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Menstrual Patterns and Age of Menarche in Young Women from the United States

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ABSTRACT

Background
Menarche is a salient event for adolescents that marks the beginning of reproductive life and the commencement of menstrual cycles. Despite this, much less is known about how the timing of menarche is related to menstrual patterns.

Methods
To that end, a cross-sectional sample of 523 young women in college from the United States provided data on menarcheal age, menses and cycle length, blood loss during menses, dysmenorrhea, and menstrual cycle regularity. Sociodemographic data such as age of first sexual intercourse, presence of biological father while growing up, self-reported body weight, and urban *versus* rural place of residence were also obtained.

Results
Mean menarcheal age was 12.89±1.31-years. Regarding cycle length, 42 (8.2%) of the women had cycles shorter than 21-days, 402 (78.2%) between 21 and 35-days, and 70 (13.6%) had cycles longer than 35-days. Concerning menorrhagia, 61 (11.8%) reported a small quantity of blood loss, 363 (70.1%) a medium quantity, and 94 (18.1%) reported a large loss of blood (menorrhagia). Duration of menstrual bleeding also showed variability with 33 (6.4%), 280 (54.2%), and 204 (39.5%) reporting menstrual bleeding lasting less than 3-days, 2 to 5-days, and greater than 5-days, respectively. The overall prevalence of dysmenorrhea was 61.7% (n=319) of the sample, while 36.3% (n=187) reported irregular menstrual cycles. Logistic regression indicated that early menarche, long menses duration, large self-reported amount of blood loss, and early age of first sexual intercourse were significant predictors of dysmenorrhea, while women with small self-reported amount of blood loss, a short menses duration, and long cycles were less likely to have dysmenorrhea. Concerning the timing of menarche, participants who were over-weight, grew up in urban environments, had dysmenorrhea, had early first consensual sexual intercourse, and grew up without a biological father, were more likely to have early menarche.

Conclusion
These findings suggest that menstrual disorders are common among a sample of young women from the United States and also identify sociodemographic variables that are related to menarcheal age.

Keywords
Dysmenorrhea; Menarche; Menstrual cycle; Menstrual patterns.

INTRODUCTION

Pubertal maturation is a prolonged transitional developmental period that culminates with adult-like anatomical and hormonal changes and the potential to bear offspring. In women, one of the hallmarks of this pubertal period is menarche or the onset of the monthly shedding of the endometrium. Menarcheal age has been decreasing in industrialized countries and is approximately 12 to 13-years of age and has perhaps stabilized.[1] This secular decline in menarcheal age has a multi-factorial etiology, having been attributed, most commonly, to better nutrition and a higher percentage of body fat,[2] but also to endocrine-disrupting chemicals in the environment,[3] or even growing up in father absent households.[4] Menstrual cycle and menses lengths show much variability, but most ovulatory cycles are between 21 to 34-days and menstrual flows last 3 to 7-days.[5,6] Frequently reported gynecological problems include dysmenorrhea (menstrual pain), menorrhagia (excessive menstrual bleeding), and oligomenorrhea (irregular menstrual cycles).

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Dysmenorrhea is characterized by pelvic pain of uterine origin occurring during, or just before, menstruation and often includes headaches, vomiting, and diarrhea during the early follicular period. Primary (without organic disease) dysmenorrhea is a frequently reported menstrual issue,[7] with samples of young women finding a very high prevalence of dysmenorrhea ranging from 70% to as high as almost 90% of participants,[5,8-12] including a 76% prevalence from a sample of over 150,000 Chinese women recruited using a mobile application (APP).[13] Menorrhagia (excessive/heavy menstrual bleeding), although not as prevalent as dysmenorrhea, still ranges from approximately 20-50% of adolescents and young women[9,14] and is often associated with dysmenorrhea,[10,15] as well as iron deficiency and anemia.[16]

Oligomenorrhea shows substantial variation with irregular cycles occurring in approximately 10-15% of sampled women.[17,18] Irregular cycles are related to age of menarche, chronological age, and even body mass index (BMI).[19] Although oligomenorrhea is common in healthy adolescents shortly after menarche,[20] early irregular cycles can be predictive of polycystic ovary syndrome,[21] cardiovascular and metabolic problems,[22] and reduced fertility.[17] Gardner examined adolescent (menarche to age 18) menstrual cycle characteristics in 54 women, finding that young post-menarcheal women with irregular menstrual cycles and dysmenorrhoea later had poor gynecological health in the second and third decades post-menarche.[23] Adolescents with irregular cycles also take longer to show endocrine profiles and ovarian morphology of adult women.[24]

Menarche and Menstrual Patterns

The age at which adolescents reach puberty is associated with later ovarian functioning and reproductive health. A later age of menarche correlates with more irregular and longer menstrual cycle lengths,[6,19,25,26] anovulatory cycles,[27] and a longer menses duration.[25] Low body weight and late age of menarche[25] have also been associated with longer and irregular periods of menstrual bleeding.[28]

Experiencing an early menarche has been associated with dysmenorrhea,[26,29,30] earlier regular cycling,[31] early onset of ovulatory cycles,[32] high serum estradiol levels,[32] and breast cancer,[33] while low estrogen metabolite levels in late menarche women.[34] However, when controlling for gynecological age, age of menarche was not associated with oligomenorrhea and menstrual cycle irregularity.[35]

Current Study

The current study sought to explore the relationship between menarcheal age and menstrual patterns, such as the prevalence of dysmenorrhea, menorrhagia, and oligomenorrhea in young reproductive-age women from northeastern United States. Given the consequences of menstrual dysfunction (e.g., depression, anxiety, and absenteeism) and correlates with later reproductive life (e.g., reduced fertility and reproductive cancers), this information is valuable for mental health practitioners and gynecologists.

The current study is also important in that numerous sociodemographic variables linked to the timing of puberty were examined, such as early rearing environment (rural *vs.* urban), self-reported obesity, presence or absence of biological father, and age of first consensual sexual intercourse. Briefly, urban adolescents generally reach menarche before those who grew up in more rural environments,[36,37] but not always,[38] and this disparity may be declining.[1] It is also well-established that puberty is linked to adiposity, with higher BMI adolescents generally reaching menarche earlier.[2,39] Adolescents from father-absent families tend to reach sexual maturity earlier than adolescents from intact families, a finding in the literature that has been reported,[4] although the etiological explanation is debatable. Finally, early menarche is associated with the milestone of first sexual intercourse or coitarche.[40,41]

MATERIALS AND METHODS

Participants

A cross-sectional descriptive design was employed to study participants from northeastern United States. Menarche and menstrual cycle data were obtained from an *ad hoc* sample 523 female college students taking Introductory Psychology at the author's university. Participants ranged in age from 18 to 33-years (mean=20.32, median=19.58) and consisted of 439 Caucasian participants (86.9%), 21 African-American participants (4.0%), 17 Asian or Pacific Islander participants (3.3 %), 14 Native American participants (2.5%), and 9 Hispanic participants (1.7%); race information was unavailable for 16 participants. The median time interval since menarche and survey completion was 7.42-years. All participants were compensated with course credit for participating in the Institutional Review Board (IRB)-approved study that was performed in accordance with the 1964 Declaration of Helsinki.

MATERIALS AND PROCEDURE

Self-report data were obtained *via* a questionnaire from participants about age and month of menarche, sociodemographic variables, and menstrual cycle characteristics. Menarche is a salient event for adolescents, thus increasing the accuracy of this self-report data.[42] Participants provided data on menstrual cycle length (in days: <21, 21-35, and >35), menses length (in days: <3, 2-5, and >5), blood flow at menses (small, medium, and large), dysmenorrhea (yes or no), and experiencing regular menstrual cycles (yes or no). Participants responded to questions about dysmenorrhea and regularity of cycles using a Likert scale, for example, "On a scale from 1 to 10, circle a number indicating the severity of your regularly experienced premenstrual symptoms such as breast tenderness or swelling, "bloating", cramps, depressed mood, anxiety, anger and irritability, lack of energy, changes in appetite, or a sense of being overwhelmed. (not noticeable 1 2 3 4 5 6 7 8 9 10 very severe)". Other reproduction-related and demographic variables measured included information on first consensual sexual intercourse, self-reported body weight, and living environment.

Statistical Analyses

The Statistical Package for Social Sciences (SPSS) version 29 was used for all data analysis. Descriptive statistics included frequencies, means, and standard deviations. Where appropriate, mean

differences were examined with one-way analysis of variances (ANOVAs), and univariate logistic regression was used to identify significant predictors of dysmenorrhea. Results were deemed statistical significance at $p<0.05$.

RESULTS

The mean menarcheal age was 12.89±1.31-years, with 283 participants (54.8%) having early menarche (<13-years) and 233 (45.2%) having late menarche (>13-years). Regarding cycle length, 42 (8.2%) of the women indicated cycles shorter than 21-days, 402 or 78.2% had cycles between 21 and 35-days, while 70 participants (13.6%) indicated a cycle length longer than 35-days. Concerning menorrhagia, 61 (11.8%) reported a small quantity of blood loss, 363 (70.1%) a medium quantity, and 94 (18.1%) reported a large loss of blood (menorrhagia). Duration of menstrual bleeding also showed variability with 33 (6.4%), 280 (54.2%), and 204 (39.5%) reporting menstrual bleeding lasting less than 3-days, 2 to 5-days, and greater than 5-days, respectively. The overall prevalence of dysmenorrhea was 61.7% (n=319) of the sample, while 36.3% (n=187) reported irregular menstrual cycles.

Sixty-one participants (11.8%) grew up in an urban environment, 321 (62.2%) in a suburban environment, and 134 participants (26.0%) in a rural environment. Concerning the age of first consensual sexual intercourse, 355 participants (67.9%) self-reported that they had engaged in consensual sexual intercourse, with a mean age of 17.23 and a range from 13.0 to 24.83-years. The mean number of sexual partners was 4.29. Meanwhile, 168 participants (32.1%) had never engaged in consensual sexual intercourse. Finally, there were 91 participants (17.4%) who grew up without a biological father in the household and 412 participants (78.8%) who grew up in intact households.

Dysmenorrhea

Given that dysmenorrhea is especially problematic for young women, putative predictors of dysmenorrhea were investigated using logistic regression. Demographic variables of age, birth season, living environment, body weight, ethnicity, and oral contraceptive use did not predict dysmenorrhea. Results indicated, though, that early menarche (<13-years, OR=1.64), long menses duration (>3-days, OR=1.72), large self-reported amount of blood loss (OR=2.79), and early age of first sexual intercourse (<17-years, OR=1.78), were related to an increased risk of dysmenorrhea. Small self-reported amount of blood loss (OR=0.258), a short menses duration (OR=0.431) and long overall menstrual cycles (OR=0.597) were associated with a reduced risk of dysmenorrhea (Table 1).

Age of Menarche

ANOVAs with Bonferroni corrections were conducted to determine if menarcheal age varied as a function of any of the above reproductive-related factors. Menarcheal age varied according to self-reported body weight (under-weight: 13.39-years, average-weight: 12.83-years, over-weight: 12.41-years), $F(2, 513)=12.36$, $p<0.001$, with all Bonferroni comparisons being significant. Women growing up in urban environments (M=12.41) had an earlier menarche than women growing up in either suburban (M=12.95, $p=0.004$) or rural environments (M=12.96, $p=0.007$), $F(2, 509)=4.41$, $p=0.013$. Finally, there was an effect of ethnicity on menarcheal age, ($F(3, 505)=6.65$, $p<0.001$), such that Hispanic participants (M=11.84) had an earlier menarche than Caucasian participants (M=12.99, $p=0.002$), but not African-American participants (M=12.34, $p>0.05$).

Blood loss was related to menarcheal age ($F(2, 511)=3.45$, $p=0.032$), with women reporting large blood loss having an earlier menarche (M=12.59) than small blood loss (M=13.08, $p=0.022$) and medium blood loss (M=12.93, $p=0.020$). Of those participants who reported having had engaged in sexual intercourse, coitarche age (M=17.18 years) positively correlated with menarcheal age, r=0.189, $p<0.001$. Participants with early coitarche (<17-years) had earlier menarche (M=12.66) than those with a later age of coitarche (M=13.01, $p=0.013$) and those who had never engaged in intercourse (M=12.97, $p=0.015$). Menarcheal age differences were not present for any of the other reproductive-related variables (Table 2 for correlates of menarcheal age). When these variables were entered into a linear (stepwise) multiple-regression, only bodyweight ($\beta=-0.481$, $p<0.001$), biological father present or absent ($\beta=0.425$, $p=0.005$), and dysmenorrhea status ($\beta=-0.255$, $p=0.032$) remained significant.

Table 1. *Reproductive-Related Risk Factors for Dysmenorrhea*

Predictors	n	β	OR (95% CI)	p
Age at Menarche				
> 13 (late)*	233		1.00	
< 13 (early)	283	0.496	1.64 (1.15-2.35)	0.007
Cycle Length				
21-35 (average)*	402		1.00	
< 21 (short)	42	-0.327	0.721 (0.377-1.38)	0.323
> 35 (long)	70	-0.515	0.597 (0.358-0.996)	0.048
Regularity				
Regular*	328		1.00	
Irregular	187	-0.251	0.778 (0.538-1.124)	0.182
Blood Duration				
3-5 days*	280		1.00	
< 3 days	33	-0.842	0.431 (0.203-0.915)	0.029
> 5 days	204	0.544	1.72 (1.17-2.53)	0.005
Blood Loss				
Medium*	363		1.00	
Small	61	-1.36	0.258 (0.143-0.465)	<0.0001
Large	94	1.03	2.79 (1.58-4.92)	<0.0001
First Sexual Intercourse				
No coitus*	168		1.00	
< 17 years (early)	162	0.577	1.78 (1.13-2.80)	0.012
> 17 years (late)	192	0.329	1.38 (0.909-2.12)	0.128

*Note. n=sample size; β=beta weight; OR=odds ratio; p=p-value; *=Referent category.*

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Table 2. *Menarcheal Age as a Function of Relevant Study Variables*

Variable	M (SD)	F	p	η_p^2
Body Weight				
Body Weight	13.39 (1.41)	12.36	<0.001	0.046
Average	12.83 (1.28)			
Over	12.41 (1.04)			
Residence				
Urban	12.41 (1.22)	4.41	0.013	0.017
Suburban	12.95 (1.28)			
Rural	12.96 (1.39)			
Dysmenorrhea				
Yes	12.76 (1.27)	7.68	0.006	0.006
No	13.09 (1.36)			
Blood Loss				
Medium*	13.08 (1.33)	3.45	0.032	0.013
Small	12.93 (1.32)			
Large	12.58 (1.22)			
First Sexual Intercourse				
< 17 years (early)	12.66 (1.26)	3.54	0.030	0.014
> 17 years (late)	13.01 (1.35)			
No coitus	12.97 (1.29)			
Biological Father				
Absent	12.55 (1.25)	7.42	0.007	0.015
Present	12.97 (1.31)			

Note. M=mean age of menarche in years; SD=standard deviation; F=F-ratio; p=p-value; η_p^2=partial eta squared.

DISCUSSION

The present study found a mean menarcheal age of 12.89-years which is consistent with other large-sample studies from the United States identifying similar menarcheal ages of 12.80-years[43] and 12.7-years.[44] Ethnic differences in menarche have also previously been reported that our consistent with the current data.[43,45] Self-reported menstrual problems were common in the current sample with 62% of the women reporting dysmenorrhea, 36% reporting irregular cycles, and 18 and 40% reporting a large loss of blood at menses and bleeding greater than 5-days, respectively, similar to other samples,[5,8-12] including undergraduate students.[46] Concerning dysmenorrhea, a logistic regression analyses indicated that early menarche, long menses duration, large self-reported amount of blood loss, and early age of first sexual intercourse were related to an increased risk of dysmenorrhea, while small self-reported amount of blood loss, a short menses duration, and long overall menstrual cycles were associated with a reduced risk of dysmenorrhea. These findings are informative, as few studies have examined multiple risk factors for dysmenorrhea. Dysmenorrhea has also been associated with early menarche[47,48] and heavy menstrual bleeding,[49,50] but the results are inconsistent,[51] highlighting the importance of further research in this area.

Dysmenorrhea significantly reduces life satisfaction and contributes to disruptions in women's social and occupational life, including absenteeism from work or school in 80-90% of young women,[9,12,52] reductions in academic performance,[53] reduced sleep quality,[54] and daytime sleepiness,[2] with an estimated annual productivity loss of two billion dollars.[55] Some studies have found that heavy and long menstrual bleeding (menorrhagia)[15,49,50,52] or just menses duration but not blood quantity,[56] and early menarche[47,48,52] are associated with dysmenorrhea. In contrast, other studies have reported no differences in menarcheal age as a function of dysmenorrhea status,[5,8,51,56] while Kamel et al[56] found a shorter period of menstrual bleeding in women with dysmenorrhea. These conflicting results warrant further investigation. Menorrhagia, too, also affects women's quality of life on many dimensions such as social and leisure activities, well-being, time away from work, and relationships with friends and family.[57] Importantly, abnormal uterine bleeding and oligomenorrhea during the adolescent years is related to later gynecological morbidity and impairments in fertility[58] and adult-onset diabetes mellitus.[59]

Concerning menstrual cycle irregularity, some studies find that cycle irregularity correlates with dysmenorrhea[8] and others have not,[56] congruent with the current study. Women with long menstrual cycle lengths in the current study were also more likely to have dysmenorrhea, consistent with two recent studies,[48,56] although average cycle lengths (21 to 35-days) have been associated with dysmenorrhea as well.[5,52] From a practical perspective, the evidence reviewed suggests that menarcheal age and menstrual cycle abnormalities are reasonable predictors of later gynecological health and morbidity (see section). Another important consideration for future research is the extent to which menstrual cycle dysfunctions correlate with any reductions in fecundity or reproductive capacity (the potential number of healthy offspring bore in a woman's lifetime).

Concerning sociodemographic variables, the present data found that urban women reached menarche before women who grew up in more rural environments, a finding that has been previously reported.[36,37,60] This discrepancy in menarcheal age remains largely unexplained, although poorer diets and more sedentary lifestyles of urban girls has been suggested.[61] In the current sample, ethnicity, obesity levels, status of the biological father's presence, and parents' educational levels did not differ between urban and rural women. Women who were overweight also had early menarche, in line with theories linking menarcheal age to adiposity.[39] Women from father absent families also reached sexual maturity earlier than women from intact families, a finding that is relatively-well-documented,[4] despite the lack of consensus on a putative causal mechanism. Finally, the average age of first consensual sexual intercourse was 17.18-years, similar to a large-sample study[62] (16.49-years Moreover, adolescents who had an early age of first sexual intercourse (<17-years) had menarche earlier than those who had first sexual intercourse after age 17 or those who had never engaged in coitus, consist with other studies.[40,41]

A weakness of the study was its cross-sectional nature that relied on self-report data. Blood flow and menses duration were not actually measured but estimated by women. Nonetheless, age of menarche and other menstrual problems are salient to women and are known to have less of a recall bias.[54] The questionnaires were also anonymously returned which decreases the reporting

of socially acceptable responses and increases accuracy. Secondly, the participants consisted of a homogeneous convenient sample of young, presumably healthy, university students and may not be completely representative of all United States (U.S.) women. It is also likely that some women had undiagnosed gynecological disorders. Lastly, information on the extent to which these menstrual problems result in menstrual distress such as depression, anxiety, shame, or work and school absenteeism was not available. Despite these limitations, the current study is important in that it provides information on the pervasiveness of menstrual disruptions in a sample of young U.S. women and how these menstrual problems relate to numerous sociodemographic variables. The high prevalence of menstrual problems in this study and many others[5,8-12] highlight the importance of education and awareness about the effects of menstrual distress so as to obtain proper treatment (if needed) and to remove any stigma associated with the natural process of menstruation.[63]

CONCLUSION

Early menarche, long menses duration, large self-reported amount of blood loss, and early first consensual sexual intercourse were related to an increased risk of dysmenorrhea, while small self-reported amount of blood loss, a short menses duration, and long overall cycles were predictive of a reduced risk of dysmenorrhea. Concerning the timing of menarche, participants who were overweight, grew up in urban environments, had dysmenorrhea, had early first consensual sexual intercourse, and grew up without a biological father, experienced early menarche.

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