

## Age at menarche in Coimbra (Portugal) school girls: a note on the secular changes

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**Summary.** The age at menarche and several menstrual symptoms were reported by 516 Portuguese school girls who took part in a cross-sectional anthropometric study in Coimbra, Portugal. The mean ages of menarche calculated using the recall method and also using probit analysis were  $12.53 \pm 1.27$  and  $12.03 \pm 1.26$  years, respectively. Parents' educational level, place of residence and size of the family did not have any significant effect on the mean age at menarche in this sample of adolescents. The order of birth was the only variable that indicated a significant effect: the firstborns reported a lower mean age at menarche (12.34 years) than the later borns (12.6 years). In this sample, 47% of the girls had a cycle length of  $\geq 29$  days, 23.4% had irregular cycles, 59% reported that the duration of bleeding was 3–5 days and the majority, 49%, did not report any pain during the bleeding days. However, 14.3% and 24.45% reported severe and medium pain. The age at menarche has declined from 15.0 (girls born in 1880–1890) to 12.03 (girls born in 1970–1980) years in the Portuguese population. This decrease in age, and also the lack of influence of the family characteristics, appear as a result of the great improvements in the social and economic living conditions that occurred in Portugal, especially after the 1970s. These improvements are mainly related to better nutrition and better health care along with many other environmental factors.

### 1. Introduction

The age at menarche, or the first menstrual period, is an important maturity indicator of maturity for the assessment of the developmental status of a pubertal female (Cameron and Nadgdee 1996). This biological event is the outcome of a number of social and biological factors, and the mean menarcheal age appears to be a particularly sensitive indicator of the biosocial status of a population (Dann and Roberts 1993, Lindgren 1976, Bielicki and Welon 1982, Laska-Mierzejewska *et al.* 1982, Vienna and Capucci 1994).

The age at menarche is known to be influenced by genetic factors and by socio-economic variables. The genetic basis of this event has been shown in studies of resemblance between sisters (Boas 1932, Reymert and Jost 1947), twins (Popenoe 1928, Petri 1934, Tisserand-Perrier 1953, Gedda and Brenci 1975, Fishbein 1977, Golden 1981, Sharma 1983; Van den Akker *et al.* 1987, Treoloar and Martin 1990, Meyer *et al.* 1991, Loesch *et al.* 1995) and also the resemblance between mothers and their daughters (Bolk 1926, Popenoe 1928, Gould and Gould 1932, Damon *et al.* 1969, Brooks-Gunn and Warren 1988, Malina *et al.* 1994, Campbell and Udry 1995). However, the magnitude of the genetic contribution still remains unclear.

Some studies have shown the influence of many environmental factors that can influence the age at menarche, namely the degree of urbanization (Ducros and Pasquet 1980, Hulanicka and Waliszko 1991, Barnes-Josiah and Augustin 1995, Cameron and Wright 1990, Graham *et al.* 1999, Pasquet *et al.* 1999). The

socio-economic status, often given by the parents' educational level or occupation, showed some statistically significant effects—girls of lower social upbringing exhibited, on average, a delay in their first menstruation, when compared with girls from well-off families (Bielicki *et al.* 1986, Laska-Mierezejewska 1995, Bodzsar 1975, Attallah *et al.* 1983, Oduntan *et al.* 1976, Uche and Okorafor 1979, Attallah 1978, Henneberg and Louw 1995). The size of the family and the order of birth also showed a significant effect on the age at menarche—girls from large families showed a delay of maturation (Roberts *et al.* 1971, Clegg 1980, Billewicz *et al.* 1981, Dann and Roberts 1984, 1993, Cameron and Nadgdee 1996, Sánchez-Andrés 1997, Apraiz 1999). Other factors like nutrition (Simodon *et al.* 1997), seasonality (Boldsen 1992), physical activity (Malina 1983) and altitude level (Gonzales *et al.* 1996) also showed a significant effect on age at menarche.

In this paper, we examine the mean age at menarche in girls of three secondary schools in the city of Coimbra. We describe the length of their menstrual cycle, the duration of the bleeding and the somatic symptoms during the bleeding days. We report mean age at menarche related to parent's educational level, place of residence, size of the family and order of birth. Finally, we report the secular changes in the age at menarche in Portuguese girls during the 20th century.

## 2. Materials and methods

### 2.1. Sample

Between November 1990 and May 1991, a cross-sectional anthropometric survey was carried out in three secondary schools in Coimbra. In total, 516 girls, with a decimal age comprised between 9 and 19 years, were examined. The different ages were regrouped in classes of 1 year each and were represented by the sign +. For each girl, information about the date of examination, her date of birth, whether she had attained menarche and, if so, the date of that occurrence was recorded. Half a year was systematically added to the age obtained.

For the girls who had already attained menarche at the time of the examination some questions relating to their menstruation were also asked: how many days was the length of her menstrual cycle, what was the duration of the bleeding, and what type of somatic symptoms occurred during the bleeding days. Descriptive statistics were carried out for socio-demographic data, and the age at menarche was calculated by means of a probit analysis (Finney 1971) and computed using the SPSS/PC statistical package.

### 2.2. Social data

During the examination, each student filled a questionnaire regarding some family characteristics and their place of residence.

Parents' educational level was categorized into four levels according to the Portuguese classification of the Instituto Nacional de Estatística (INE 1991): 1—None; 2—Primary; 3—Secondary; and 4—University level. Due to the small number of individuals without any education, these were not analysed and just three categories were considered.

The place of residence was classified into two categories using the Portuguese classification based on population size (INE 1996): 1—Semi-urban (population less than 5000) and 2—Urban (population over 5000).

The number of siblings, and the girls' position in the sibship was also recorded. To define the size of the family, four categories were used: 1, 2, 3 and  $\geq 4$  children

in the family. To define the order of birth, three categories were used; 1—First born; 2—Second born; and  $\geq 3$ —Third or later born.

Because some of the questions were not properly answered by the girls we do not have the same number of subjects for some categories of the social data.

### 2.3. Definitions of reproductive characteristics

The *length of the menstrual cycle* was defined as the interval (in days) from the first day of one menstruation to the first day of the next menstruation. Each girl reported how many days were comprised between two consecutive cycles and based on this information, five groups were considered: 1— $< 21$  days; 2—22–23 days; 3—24–25 days; 4—27–28 days; 5— $\geq 29$  days and Irregular pattern.

The *duration of the bleeding (days)* was recorded as the number of bleeding days, on average, that each girls reported. This variable was also grouped in three categories: 1—3–5 days; 2—5–7 days and 3— $\geq 8$  days.

For *pain during the bleeding days*, each girl was asked about concerning the existence of some pain during the bleeding days. The answers were then classified according to the following scale: 1—No pain; 2—Mild pain; 3—Medium pain and 4—Severe pain.

## 3. Results

### 3.1. Social data

Table 1 summarizes some of the family characteristics of each adolescent. The parent's educational level is very low, with 38.3% of the fathers and 42.3% of mothers having attended only primary school. Only 30.6% of the fathers and 23.3% of the mothers reached an university level.

The majority of the adolescents lived in urban places, in the centre of the city (66.1%). Thirty-four per cent of the girls lived in semi-urban places, not far from

Table 1. Socio-demographic characteristics of the sample (%),  $n = 516$ .

	<i>n</i>	%
<b>Father's education</b>		
Primary school	175	38.3
Secondary school	142	31.1
University	140	30.6
<b>Mother's education</b>		
Primary school	196	42.3
Secondary school	159	34.3
University	108	23.3
<b>Place of residence</b>		
Semi-urban	175	33.9
Urban	341	66.1
<b>Size of the family</b>		
1	92	17.8
2	292	56.6
3	87	16.9
$\geq 4$	37	8.7
<b>Order of birth</b>		
1	286	55.4
2	162	31.4
$\geq 3$	68	13.2

the city. Concerning the size of the family, we found that more than half of the girls had two siblings, and 55.4% were the first born within the family.

### 3.2. Mean age at menarche

Table 2 presents the number and percentage of girls who experienced the first menstruation in each age class. Table 3 summarizes the average age at menarche using the recall age and the probit analysis. The average mean age, using recall of age at menarche, was  $12.53 \pm 1.27$  years. From probit analysis the median age at menarche was  $12.03 \pm 1.26$  years. Concerning the influence of family characteristics, for post-menarcheal girls, one-way analysis of variances (ANOVAs) were used: parents' educational level, place of residence and family size did not show any significant influence on the mean age at menarche. On the other hand, birth order showed a significant influence on mean age at menarche with later born girls presenting a later age at menarche ( $p \leq 0.01$ ).

### 3.3. Menstrual characteristics

Table 4 summarizes the menstrual characteristics collected from the girls who had already attained menarche. Some of the girls (23.35%) reported having irregular periods, very few girls (0.54%) had a menstrual cycle shorter than 21 days, 1.64% had cycles of 24–25 days, 20.6% had cycles of 27–28 days and the majority of girls (47%) had a cycle length of  $\geq 29$  days. The majority of the girls (59%) reported 3–5 days of bleeding. The highest percentage (49%) reported absence of pain during the bleeding days, but 24.5% stated that they felt medium pain. Finally, 14.3% of the girls reported severe pain during the bleeding days.

### 3.4. Secular changes in the Portuguese population between 1880 and 1980

Figure 1 shows the secular trend in age at menarche in Portugal. Previous data (Sacadura 1912, Rosas and Saavedra 1921, Morato 1930, Antunes and Marques 1989, Rocha and Xavier Morais 1990, Rocha *et al.* 1998) were considered. It is

Table 2. Total number of girls and percentages of menstruating girls in each age group.

Age	Total number of girls	Menstruating girls		Non-menstruating girls
		<i>n</i>	%	<i>n</i>
9+	1			1
10+	47	2	4.3	45
11+	62	8	12.9	54
12+	71	38	53.5	33
13+	88	77	87.5	11
14+	81	74	91.4	7
15+	87	84	96.6	3
16+	49	49	100	
17+	19	19	100	
18+	9	9	100	
19+	2	2	100	
Total	516	362		154

Table 3. Age at menarche in the total sample, and organized by parents' educational level, place of residence, size of the family and order of birth (one-way ANOVA and probit analysis).

	Recall age		Probit analysis	
	<i>n</i>	Mean ± SD	<i>n</i>	Median ± SD
Total sample	360	12.53 ± 1.27	362	12.03 ± 1.26, $\chi^2 = 14.528$ , d.f. = 8, $p = 0.07$
<b>Father's education</b>				
Primary school	119	12.62 ± 1.32	175	12.27 ± 1.19, $\chi^2 = 2.277$ , d.f. = 8, $p = 0.971$
Secondary school	91	12.38 ± 1.15	142	12.4 ± 1.34, $\chi^2 = 7.119$ , d.f. = 7, $p = 0.417$
University	106	12.5 ± 1.35 $F = 0.894$ , NS	140	11.52 ± 1.28, $\chi^2 = 4.742$ , d.f. = 7, $p = 0.691$
<b>Mother's education</b>				
Primary school	139	12.62 ± 1.32	196	12.17 ± 1.26, $\chi^2 = 6.171$ , d.f. = 8, $p = 0.628$
Secondary school	102	12.26 ± 1.13	159	12.12 ± 1.45, $\chi^2 = 6.214$ , d.f. = 7, $p = 0.516$
University	81	12.55 ± 1.32 $F = 2.474$ , NS	108	11.74 ± 1.08, $\chi^2 = 4.118$ , d.f. = 7, $p = 0.766$
<b>Place of residence</b>				
Semi-urban	125	12.51 ± 1.2	341	11.63 ± 1.36, $\chi^2 = 7.191$ , d.f. = 8, $p = 0.516$
Urban	235	12.56 ± 1.39 $F = 0.095$ , NS	175	12.25 ± 1.16, $\chi^2 = 11.696$ , d.f. = 7, $p = 0.111$
<b>Size of the family</b>				
1	68	12.19 ± 1.21	92	11.82 ± 0.92, $\chi^2 = 4.119$ , d.f. = 6, $p = 0.661$
2	192	12.53 ± 1.22	292	12.16 ± 1.27, $\chi^2 = 6.059$ , d.f. = 8, $p = 0.641$
3	65	12.67 ± 1.42	87	11.83 ± 1.65, $\chi^2 = 13.610$ , d.f. = 7, $p = 0.059$
≥4	30	12.83 ± 1.21 $F = 2.475$ , NS	37	11.49 ± 1.33, $\chi^2 = 3.176$ , d.f. = 7, $p = 0.812$
<b>Order of birth</b>				
1	201	12.34 ± 1.25	286	12.07 ± 1.16, $\chi^2 = 5.796$ , d.f. = 8, $p = 0.670$
2	111	12.79 ± 1.22	162	11.97 ± 1.31, $\chi^2 = 16.116$ , d.f. = 7, $p = 0.024$
≥3	41	12.6 ± 1.37 $F = 4.672^*$	56	11.72 ± 1.86, $\chi^2 = 3.446$ , d.f. = 7, $p = 0.841$

\* $p \leq 0.01$ ; NS, not significant.Table 4. Length of menstrual cycle, duration of bleeding, and somatic symptoms during bleeding days ( $n = 362$  girls).

	<i>n</i>	%
<b>Cycle length (days)</b>		
21	2	0.54
22–23	3	0.82
24–25	6	1.64
27–28	75	20.6
≥29	171	46.97
Irregular	85	23.35
Non-response	20	5.52
<b>Duration of the bleeding (days)</b>		
37 013	213	58.51
37 076	47	12.91
≥8	97	26.64
Non-response	5	1.38
<b>Pain during the bleeding (days)</b>		
No pain	176	48.6
Mild	45	12.36
Medium	89	24.45
Severe	52	14.28

clear from figure 1 that a decrease in the mean age at menarche occurred in the Portuguese population. Girls born in the decade 1880–1890 had a mean age at menarche of 15 years and those who were born in 1970–1980 had a median age at menarche of 12.03 years (present study).

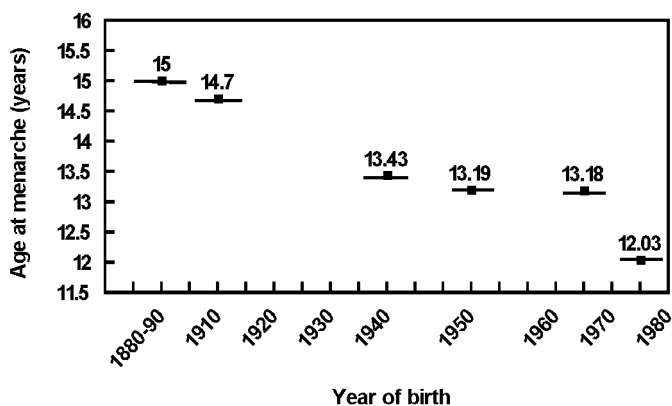


Figure 1. Secular trend in age at menarche in the Portuguese population (1880–1980).

#### 4. Discussion

The mean age at menarche among Coimbra girls is similar to the values reported by other authors, for other populations such as Italy (Martuzzi Veronesi and Guerese 1994), Spain (Marrodan *et al.* 2000), Venezuela (Farid-Coupal *et al.* 1981) and England (Whincup *et al.* 2001).

As in almost all the developed populations, only birth order showed a significant effect on the mean age at menarche, with later born girls reporting a later age at menarche. The other socio-demographic characteristics, namely parents' educational level, size of the family and place of residence, did not show any significant effect. Similar results were found in many other studies (Roberts *et al.* 1971, Billewicz *et al.* 1981, Dann and Roberts 1984, 1993, Clegg 1980, Cameron and Nadgdee 1996, Sánchez-Andrés 1997, Apraiz 1999).

In 1967, menstrual discomfort was studied among Stockholm girls (Furu 1976), using indicators such as absence from school, and/or use of analgesics or other medication during the periods. Nine per cent of these girls were believed to experience severe discomfort, while 25% and 28% experienced moderate and mild discomfort, respectively. Thirty-eight per cent of Stockholm girls reported no menstrual discomfort. In a more recent study with Thai girls, Chompootawee *et al.* (1997) reported that only 27% of the Thai girls had no complaints or menstrual discomfort. In our study, we found that almost half of the Portuguese girls (49%) did not report pain during the bleeding days, but a large number reported medium and severe discomfort, 25% and 15% respectively. These numbers, in our opinion, require a deeper study about menstrual symptoms in order to find their origin and the role of socio-demographic factors in this menstrual discomfort. In a study on Swiss girls, Flug *et al.* (1984) found that cycles of 21–27 and 28–34 days constituted 64–81% of all cycles. In our sample, the majority of girls, 47%, reported  $\geq 29$  days. In a study of Turkish adolescents, Vicdan *et al.* (1996) found that 77.8% of these adolescents had cycles between 20 and 35 days. It is difficult to make comparisons among populations because each author defines his own methodology. The same situation happens with the duration of the bleeding (days). In our sample we found that about 59% of the girls had cycles of 3–5 days. Other authors (Harlow and Ephross 1995, Cleckner-Smith *et al.* 1998) found that in 94.7% of the girls from their adolescent samples had menstrual flow between 4 and 8 days. Eight per cent reported 3–6 days. Due to the large connection between menstruation

and women's health, this is a topic that deserves more attention in future research on this subject.

A secular trend in the age at menarche, towards an earliest age, occurred in the Portuguese population. Published data showed that in the birth decade of the 1880s the mean age was 15 years and in 1980 declined to a value of 12.03 years. These findings are in agreement with the secular trend in mean stature in the male population (Padez 2002). Both stature and menarche are influenced by environmental factors such as nutrition and health care, among many other variables. The increase in mean stature and the decrease in mean menarcheal age represent a general improvement in the living conditions that occurred in Portugal after the 1970s. The Portuguese nutritional pattern changed between 1960 and 1997 (Barreto 1996, 2000). Some products, like milk, meat, eggs, sugar, proteins and fats, increased considerably. The health system benefited from many improvements. All these changes were reflected in a decrease in post-neonatal mortality, an increase of life expectancy, and in the improvement of other indicators such as the number of physicians per 1000 population, and the percentage of infants born at maternity centres (Barreto 1996, 2000).

The post-neonatal mortality rate is generally regarded as a sensitive indicator of infant health (Kessel 1990), and infant nutritional status as well as the prevalence of infections are the most important determinants of post-neonatal mortality (Stembera 1990).

Many studies suggested that adverse environmental factors have their strongest effects during childhood (Brundtland *et al.* 1980, Nystrom Peck and Vagero 1987, Tanner 1992, Nystrom Peck and Lundberg 1995, Schimidt *et al.* 1995, Wadsworth 1997, Cole 2000). The subjects of the present study were born between 1970 and 1980. If their birth period is paired with changes associated with nutrition, the changes in the health system and the general socio-economic development, it is clear that they were the first to take advantage of these social improvements.

Similar results have been found in almost all the European countries, including Spain (Prado 1990), The Netherlands (van Wieringen 1986), Germany (Bremerhaven) (Ostersehl and Danker-Hopfe 1991), the Czech Republic (Prokopec 1989) and Hungary (Szeged) (Eiben 1994). Some studies provide evidence of a stagnation in age at menarche over the past decade(s), for example in Belgium (Vercauteren and Susanne 1985), Norway (Brundtland *et al.* 1980) and in Massachusetts, USA (Damon 1974). A reversal of this trend has been observed in Sweden (Stockholm) (Lindgren and Hauspie 1989), Hungary (Kormend) (Eiben 1994) and Croatia (Zagreb) (Prebeg 1995). From these studies it seems that the age at menarche is still decreasing in many countries, but has reached a plateau or even reversed its trend in others. More studies are needed to evaluate what is happening in the Portuguese population.

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**Zusammenfassung.** Es werden Menarchealter und einige Menstruationssymptome von 516 portugiesischen Schülerinnen dargestellt, welche an einer anthropometrischen Querschnittsstudie in Coimbra (Portugal) teilnahmen. Das mittlere Menarchealter, welches mittels retrospektiver Methode bestimmt wurde, betrug  $12.53 \pm 1.27$  Jahre beziehungsweise  $12.03 \pm 1.26$  Jahre bei Ermittlung mittels Probitanalyse. Bildungsniveau der Eltern, Wohnort und Größe der Familie hatten keinen signifikanten Einfluss auf das mittlere Menarchealter in dieser Stichprobe. Der Rang in der Geschwisterreihe war die einzige Variable, die einen signifikanten Einfluss zeigte: bei den Erstgeborenen trat die Menarche früher auf (12.34 Jahre) als bei den später Geborenen (12.6 Jahre). In dieser Stichprobe hatte 47% der Mädchen eine Zykluslänge von  $^{3}29$  Tagen, 23.4% hatten unregelmäßige Zyklen, 59% berichteten, dass die Blutungsdauer 3–5 Tage beträgt und die Mehrheit von über 49% hatte keine Schmerzen während der Blutung. 14.3% bzw. 24.45% berichteten über starke bzw. mittlere Schmerzen. Das mittlere Menarchealter ist in der portugiesischen Bevölkerung von 15.0 Jahren auf 12.03 Jahre gesunken. Diese Abnahme beim Menarchealter sowie fehlende familiäre Einflussfaktoren sind wahrscheinlich auf die immensen Verbesserungen der sozialökonomischen Lebensbedingungen, welche in Portugal besonders nach den siebziger Jahren auftraten, zurückzuführen. Bei diesen Verbesserungen spielen neben vielen anderen Umweltfaktoren die Verbesserung der Ernährung und bessere Gesundheitsvorsorge eine wesentliche Rolle.

**Résumé.** L'âge des premières règles et plusieurs symptômes pré-menstruels ont été rapportés par 516 élèves qui ont participé à une étude transversale de la croissance à Coimbra (Portugal). Les âges moyens des premières règles estimés par mémorisation et par l'analyse des probits, sont respectivement de  $12.53 \pm 1.27$  et  $12.03 \pm 1.26$  ans. Le niveau éducatif des parents, le lieu de résidence et la taille de la famille ne présentent pas d'effet significatif sur l'âge moyen des premières règles dans cet échantillon d'adolescentes. L'ordre de naissance est la seule variable qui indique un effet significatif: les aînés ayant un âge moyen aux premières règles plus bas (12.34 ans) que les puînés (12.6 ans). 47% des filles de cet échantillon avaient un cycle long de 29 jours, 23.4% avaient un cycle irrégulier, 59% déclaraient que la durée de leur saignement était de 3 à 5 jours, sans occasionner de douleurs pour la majorité (49%) d'entre-elles. Cependant, 14.3 et 24.45% déclarèrent des douleurs moyennes à fortes. L'âge des premières règles a diminué de 15.0 à 12.03 ans dans la population portugaise. Cette décroissance ainsi que l'absence d'influence des caractéristiques familiales paraissent exprimer les grandes améliorations économiques et sociales des conditions de vie qui ont pris place dans le pays, notamment à partir des années 1970. Parmi de nombreux facteurs de l'environnement, les améliorations dominantes paraissent surtout être une meilleure nutrition et de meilleurs soins médicaux.

**Resumen.** Se presentan datos sobre la edad de menarquia y diversos síntomas menstruales de 516 escolares portuguesas que tomaron parte en un estudio antropométrico transversal realizado en Coimbra (Portugal). Las edades medias de menarquia, calculadas utilizando tanto el método retrospectivo como el análisis probit, fueron  $12.53 \pm 1.27$  y  $12.03 \pm 1.26$  años, respectivamente. El nivel educativo de los padres, el lugar de residencia y el tamaño de la familia no mostraron ningún efecto significativo sobre la edad media de menarquia en esta muestra de adolescentes. El orden de nacimiento fue la única variable que mostró un efecto significativo: las primeras en nacer presentaban una edad media de menarquia (12.34 años) menor que las últimas (12.6 años). En esta muestra, el 47% de las niñas tenía un ciclo de 29 días, el 23.4% tenía ciclos irregulares, el 59% informó que la duración del sangrado era de 3-5 días y la mayoría, un 49%, no indicó ninguna molestia durante los días de sangrado. Sin embargo, el 14.3% y el 24.45% señalaron dolores agudos y medios. La edad de menarquia ha ido declinando desde los 15.0 años a los 12.03 en la población portuguesa. Este descenso en edad, así como la ausencia de influencia de las características familiares, parece el resultado de las grandes mejoras en las condiciones de vida sociales y económicas que han tenido lugar en Portugal, especialmente desde la década de los 70. Estas mejoras están en su mayor parte relacionadas con una mejor alimentación y mejores cuidados sanitarios, entre otros muchos factores ambientales.