Social Background and Age at Menarche in Portuguese University Students: A Note on the Secular Changes in Portugal

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ABSTRACT   Menarcheal age of a sample of Portuguese university students (n = 3,366), born between 1972 and 1983, age 18–23 years, was analyzed. The influence of parents' educational level and occupation, family size, birth order, and degree of urbanization of girl's locality of residence during childhood and adolescence were analyzed as well as secular trend in the Portuguese population. Mean age at menarche for girls born in 1983 was 12.32 years. Parents' educational level and occupation did not show any significant influence on mean age at menarche. Place of residence during childhood years and adolescence showed a significant effect on mean age at menarche, with girls from rural places with a later age at menarche than those who spent their childhood or adolescence in urban areas ($P \leq 0.01$ and $P \leq 0.05$ for childhood and adolescence, respectively). Family size and birth order showed the highest effect. Girls born in small families, with one child, matured earlier (12.32 years) than those born in large families with four or more children (12.67 years), ($P \leq 0.01$). Also, girls that were first-born had an earlier menarche (12.41 years) than those who were third or later (12.58 years, $P \leq 0.01$). Regression analysis selected family size and place of residence in childhood as the most important determinants of mean age at menarche in our university students. In this sample, from 1972 to 1983, mean age at menarche remained stable. When we considered published data from all the Portuguese population we found a decrease in mean age at menarche from 15 years for girls born in 1880 to 12.44 for those born in the 1980s. This decrease was the result of great improvements in the social and economic living conditions that occurred in Portugal especially after the 1970s concerning nutrition and health care, among many other environmental factors. Am. J. Hum. Biol. 15:415–427, 2003.   © 2003 Wiley-Liss, Inc.

Age at menarche, the first menstrual period, is an important maturity indicator in assessing 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 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).

Age at menarche is known to be influenced by genetic factors and by socioeconomic variables. The genetic basis of this event is shown by studies of resemblance between sisters (Boas, 1932; Reymert and Jost, 1947), twins (Popenoe, 1928; Petri, 1934; Tisserand-Perrier, 1953; Gedda and Brenzi, 1975; Fishbein, 1977; Golden, 1981; Sharma, 1983; van den Akker et al., 1987; Treloar and Martin, 1990; Meyer et al., 1991; Loesch et al., 1995), and 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 genetic contribution still remains unclear.

Among the environmental factors that could influence age at menarche, some studies have shown the influence of degree of urbanization: urban girls on average mature earlier than rural girls, for example, in France (Ducros and Pasquet, 1980), in Poland (Hulanicka and Waliszko, 1991), in Nigeria (Oduntan et al., 1976; Uche and Okorafor, 1979), in Egypt (Attallah, 1978), in Haiti (Barnes-Josiah and Augustin, 1995), in Venezuela (Farid-Coupal et al., 1981), in South Africa (Cameron and Wright, 1990), in China (Graham et al., 1999), and in Cameroon

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(Pasquet et al., 1999). Socioeconomic status, often given by parents' educational level or occupation, has also shown a significant influence; girls of lower social origin on average exhibiting a delay in first menstruation compared with girls from well-off families. This was found in studies in Poland (Bielicki et al., 1986; Laska-Mierezejewska, 1995), in Hungary (Bodzsar, 1975), in Khartoum (Sudan) (Attallah et al., 1983), in Nigeria (Oduntan et al., 1976; Uche and Okorafor, 1979), in Egypt (Attallah, 1978), and South Africa (Henneberg and Louw, 1995). Family size and birth order also have shown a significant effect on age at menarche, with girls in large families exhibiting a delay of maturation (Roberts et al., 1971; Billewicz et al., 1981; Dann and Roberts, 1984, 1993; Clegg, 1980; Cameron and Nadgdee, 1996; Sánchez-Andrés, 1997; Apraiz, 1999). Other factors such as nutrition (Simodon et al., 1997), seasonality (Boldsen, 1992), physical activity (Malina, 1983), and altitude level (Gonzales et al., 1996) also have shown significant effects on age at menarche.

However, the influence of the above factors depends on the country and time of the study. At present, only family size and birth order seems to present a consistent significant influence on age at menarche in all the populations, from industrialized to developing countries. On the other hand, the effects of socioeconomic factors such as parents' educational level and occupation is absent in almost all industrialized populations, as in France (Demoulin, 1998), Greece (Papadimitriou et al., 1999), Bologna, Italy (Martuzzi Veronesi and Gueresi, 1994), or England (Roberts et al., 1971; Dann and Roberts, 1993; Roberts et al., 1986). Similarly, no significant effect of father's occupation and urbanization has been observed on mean age at menarche in Bologna, Italy (Martuzzi Veronesi and Gueresi, 1994) or Spain (Marrodan et al., 2000; Sánchez-Andrés, 1997). This is a result of improvements in living conditions that occurred during the 20th century, which can be seen also in the secular trend towards an earlier age at menarche.

The secular shift towards a younger age at menarche has been observed in several European countries, such as Spain (Prado, 1990), the Netherlands (van Wieringen, 1986), Bremerhaven (Germany) (Ostersehlt and Danker-Hopfe, 1991), the Czeck Republic (Prokopec, 1989), and Szeged (Hungary) (Eiben, 1994). Some studies provide evidence of a stability in age at menarche over the past decade(s), e.g., in Belgium (Vercauteren and Susanne, 1985), Norway (Brundtland et al., 1980), and in Massachusetts, USA (Damon, 1974). A reversal of this trend, with an increase in mean age at menarche, has been observed in Stockolm, Sweden (Lindgren and Hauspie, 1989), Kormend, Hungary (Eiben, 1994), and Zagreb, Croatia (Prebeg, 1995). From these studies it seems that age at menarche is still decreasing in many countries, but has stayed unchanged or shown a rising trend in others.

The aim of the present study was to investigate the influence of some sociodemographic conditions, in particular, parents' educational level and occupation, family size, birth order, and degree of urbanization of the girl's locality of residence during childhood and adolescence on age at menarche of Portuguese university students. The secular change in the age at menarche in Portugal during the 20th century was also analyzed.

MATERIALS AND METHODS

Sample

From 1995 until 2001, 3,366 females, age 18–23 years and born between 1972 and 1983, were examined at the Department of Anthropology of the University of Coimbra for a project that concerns how body size and maturation are related to sociodemographic characteristics.

The subjects of our sample were selected randomly among all students in the University of Coimbra and were invited to participate in this project. Most of the selected subjects agreed to participate. In each year about 800 subjects were examined, always in the first semester. All were measured and filled out a questionnaire. The measurements were taken always by the same observer, using the same instruments, and were always done between 14.00 and 18.00 hours.

Height and weight were taken according to international protocols (Weiner and Lourie, 1981). Each student was measured without shoes and wearing light-weight clothes. Height was measured to the nearest centimeter and weight was recorded to the nearest 100 g. One Kg was subtracted from the weight to allow for clothes. Body mass

index was calculated with height and stature: Body Mass Index $= \text{Weight/height}^2$.

Each student was asked about the age to nearest whole year at which she had attained menarche and about details of some social and family characteristics.

Social data

During each examination, each student filled a questionnaire regarding family characteristics and place of residence during her childhood and adolescence.

Parents' educational level was categorized into four levels according to the Portuguese classification of the *Instituto Nacional de Estatistica*: 1, None; 2, Primary; 3, Secondary; and 4, University level (INE, 1991a,b).

Parents' occupation was categorized at eight levels for the father and nine for the mother according to the Portuguese classification Classificação Nacional das Profissões (INE, 1994): 1, Executive civil servants, industrial directors and executives; 2, Professionals and scientists; 3, Middle management and technicians; 4, Administrative and related workers; 5, Service and sales workers; 6, Farmers and skilled agricultural and fisheries workers; 7, Skilled workers, craftsmen and similar; 8, Unskilled workers; 9, Housewife (just for females).

Place of residence during childhood and adolescence was classified into three categories using the Portuguese classification based in population size (INE, 1996): 1, Rural places (population below 2,000); 2, Semi-urban (population 2,000–5,000); and 3, Urban (population over 5,000). Childhood was considered to last through age 7; older ages were classified as adolescence (Bogin, 1999).

The number of siblings for each subject and her position in the sibship was also ascertained. For family size, four categories were identified: 1, 2, 3, and ≥ 4 children in the family. Birth order included three categories: 1, First born; 2, Second born; ≥ 3, Third or later born.

Some of the questions on social data were not properly answered, and these answers were excluded. Therefore, the number of subjects is not equal for all variables.

One-way analysis of variance for age at menarche and some of the above social data (year of birth; mother and father educational level and occupation; place of residence during childhood and adolescent years; family

size; and birth order) was done. A multiple regression analysis, with stepwise method, using the explanatory variables and age at menarche as dependent variable was performed.

RESULTS

Social data

Table 1 summarizes some of the family characteristics of each student. Concerning parents' educational level, 44% of the fathers and 48% of mothers attended only primary school. Only 19% of the fathers and 14% of the mothers reached a university level. For the entire Portuguese population, 63% of males and 60% of females attended only primary school and 7% of males and females reached university level.

In accordance with their educational level, only 0.3% of fathers and 0.1% of mothers were in the "highest" level of our *Classificação Nacional das Profissões*. The greatest percentage of the fathers were professionals and scientists (25%), middle management and technicians (17%), and skilled workers (25%). For mothers the greatest percentage was housewife (32%), middle management and technicians (20%), and professionals and scientists (15%). For all Portuguese, the majority of males and females were skilled workers (32.5%) and unskilled workers (16.6%).

The majority of the students spent their childhood in urban (40.4%) and rural (30.5%) environments. For adolescence years, the majority (39.1%) lived in urban places. For all the Portuguese population, only 17% lived in rural places and 56% lived in urban areas.

Concerning family size, more than half of the students (54%) had two brothers or sisters and 52.4% were first-born within the family. In the Portuguese population as a whole, 33% of the families had one child and 26% two.

Secular changes

As shown in Table 2, mean age at menarche and weight remain stable for girls born between 1972 and 1983. At present, mean age at menarche is 12.32 years. On the other hand, mean height showed a significant dependence on the year of birth $(\text{F} = 17.048, P \leq 0.001)$ in the same period of time, with a mean value of 160.0 cm for those born in 1983.

TABLE 1. Sociodemographic characteristics of the sample (%), n = 3,373 and of the Portuguese population (INE, 1991)

| | Parent's educational level | | | | Portugal | | | |
| | Father | | Mother | | Males | | Females | |
	N	%	N	%	N	%	N	%
None	29	0.9	28	0.8	317,525	7.3	638,046	13.5
Primary	1,477	43.8	1,612	47.8	2,763,130	63.3	2,812,293	59.6
Secondary	1,145	33.9	1,213	36	984,564	22.6	944,446	20
University	640	19	473	14	298,410	6.8	327,120	6.9

| | Parent's occupation | | | | Portugal | |
| | Father | | Mother | | Males and females | |
	N	%	N	%	N	%
Executive civil servants, industrial directors and executives	9	0.3	3	0.1	174,473	4.2
Professionals and scientists	790	24.7	503	15.4	230,190	5.6
Middle management and technicians	552	17.3	651	20	306,211	7.4
Administrative and related workers	305	9.5	282	8.6	438,820	10.6
Service and sales workers	404	12.6	348	10.7	555,274	13.4
Farmers and skilled agricultural and fisheries workers	318	9.9	92	2.8	353,412	8.6
Skilled workers, craftsmen and similar	806	25.2	264	8.1	1,341,837	32.5
Unskilled workers	16	0.5	64	2	686,988	16.6
Housewife	—	—	1,054	32.3	—	—

| | Place of residence | | | | Portugal | |
| | Childhood | | Adolescence | | Males and females | |
	N	%	N	%	N	%
Rural	1,030	30.5	1,034	30.7	1,706,498	17
Semi-urban	978	29	1,019	30.2	2,643,966	27
Urban	1,364	40.4	1,320	39.1	5,516,685	56

| | Family size | | Birth order | | Portugal | |
	N	%	N	%	N	%
1	428	13	1,768	52.4	911,151	32.9
2	1,832	54	1,103	32.7	729,152	26.4
3	7,358	22	430	12.7	209,146	7.6
≥4	336	10	—	—	118,748	4.3

Social and family characteristics

Table 3 summarizes the influence of social and family characteristics on mean age at menarche of Portuguese university students. Parents' educational level and occupation did not show any significant effect on mean age at menarche. Place of residence during both childhood and adolescence showed a significant effect on age at menarche. Girls that spent their childhood and adolescence in rural places had a delay in their maturation, with a mean age at menarche of 12.53 years and 12.52 years, respectively, compared to those who lived in urban places, with a mean age at menarche of 12.38 and 12.4 years ($P \leq 0.01$ and $P \leq 0.05$). Family size and birth order showed a significant effect on age at menarche. Girls born in large families, with four or more children, had a later age at menarche age (12.67 years) than those born in small families with one child (12.32 years), ($P \leq 0.001$). The same occurred for birth order: later-born girls had a delay in maturation (12.58 years) compared to first born (12.41 years) ($P \leq 0.05$).

In Table 4, the interaction between family size and birth order was considered. ANOVA analysis showed that there was no interaction between those variables. Considering

TABLE 2. Mean age at menarche, height, weight, and body mass index of Portuguese female students observed between 1995 and 2001 and born between 1972 and 1983; regression analysis

Year of birth	Age at menarche (years)		Height (cm)	Weight (Kg)	Body mass index
	N	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1972	124	12.47 ± 1.2	159.9 ± 5.8	56.6 ± 7.2	22.1 ± 2.3
1973	198	12.46 ± 1.3	159.7 ± 5.8	56.6 ± 7.1	22.2 ± 2.4
1974	241	12.49 ± 1.3	160.4 ± 6.2	57.2 ± 7.5	22.2 ± 2.7
1975	337	12.51 ± 1.4	159.8 ± 5.6	56.3 ± 6.9	22.0 ± 2.4
1976	320	12.46 ± 1.14	160.3 ± 6.0	56.8 ± 7.3	22.1 ± 2.4
1977	422	12.36 ± 1.2	160.5 ± 5.6	57.3 ± 6.6	22.2 ± 2.4
1978	377	12.45 ± 1.25	160.9 ± 5.9	57.6 ± 7.2	22.2 ± 2.6
1979	387	12.43 ± 1.27	161.2 ± 5.7	57.4 ± 7.2	22.1 ± 2.6
1980	327	12.30 ± 1.19	161.1 ± 5.4	57.1 ± 8.1	22.0 ± 2.7
1981	357	12.52 ± 1.3	161.6 ± 5.8	56.7 ± 8.4	21.7 ± 2.8
1982	130	12.54 ± 1.28	160.5 ± 5.7	58.0 ± 9.6	22.5 ± 3.3
1983	109	12.32 ± 1.25	160.0 ± 5.7	56.4 ± 8.8	22.0 ± 3.1
Total	3,329	12.44 ± 1.26	160.6 ± 5.8	57.0 ± 7.5	22.1 ± 2.6
		$R^2 = 0.000$, $F = 0.729$, NS	$R^2 = 0.005$, $F = 17.048*$	$R^2 = 0.000$, $F = 1.192$, NS	$R^2 = 0.001$, $F = 1.842$, NS

* $P \leq 0.001$.

each birth order, mean age at menarche increased in each one and reached a significant difference in girls who were second born ($P \leq 0.05$).

Regression analysis

In order to analyze which were the most important explanatory variables in the mean values of age at menarche, we performed a multiple regression analysis with stepwise method (Table 5). Family size was the selected variable, in the first step ($P \leq 0.001$) and place of residence in childhood and family size were both selected in the second step ($P \leq 0.001$).

Secular changes in the Portuguese population between 1880–1980

Figure 1 shows the secular trend in age at menarche in Portugal. Previous data published by other authors (Sacadura, 1912; Rosas and Savedra, 1921; Morato, 1930; Gama Antunes and Rosado Marques, 1989; Rocha and Morais, 1990; Rocha et al., 1998) were considered by year of birth from 1880 until 1960, as well as our own data for girls born between 1972 and 1983. It is clear from Figure 1 that a deep decrease in mean age at menarche has occurred in the Portuguese population. Girls born in the decade 1880–1890 had a mean age at menarche of 15 years and those born in the 1970s and early 1980s had a mean age at menarche of 12.44 years. As previously noted, during the last decade, the 1970s, the mean age at menarche has remained stable.

DISCUSSION

Menarcheal age is recognized as an important indicator of pubertal development in females. In addition, mean or median menarcheal age for groups of girls is an important indicator of population health, well-being, and socioeconomic stratification and progressively declines when subjected to improving environmental conditions (Cameron and Nadgdee, 1996).

Portugal had great improvements in living conditions 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, especially during the 1970s. The same happened with the health system, which showed many improvements during that decade.

Parents' educational level and occupation

In this sample of Portuguese university students, age at menarche did not show any significant influence of parents' educational level and occupation. This is probably a consequence of the great improvements in the social and economic conditions that occurred primarily after the 1960s and during the 1970s, especially in terms of nutrition and health care (Barreto, 1996, 2000), which

TABLE 3. Mean age at menarche in relation to parents' educational level and occupation, place of residence during childhood and adolescence, family size, and birth order, one-way and regression analysis

	N	Mean ± SD	F	R^2	F
Father education					
None	29	12.66 ± 1.17			
Primary	1,461	12.45 ± 1.27			
Secondary	1,128	12.41 ± 1.26			
University	629	12.47 ± 1.19	0.656, NS	0	0.031, NS
Mother education					
None	28	12.96 ± 1.43			
Primary	1,590	12.43 ± 1.24			
Secondary	1,196	12.42 ± 1.27			
University	468	12.49 ± 1.23	2.002, NS	0	0.003, NS
Place residence—Childhood					
Rural	1,017	12.53 ± 1.24			
Semi-urban	963	12.44 ± 1.25			
Urban	1,348	12.38 ± 1.26	3.412*	0	7.842**
Place residence—Adolescence					
Rural	1,021	12.52 ± 1.25			
Semi-urban	1,006	12.42 ± 1.27			
Urban	1,302	12.40 ± 1.25	3.026*	0	5.318*
Family size					
1	423	12.32 ± 1.25			
2	1,811	12.42 ± 1.25			
3	724	12.48 ± 1.25			
≥4	330	12.67 ± 1.27	5.314***	0	14.432***
Birth order					
1	1,748	12.41 ± 1.24			
2	1,088	12.44 ± 1.27			
≥3	422	12.58 ± 1.25	3.241*	0	5.244*
Father's occupation					
Executive civil servants, industrial directors and executives	9	12.89 ± 1.76			
Professionals and scientists	774	12.45 ± 1.22			
Middle management and technicians	547	12.45 ± 1.23			
Administrative and related workers	300	12.38 ± 1.27			
Service and sales workers	399	12.35 ± 1.21			
Skilled workers, craftsmen and similar	315	12.57 ± 1.28			
Farmers and skilled agricultural and fisheries workers	797	12.42 ± 1.28			
Unskilled workers	16	12.50 ± 1.15	1.081, NS	0	0.176, NS
Mother's occupation					
Executive civil servants, industrial directors and executives	—				
Professionals and scientists	498	12.47 ± 1.22			
Middle management and technicians	643	12.44 ± 1.24			
Administrative and related workers	274	12.36 ± 1.23			
Service and sales workers	344	12.33 ± 1.24			
Skilled workers, craftsmen and similar	92	12.51 ± 0.17			
Farmers and skilled agricultural and fisheries workers	262	12.34 ± 1.32			
Unskilled workers	64	12.31 ± 1.11	1.309, NS	0	0.416, NS

*$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$.

TABLE 4. Mean age at menarche (years) by birth order and family size

	Birth order			
Family size	1	2	≥3	Total
1	12.34 ± 1.25 (423)	—	—	12.32 ± 1.25 (423)
2	12.43 ± 1.23 (960)	12.40 ± 1.28 (826)	—	12.42 ± 1.25 (1,811)
3	12.39 ± 1.28 (295)	12.49 ± 1.24 (208)	12.56 ± 1.24 (214)	12.48 ± 1.25 (724)
≥4	12.72 ± 1.33 (68)	12.83 ± 1.16 (54)	12.60 ± 1.27 (206)	12.67 ± 1.27 (330)
All	12.41 ± 1.25 (1,746)	12.44 ± 1.27 (1,088)*	12.58 ± 1.26 (420)	12.44 ± 1.26 (3,288)**

*$P \leq 0.05$; **$P \leq 0.01$.
Interaction between birth order and family size given by ANOVA analysis, F = 0.808, NS.

	Age at menarche		
	Variable in analysis	R²	F
Step 1	Family size	0	13.109*
Step 2	Place of residence in childhood		
	Family size	0.01	9.388*

Age at menarche was dependent variable.
* $P \leq 0.001$.

deeply decreased the social inequalities in Portuguese society. We could say that Portuguese society became more homogenous during the 1970s. In Europe, similar patterns have been observed in a sample from Brussels (Susanne and Vercauteren, 1997), where the authors found no significant differences due to social background in age at menarche; in Greek girls (Papadimitriou et al., 1999) in the modern middle-class Athenian society, parental education did not influence age at menarche in middle-class Athens; in northeast England the same happened (Roberts et al., 1971, 1986). At present, some populations such as Poland (Bielicki and Welon, 1982; Bielicki et al., 1986; Laska-Mierezejewska, 1995) and many developing countries, for example, Khartoum (Sudan) (Attallah et al., 1983), Nigeria (Uche and Okorafor, 1979;

Oduntan et al., 1976), Egypt (Attallah, 1978), Haiti (Barnes-Josiah and Augustin, 1995), and Venezuela (Farid-Coupal et al., 1981), showed a significant influence of parents' educational level and occupation. In France, Pasquet and Ducros (1980) found a significant influence of father occupation only between daughters of white-collar workers and farmers. Again in Poland, Bielicki et al. (1986) also found a significant effect of fathers' occupation on age at menarche of their daughters.

This is in striking contrast with the effect of parents' educational level and occupation in height in the same university sample. For educational level, the difference between those whose father and mother had a university level and those whose parents' had no education was 2.6 cm in the case of the father and 1.9 cm in the case of the mother. For parents' occupation, the difference between the two extremes reached 5.6 cm in fathers' occupation and 2.7 cm in mother (Padez, 2002a). We concluded that the two processes, growth and maturation, did not behave in the same way or were influenced differently by environmental factors.

Place of residence in childhood and adolescent years

Concerning place of residence in childhood and adolescent years, both showed a significant
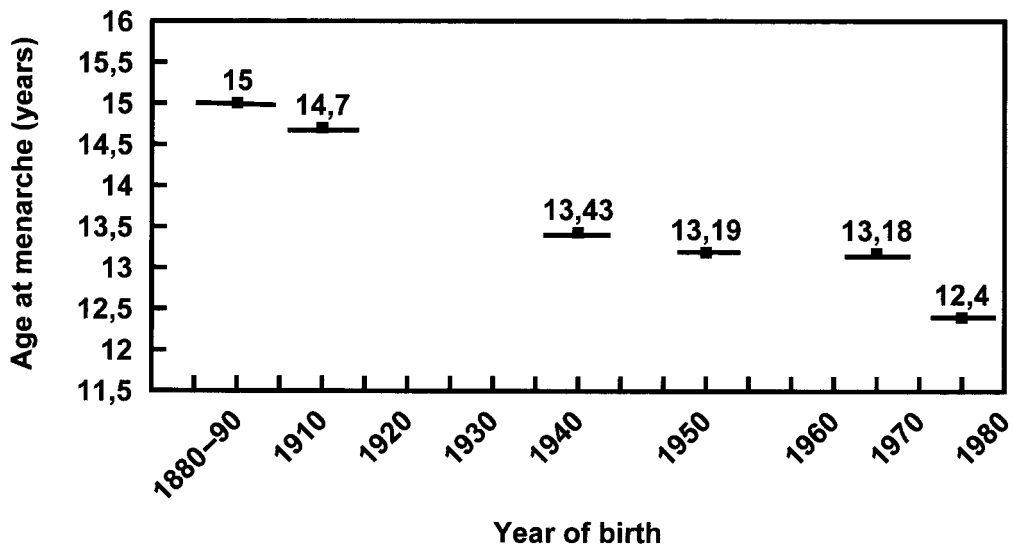

Fig. 1. Secular trend in age at menarche in the Portuguese population (1880–1980).

effect on age at menarche, with girls that spent their childhood and adolescent years in rural places maturing later than those who grew up in urban places. At present, the majority of populations from developed countries did not show any significant effect of degree of urbanization, as the works of Martuzzi Veronesi and Gueresi (1994) in Italy and in Spain (Marrodan et al., 2000) showed. Some populations, for example, in France (Ducros and Pasquet, 1980; Crognier and Rocha, 1979; Boetsche and Bley, 1980) and in Poland (Hulanicka and Waliszko, 1991), showed a significant effect of urbanization in age at menarche. However, the effect of places of residence on age at menarche is greatest in developing countries such as Nigeria (Uche and Okorafor, 1979; Oduntan et al., 1976), Egypt (Attallah, 1978), and Haiti (Barnes-Josiah and Augustin, 1995) (Table 6).

The urban–rural differences are probably related to the fact that various important parameters of the "quality" of the socio-economic environment are positively correlated with the size of the town or city. Larger urban centers tend to have much better health-care facilities, better sanitary standards of dwellings, and better schools, among several other characteristics (Bielicki and Szklarska, 1999). Despite the improvements in the Portuguese health system, there are deep differences between rural and urban districts in some health indicators like, for instance, the number of physicians per 1,000 population. In Castelo Branco, a very rural and inland district, in 1990 there were 82 physicians per 1,000 population. On the other hand, in Lisbon, Coimbra, and Porto (the big cities) there were 584, 716, and 383 physicians per 1,000 population, respectively (INE, 1991).

Family size and birth order

Family size and birth order had the strongest influence on mean menarcheal age in our sample. Later age at menarche was strongly associated with increasing family size, with a difference of 0.35 years ($P \leq 0.001$) between families with one children (12.32 years) and those with four or more children (12.67 years). The analysis of birth order showed that an older menarcheal age was related with a higher rank in sibship, with a difference of 0.17 year in menarcheal age between the first-born (12.41 years) and the third and later born children (12.58 years).

Our results are consistent and showed the same pattern that many authors found in several populations, such as France

TABLE 6. Variation of mean and median menarcheal age with degree of urbanization

Source	Country	N	Age at menarche (years)			
Pasquet and Ducros, 1980	France		Urban—12.71 Rural—12.86, p < 0.01			
Crognier and Tavares, 1979 Boetsche and Bley, 1980	France		Rural—13.05 Parisian—12.78			
Mantzagrioti-Meimatidi, 1985	Greek		Urban—12.47 Rural—12.76			
Papadimitriou et al., 1999		1,134	Athens—12.27			
Laska-Mierzejewska et al., 1982	Poland	13,317	Warsaw—12.73 Rural—13.4			
Hulanicka and Waliszko, 1991				Cities	Towns	Villages
			1955	13.41	13.94	14.28
			1966	12.9	13.58	13.95
			1978	12.84	13.15	13.47
			1988	12.96	13.40	13.53
Oduntan et al., 1976	Nigeria	2,357	Urban—13.70 Rural—14.50			
Uche and Okorafor, 1979		1,365	Urban—13.48 Semi-urban—14.05			
Marrodan et al., 2000	Spain	811	Rural—12.90 Madrid—12.79, NS			
Pasquet et al., 1999	Cameroon	911	Urban—13.18 Suburban—13.98 Rural—14.27			

(Demoulin, 1998), England (Roberts et al., 1971; Billewicz et al., 1981; Dann and Roberts, 1993; Roberts, 1994), South Africa (Cameron and Nadgdee, 1996), Poland (Laska-Mierezejewska, 1995), and Spain (Sánchez-Andrés, 1997; Apraiz, 1999) (Tables 7, 8). The range that we found in our sample is similar to those found in the above populations. The explanation for the effect of family size and birth order in age at menarche is not clear. Some authors (Malina et al., 1997; Apraiz, 1999) suggest that these effects may be due to the shorter time interval between births of the mother.

Secular changes in the Portuguese population

A deep secular trend in age at menarche, towards an earlier age, has occurred in the Portuguese population. Published data showed that in the birth decade of the 1880s mean age was 15 years and in the 1980s reached a value of 12.4 years. This is in agreement with the secular trend in mean stature in the male population (Padez, 2002b). 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 the general improvements in 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. Milk consumption increased almost four times in that period, as well as meat. The health system had many improvements, mainly after the 1970s. This was reflected in a decrease in post-neonatal mortality, an increase in life expectancy, and improvement in other indicators such as the number of physicians per 1,000 population and the percentage of infants born at maternity centers (Barreto, 1996, 2000). The post-neonatal mortality rate is generally regarded as a sensitive indicator of infant health (Kessel, 1990), and infant nutritional status and the prevalence of infections are the most important determinants of post-neonatal mortality (Stembera, 1990). Many studies suggest that adverse environmental factors have their strongest effect during childhood

TABLE 7. Variation of mean and median menarcheal age with family size

Source	Country	N	Age at menarche (years)	
Susanne and Vercauteren, 1997	Belgium	1,048	1–2	13.00
			≥3	13.26, $P < 0.001$
Pasquet and Ducros, 1980	France		1	12.52
			2	12.64
			3	12.79
			4–5	12.9
			+6	13.07, $P < 0.01$
Bodzsár, 1998	Hungary		1972	1982
			≤2–12.76	12.63
			≥3–12.92	12.96
Roberts et al., 1971	UK	1,654	1	13.04
			2	13.14
			3	13.45
			4	13.68
			+5	13.66
Billewicz et al., 1981		699	1 + 2	13.24
			3 + 4	13.34
			+5	13.74
Apraiz, 1999	Spain	895	1	12.48
			2	12.75
			3	13.01
			≥4	12.6, $P < 0.05$
Laska-Mierzejewska et al., 1982	Poland			Warsaw Villages
			1	12.72 13.09
			2	12.94 13.43
			3	13.04 13.51
			4	— 13.55
			5+	— 13.68

TABLE 8. Variation of mean and median menarcheal age with birth order

Source	Country	N	Age at menarche (years)	
Pasquet and Ducros, 1980	France		1	12.68
			2	12.74
			3	12.9
			+4	12.98, $P < 0.01$
Floris et al., 1991	Italy	3,261	1	12.62
			2	12.71
			3	12.78
			$\geq$4	12.82
Billewicz et al., 1981	England	699	1 + 2	13.34
			3 + 4	13.41
			+5	13.75
Apraiz, 1999	Spain	895	1	12.59
			2	12.87
			3	13.14
			$\geq$4	12.42, $P < 0.05$

(Cole, 2000; Nystrom Peck and Lundberg, 1995; Nystrom Peck and Vagero, 1987; Brundtland et al., 1980; Schmidt et al., 1995; Tanner, 1992). The subjects of the present study were born between 1972–1983. If their birth period is paired with changes associated with nutrition, the health system, and socioeconomic development, it is clear that they were the first to take advantage of these social conditions. Similar results occurred in almost all European countries such as Spain (Prado, 1990), The Netherlands (van Wieringen, 1986), Germany (Bremerhaven) (Ostersehlt 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), e.g., in Belgium (Vercauteren and Susanne, 1985), Norway (Brundtland et al., 1980), and 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 age at menarche is still decreasing in many countries, but has stayed unchanged or reversed its trend in others. Although our results showed a stability in age at menarche of these university students, we cannot claim that our sample is representative of all the Portuguese population. Our university students are a kind of "selective class" within the general Portuguese population. One of the reasons is probably linked to their social class. Looking at their parent's educational level compared with all the Portuguese population, it is clear that they belong to a higher social stratum: 19% of their fathers and 14% of their mothers had a university educational level, in contrast to the general population, where only 6.8% of men and 6.9% of females did. More education means better occupation and probably a higher income. But, on the other hand, our students belong to all social strata; they came from all parts of Portugal and the sample is large. However, it is curious to find that, whereas the secular trend to diminishing menarcheal age appears to have stopped, the trend to increasing stature has not. We could hypothesize that the two processes, growth and maturation, are differently influenced by environmental conditions. However, a comparison of age at menarche in some other European countries (Table 9) shows a range from 13.57 years in Iceland (Tryggdóttir et al., 1994) to 12.27 years in Greece (Papadimitriou et al., 1999); our results are not far from other populations and it is possible that age at menarche in Portugal is now stable.

In summary, the results demonstrate a great decrease in mean age at menarche in the Portuguese population and probably a stability in mean age at menarche of university students. These results are in accordance with those of a secular trend in stature that occurred in Portugal during the 20th century, showing that this is the result of great improvements in living conditions that occurred in Portugal mainly in the 1970s. Place of residence during childhood and family size were the most important

TABLE 9. Mean or median age at menarche in European countries

Reference	Country	Menarche (years)	
		N	Mean/Median ± SD
Marrodán et al., 2000	Spain—Rural	342	12.79 ± 1.04
	Spain—Madrid	469	12.90 ± 1.03
Rebato et al., 1993	Spain—Basque country	894	12.75 ± 0.93
Boetsch and Bley, 1980	France—Paris	338	12.80 ± 0.7
Vercauteren and Susanne, 1985	Belgium	4,177	13.06 ± 0.06
Tryggdóttir et al., 1994	Iceland	4,756	13.57 ± 1.29
Whincup et al., 2001	Britain	1,166	12.9
Rimpela and Rimpela, 1993	Finland	799	13.3
Lindgren et al., 1991	Sweden	1,119	13.19 ± 1.08
Helm and Gronlund, 1998	Denmark	976	13.00 ± 1.15
Ostersehlt and Danker-Hopfe, 1991	Germany	2,223	13.01 ± 1.19
Kirchengast and Hartmann, 2000	Austria	4,996	13.20 ± 1.5
Stoev and Yordanov, 1998	Bulgaria	—	12.7–12.8
Viegnerová and Bláha, 1998	Czech	—	13.1
Bodzsár, 1998	Hungary	7,122	12.71
Vienna and Capucci, 1994	Italy—Rome	275	12.44
	Italy—Molise	117	12.51
Papadimitriou et al., 1999	Greece	1,134	12.27 ± 1.13
Jansen and Hazebroek, 1994	The Netherlands	—	13.08
Laska-Mierzejewska et al., 1982	Poland—Warsaw	5,546	12.73 ± 1.10
	Poland—Rural	7,771	13.40 ± 1.20
Godina, 1998	Russia	—	13
Present study	Portugal	3,329	12.44 ± 1.26

factors that influence mean age at menarche. This is in accordance with the hypothesis of a greatest influence of environmental conditions during childhood. As in almost all the populations, family size also had a great influence. Girls from small families had an earlier maturation than those from larger families.

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