Original Article

Onset of menstrual cycle and menses features among secondary school girls in Italy: A questionnaire study on 3,783 students

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ABSTRACT

Premise: Healthcare professionals need updated information about what is the range of "normal" variation of menstrual cycle features to support young girls and their parents in managing reproductive health, and to detect diseases early. **Materials and Methods:** This cross-sectional study aimed to provide an updated picture of age at menarche and main menstrual cycle characteristics and complaints in an Italian population-based sample of 3,783 adolescents attending secondary school. Girls filled in a self-administered anonymous questionnaire including questions about demography, anthropometry, smoking and drinking habits, use of contraceptive, socioeconomic status, age at menarche, menstrual pattern, and physical/psychological menstrual complaints. Mean age at menarche and prevalence of polymenorrhea (cycle length < 21 days), oligomenorrhea (cycle length > 35 days), irregularity, dysmenorrhea, and of physical/psychological complaints were computed. Factors associated with age at menarche and menstrual disturbances were explored by using multiple logistic models. **Results:** The girls' mean age was 17.1 years (SD 1.4 years) and the mean age at menarche was 12.4 years (SD 1.3 years); menarche occurred with two monthly peaks of frequency in July–September and in December–January ($P < 0.0001$). Age at menarche was significantly associated with geographic genetics (as expressed by parents' birth area), mother's menarcheal age, BMI, family size, and age at data collection. The prevalence of polymenorrhea was about 2.5%, oligomenorrhea was declared by 3.7%, irregular length by 8.3%, while long bleeding (>6 days) was shown in 19.6% of girls. Gynecological age was significantly associated with cycle length ($P < 0.0001$) with long cycles becoming more regular within the fourth year after menarche, while frequency of polymenorrhea stabilized after the second gynecological year. Oligomenorrhea and irregularity were both significantly associated with long menstrual bleeding (adjusted OR = 2.36; 95% CI = 1.55-3.60, and adjusted OR = 2.59; 95% CI = 1.95-3.44, respectively). **Conclusions:** The findings of the study support the levelling-off of secular trend in menarche anticipation in Italy and confirm the timing in menstrual cycle regularization. The study provides updated epidemiological data on frequency of menstrual abnormalities to help reproductive health professionals in managing adolescent gynecology.

Key words: Adolescence, cross-sectional, menarche, menstrual disorders, seasonal peaks

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Introduction

Adolescence is roughly considered to be the period between 10 and 19 years of age. The adolescent experiences not only physical growth but also emotional, psychological, social, and mental changes.

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Menarche is a milestone in a woman's life as it denotes the start of reproductive capacity. Over the past 100 years, age at menarche has declined, the adolescent growth spurt has occurred at younger ages, and peak height growth velocity has increased.[1-4] Today, in many countries age at menarche ranges between 12 and 13 years.[1,5]

The length of the average menstrual cycle is 28 days, but the range of "normal" in adult women is wide, from 22-35 days. Menstrual cycles tend to be more irregular in young teenage women during the first few years after menarche, and again in the 40's, during 3-5 years prior to menopause. A number of medical conditions can cause irregular periods, including thyroid disease, rapid gain or loss of weight, and virtually any significant chronic illness.[6]

In 75% of adolescents at the first gynecological year (one year after menarche), average menstrual cycle length is 21-45 days,[7] but by the third gynecological year, 60-80% of girls have menstrual cycles 21-35 days long, as adult women.[8] For a few years after menarche, several abnormalities of menstrual bleeding may distress the young girls.[9]

Therefore, healthcare providers have two main concerns: a) to timely detect conditions suggestive of significant pathologies, such as endometriosis, polycystic ovary syndrome, coagulation disorders, and eating disorders, which can have a major impact on women's future reproductive or general health; b) to adequately support the girls to be confident and informed with their sexual health.

For an effective obstetric and gynecological healthcare, pediatricians and gynecologists stress the need for preventive health visits during adolescence, between the ages of 13 and 15 years, with subsequent annual clinic assessment, to begin a dialogue and establish a confidential setting where a girl can feel good and free to show her concerns on her own reproductive health. In some cases, this visit may be appropriate earlier, based on the concerns of the parents.[10] Care should be delivered according to the individual's stage of physical, sexual, psychological, and cognitive development.[10]

The aim of this study is to provide support to young girls and their parents on girls' physical development, referring to data defining 'normal' menarche and menstrual health. For the reproductive healthcare professionals, it is important to indicate what is expected in the first period, and what is the range of "normal" variation of cycle features in the subsequent menses.[8,10] Given that a number of external factors (nutritional, socioeconomic, and behavioral) have an impact on reproductive health timing and features, it is important to update information on menstrual pattern in adolescents.

This study aims to provide an updated picture of age at menarche and main menstrual cycle characteristics and complaints in an Italian population-based sample of adolescents attending secondary school.

Materials and Methods

Sample population

This cross-sectional multicenter study was conducted on a large sample of Italian secondary school girls, attending schools randomly chosen from 13 cities in northern Italy (Brescia, Bolzano, Ferrara, Modena, Novara, Padua, Parma, Pavia, Reggio Emilia, Torino, Trieste, Verona, and Vicenza) and three in southern Italy (Foggia, Lecce, and Taranto). Secondary schools were randomly selected from each city. Details of the sampling strategy have been published elsewhere.[11]

The girls were contacted at school, and those who had had menarche were recruited. All participants were informed about the nature, purpose, and procedures of the study, and informed written consent was obtained from the students and their legal guardians.

The procedures followed were in accordance with the ethical standards of the local institutional responsible committee on human experimentation and with the Helsinki Declaration.

Girls were asked to fill out a self-administered anonymous questionnaire prepared by a pediatric endocrinologist and a pediatric neuropsychiatrist from the Pediatric Unit of the University of Padua and was tested by the Department of Pediatrics.

In each school, the local investigator explained the aims of the survey and the questionnaire to the science teachers who explained and handed the questionnaire to their students to fill out.

Of the 6,924 questionnaires that were administered, 4,992 (71%) were collected. One hundred questionnaires were dropped because of incomplete information about girls' birth date, and other 1109 questionnaires were excluded due to incomplete information about the date of first menses.

In the end, the questionnaires of 3,783 students who reported both their birth date and their menarcheal date were included in the data set.

Variables

The questionnaire includes questions about girls' and family demographic details, anthropometry (weight,

height), smoking and drinking habits (yes/no; frequency), use of contraceptive pills and reasons for their use (as a contraceptive, to regularize their menstrual cycle), and socioeconomic status as expressed by Hollingshead index.[12] scoring from 0 (lowest social level) to 14 (highest social level).

The girls were asked to indicate their birth date (day, month, and year) and as accurately as possible, the date of their first menstrual bleeding (at least the month and the year); when the day was missing, the event was considered to have occurred at half month. The questions regarding the girls' menstrual pattern concerned duration of the most recent menstruation intervals (<21 days, 21-35 days, >35 days, variable), average days of bleeding (<4 days, 4-6 days, >6 days), and any menstrual problems and their frequency. The impact of the menstrual cycle on the girls' physical and psychological complaints (abdominal pain, headache, weakness, instable mood, irritability, crying, and loneliness) was also investigated.

The following categorization was applied to quantitative/ranked variables. Age at menarche was expressed and analyzed as a decimal year. Body mass index (kg/m^2, BMI) was analyzed both as a quantitative and categorical variable (<18.5 was considered underweight; 18.5-25, normal; 25-30, overweight; >30, obese).

The socioeconomic class scores were categorized into four levels: 0-4 was considered low; 5-8, middle; 9-12, high; 13-16, very high.

The parents' birth place was dichotomized into North or South, with isles included in the latter group, and these designations were used as a proxy for the geographical genotype (0 = both from North, 1 = 1 from North and 1 from South, 2 = both from South).

Physical activity was classified as follows: no–low corresponding to < 2 hours/week; moderate as 2-6 hours/week; high as > 6 hours/week.

The following definitions were used to describe menstrual cycle disorders: polymenorrhea was a menstruation interval lasting less than 21 days; oligomenorrhea occurs in intervals greater than 35 days. The latter choice depended on the observation that among girls, by the third gynecological year, about 80% of menstrual cycles are 21-35 days long, as is typical in adult women.[8] Excessive bleeding length was defined as bleeding lasting more than 6 days.

Abdominal pain was ranked on four levels as follows: no or mild/moderate abdominal pain; severe abdominal pain without any use of drugs, or sufficient to limit the girl's activities; severe abdominal pain treated with drugs, and/or activity limitations during bleeding days; severe abdominal pain treated with drugs and/or activity limitations before bleeding days.[13] The higher level was termed as dysmenorrhea.

Statistical analysis

Descriptive analyses were performed on quantitative and qualitative variables for the total sample.

Mean values and standard deviations (SD) were calculated for quantitative variables; median age at menarche, and 95%CI were evaluated. The prevalence of polymenorrhea, oligomenorrhea, and dysmenorrhea and of physical and psychological complaints was computed.

The normality of quantitative variables was verified by the Shapiro–Wilk test. Parametric and non-parametric one-way analyses of variance (ANOVA) were used to check differences between mean values of quantitative variables. The distributions of age at menarche across BMI levels were compared using Kolmogorov–Smirnov test.

Differences in proportions were analyzed using the chi square test or Fisher's exact test, as appropriate. Chi-square test was applied to compare monthly/seasonal distributions of menarche between Northern and Southern girls or across gynecological ages. Chi-square test was also applied to verify difference in menstrual cycle length, duration of bleeding, and premenstrual complaints across gynecological ages.

In evaluating the effects of covariates on menarcheal age, simple and multiple regression models using were applied. The multivariate model included the variables that were statistically associated with the age at menarche in the analysis using one covariate at a time: living area, parents' birth area, girl's BMI, family size, mother menarcheal age and age at data collection.

The same approach was applied to identify the variables associated with cycle abnormalities. Polymenorrhea, oligomenorrhea, irregular length, and bleeding lasting more than 6 days were used as outcomes in separate multivariable stepwise logistic models.

For polymenorrhea, oligomenorrhea, and irregular length, the following variables were entered in the models: social score, physical activity, living area, BMI, family size, smoke, pill use, drinking alcoholic beverages, living area, age at data collection, gynecological age, and bleeding > 6 days.

For bleeding lasting more than 6 days, the variables entered in the model were: social score, physical activity, living area, BMI, family size, pill use, smoke, drinking alcoholic beverages,

age at data collection, gynecological age, menstrual cycle length (as categorical: polymenorrhea/oligomenorrhea/irregularity vs. normal cycle length, 21-35 days).

The significance level was fixed at 0.05, and all tests were two-tailed. All the analyses were performed using the SAS statistical software release. 9.13 (SAS Institute, Cary, NC).

Results

In total, 3,783 adolescent girls took part in the study. The demographic and clinical characteristics of the sample are described in Table 1. The mean age was 17.1 (SD 1.4) years and the mean BMI was 20.3 (SD 2.5) kg/m^2. Among girls, 5.0% belonged to families with low social score. Intense physical activity was declared by 9.7% of the girls, smoking habit by 30.3%, and drinking alcoholic beverage by 54.0%. Pill was used for contraception by 8.5% of girls, while 4.8% consumed the pill to regularize menses.

Menarche

The mean age at menarche was 12.4 (SD 1.3) years, and the median age was 12.4 years (95% CI - 12.34-12.46 years). Early menarche (≤10 years) occurred on 12.6% of the adolescents while late menarche (≥15 years) was declared by 2.3% of girls. Mean age at menarche of girls living in Southern cities was significantly lower than that of those living in Northern cities (12.17 ± 1.27 years vs. 12.44 ± 1.28 years; $P < 0.0001$); they also were significantly younger (16.7 ± 1.6 years vs. 17.2 ± 1.3 years; $P < 0.0001$). More details about onset of menses have been published in a previous paper.[11] Menarche occurrence showed two monthly peaks ($P < 0.0001$) of frequency in July-September and in December–January [Figure 1]. Monthly frequency marginally differed ($P = 0.06$) from previous data in Italy,[14] whilst no significant difference was found between North and South living areas ($P = 0.43$; data not shown). Moreover, no significant variation was seen in month at menarche according to month at birth ($P = 0.60$, data not shown). Menarche occurred with higher frequency in summer based on ages at onset of menarche, except for ages of 15 years or more [Figure 2]. Mean age at menarche was marginally different among seasons (spring: 12.32 ± 1.30 years; summer: 12.46 ± 1.28 years; autumn: 12.45 ± 1.27 years; winter: 12.38 ± 1.26 years; $P = 0.08$).

The mean and median age at menarche by BMI groups is detailed in Table 2. The data show significant differences with menarcheal age progressively declining from 12.8 years for subjects with BMI < 18.5 kg/m^2 to 11.7 years for overweight/obese subjects (BMI ≥ 25 kg/m^2), even though mean chronologic age was comparable between groups. In Figure 3, the cumulative distribution of age at menarche is compared among the four BMI groups ($P = 0.05$).

For the total sample, in simple regression model analysis, mothers' menarcheal age was significantly and positively associated with the girls' age at menarche ($P < 0.0001$). Living area ($P < 0.0001$), parents' birth area ($P < 0.0001$), family size ($P = 0.008$) also significantly associated with age at menarche. Meanwhile, no relationship was observed between menarcheal age and social level, physical activity, or birth order (data not shown).

The results of different multiple regression models that evaluated the independent predictive role of the variables

Table 1: General characteristics of 3,783 girls attending secondary school

	n	%	Mean±SD	Range
Age at data collection (years)	3783		17.1±1.4	14-21
Living area	3675			
North	3218	87.6		
South	457	12.4		
Parents' birth area	3599			
Both from North	2186	60.7		
One from North and one from South	651	18.1		
Both from South	762	21.2		
BMI (kg/m^2)	3549		20.3±2.5	13.0-37.9
<18.5	823	23.2		
18.5–20.0	967	27.3		
20.1–25.0	1601	45.1		
>25.0	155	4.4		
Family size (*n*)	3736		4.0±0.9	2-11
≤3	967	25.9		
4	1972	52.8		
≥5	797	21.3		
Social score (range 0-14)	3473		9.5±3,1	2-14
Low (0-4)	175	5.0		
Middle (5-8)	1155	33.3		
High (9-12)	1493	43.0		
Very high (≥13)	650	18.7		
Physical activity	3783			
No-low (<2 hours/week)	1834	48.5		
Moderate (2-6 hours/week)	1580	41.8		
Intense (>6 hours/week)	369	9.7		

SD: Standard deviation, BMI: Bosy mass index

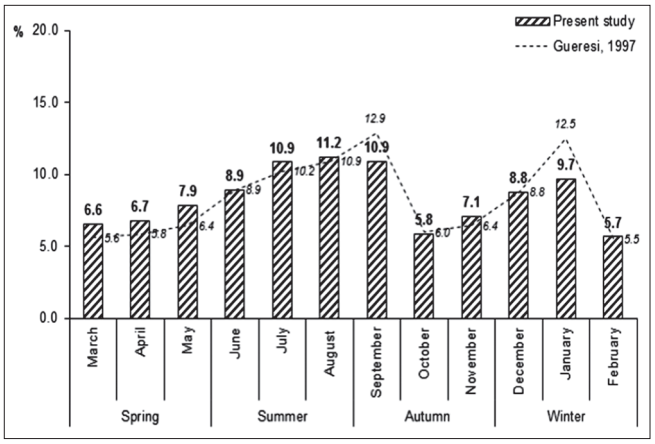

Figure 1: Monthly distribution of menarche. Results from the present study are compared ($P = 0.06$) with previous data in Italy (Gueresi, 1997; Ref. 14)

Table 2: Mean (±SD) and median (inter quartile range) of at data collection, BMI, and age at menarche by BMI group

	BMI (kg/m²)							
	<18.5 *N*=823		18.5-19.9 *N*=970		20.0-25.0 *N*=1601		>25.0 *N*=155	
	Mean±SD	Median	Mean±SD	Median	Mean±SD	Median	Mean±SD	Median
Age at data collection* (years)	17.0±1.4	17.1 (16.3-17.9)	17.1±1.3	17.2 (16.4-17.9)	17.2±1.3	17.2 (16.4-18.1)	17.2±1.5	17.4 (16.3-18.0)
BMI** (kg/m²)	17.5±0.8	17.7 (17.1-18.2)	19.3±0.4	19.3 (18.9-19.6)	21.7±1.3	21.5 (20.7-22.5)	27.3±2.3	26.7 (25.7-28.0)
Age at menarche** (years)	12.7±1.2	12.8 (12.0-13.6)	12.5±1.2	12.5 (11.7-13.3)	12.3±1.3	12.3 (11.4-13.1)	11.9±1.4	11.7 (10.9-12.8)

*P=0.11, **P<0.0001, SD: Standard deviation, BMI: Body mass index

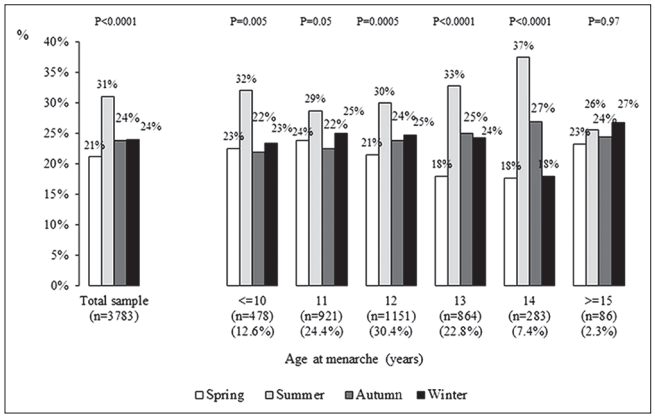

Figure 2: Seasonal distribution of menarche, by age at menarche

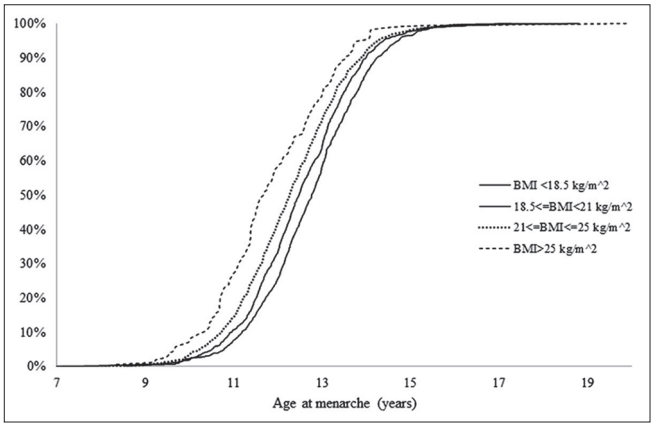

Figure 3: Cumulative distribution of age at menarche by BMI groups (P : 0.05)

statistically associated with age at menarche are shown in Table 3.

In the model including all the potential predictors, the mother's menarcheal age alone explained about 10% of the total variance (about 14%). Living area was the only variable that was not confirmed to have an independent association with the age at menarche (P = 0.13).

Menstrual cycles abnormalities and complaints

With regards to menstrual cycles abnormalities [Table 4], polymenorrhea was present in 2.5% of the girls, oligomenorrhea in 3.7%, and irregularity in 8.3% of the whole sample. About 27.9% of adolescents declared to have experienced irregularity in the recent past, while this proportion grew to 72.8% when observation was extended to the period since menarche. Additional details on menstrual irregularities have been published previously.[15]

To describe differences across gynecological age, menstrual cycle and bleeding length along with perimenstrual disturbances are shown in Table 5. The prevalence of oligomenorrhea significantly declined from over 9% to about 3% at the second gynecological year. Polymenorrhea decreased from 5.9% to about 2.0% even in the first year since menarche. Blood flow lasting more than 6 days was found in about 19.6% of girls. Among premenstrual disturbances, dysmenorrhea, mood changes, irritability, and headache showed consistently higher prevalence at least at 5 years since menarche.

In Table 6, the results from different multiple logistic regression models (stepwise procedure) are shown. In each model, a menstrual abnormality is used as dependent condition, whilst more family and individual characteristics were tested for being independently associated.

As shown, polymenorrhea was only associated with gynecological age (OR = 0.86, 95%CI: 0.75-0.99). Both oligomenorrhea and irregular length associated with pill use (OR = 0.48, 95%CI: 0.25-0.90; OR = 0.63, 95%CI: 0.51-0.79, respectively); gynecological age (OR = 0.71, 95%CI: 0.60-0.83; OR = 0.81, 95%CI: 0.77-0.85, respectively); bleeding length (OR = 2.06, 95%CI: 1.35-3.14; OR = 2.03, 95%CI: 1.68-2.45, respectively). In addition, oligomenorrhea was associated with age at data collection (OR = 1.25, 95%CI: 1.02-1.53).

Long lasting bleeding (>6 days) was significantly and inversely associated with family social level (OR = 0.94, 95%CI: 0.80-1.00) and pill use (OR = 0.66; 95%CI: 0.52-0.85). Conversely, it was significantly and positively associated with oligomenorrhea (OR = 2.36, 95%CI: 1.55-3.60) and

Table 3: Results from different multiple linear stepwise regression models with age at menarche as dependent variable and general and family characteristics as risk factors[+]

	Living area*	Parents' birth area*	BMI (kg/m^2)	Family size*	Mother's menarcheal age (years)	Age at data collection (years)
Model 1						
Estimate	−0.10	−0.11	−0.09	0.09		
Standard error	0.08	0.03	0.009	0.03		
P	0.21	0.001	<0.0001	0.0003		
Model 2						
Estimate	−0.20	−0.08	−0.08	0.09	0.23	
Standard error	0.08	0.04	0.009	0.03	0.01	
P	0.02	0.02	<0.0001	0.0004	<0.0001	
Model 3						
Estimate	−0.13	−0.07	−0.08	0.07	0.23	0.11
Standard error	0.09	0.03	0.009	0.03	0.01	0.02
P	0.13	0.03	<0.0001	0.0004	<0.0001	<0.0001

[+]The following predictors were tested by means of multiple linear stepwise regression models: social level, physical activity, birth order, living area, parents' birth area, BMI, family size, mother's menarcheal age, age at data collection. *Living area: 0: North, 1: South; Parents' birth area: 0: Both from North, 1: One from North and one from South, 2: Both from South; Family size: number of people in the family, BMI: Body mass index

Table 4: Menstrual cycle features among girls attending secondary school

	n	%
Cycle length	3539	
Polymenorrhea<21 days	90	2.5
Normal length 21-35 days	3024	85.5
Oligomenorrhea>35 days	130	3.7
Irregular length	295	8.3
Polymenorrhea in the past	1131/3321	34.1
Oligomenorrhea in the past	1843/3457	53.3
Irregularity in the recent past	1019/3655	27.9
Irregularity since menarche	2531/3475	72.8
Blood flow (days)	3761	
<4	105	2.8
4–6	2918	77.6
>6	738	19.6

irregularity (OR = 2.59; 95%CI: 1.95-3.44) compared to normal cycle length (21–35 days). Neither gynecological age nor BMI were significantly associated with bleeding excess.

Discussion

This study provides an update of knowledge about the onset of menstrual cycle and menses features among secondary school girls in Italy. The date of first menses was retrospectively collected from girls attending secondary school, who had already had their first menses. The information was self-reported by girls through a structured questionnaire. The mean age of the girls was 17.19 years (SD = 1.42), and only 6.2% of the girls were older than 18 years. The short time between the event and the data collection allows to be confident on limiting the recall bias.

Age at menarche

The results indicated that the median age for all the girls at menarche was 12.40 years. Our results on age at first period are comparable to those produced by previous studies on Italian girls,[14,16] confirming that 95% of Italian girls have menarcheal age ranging from 10 to 15 years. Comparisons, adjusted for age at data collection, suggest that living area (North vs. South) is not an independent marker.

During the past century, age at menarche has shown a constant and gradual decrease in many countries around the world. In Europe and United States, each decade accounted for a mean anticipation of about 2-3 months.[17] Recently, several studies showed a stabilization of the menarcheal age at 12-13 years.[8,11,18-21] The estimated menarcheal age found in the present study is largely consistent with findings from other countries,[22] suggesting that in Italy menarcheal age is leveling off.

Season and age at menarche

Several studies on different populations indicated that onset of menarche is not equally distributed during seasons. The most frequently reported pattern has been bimodal, with peak occurring both in summer and winter.[23,24] A similar pattern was also previously shown in Italy among adolescents.[14] Despite this seasonal cycle has been shown in several countries, its etiology is still largely unexplained. Different elements have been invoked: photoperiod, phylogeneticand ontogenetic factors, and seasonal changes in food availability,[25] psychosocial stress,[14] latitude[26] and ultraviolet radiation dose,[27] and birth month.[28]

Our study confirmed the monthly bimodal pattern of menarche in Italy, even though frequency peaks were less evident in our sample population than in Gueresi's [Figure 2].

A north-south gradient in age at menarche was described; girls who live at higher latitudes appear to have an earlier initiation of menses than girls who live closer to the equator. Although this pattern might be explained by differences in temperature, light-dark rhythms, and socioeconomic conditions, it also corresponds to a gradient with latitude in sun exposure that, in some regions, coincided with vitamin D status.[26]

Table 5: Menstrual cycle duration and blood flow length, by gynecological age

	Gynecological age (years)									*P*
	<1	1	2	3	4	5	6	7	≥7	
Number	51	152	332	660	775	767	491	183	116	
Cycle length (%)										
Polymenorrhea (<21 days)	5.9	2.0	2.1	4.2	2.6	1.7	1.8	2.7	1.7	<0.0001
Normal (21-35 days)	70.6	75.0	81.9	80.5	88.0	87.6	89.0	92.4	89.7	
Oligomenorrhea (>35 days)	9.8	9.9	3.3	4.6	2.8	3.1	3.1	1.1	2.6	
Irregular length	13.7	13.2	12.7	10.8	6.6	7.6	6.1	3.8	6.0	
Blood flow lasting (%)										0.09
<4 days	3.6	3.7	2.4	2.7	2.0	3.0	3.1	4.7	2.5	
4-5 days	53.6	36.2	52.1	51.9	52.9	52.3	54.4	56.5	60.5	
6 days	23.2	33.7	26.5	24.8	25.7	25.8	22.5	23.8	19.3	
>6 days	19.6	26.4	19.0	20.7	19.5	18.9	20.0	15.0	17.5	
Premenstrual symptoms (%)										
Dysmenorrhea	2.0	1.4	4.3	3.8	5.4	5.8	8.7	8.2	6.7	0.004
Headache	3.6	10.6	7.5	8.3	8.8	10.2	12.7	16.1	14.1	0.003
Weakness	7.1	1.9	7.8	7.9	6.8	9.5	10.6	11.9	16.5	0.0003
Mood instability	16.1	6.8	12.1	17.9	16.1	18.7	21.9	21.8	18.2	<0.0001
Irritability	10.7	6.1	16.4	20.0	19.2	19.1	21.5	26.9	23.1	<0.0001
Crying	10.7	4.9	8.0	8.6	10.2	10.3	12.1	11.9	12.4	0.14
Aloneness	1.8	1.8	2.7	2.3	3.2	4.0	4.3	2.6	5.0	0.39

Table 6: Results from different multiple logistic stepwise regression models with menstrual abnormalities as dependent variable and general and family characteristics as covariates*

Menstrual abnormality dependent	Covariate	OR	95% CI	*P*
Polymenorrhea	Gynecological age (y)	0.86	0.75-0.99	0.04
Oligomenorrhea	Pill use	0.48	0.25-0.90	0.02
	Age at data collection (y)	1.25	1.02-1.53	0.0001
	Gynecological age (y)	0.71	0.60-0.83	<0.0001
	Bleeding>6 days	2.06	1.35-3.14	0.0008
Irregular length	Pill use	0.63	0.51-0.79	<0.0001
	Gynecological age (y)	0.81	0.77-0.85	<0.0001
	Bleeding>6 days	2.03	1.68-2.45	<0.0001
Bleeding>6 days	Social score (0-16)	0.94	0.80-1.00	0.05
	Smoking habit	1.23	1.01-1.51	0.04
	Pill use	0.66	0.52-0.85	0.001
	Normal cycle length 21-35 days	ref		
	Polymenorrhea *vs.* ref	0.98	0.52-1.84	0.10
	Oligomenorrhea *vs.* ref	2.36	1.55-3.60	0.02
	Irregular length *vs.* ref	2.59	1.95-3.44	0.0003

*The following covariates were tested by means of different multiple logistic stepwise regression models, For polymenorrhea, oligomenorrhea, and irregular length: social score, physical activity, living area, BMI, family size, smoke, pill use, drinking alcoholic beverages, living area, age at data collection, gynecological age, bleeding > 6 days. For Bleeding lasting more than 6 days: Social score, physical activity, living area, BMI, family size, pill use, smoke, drinking alcoholic beverages, age at data collection, gynecological age, Polymenorrhea/Oligomenorrhea/Irregularity vs. Normal cycle length (21-35 days). OR: Odds ratio,CI: Confidence interval

Nevertheless, our data showed that living area (North vs South) was not significantly associated with age at menarche and a similar monthly pattern of age at menarche in Northern and Southern Italy was found. Given that Italy stretches from 47°N to 35°N latitudes, the irradiation varies accordingly from North to South in an increasing trend (global horizontal annual radiation 1350 kWh/m^2 at North and 1500 kWh/m^2 at South), and seasonality is more pronounced at North, differently from other studies.[27] This survey suggests that latitude and radiation dose may not be associated with age at menarche in Italy. In addition, our results indicated that neither social level nor body mass is associated with seasonal menarche peaks (data not shown). Moreover, in contrast with Matchock and colleagues[28] our data did not confirm any relationship between birth month and monthly pattern (data not shown). In the picture described by the results of the present study, the hypothesis, sustained by Park and colleagues[29] for Korean girls, that monthly peaks in age at menarche may be mainly associated with psychological stress levels induced by school activity, is credible in Italy as well. In fact, our survey showed that menarche is more common in decreasing order in August (11.2%), July-September (10.9%), January (9.7%), and December (8.8%), and those months coincide with periods of school vacation in Italy (June-September and December-January).

Inconsistently with other studies,[14,28] we find that late menarche did not occur in preferential months or seasons, suggesting that physiopathological mechanisms may prevail over any other possible factors privileging a specific season.

Factors associated with age at menarche

The decreasing trend of age at menarche observed in the past has been largely attributed to improvement in socioeconomic conditions and in food availability, which would contribute to ameliorate the children nutritional status.[22,30-32] Research supports the hypothesis that a critical fat mass is necessary for menarche to occur.[33] In the present study, the current BMI, calculated from self-reported weight and stature at the time of the survey, was used as a surrogate

of the nutritional status of the girl at menarche, assuming that in absence of diseases, nutritional conditions track from childhood BMI to adulthood. Moreover, previous studies had verified a large agreement between BMI and the body-silhouette among adolescents.[34] Despite this approximation, in accordance with evidence from literature, this survey confirms the significant association between larger body-silhouette and earlier menarche [Figure 3], with overweight (BMI > 25 kg/m^2) girls having earlier menses about 10 months earlier than underweight girls do (BMI < 18.5 kg/m^2). Also, after adjusting for other significant covariates (parents' birth area, family size, mother's menarcheal age, and adolescent's age at data collection) the relationship was confirmed ($P < 0.0001$).

The final multiple regression model includes the main relevant covariates suggested by results from literature: Mother's menarcheal age (representing part of the genetic determinant), parents' birth area (that is a proxy for genetic and cultural factors), adolescent's age at menarche, which is a consequence of the study design (given that only girls who already had menarche were included; the total of younger girls had menarche early; meanwhile, only a part of the older girls may have had menarche early).

Cycle length and blood flow length

Our results indicate that [Table 5] that by the mean age of 17.1 years, 2.5% of the girls had cycles shorter than 21 days and in 3.4% they were longer than 35 days. A shorter than normal bleeding period (<4 days) was reported by 3.2% of the whole sample, and a long bleeding period (>6 days) by 19.6% of the girls.

As expected, regularization was seen for girls showing abnormalities in the first years after menarche. Despite this, the prevalence of polymenorrhea persisted with similar levels since the second gynecological year (about 2%). Anovulatory cycles with unopposed estrogen stimulation may lead to endometrial proliferation and hyperplasia. Without sufficient progesterone to stabilize and differentiate the endometrium, this mucous membrane becomes fragile and sloughs irregularly. Estrogen also affects uterine vascular tone, angiogenesis, prostaglandin formation, and endometrial nitric oxide production.[35]

On the contrary, the prevalence of both oligomenorrhea and irregular length decreased regularly during the first gynecological years, stabilizing at about 3% and 6%, respectively, within the forth gynecological year. Conversely, blood flow did not show any significant change with gynecological age. Actually, the results from the multivariate models show that oligomenorrhea and irregular length are significantly associated with bleeding longer than 6 days.

In conclusion, in the 19th century the onset of menstruation occurred around the age of 15; now, the average age of menarche is around 12 years. Abnormal bleedings during the first years after menarche are the main complaint in adolescent, principally due to anovulation. This depends on the immaturity of the hypothalamic–pituitary–ovarian axis. It is generally assumed that it takes up 24 months for regular ovulatory cycles to appear after menarche.[36] Approximately, half of persistent symptomatic menstrual irregularity is due to neuroendocrine immaturity, whilst half is due to increased androgen levels. The former condition corresponds to a short/deficient luteal cycle phase, whilst the latter related to polycystic ovary syndrome.[7] Initial anovulatory cycles tend to be pain free, but they can be associated with heavy menstrual bleeding[37] because estrogens, as opposed by progesterone, induce an instable endometrial lining, the breakdown of which causes major uterine bleedings. When regular ovulatory cycles commence, the cycle length becomes more regular (lower prevalence of oligomenorrhea and irregular cycles) but often they become more painful due to increased levels of circulating prostaglandins. This corresponds to growing prevalence of premenstrual and menstrual pain symptoms, with higher prevalence of dysmenorrhea at older gynecological ages.

Despite existing knowledge about the impact of dysmenorrhea and menstrual cycle abnormalities in the daily lives of many adolescent women, it is noteworthy that this particular age group is still often neglected. Traditionally, education about menstruation and puberty was a part of the maternal role. Physicians are generally expected sources of trustworthy information about menses, but they are often uncomfortable with discussing the topic of menstruation and sexuality in general.

Healthcare providers have an immense importance for these adolescent girls who are going through pubertal transition because have an opportunity to discuss reproductive health issues with mothers and their daughters, to make an early diagnosis, and to choose an appropriate treatment, thus minimizing the negative outcomes caused by these disorders in the lives of adolescents.

Many of the menstrual dysfunction problems can be effectively handled by the well-trained general clinician. Specific, complex situations should be referred to the appropriate specialist (gynecologist or endocrinologist), preferably someone skilled with adolescents' issues.

References

1. Parent AS, Teilmann G, Juul A, Skakkebaek NE, Toppari J, Bourguignon JP. The timing of normal puberty and the age limits of sexual precocity: Variations around the world, secular trends, and changes after migration. Endocr Rev 2003;24:668-93.
2. van Wieringen JC. Secular growth changes. In: Falkner R, Tanner JM, editors. Human growth: A comprehensive treatise. Vol 3. London: Plenum Press; 1986. p. 307-31.

3. Ljung BO, Bergsten-Brucefors A, Lindgren G. The secular trend in physical growth in Sweden. Ann Hum Biol 1974;1:245-56.
4. Lindgren GW. Regional differences in peak-height-velocity age of Swedish schoolchildren as an effect of economic history and urbanization. In: Tanner JM, editor. Auxology '88: perspectives in the science of growth and development. London: Smith-Gordon and Company Ltd; 1989. p. 199-202.
5. Deligeoroglou E, Creatsas G. Menstrual disorders. Endocr Dev 2012;22:160-70.
6. Adams Hillard PJ, Deitch HR. Menstrual disorders in the college age female. Pediatr Clin North Am 2005;52:179-97.
7. Rosenfield RL. Clinical review: Adolescent anovulation: Maturational mechanisms and implications. J Clin Endocrinol Metab 2013;98:3572-83.
8. ACOG Committee on Adolescent Health Care. ACOG Committee Opinion No. 349, November 2006: Menstruation in girls and adolescents: Using the menstrual cycle as a vital sign. Obstet Gynecol 2006;108:1323-8.
9. Fraser IS, Critchley HO, Munro MG, Broder MG. Can we achieve international agreement on terminologies and definitions used to describe abnormalities of menstrual bleeding? Hum Reprod 2007;22:635-43.
10. ACOG Committee Opinion no. 598: Committee on Adolescent Health Care: The initial reproductive health visit. Obstet Gynecol 2014;123:1143-7.
11. Rigon F, Bianchin L, Bernasconi S, Bona G, Bozzola M, Buzi F, *et al.* Update on age at menarche in Italy: Toward the levelling off of the secular trend. J Adolesc Health 2010;46:238-44.
12. Hollingshead A. Two factor index of social position. New Heaven: Yale University Press; 1957.
13. Proctor M, Farquhar C. Diagnosis and management of dysmenorrhoea. BMJ 2006;332:1134-8.
14. Gueresi P. Monthly distribution of menarche in three provinces of north Italy. Ann Hum Biol 1997;24:157-68.
15. Rigon F, De Sanctis V, Bernasconi S, Bianchin L, Bona G, Bozzola M, *et al.* Menstrual pattern and menstrual disorders among adolescents: An update of the Italian data. Ital J Pediatr 2012;38:38.
16. Danubio ME, De Simone M, Vecchi F, Amicone E, Altobelli E, Gruppioni G. Age at menarche and age of onset of pubertal characteristics in 6-14-year-old girls from the province of L'Aquila (Abruzzo, Italy). Am J Hum Biol 2004;16:470-8.
17. Wyshak G, Frisch RE. Evidence for a secular trend in age of menarche. N Engl J Med 1982;306:1033-5.
18. Gaudineau A, Ehlinger V, Vayssiere C, Jouret B, Arnaud C, Godeau E. Factors associated with early menarche: Results from the French Health Behaviour in School-aged Children (HBSC) study. BMC Public Health 2010;10:175.
19. Liestol K, Rosemberg M. Height, weight and menarcheal age of schoolgirls in Oslo: An update. Ann Hum Biol 1995;22:199-205.
20. Papadimitriou A, Fytanidis G, Douros K, Bakoula C, Nicolaidou P, Fretzayas A. Age at menarche in contemporary Greek girls: Evidence for leveling-off of the secular trend. Acta Paediatr 2008;97:812-5.
21. Euling SY, Herman-Giddens ME, Lee PA, Selevan SG, Juul A, Sørensen TI, *et al*. Examination of US puberty-timing data from 1940 to 1994 for secular trends: Panel findings. Pediatrics 2008;121 (Suppl 3):S172-91.
22. Bau AM, Ernert A, Schenk L, Wiegand S, Martus P, Gruters A, *et al*. Is there a further acceleration in the age at onset of menarche? A cross-sectional study in 1840 school children focusing on age and bodyweight at the onset of menarche. Eur J Endocrinol 2009;160:107-13.
23. Albright DL, Voda AM, Smolensky MH, Hsi BP, Decker M. Seasonal characteristics of and age at menarche. Chronobiol Int 1990;7:251-8.
24. Boldsen JL. Season of birth and recalled age at menarche. J Biosoc Sci 1992;24:167-73.
25. Valenzuela CY, Srikumari CR, Gopinath PM, Ghose N, Gajalakshmi P, Csoknyay J. New evidence of non-seasonal factors in the menarche rhythm. Biol Res 1996;29:245-51.
26. Grivas TB, Vasiliadis E, Mouzakis V, Mihas C, Koufopoulos G. Association between adolescent idiopathic scoliosis prevalence and age at menarche in different geographic latitudes. Scoliosis 2006;1:9.
27. Dossus L, Kvaskoff M, Bijon A, Engel P, Verdebout J, Fervers B, *et al*. Latitude and ultraviolet radiation dose in the birthplace in relation to menarcheal age in a large cohort of French Woman. Int J Epidemiol 2013;42:590-600.
28. Matchock RL, Susman EJ, Brown FM. Seasonal rhythms of menarche in the United States: Correlates to menarcheal age, birth age and birth month. Womens Health Issues 2004;14:184-92.
29. Park SH, Shim YK, Kim HS, Eun BL. Age and seasonal distribution of menarche in Korean girls. J Adolesc Health 1999;25:97.
30. Frish RE. Menarche and fatness: Re-examination of the critical body composition hypothesis. Science 1978;200:1509-13.
31. Meyer F, Moisan J, Marcoux D, Bouchard C. Dietary and physical determinants of menarche. Epidemiology 1990;1:377-81.
32. Herman-Giddens ME, Slora EJ, Wasserman RC, Bourdony CJ, Bhapkar MV, Koch GG, *et al.* Secondary sexual characteristics and menses in young girls seen in office practice: A study from the Pediatric Research in Office Settings network. Pediatrics 1997;99:505-12.
33. Frisch RE, Revelle R. Height and weight at menarche and hypothesis of menarche. Arch Dis Child 1971;46:695-701.
34. Jorga J, Marinkovic J, Kentric B, Hetherington M. Alternative methods of nutritional status assessment in adolescents. Coll Antropol 2007;31:413-8.
35. Livingstone M, Fraser IS. Mechanisms of abnormal uterine bleeding. Hum Reprod Update 2002;8:60-7.
36. Snook ML, Nayak S, Lara-Torre E, Sanfilippo JS. Adolescent gynecology: Special considerations for special patients. Clin Obstet Gynecol 2012;55:651-61.
37. William CE, Creighton S. Menstrual disorders in adolescents: Review of current practice. Horm Res Pediatr 2012;78:135-43.

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Appendix - Korb Working Group

The authors of this paper performed the present study on behalf of all the members of the KORB (Kids Observatory Research Board) working group: Sergio Bernasconi, Luigi Bianchin, Gianni Bona, Mauro Bozzola, Fabio Buzi, Carlo De Sanctis, Vincenzo De Sanctis, Giorgio Radetti, Franco Rigon, Luciano Tatò, Giorgio Tonini, and Egle Perissinotto.