy	38,551 (13.5)	12,281 (15.1)	
Experiences of depressive mood for 2 or more continuous weeks	114,700 (40.1)	34,241 (42.2)	<.001
Suicidal ideations	63,621 (22.2)	20,586 (25.4)	<.001
Suicidal attempts	14,839 (5.2)	5484 (6.8)	<.001
Suicidal plan	7312 (2.6)	3308 (4.1)	<.001

Table 3

The effect of early menarche on the sexual behaviors.

	Not early menarche (n = 286,194)	Early menarche (n = 81,120)	*P* value
Inter-sexual kissing or petting	31,552 (11.0)	9785 (12.1)	<.001
Sexual intercourse experience	7287 (2.5)	3626 (4.5)	<.001
First sexual intercourse			
Elementary school	933 (12.8)	1049 (28.9)	<.001
Middle/high school	6364 (87.2)	2577 (71.1)	<.001
Homosexual kissing or petting	1851 (0.6)	1083 (1.3)	<.001
Victims of sexual assault	2940 (1.0)	1405 (1.7)	<.001
Assailants of sexual assault	597 (0.2)	469 (0.6)	<.001
History of pregnancy	1742 (0.6)	926 (1.1)	<.001
Sex education experience	200,340 (70.0)	58,068 (71.6)	<.001
Sexual transmitted diseases experience	69 (0.1)	131 (0.2)	<.001
Abortion experience	306 (0.1)	414 (0.5)	<.001

Table 4

Adjusted relative odds (95% CI) on multivariate analysis of the association between early menarche and suicidal ideations and suicidal attempts.

	Adjusted ORs (95% CI)
Suicidal ideations	
Not early menarche	Reference
Early menarche	1.07 (1.05–1.10)
Suicidal plans	
Not early menarche	Reference
Early menarche	1.35 (1.28–1.41)
Suicidal attempts	
Not early menarche	Reference
Early menarche	1.13 (1.09–1.18)

Adjusted for age, school type, residence area, family structure, family affluence scale, smoking, alcohol, regular exercise, sleep duration and satisfaction, substance use, sexual experience, perceived stress and health status, and depressive mood.
CI = confidence interval, OR = odds ratio.

depression.[22] In particular, when facing stressful life events, a risk-taking cognitive strategy is used because the less mature cognitive maturation versus physical maturation can affect their ability to adapt to changes in other aspects compared with their peers, and self-regulation could be decreased.[27] This discrepancy between physical maturation and emotional/cognitive maturation might be associated with suicidal ideation in girls with early menarche.

Early exposure to sexual hormones by earlier menarche could increase the vulnerability of the developing brain of adolescents to psychopathology.[28] The increase in gonadal steroid hormones during puberty affects the organization of the developing brain.[29] The organizing and activational effects of gonadal steroid hormones cause a continuous change in the brain structure. Because the developing brain is more sensitive to organizing effects, early exposure to gonadal hormones by early puberty increases the risk for increased psychopathology in adolescents.[30] There is a difference in the maturation process

between the following 2 neural systems associated with the dopaminergic pathway during puberty: the prefrontal cortex, which is related to cognitive control, and the subcortical limbic region, which is related to arousal and impulsivity.[31] The maturation of the subcortical limbic region tends to be normally delayed relative to the maturation of the prefrontal cortex.[32] Earlier exposure to gonadal hormones may further exacerbate this discrepancy in adolescents. Decreased inter-connection between the abovementioned brain areas could cause impulsive and risk-taking in adolescents with early pubertal timing.[32] Early exposure to gonadal hormones could be relevant to the results of this study, which found a higher risk of suicidal ideation in girls with early menarche. However, further research and biological evidence of this association are necessary.

The present study had several limitations. First, its cross-sectional nature limited our certainty about the relationships of early menarche and suicidal behavior. Second, this survey was conducted in a school computer room and the data were collected by self-report questionnaires only. Because certain sensitive questions, such as those relating to suicidal behavior and psychosocial factors, may have influenced student's replies based on their peer group, bias cannot be ruled out. Second, this study did not adjust the family history of suicidal behaviors and other several cofounding factors need to be adjusted. This must be taken into account when considering the risk factors for suicidal risk and other risk taking behaviors.

Nevertheless, this survey used a large and representative sample of Korean adolescents, and all analyses were based on sample weights and adjusted for multiple confounding risk factors for suicidal behavior, including depression. Thus, these results can be generalized to the entire Korean girl adolescent population.

In conclusion, early menarche was associated with the risk of suicidal behavior. Future prospective studies are required in the early menarche fields, as well as studies aimed at developing preventive strategies to decrease suicidal behavior. Thus, public health professionals must be assessed not only for physical health but also for psychological problems. Collaboration between allergists and mental health professionals is expected to lead to synergistic mental health care of patients with early menarche.

Author contributions

All authors contributed conception, analysis, interpretation, revising, and final approval of the manuscript. SR Kim take responsibility for the integrity of the data and the accuracy of the data analysis. JH Chung and SJ Lee served as a principal investigator and had full access to all of the data in the study.
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