AMERICAN JOURNAL OF HUMAN BIOLOGY 18:83–92 (2006)

Original Research Article

Secular Trends in Age at Menarche Among Caboclo Populations From Pará, Amazonia, Brazil: 1930–1980

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ABSTRACT The present study is part of a large research project on growth, development, nutrition, and health of Caboclo populations from the Brazilian Amazon. The aim of this paper is to analyze the age of menarche in adolescents ($N = 164$) and adult women (219) in the studied populations. Caboclo are admixed rural, peasant groups that live along the Amazon river and its tributaries, and there are few previous studies about them. Probit analysis of the status quo data yielded a median age at menarche of 12.29 ± 1.76 years. The retrospective method was applied to recall data of the 77 post-menarcheal adolescents, yielding an average of 13.06 ± 1.27 years. Number of children in the family did not show any statistical influence on age at menarche in any age group. In adult women, age at menarche decreased from 14.50 in those born in 1930 to 12.88 for those born in 1980 ($F = 4.371, P = 0.001$). The downward trend found was, on average, 0.237 year per decade in the study period. The median age at menarche in the adolescents (12.29 years) is one of the lowest values found for Central and South American populations. In the ecological context, a low age at menarche could be an adaptive advantage because it provides a greater chance for reproduction at a young age in an environment where, until recently, life expectancy was low. As has been reported for other developing countries, the change found in age at menarche in the women born from the 1930s to the 1980s is likely to be related to changes in health and nutritional factors that occurred in Brazil because this country experienced significant improvement in living standards related to education, vaccination, and health conditions, which, although not equally, reached all regions after the 1960s. Am. J. Hum. Biol. 18:83–92, 2006.

Menarche, the onset of the first menses, is a significant milestone in a woman's life and reproductive cycle (Uskul, 2004), and it is an important maturity indicator for assessing the developmental status of a pubertal female (Cameron and Nadgdee, 1996). This biological event is the outcome of a number of social, ecological, and biological factors, and the mean menarcheal age appears to be a particularly sensitive indicator of the biosocial status of a population (Bielicki and Welon, 1982; Laska-Mierzejewska et al., 1982). Menarche is also a sociocultural event shaped and constructed by cultural institutions such as religion, science, and the media (Chandra and Chaturvedi, 1992; Laws, 1990; Paige and Paige, 1981).

Age at menarche is known to be influenced by genetic factors (Loesch et al., 1995; Meyer et al., 1991) as well as by variables such as the degree of urbanization (Pasquet et al., 1999), the socioeconomic status (Henneberg and Louw, 1995), the number of children in the family, and the order of birth (Apraiz, 1999). Other factors such as nutrition (Simodon et al., 1997), seasonality (Boldsen, 1992), physical activity (Malina, 1983), and altitude (Gonzales et al., 1996) also have shown a significant effect on age at menarche. In a recent review of published studies on the variability of age at menarche throughout the world, Thomas et al. (2001) found that the factors that best explained the variation in age at menarche were adult illiteracy rate and vegetable caloric consumption. At present, almost no industrialized countries show statistically significant differences in mean age at menarche for different social classes (Demoulin, 1998; Martuzzi Veronesi

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Received 15 February 2005; Revision received 19 August 2005; Accepted 2 September 2005

Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/ajhb.20458

and Gueresi, 1994). Due to improvements in the general pattern of living conditions, especially concerning health care and nutrition, age at menarche in Europe, North America, and other developed countries has shown a general downward trend (Eveleth and Tanner, 1990; Malina et al., 2004a). On the other hand, large differences among social class have been reported for the "developing" countries in Asia and Africa, where the gap between rich and poor is very large (Attallah et al., 1983; Oduntan et al., 1976; Uche and Okorafor, 1979).

In this paper, we describe the age at menarche of women and girls from Caboclo populations located in the Middle Amazon region, in the State of Pará, Brazil. As far as we know this is the first study concerning this reproductive event on such group. We also report the secular changes in age at menarche in the women born between 1930 and 1980, and discuss the possible reasons for such a change. Caboclos are unique in Latin America because of their trihybrid origins. Most other Latin American populations are "Mestizos" of indigenous populations and Europeans (the majority), Africans and Europeans, or Africans and Indians (the minority) only. This study is important because it increases our knowledge about human variability and adaptation, because there have been no studies of menarche in Caboclos, and because it can help anthropologists to better understand the dynamic socioecological relationships of a complex biological trait such as menarche.

Caboclo populations and their lifestyle

Caboclo populations are rural, peasant groups originating from the admixture of the Native South Amerindian populations, the Africans brought as slaves to Brazil and the European colonizers (Parker, 1985; Wagley, 1974). They inhabit all major ecosystems of the Amazon and have lived in the area for almost two Centuries (Lima-Ayres, 1992; Nugent, 1993). These populations traditionally live along the Amazon River and its tributaries, and have limited access to health care, sanitary facilities, and other public health services. As a result of their geographic quasi-isolation and their pattern of settlement in the region, only a few studies about their health and developmental characteristics have been published (Murrieta et al., 1998; Silva, 2001, 2002).

The populations investigated (Fig. 1) come from two locations: Caxiuanã, a black water ecosystem, in the Caxiuanã bay, Melgaço county (MPEG, 1993, 1994; Silva et al., 1995), and Ituqui Island, a white water ecosystem in the Amazon River, Santarím county (Murrieta 2000; Silva, 2001). Even though they inhabit different ecosystems, these groups share a common lifestyle, subsistence activities, religion, diet, and admixed ancestral background. Among the Caboclos, the houses are usually built and covered with a variety of materials, such as wood and wood shingles, thatch, clay bricks and tiles, and concrete. At the time of field research, no electricity or piped water reached the communities. Caboclo subsistence activities are varied and usually include slash-and-burn agriculture of manioc (*Manihot esculenta*), corn (*Zea mays*), tobacco (*Nicotiana tabacum*), sugar cane (*Saccharum officinarum*), bananas (*Musa* sp.), legumes and edible fruit trees, fishing for home consumption and market sale, hunting, extraction of natural products such as "açai" (*Euterpe olleracea*) and Brazil nuts (*Bertoletia excelsia*), and small commerce. Frequently, some of the local men work under contract for the timber and cattle industries in other states. Retirement pensions from the federal government are also an important source of income (Nugent, '1993; Silva, 2001; Silva et al., 1995; Silveira et al., 1997). As throughout the rural areas of the Amazon, the main cash-generating activities of the communities vary greatly from wage work at the Ferreira Penna Research Station in Caxiuanã and in the timber industry, to fishing for sale, to buying and selling surpluses of products such as Brazil nuts, açai, and manioc flour in the cities of Melgaço, Portel, Breves, Santarém, or Belém. Most families rely on more than one activity for income, and over 85% raise domestic animals such as chicken, pigs, ducks, sheep, and cows, which are used for home consumption and sold occasionally when emergency cash is needed (Silva, in press).

The Caboclo diet is generally based on manioc flour, fish, rice, hunted game, and, during the dry season, açai. The daily diet varies little between the wet and dry seasons and is sometimes complemented with other products such as coffee, sugar, crackers, canned meats, pasta, beans, powdered milk, and chocolate, and sometimes free-range

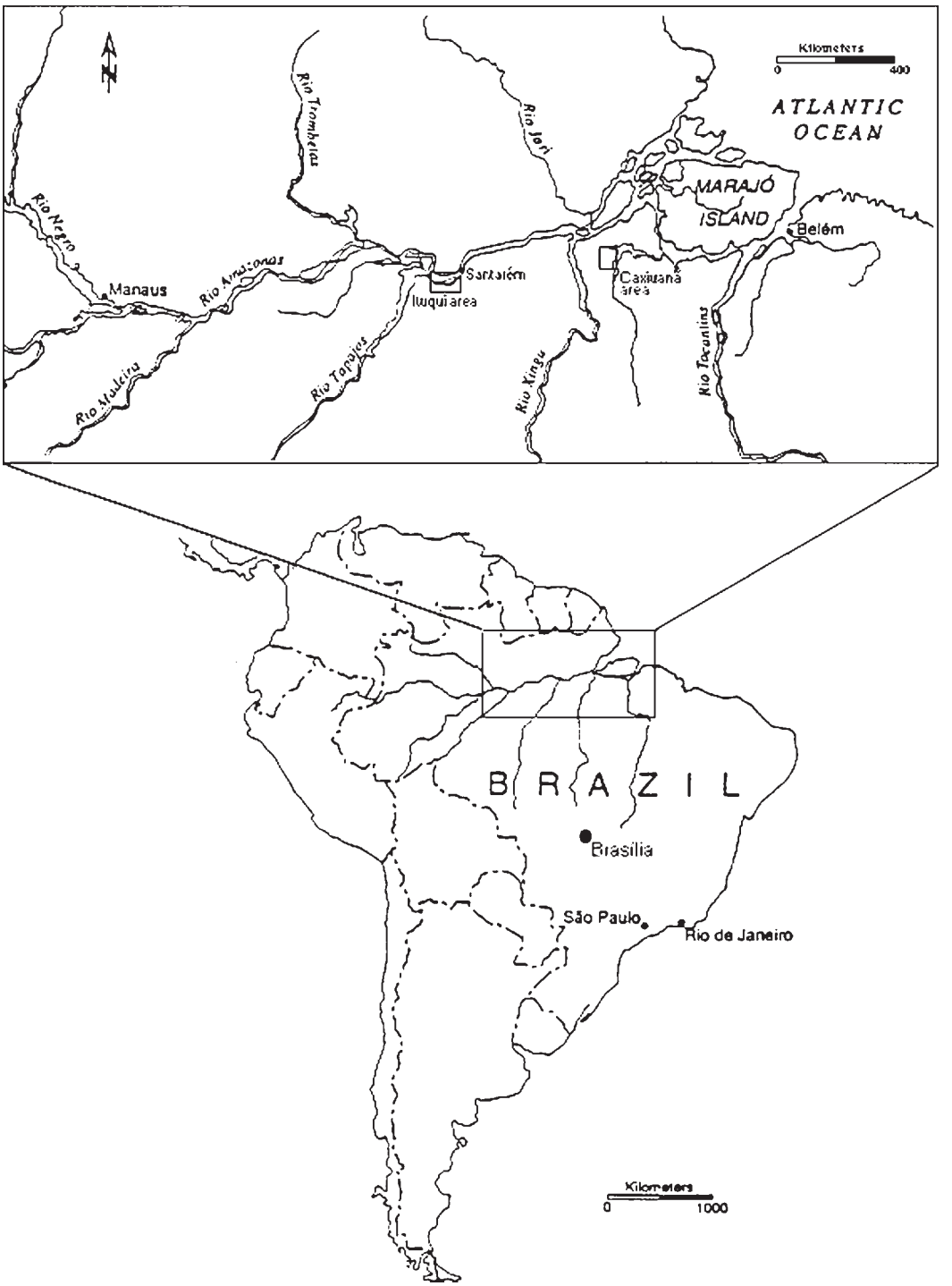

Fig. 1. Location of the study areas.

chicken, duck, or pig. On Ituqui Island beef is also sometimes eaten; in Caxiuanã, beef is rarely eaten.

MATERIALS AND METHODS

Sample

At the time of data collection, in 1996–97, there were 212 people representing 40 families living in Caxiuanã. All families participated in the research. The populations investigated on Ituqui Island include approximately 857 people, of which, 682 individuals (79.58%) from 150 families participated in the investigation. A total of 322 adolescents and adult women from the two groups were measured and interviewed with the use of a personal questionnaire about their menstruation and details of some demographic and lifestyle conditions. Included in this analysis are 164 adolescents of age 8–19 years and 158 women of age 20–92 years.

For adolescents, the age at menarche was determined by asking the girls if they had or had not started menstruating and at which age they had menstruated for the first time. A correction factor of 0.5 year was systematically added to the age obtained. The age of the girls represents the decimal age regrouped in classes of 1 year. For example, the age category of "8" includes all girls ranging in age 8.0 to 8.99 years.

Age at menarche was determined by the retrospective method for adult women. Each woman was asked about the age, to nearest whole year, when she had reached menarche. A correction factor of 0.5 year was systematically added to the age obtained in this case also.

Statistical analysis

Descriptive statistics were carried out for sociodemographic data and for age at menarche by the recall method. One-way ANOVA was applied, with age at menarche as the dependent variable and size of the family as the independent factor. For information obtained by the status quo procedure, the age at menarche was calculated by probit analysis (Finney, 1971) and computed using the SPSS/PC 11.0 statistical package (SPSS, Inc., Chicago, IL).

RESULTS

Social data

Tables 1a and 1b summarize several sociodemographic characteristics of the populations investigated. Most families have between 4 and 7 children per couple (45%). In general, 40% of houses have 1–5 people, 40% have 6–9 people, and 20% have 10 or more people living in the house. The majority of individuals over the age of 18 years are married (63.2%). In an analysis of consumer goods present in the houses (radios, clocks, shotguns, bicycles, gas stoves, sofa, wardrobe, chest of drawers, bed, motor boat, television), 65% of houses have some type of consumer goods, but only 18.5% have two or more consumer items. Cattle are owned by 73.3% of the families. Most of the houses are small with only two (34.6%) or three rooms (35.6%). Most often, the kitchen is

TABLE 1. Sociodemographic characteristics of the populations

	n	%
(a) Family characteristics and economic indicators		
No. of children in the family		
0–3	112	27.9
4–7	181	45.0
≥8	109	27.1
No. of people in house (%)		
1–5	46	39.7
6–9	46	39.7
≥10	24	20.7
Marital status (%)		
Single	156	35.2
Married	280	63.2
Separated/Widowed	7	1.6
Consumer goods (% of houses)		
None	295	65.1
1–2	84	18.5
3–4	52	11.4
5–6	22	4.9
Cattle		
Yes	33	73.3
No	12	26.7
(b) Sociodemographic characteristics of the populations: House condition		
No. of rooms per house (%)		
1	14	13.5
2	36	34.6
3	37	35.6
4+	4	3.9
Kitchen inside the house?		
Yes	89	84.8
No	16	15.2
Latrine inside the house?		
Yes	1	1
No	104	99

inside the house (84.8%), and in most houses (99%) the latrine is outside the house.

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 method and probit analysis. The mean age using the recall method was 13.06 ± 1.27 years. From the probit analysis, the median age at menarche was 12.29 ± 1.76 years. There is no statistically significant influence of number of children in the family, or any other socioeconomic factor investigated, on age at menarche among the Caboclo, regardless of the method of analysis used (Table 4).

Changes in age at menarche among the Caboclo

Figure 2 shows the changes in mean age at menarche for the women born between 1930 and 1980. Mean age at menarche decreased from 14.41 to 12.88 years ($F = 4.371$, $P = 0.001$). The downward trend was, on average, 0.237 year per decade.

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

Age (years)	Total no. of girls	Menstruating girls		Non-menstruating girls	
		n	%	*n*	%
8	15			15	100
9	22			22	100
10	17	4	23.5	13	76.5
11	27	4	14.8	23	85.2
12	13	5	38.4	8	61.6
13	15	11	73.3	4	26.7
14	11	10	90.9	1	9.1
15	6	6	100		0
16	9	8	88.9	1	11.1
17	7	7	100		0
18	16	16	100		0
19	6	6	100		0
Total	164	77	100	87	53

TABLE 3. Average age at menarche

	Mean ± SD (years)
Recall age method ($n = 77$)	13.06 ± 1.27
Probit analysis ($n = 164$)	12.29 ± 1.76[a]
	$\chi^2 = 11.547$, $P = 0.317$, df = 10

[a]Median.

DISCUSSION

Few studies in Brazil have assessed age at menarche, and these have shown a great deal variability in the timing of this event. Mean age at menarche has varied from 12.2 years (Matsudo, 1982) to 13.9 years (Antunes et al., 1984). In the National Survey on Health and Nutrition, done in 1989, mean age at menarche was 13.2 years (INAN, 1990). Other studies (Borges and Pires Júnior, 2000; Fuzzi, 1989; Kac et al., 2000; Picanço, 1995; Tavares et al., 2000; Zerwes and Simões, 1993) have analyzed secular trends in age at menarche and associations between age at menarche and socioeconomic conditions, nutritional status, and place of residence: urban or rural. One study showed a later age at menarche among schoolgirls of age 10–18 years residing in coastal areas in Santa Catarina State, Southern Brazil (Ben and Petroski, 1988). More recently, Tavares et al. (2004) studied the effect of month of birth and season of the year on the age at menarche, but none of these factors showed a statistically significant effect on that event. However, to date, there have been no reports of age at menarche and secular trends among the Caboclo.

The mean menarcheal ages in the Caboclos, calculated by recall and probit analysis were 13.06 and 12.29 years, respectively. One of the most unexpected findings of this study is that there is no association between number of children in the family and age at menarche in the population studied. This result is contrary to some findings in other populations (Cameron and Nadge, 1996; Padez, 2003), and requires further investigation. In a rural community in Southeast Brazil, Tavares et al. (2000) also did not find any difference in age at menarche in relation to number of children in the family, but other studies in Brazil (Riehmer and Violato, 1983; Silva et al., 1982) did find statistically significant relationships between age at menarche and number of children in the family in girls from São Luis (Maranhão state, Northeast Brazil) and Rolândia (Paraná state, South Brazil), with a later age at menarche in girls from larger families. Those authors explained this relationship as a major socio-

TABLE 4. Age at menarche in the adolescent sample in relation to number of children in the family (one-way ANOVA and probit analysis)

	Recall age		Probit analysis	
	n	Mean ± SD (years)	*n*	Median ± SD (years)
No. of children				
0–3	11	12.95 ± 1.21	25	11.99 ± 1.52, $\chi^2 = 5.718$, df. = 10, $P = 0.839$
4–7	34	13.18 ± 1.31	78	12.58 ± 1.86, $\chi^2 = 8.521$, df. = 10, $P = 0.578$
≥8	25	13.02 ± 1.38	50	12.11 ± 1.65, $\chi^2 = 4.72$, df. = 10, $P = 0.909$
		$F = 0.163$, NS		

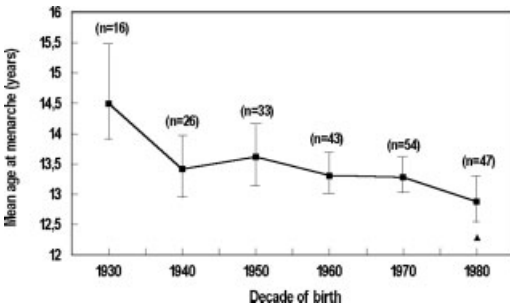

Fig. 2. Secular changes of mean age at menarche (CI 95%) for women born between 1930 and 1980.

economic influence in larger families. Additionally, Colli et al. (1985) found that in the urban area of Santo Andrí (São Paulo state, Southeast Brazil), girls from higher socioeconomic status attained menarche earlier than girls from lower socioeconomic status.

In Caboclo populations, the lack of a significant effect of the number of children in a family on the age at menarche can likely be attributed to a homogeneous social status with little social stratification. The early age at which menarche occurs indicates that the Amazon environment overall provides enough quality foods for all and that the ongoing socioeconomic changes taking place there have not yet created deep social differentiation within these populations. This may explain why there is no relationship between the variables investigated and onset of menstruation.

The downward trend found was, on average, 0.237 year per decade from 1930 to 1980. Several studies from many countries have systematically shown a reduction in mean age at menarche. These reduction rates (per decade) varied from 0.0123 year in Brazilian women born between 1920 and 1970 (Kac et al., 2000) to 0.7 year in Chinese women over a 40-year period (Graham et al., 1999). Other studies found values of 0.24 year in Norwegian women born between 1830 and 1960 (Rosenberg, 1991), 0.55 year in Moroccans born between 1982 and 1991 (Loukid et al., 1996), 0.25 year in English women born between 1840 and 1990 (Rees, 1993), 0.27 year in North American women born between 1920 and 1940 (Wyshak, 1983), 0.28 year in Icelandic women born between 1900 and 1950 (Tryggvadóttir et al., 1994), 0.64 year in South Korean women (Hwang et al, 2003), and 0.78 year per decade in rural Mexican women (Malina et al., 2004a). However, the comparison of the rate of decrease in mean age at menarche among several populations is not clearcut, as there may be significant variation depending on the period tested, reflecting the socioeconomic status of the population and its change during the period studied (Hwang et al., 2003).

The changes in age at menarche among the Caboclo women born in the 1930s (14.50 years) to the 1980s (12.88 years) are likely related to improvements in the health and nutritional situation of these populations through the second half of the last century, as Brazil experienced significant improvement in living standards, e.g., those related to education and health care, during this period (Monteiro et al, 1994). Even though access to health care and education is still limited among rural Brazilian populations, there has been some improvement in access to vaccination, prenatal care, birthing care, treatment of acute and chronic diseases, basic hygiene education, and access to higher-quality foods among the Caboclo in the past half-century (Ministério da Saúde, 2003; Nugent, 1993; Silva, 2001). As has been demonstrated in other countries (Malina et al., 2004a, 2004b) with a lower

disease burden, nutritional resources are directed toward physiological growth, and hence maturity is reached earlier.

The current mean menarcheal age in this population is among the lowest found in Brazil. In this country age at menarche has ranged from 12.2 years in girls from Guarulhos and São Caetano do Sul, São Paulo state (Matsudo, 1982), to 13.20 for the national data (INAN, 1990), to 13.98 years in girls from Monte Belo, Minas Gerais state (Antunes et al., 1984). The most recent work (Junqueira do Lago et al., 2003) with women from Rio de Janeiro city found a mean age at menarche of 12.3 years, similar to the value among the Caboclo adolescents. Considering the continental size of Brazil, this variability among the different studies is certainly related to a combination of environmental (climate, altitude, latitude), genetic, sociodemographic factors (nutrition, SES, number of children in the family, sanitary conditions), and overall health situation, among other factors (Cipolotti et al., 2000; Duarte, 1993). However, as shown in Table 5, there are still only a few studies of age at menarche in rural groups in Brazil and other Latin American countries, limiting considerably the possibility of more in-depth comparative studies.

When these results are compared to those of other Latin American populations (Table 5), the median age at menarche of the Caboclo population (12.29 years) is among the lowest of Central and South America, similar to the age of 12.3 years of girls from Mexico City (Siegel, 1999) and much lower than the mean of 15.37 years in Haitian girls (Barnes-Josiah and Augustin, 1995).

As with other cross-sectional analyses, this study has some limitations. First, it may not be possible to generalize the estimates to other rural Brazilian populations, as these people live in widely different environments within the country and their degree of genetic admixture also varies greatly. Second, despite the fact that almost all girls and women in the populations were included in the study, these are very small groups and further analyses of other sociocultural indicators are needed in order to fully understand all the characteristics of the life cycle of these communities. A third limitation is that, as with other similar studies, the assessment of the outcome and exposure is

TABLE 5. Mean (or median) age at menarche in other Latin American populations**

Reference	Region	N	Mean ± SD
Caboclo (present study)	Brazil	164	12.29 ± 1.76*
INAN (1990)	Brazil	6928	13.20 ± 1.20
Kac et al (2000)	Brazil (urban), 1930–1939	1955	13.07
	Brazil (urban), 1940–1949		12.83
	Brazil (urban), 1950–1959		12.7
	Brazil (urban), 1960–1969		12.6
	Brazil (urban), 1970–1979		12.4
Tavares et al. (2000)	Brazil (rural)	1602	12.52
Junqueira Do Lago et al. (2003)	Brazil (Rio de Janeiro)	2053	12.3 ± 1.64
Malina et al. (2004a)	Mexico Oaxaca (rural)	238	13.0 ± 1.0*
Siegel (1999)	Mexico City (urban)	519	12.3*
Khan et al. (1996)	Guatemala (rural)	497	13.7 ± 1.3
Jordan (1985)	Cuba	13143	13
Barnes-Josiah and Augustin (1995)	Haiti	10563	15.37 ± 1.74
Farid-Coupal et al. (1981)	Venezuela, urban	955	12.68 ± 0.08*
Macías-Tomei et al. (2000)	Venezuela (Carabobo)	48	12.55*
Chavarro et al. (2004)	Colombia	3206	12.68 ± 1.31
Pardo and Uriza (1991)	Colombia		12.8
Gonzales et al. (1996)	Peru, urban	503	13.08*
	High altitude	625	14.33
Greska (1990)	Bolivia (European amustry)	455	13.10*
	Bolivia (Ayamara)	375	13.40*
Lejarraga et al. (1980)	Argentina (La Plata)	6494	12.69*
Zurlo de Mirotti et al. (1995)	Argentina		12.59
Rona and Pereira (1974)	Chile, urban	354	12.6*
Codner et al. (2004)	Chile, urban	758	12.7

*Median Values.

prone to recall bias. However, other investigators have found the recall method to be reliable, accurate and valid enough to provide assurance in epidemiological research (Must et al., 2002). The test–retest method yielded high reliability (Kappa = 0.81) in a report from Italy (Bosetti et al., 2001), and in Sweden, Bergsten-Brucefors (1976) found correlations between actual age at menarche and recall after 4 years to be high. The same results were found in the U.S. ($r = 0.83$; Koprowski et al., 2001).

In summary, this work reports the first estimate of age at menarche in Caboclo populations as well as an evaluation of the secular changes that have occurred in this physiological variable over a 50-year span. This population does not show any significant effect from the number of children in the family, a factor that usually presents a statistically significant influence on age at menarche. This is an important finding that requires further investigation. A significant change in age at menarche toward earlier menarcheal age in the past 50 years in this population is shown. This indicates that, despite the harsh environment in which they live, there has been general improvement in overall nutrition, vaccination, and health conditions in Brazil, which reached all regions after the 1960s, even some of the most remote areas of the Amazon Basin.

ACKNOWLEDGMENTS

This research and publication could not have been completed without the collaboration of many institutions and colleagues. First, thanks are due to the communities of Caxiuanã and Ituqui Island for their participation in the study. Thanks to CNPq/Brazil, to the Museu Paraense Emílio Goeldi (MPEG), the Brazilian Institute of the Environment and Natural Resources (IBAMA) in Breves, and the Projeto Várzea/UFPA/IPAM, for their financial and logistic support. HPS also thanks the Department of Anthropology of The Ohio State University for support in the U.S. and the Totta Bank for support in Portugal. Thanks are also due to the two anonymous reviewers and to Prof. Heather Edgar for their comments, and to David McGrath, Rui Murrieta, and Pedro Lisboa for their friendship and support during field work.

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