

# *Menstruation in Adolescents*

## *What's Normal, What's Not*

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The conventional wisdom about menstruation in adolescents, perpetuated in textbooks, requires updating. Recently published national surveys and reviews of large historical databases provide information about menstruation in adolescents, including the following: (1) Girls are experiencing earlier pubertal development than previously noted, suggesting that guidelines for the evaluation of potentially pathologic precocious puberty be reassessed. (2) There are racial differences in pubertal development, with African American girls experiencing earlier signs than Caucasian girls, and Mexican American girls intermediate in pace. (3) The absence of pubertal development by age 14 is associated with a high probability of conditions with impaired reproductive potential. (4) Absence of menarche by age 15 is statistically uncommon and should be evaluated. (5) Parameters for normal menstrual cyclicality indicate that most menstrual cycles for adolescents are between approximately 20 and 45 days. (6) Because menstrual cycles outside of this range are statistically uncommon, consideration should be given to evaluating adolescents with bleeding that is either too frequent or too infrequent. (7) A number of conditions with the potential for significant sequelae in adulthood can present as abnormal menses in adolescence, and thus merit early diagnosis and management.

*Key words:* menstruation; menarche; adolescents; puberty

### **Menstruation in Adolescents: What Do We Know in 2008?**

The age at menarche has declined in developed countries in the West from approximately 1800 until the 1950s.<sup>1</sup> It was suggested that perhaps the age of menarche had plateaued, although further small declines in age have subsequently been reported.<sup>2-8</sup> These reports have been drawn from a number of databases, including the National Health Examination Survey conducted between 1963 and 1970,<sup>2</sup> the National Health and Nutrition Examination Surveys from the 1980s to 2002 (NHANES),<sup>3,8</sup> the Fels Longitudinal Study<sup>6</sup> (which examined cohorts of girls born from the 1930s to the 1980s), the Bogalusa Heart Study,<sup>6</sup> and the National Heart, Lung, and Blood Institute Growth and Health Study.<sup>9</sup>

Several studies have confirmed the racial differences in age of menarche—with African Americans experiencing the earliest menarche, white girls the latest,

and, to the extent that they have been studied, Mexican American girls having an intermediate time of menarche between these two groups.<sup>3-5</sup> The homogeneity of early study populations, as well as variations noted in subsequent more diverse populations, leads to caution in interpreting available studies and calls for further studies that include more racially diverse populations.

While it has been postulated that increasing body mass index (BMI) and weight are factors in the earlier onset of menarche,<sup>2,9,10</sup> studies have not been consistent in demonstrating this to be the case. Analysis of the Fels Longitudinal Study revealed that girls with early menarche tended to have higher BMIs than did girls with average or later menarche, but these differences did not emerge until after menarche.<sup>6</sup> The Bogalusa Study did find a trend between increasing BMI and earlier menarche.<sup>11</sup>

There have been discussions in the literature of the consistencies and discrepancies among the studies, including analyses of differences in methodology, data collection, data analysis, and populations.<sup>12,13</sup> It has been suggested that the decline in age of menarche occurring prior to the 1960s were related to improvements in nutrition, eradication of infectious diseases, and improvements in overall health. In general, girls in

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developed countries experience earlier menarche than do those in developing countries. In contrast to the suggested reasons for this earlier decline, the more recent declines have been characterized as “not healthful” and potentially related to “overnutrition,” declines in physical activity, and chemical pollution.<sup>14</sup> The psychological impact of earlier development in which the disparity between physical and social/emotional maturity has grown, as well as the potential adverse health impact on conditions such as breast cancer, has been noted.<sup>14</sup>

### Puberty and Menarche

Traditionally precocious puberty has been defined as existing in girls showing any signs of pubertal development prior to age 8, the implication being that the likelihood of a significant pathologic finding merited aggressive evaluation. The classic article describing pubertal changes in girls from Marshall and Tanner was based on a longitudinal growth study evaluating pubertal growth in 192 white British girls in an orphanage.<sup>15</sup> The publication in 1997 of an office-based assessment of pubertal development in a more diverse population of more than 17,000 girls found that 27% of African American girls had signs of pubertal development by age 7, with 48% showing signs of puberty by age 8.<sup>16</sup> The corresponding findings for white girls were approximately 7%, with pubertal development by age 7, and nearly 15% by age 8. The conclusions from this study were that a reassessment of the definition of precocious puberty was warranted, and that a more appropriate guideline for U.S. girls would be signs of puberty before age 6 in African American girls and before age 7 in white girls, in the absence of other findings that would suggest significant pathology.<sup>17</sup> While some have questioned the findings of this study, subsequent data from other studies seem to confirm this trend.

While there has been a focus on early pubertal development and menarche, somewhat less attention has been paid to the opposite end of the spectrum—girls who experience delayed pubertal development. In a classic study from 1981 reporting conditions associated with delayed puberty, only 14% of the girls evaluated in a tertiary care center were felt to have the potential for subsequent normal reproduction.<sup>18</sup> Current assisted reproductive technologies provide options for some of these girls.<sup>19</sup> The absence of pubertal development by age 14 merits investigation for conditions such as vaginal agenesis and ovarian insufficiency, although it has been suggested that an evaluation be initiated at the

point when the girl’s pubertal development begins to deviate from that of her peers.<sup>19–21</sup>

With regard to menarche, considerable data now exist to challenge the conventional wisdom and classic definition of primary amenorrhea as the absence of menarche by age 16. The age of 15 appears to be a more valid and data-based benchmark, representing the 95–98th + percentile for menarche.<sup>3–5</sup>

### Characteristics of Menstrual Flow

Menstrual bleeding typically lasts 2–7 days in 80–90% of adolescents.<sup>24,25</sup> In adults, mean measured blood loss/cycle is 30 mL, and chronic blood loss of >80 mL is associated with anemia.<sup>26</sup> This information provides little clinical guidance. Women often have difficulty quantifying the amount of blood loss, and descriptions of menstrual bleeding (light, medium, or heavy) are based on experience—of which adolescents have little. Even adult women’s descriptors for bleeding do not necessarily correlate with measured blood loss. In one study, almost half of women who described their periods as heavy had measured blood loss of <80 mL, and slightly more than half of those who described their periods as medium had measured losses of >80 mL.<sup>26,27</sup> The terminology describing excessive menstrual bleeding has been confusing, with the term *menorrhagia* being particularly problematic. Menorrhagia has been variably described as either excessively heavy bleeding at regular intervals, or prolonged bleeding >7 days. Recent efforts have been made to abandon the term menorrhagia, replacing the terminology instead with more specific, simple, and clearly defined descriptors of menstrual frequency, regularity, duration, and volume.<sup>28</sup>

Among adolescents, very heavy menstrual bleeding/hemorrhage is associated with the diagnosis of bleeding disorders. In one study, nearly 50% of adolescents presenting with “acute menorrhagia” at the time of menarche were found to have a bleeding disorder, including disorders of platelet number and function (e.g., idiopathic thrombocytopenic purpura), hematologic malignancies, and von Willebrand disease.<sup>29</sup> Other studies have corroborated these findings, suggesting that adolescents who present at menarche with “acute menorrhagia” or with severe anemia should be screened for bleeding disorders.<sup>30–35</sup> The prevalence of von Willebrand disease in the general population is approximately 1–2%, and has been shown to be considerably higher among adult women with heavy bleeding.<sup>36</sup>

## Cycle Length

Adolescent menstrual cycles are often variable in length, but typically become more regular with increasing gynecologic age.<sup>24,25,37–39</sup> The fact that cycles are commonly irregular does not imply that there are no parameters by which to gauge normalcy. Several very large studies provide a great deal of information based on many years of prospectively recorded data. One dataset, studied and reported by Treloar and currently described as the Tremin Trust, includes prospectively charted data from approximately 2,700 women reporting over 275,000 cycles.<sup>38</sup> Reports from Vollman analyzed more than 650 women reporting over 31,000 cycles.<sup>40</sup> Data from these reports and others indicate that during adolescence, most cycles range from approximately 20 to 45 days, even in the first gynecologic year.<sup>24,25,38–40</sup> These studies are fairly consistent in noting approximately 20 days as the lower limit of normal; the upper limit of normal (as defined by two standard deviations) is somewhat more variable at 40–45 days. This range is wider than the normal range in adults (24–38 days).<sup>26,28,38</sup> Cycles outside of the range of 20–45 days are statistically uncommon, even in young girls, and deserve evaluation.

The pathologic conditions that may be associated with such deviations are listed in Table 1 and are discussed subsequently. What has not been adequately addressed through prospective study is the incidence of pathology among the 2–5% of teens whose cycles fall outside of the statistical norms. The overall trend is for cycles to become more regular with increasing age and gynecologic age. By the third gynecologic year, 60–80% of cycles are 21–34 days long,<sup>24,25</sup> close to what is characteristic for adults. The individual's normative cycle length is established by approximately the 5th or 6th gynecologic year or by age 19–20.

Although amenorrhea has been defined as having no menses for an interval of 6 months, the basis for selecting this duration is unclear.<sup>20</sup> Sixty-five days is greater than the 95th percentile, even in the first gynecologic year, and thus appropriately merits evaluation.<sup>20,38</sup> Some authors have suggested an interval of 90 days as warranting investigation in women of all ages.<sup>41</sup> This suggestion merits consideration during middle adolescence and beyond. Others have suggested that in adults during the middle reproductive years, a change in an established regular menstrual pattern warrants an evaluation; an assessment is appropriate whenever the patient expresses concern, using these parameters as guidelines for what is statistically common.<sup>20</sup> In an effort to simplify the terminology, it is strongly suggested that the terms amenorrhea and

**TABLE 1. Conditions associated with cycles outside the range of 20–45 days (not including causes of delayed puberty or primary amenorrhea)**

Chronic anovulation
With inappropriate steroid feedback
Hyperandrogenism (PCOS)
CNS-hypothalamic-pituitary dysfunction
Eating disorders
Anorexia nervosa
Bulimia
Exercise-induced
Chronic disease
Hyperprolactinemia
Thyroid dysfunction
Ovarian insufficiency

oligomenorrhea be replaced by the more specific description of infrequent menses.<sup>40</sup>

Anovulation is cited as the primary reason for longer cycles in adolescents; however, some cycles are ovulatory, with a long follicular phase. Some shorter-than-average cycles are ovulatory, whereas many cycles within the “normal” range of 20–45 days are anovulatory.<sup>42,43</sup> Menstrual molimina have been considered to be indicators of ovulatory cycles.<sup>44</sup> Because dysmenorrhea occurs in up to 90% of adolescents, its absence is notable.

Some causes of anovulation in adolescents are similar to those seen in adults and include, most commonly, disorders of androgen excess, (e.g., polycystic ovary syndrome), which typically begins during adolescence.<sup>45</sup> Some causes of anovulation occur more commonly among adolescents than adults, such as eating disorders.<sup>46</sup> Exercise-induced amenorrhea, including the female athlete triad (anovulation, disordered eating, and osteopenia or osteoporosis), is more common among adolescents and young adults than in older women.<sup>47</sup> Both eating disorders and exercise-induced amenorrhea are associated with adverse impacts on bone health, with the potential for life-long consequences.<sup>48,49</sup>

## Clinical Assessment of Menstrual History

In taking a menstrual history from an adolescent, the mother's perspective is often valuable. The author's practice is to structure the office visit with an initial interview in which both mother and daughter are seen together, followed by time with the mother alone, confidential time with the adolescent alone, followed by a summary of findings and recommendations

to both mother and daughter.<sup>50</sup> This allows the mother (or significant adult) to prompt or corroborate the clinical responses from the teen, as well as to provide additional information—for example, “She doesn’t want to tell you how heavy her periods are because she’s afraid you’ll make her have an exam”, or “I have to change the sheets for 2 days every month” or “she regularly soils her panties.”

The date of menarche should be established as accurately as possible; the closer the evaluation is to the actual date of menarche, the more accurate this history. An accurate assessment of the date of menarche allows a calculation of gynecologic age, not just in years, but in months. The gynecologic age is the difference between the chronologic age (e.g., 14 years 3 months) and the age of menarche (e.g., 13 years 5 months, for a gynecologic age of 10 months).

Adolescents frequently do not keep accurate records of menstrual periods. An astute primary clinician could encourage girls to do so, and the resulting data could then be used to assess whether or not the cycles were within normal parameters. Such prospective record-keeping is always more accurate than a retrospective history of menstrual irregularity. Adolescents sometimes keep track of their menstrual periods on their cell phones.

It is also pertinent to clarify what an adolescent means when she states that her periods are “irregular,” as this term has been used to describe any of the following: cycles “every 3 weeks”—counting from the end of one cycle to the beginning of the next; cycles that are not perfect 28-day cycles every month; cycles that don’t always occur on the same day of the week, or that don’t always occur on the same date of the month; periods that occur “twice a month,” for example, every 25 days; “skipped months” with bleeding occurring at the end of one month, no bleeding during the subsequent month, followed by bleeding at the beginning of the following month; bleeding that lasts a variable number of days; as well as flow that is variable in quantity. It may be helpful to simply ask if the periods are “about once a month”, and if not, to ask for a description of a range. It can also be helpful to ask if they have written down the dates on a calendar, or recorded them somewhere (for example, on their cell phone calendar); if not, a cautiously skeptical assessment of cycle length is warranted, and prospective charting is recommended. Asking “What’s the longest you’ve gone without a period?” can be helpful. Additional aspects of a menstrual history in adolescents are listed in Table 2.

Mothers may shape their daughters’ perspectives of blood loss, and their perspective may in turn have been

shaped not only by their own menstrual histories, but also those of *their* mothers. Sometimes a clinical history of “all the women in my family have had hysterectomies for bleeding” will suggest this possible diagnosis.

The common clinical practice of asking patients to describe the amount of bleeding per day as number of pads or tampons used during a typical day may provide some guidance, although these assessments are subject to variables such as the individual’s fastidiousness, a young girl’s familiarity or comfort with menstrual hygiene products, and even variation among and between the capacity of types and brands of pads and tampons.<sup>51</sup> Adolescents may experience more external constraints to pad changes than do adults, as it is not uncommon for school rules and limited time between classes to make menstrual hygiene problematic. Typical flow requires 3–5 pad/tampon changes/day. Another commonly assessed clinical parameter which appears to be based on anecdotal clinical observations is to conclude that flow requiring the change of a soaked tampon or pad as frequently as hourly over 2 or more hours is cause for clinical concern.<sup>35</sup> With a clinical history that is of concern, an objective assessment with Hgb/Hct and RBC indices—possibly with serum iron, ferritin, or TIBC, if anemic—will supplement the clinical history. A urine or serum pregnancy test is mandatory in any adolescent who presents with menstrual abnormalities. While a confidential sexual history should be obtained, an adolescent may be unwilling or unable to acknowledge voluntary or even nonconsensual intercourse. The consequences of missing a pregnancy-related cause of abnormal bleeding warrant screening for pregnancy with laboratory testing in addition to the confidential history<sup>52</sup> (Table 3).

## Physical Examination

A general physical examination is appropriate in evaluating an adolescent for disorders of menstrual function; the extent of the gynecologic examination depends on the clinical presentation, the menstrual history, the girl’s age, and whether or not coitarche has occurred. For every examination, even those not including a gynecologic examination, every effort should be made to help the adolescent feel in control. She should be asked if she would like to have her mother or other individual with her; she should be given an explanation of the extent of the examination; and she should be informed of what aspects of the exam are essential as well as which aspects can be deferred or for which an imaging examination can be substituted. Measurements of height and weight, with a calculation

**TABLE 2. Questions to elicit menstrual history of an adolescent**


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How old were you when you had your first period?  
 Do you remember more specifically?—[prompting] Was it winter or summer? Were you closer to 12 or 13 or somewhere in between?  
 Do you write down the dates of your periods?  
 Do your periods come about once a month?  
 Have you ever skipped a month?  
 What's the longest you've gone without a period?  
 How many days do your periods typically last?  
 Would you describe your periods as light, medium, or heavy?  
 Do you typically use tampons or pads?  
 Have you ever used tampons?  
   Do you regularly use tampons?  
   Any difficulty in using tampons?  
 On a typical day, how many times a day do you have to change a tampon or a pad? Think about from the time you get up in the morning, the number of times you change at school, and then the number of times you change after you get home from school.  
 If bleeding described as heavy:  
   Do you ever have accidents? Messing up panties or clothes or sheets?  
   Can you go all night without getting up to change?  
   Do you ever have to wear a tampon and a pad together?  
 Do you have cramps or pain with your periods?  
   Primary dysmenorrhea is suggested by: onset cramps with the onset of bleeding or slightly before; worst pain day 1 or 2, pain that typically isn't severe throughout the bleeding  
 Do you have any other symptoms with your periods?  
   Headaches?  
   Bloating?  
   Breast tenderness?  
   Anything else?  
 Do you miss school or have to change your plans because of your periods?  
   Is it because of how heavy they are?  
   Is it because of pain?  
   Is it because of other symptoms?

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**TABLE 3. Laboratory tests as indicated by menstrual dysfunction**


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Urine or serum pregnancy test is mandatory for **any menstrual dysfunction**  
**Heavy bleeding:** CBC and platelets (review Hgb/Hct, red cell indices, possible serum iron or TIBC or serum ferritin), coagulation studies (PT, aPTT), von Willebrand screening—ristocetin co-factor or vW antigen, PFA-100  
**Irregular bleeding:** TSH, androgens (if signs of androgen excess—hirsutism, moderate–severe acne) to confirm the clinical diagnosis of PCOS by excluding other causes of androgen excess  
**Amenorrhea:** Estradiol (to confirm a clinical suspicion of hypoestrogenism and to provide documentation to skeptical adolescents and/or parents), androgens (if signs of androgen excess—hirsutism, moderate–severe acne), prolactin, TSH, FSH to diagnosis ovarian insufficiency

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of BMI and BMI percentile for age, will assist in the diagnosis of PCOS or eating disorders. A careful examination should reveal signs of hirsutism and acne, but since facial hirsutism usually prompts bleaching, waxing, use of depilatories, shaving, plucking, electrolysis, or laser hair removal, the adolescent should be asked in a sensitive manner about these practices.<sup>52</sup> A visual inspection of the external genitalia may reveal signs of clitoromegaly, a hypoestrogenic vaginal introitus, or any signs suggesting vaginal or uterine anomalies. In a young adolescent who is anxious or shy, transabdominal pelvic ultrasound can provide sufficient evidence of the normalcy of the internal genitalia if the adolescent is unable or unwilling to undergo a bimanual or specu-

lum examination. The examination is supplemented by the history and laboratory evaluation to arrive at a diagnosis.

## Summary

In contrast to the general impression that “anything goes” for adolescent menstrual cyclicity, menstrual flow, and duration of menses, there are evidence-based parameters that provide guidelines for assessing normalcy. The following guidelines should be disseminated to adolescents, their parents/guardians, coaches, primary clinicians, and general gynecologists:

- (1) Pubertal development should begin between the ages of 6 and 13 years (for African Americans) or 7 and 13 years (for Caucasians).
- (2) Menarche should occur by the age of 15 years.
- (3) Menstrual cycles in adolescents are typically between 20 and 45 days, and the occurrence of cycles that are outside of this range is statistically uncommon and thus should prompt evaluation.

Because abnormal menses can result from a number of conditions with the potential for significant sequelae and future reproductive and other health consequence, the menstrual cycle can be considered a “vital sign.” Abnormalities of this vital sign should prompt evaluation and assessment, as would abnormalities of blood pressure, pulse, and respiration.

### Conflicts of Interest

The author states that she has received past research grant support from Berlex, Wyeth-Ayerst, and Duramed pharmaceuticals; has been a member of the speakers bureaus for Wyeth-Ayerst, Berlex, Pharmacia-Upjohn, 3-M, Merck, GlaxoSmithKline, ARHP, Bayer-Schering Pharma, Organon; and has been a consultant and member of scientific advisory boards of Procter & Gamble, Wyeth-Ayerst, Organon, Glaxo, and Bayer-Schering Pharma.

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