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Age, Season at Menarche, Family Factors and Adult Body Traits in Girls from Yucatan, Mexico (Comparative Study)

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KEY WORDS Menarche. Environmental Stress. Growth and Maturation.

ABSTRACT A total of 1010 girls and 529 of their mothers were examined in the port town of Progreso, Yucatan, Mexico in June-September 1993. Investigations included living conditions, year and season of birth and menarche using a retrospective method, some characteristics of the menstrual cycle and 4 somatic variables. Data from Progreso were compared with Polish examinations and data of the Fels Longitudinal Study in USA.

The Acceleration rate of maturation in Progreso girls is 0.16 a year per decade.

Girls who matured earlier were shorter in young adult age (30), but heavier and fatter. They follow this position also in age of 50-60.

Girls matured more frequently than randomly in the month of their birth. This was especially true for girls who were born in the dry and hot days of April and May. In girls born during the rainy season acceleration of maturation in relation to month of birth was observed. In girls born in other months rather retardation of maturation took place. Shift in an expected menarche month was related to environmental stress. The main stimulating factor is probably solar radiation, and a mechanism related to increase of vitamin and hormonal level in organism. Sensitivity of girls manifested by occurrence of menarche (and may be by more general symptoms) was dependent on season of birth. It might be related to the season of conception and pregnancy.

INTRODUCTION

Menarche is only one phenomenon of sexual maturation, but it is evident and easily to recognize. Menarche is not a final phenomenon of sexual maturation, but probably because of endocrine regulation is connected with other phenomena of puberty and growth processes including influence on adult body size.

Many papers exist related to age at menarche, less related to season of menarche, and factors which control puberty. Only very few study family factors as a significant environment of growth and maturation. These factors are very important because they are under each family's control. This paper is included into a program of cross cultural studies on growth and maturation, and views the family as a microenvironment of human development.

This paper presents the following hypotheses: 1. There is a relationship between age of maturation and final body size; 2. Occurrence of menarche is most frequent in the month of birth; 3. Shift in the expected menarche month is related to environmental stress; 4. Receptivity of children by occurrence of menarche (and may be in more general terms) is dependent from season of birth. It may also be related to season of conception and pregnancy.

MATERIAL AND METHODS

Examinations of 1010 girls and 529 of their mothers from Progreso, Yucatan in Mexico were realized in June-September 1993. Progreso is a sea Port on the Gulf of Mexico, with 40,000 permanent inhabitants, it is also a summer resort for Merida (Fig. 1). Investigations include living conditions (size and character of house, sanitary status, electric and electronic equipment, vehicle, number of books, newspapers read, air conditioning), year and season of birth and menarche (by retrospective method), and some characters of the menstrual cycle (Table 1). In girls measurements of 4 somatic traits (stature, body weight, arm circumference and fatfold on triceps brachii) were also taken using the Martin-Saller method. Data are compared with Polish examinations and data collected in Merida in 1989 (Wolanski et al 1994).

School-girls from Progreso are more physically developed, than their age coevals from Progreso (Wolanski 1994 - report for CONACyT). This means that a better nourished part of each age cohort attends schools in Progreso. Fathers of girls under study were born on aver-

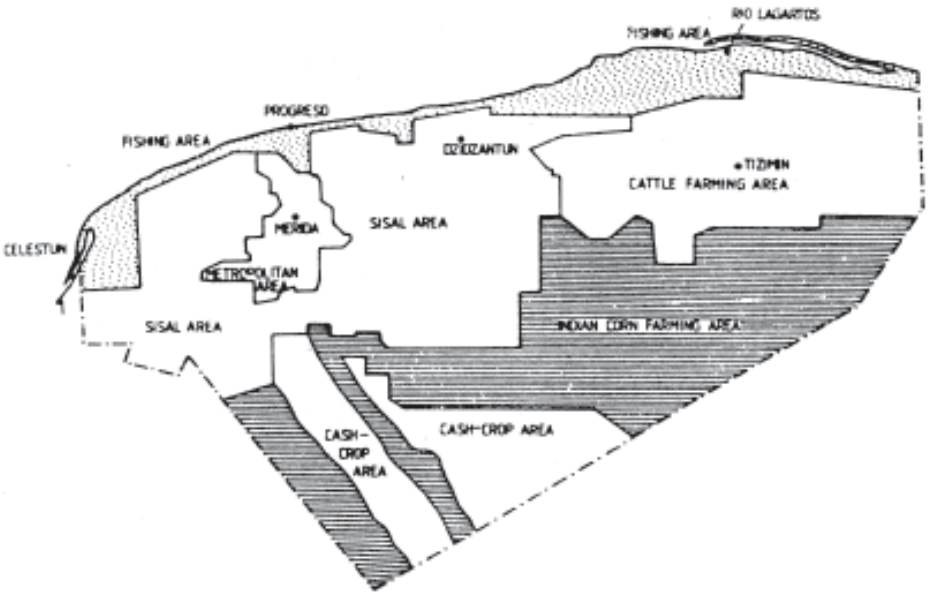

Fig. 1. Map of Yucatan and localization of Port of Progreso and state capital Merida

Table 1: Correlation coefficients of age at menarche, duration of menstrual cycle in days and number of bleeding days in school girls, with parents and family characters in the Progreso population (studied in 1993; N = 1010). Mentioned only statistically significant correlations, Mean duration of cycle is 28.9 (SD=2.38, min-max 20-35, No 799), mean number of bleeding days is 4.9 (SD = 1.53, min-max 2-9, No 957)

Correlation coefficient r	*Age men*	*Cycled*	*Bleed. d*
Possession of refrigerator	-.002	.088*	-.037
Profession of father	.076*	.058	.003
Age of mother at child birth	.149**	-.063	-.032
Number of pregnancies in mother	.111**	-.078	-.029
Age at menarche of mother	.155**	.016	-.026
How many have siblings	.108**	-.068	-.025

age around 1949, and mothers around 1952. Mean age of mother at child birth was 24.9 (SD = 6.47) years, which means that duration of generation in the studied population is about 25 years.

Physique and age at menarche are compared with Polish data (1709 women studied in Polish towns and villages - Wolanski, unpublished data), and US Whites from Ohio (Wellens et al., 1992).

RESULTS

A. Age at Menarche

1. Age of Mother at Girls Birth, Age at Menarche of Her Daughters, and Daughters' Month at Menarche

The mean age at menarche in the sample of school girls from Progreso is 12.11 years and that of their mothers is 12.51 (Table 2).

Girls born in September, February and June mature earlier, those born in October-December and March mature later. In girls who mature at a younger age (11.85 years, SD=1.29,

Table 2: Age of mother at birth of daughter, age at menarche of mother and daughter in the Progreso studies

Age of mother at child birth in years Mean 24.94 SD 6.470 Min-max 14-47	No. 938
Age at menarche in mothers in years Mean 12.51 SD 1.637 Min-max 8-17	No. 533
Age at menarche in girls in years Mean 12.11 SD 1.360 Min-max 9-17	No. 1010

No.=79) menarche occurs in September, and for those who mature at an older age (12.5, SD=1.43, No.=47) in October (unpublished data of Rojas 1994 - Table 3).

lation to such factors.

Multiple regression shows significant correlations between age at menarche and some family characteristics (Table 6). In Progreso girls

Table 3: Month at Menarche of Girls, and their Age at Menarche and Mothers' Age at girls' birth in 1010 girls from Progreso, Mexico, 1993 (Rojas 1994)

Month at Menarche	*Mean age at menarche*	*Standard deviation*	*Mean age of mother*	*Standard deviation*	*No. of girls*
January	12.02	1.28	24.79	6.52	82
February	11.96	1.12	24.71	6.67	58
March	12.35	1.25	24.64	6.89	59
April	12.07	1.25	24.56	6.34	100
May	12.04	1.29	24.49	6.65	119
June	11.98	1.44	25.43	6.64	169
July	12.14	1.47	23.95	6.41	65
August	12.27	1.26	25.02	6.97	101
September	11.85 min	1.29	26.27 max	6.11	79
October	12.50 max	1.43	23.26 min	5.62	47
November	12.28	1.06	25.41	6.28	44
December	12.37	1.33	25.19	5.82	87

Studies relating also age of mother at birth of a girl to the particular month in which these girls mature several years later. In daughters of older mothers (26.25 years, SD=5.63, No.=73) menarche occurs in September, when in daughters of younger mothers (23.26 years, SD=5.62, No.=46) in October. It is interesting to note that the months with the highest and lowest ages at menarche for daughters are September and October, which are the same months with regards to age of mother at time of birth of a particular girl. But the sequence is reversal.

Generally for girls who mature in age from 12.0 to 12.3 years, menarche occurs more or less in subsequent months: January, May, April, July, August and November.

Girls born from mothers between of 23.3 and 24.8 years old mature in subsequent months in reverse order in October, July, May, April, March, February and January; in age 25.2-25.4 in November and December.

2. Factors of the Sexual Maturation Rate (of Age at Menarche)

A factor analysis was made in the Mexican and Polish samples using different family and parents characteristics for indentification of latent factors (Table 4 and 5), followed by a multiple regression of age on menarche in re-

age at menarche related to family size (smaller family - earlier maturation) and age of parents at child birth (younger parents - earlier maturation). In the Polish sample, however,

Table 4: Factor analysis (Varimax rotation) of Progreso (Yucatan, Mexico) family and parent's properties (N = 1010 - Rojas 1994)

Properties	*F 1* *Age at reprod.*	*F 2* *Family size*	*F 3* *Culture*
Mothers' age at child birth	.941	.160	.009
Mothers' age at girls' menarche	.881	.208	.057
Fathers' age at child birth	.821	.104	.008
No. of siblings	.135	.947	-.056
No. of pregnancies	.137	.931	-.090
Parity	.493	.740	-.035
Father's education	-.046	-.190	.700
Income	-.030	-.015	.698
No. of rooms	.101	.076	.623
Mother's education	-.002	-.306	.571
No. of books in home	.022	.052	.527
% of var.explained	33.4	19.2	12.3

culture has a strong influence on age at menarche (girls mature earlier in families of parents with better education and higher income; this factor explains 4.5% of the variance), the second factor (younger parents - earlier menarche) is the same as in Mexico. This last phe-

Table 5: Factor analysis (Varimax rotation) of Polish family and parent's properties (N = 1531)

Properties	*F 1 Culture*	*F 2 Family size*	*F 3 Age at reprod.*	*F 4 Living condit.*	*F 5 Genetic*
Father's education	.868	-.022	-.112	.091	.057
Mother's education	.864	-.035	-.126	.054	.063
No of employees	-.141	.743	-.080	-.337	-.045
No of persons	-.179	.719	-.038	-.048	-.059
No of rooms	.249	.500	.089	.102	.059
Age of mother	-.075	-.009	.914	-.033	-.037
Age of father	-.127	-.015	.902	-.053	.005
Kind of region	.076	327	-.005	-.763	-.127
Income	-.015	.558	-.042	.566	-.003
Sanitary conditions	.487	-.118	.053	.520	.011
Marital distance	.166	.075	-.082	.299	.006
Mother's stature	-.063	-.071	-.028	.021	.796
Father's stature	.168	.039	-.001	.068	.723
% of var.explained	19.2	14.8	11.3	9.0	8.1

(12.32). The daughters of the best and lowest educated parents in the scale of the populations under study are between in average age mature girls of better educated parents (12.16), and lower educated parents (12.09). Differences are statistically significant.

3. Secular Changes

An acceleration of menarche in last 20-25 years was observed in Yucatan. Before 1963 (girls born before 1950) the trend was slightly marked (Fig. 2). The trend in past decades is of about 0.2 years per decade. Acceleration is greater in mixed families, than in both Maya and non-Maya families.

B. Age At Menarche and Adult Body Size and Weight

In relation to stabilization of stature there

Table 6: Multiple regression of age at menarche of daughters according to five family factors in Polish populations: F1 = education and income (culture), F2 = number of family members (family size), F3 = age of parents at child birth (parental age), F4 = housing and living conditions (living conditions), F5 = parental stature (genetic); and in three family factors in Mexican population (Progreso, Yucatan): F1 = age of parents at child birth (reproductive age), F2 = number of siblings (family size), F3 = parents education and income (culture). Data for Poland by Wolanski, data for Mexico by Rojas

Factor	*Poland*				*Mexico*			
	B	*SE B*	*t*	*% Var*	*F*	*B*	*SE B*	*t*
F1 Culture	-.452	.076	-5.941***	4.53	F3	.003	.055	.072
F2 Family size	-.014	.071	-.197	.00	F2	.234	.055	4.232**
F3 Reproductive age	.211	.069	3.078**	1.39	F1	.111	.053	2.105 *
F4 Living conditions	-.028	.071	-.400	.07				
F5 Genetic	.105	.072	1.448	.21				

nomenon existing in both samples is also an evidence of secular trend (acceleration of maturation).

These regularities show that in girls born from younger parents menarche occurs earlier. From chi-square analysis we know, that daughters of older parents mature a little earlier, but that daughters born from parents in average age of reproduction mature later. Girls from smaller families have menarche at an earlier age. Bigger income per family member in small families is more important than parental fertility. The relationship between age at menarche to education, income of parents is not linear between. Daughters of over average educated parents mature earliest (11.94 years) and later mature girls of below average educated parents exists a pattern D (Fig. 3) of growth. Those earlier to mature are shorter (positive correlation). The same phenomenon is observed in Yucatan, Polish and US girls (Figs. 4-6).

According to body weight and fatfold thicknesses a pattern A (Figs. 4-6) of growth exists in all three compared samples. Earlier maturation is associated with bigger weight and more abundant adipose tissue (negative correlation).

C. Seasonality of Menarche

1. Month of Births and Menarche

37.4 per cent of all girls mature between April and June (random is 25%), this is probably the most stressful period according to climate (dry hot period and transition to rainy season). Menarche occurs less frequently between

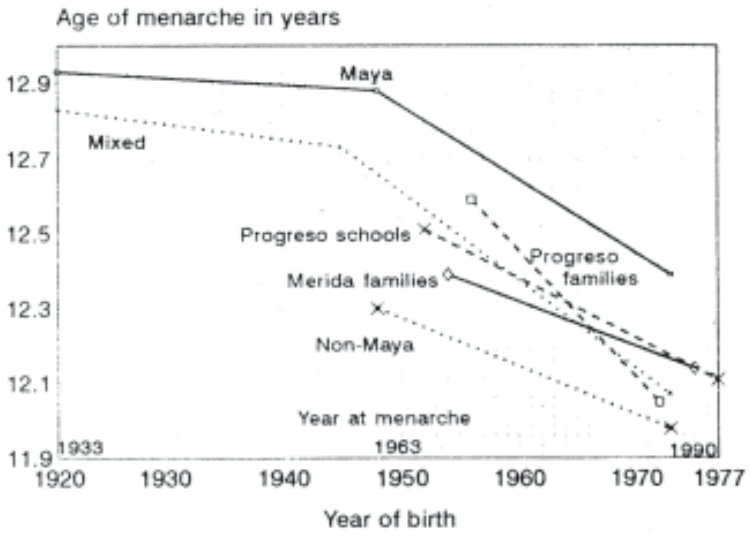

Fig. 2. Secular changes in age at menarche in Yucatan

October and November (10% *versus* 16.7) and between February and March (12% *versus* 16.7 - Table 7, Fig. 7).

Girls mature more frequently than randomly during the month of their birth. Correlation between month of menarche and birth is r = 0.07* in Progreso'93 and .17** in Merida'89 and it is statistically significant at the .05 and .01 level (Table 8).

In the mothers' generation the most frequent months at menarche were September, February and March; in daughters April-June, and August. Also in relation to the months at menarche there exists a shift between generations.

Most frequent month of birth in the mothers' generation is June, January and August (Fig. 8), in the daughters' generation it is August, September and December (Fig. 7). There exists a shift between generations in both month of birth and at menarche.

Concordance between month of birth and month at menarche is especially evident for girls who were born in February, April and May

Table 7 :Month of birth of father, mother and daughter and month at menarche of mother and daughter. Progreso studies 1993

Month	*Month of birth of*						*Month at menarche*			
	Father		*Mother*		*Daughter*		*Mother*		*Daughter*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
1	59	8	88	11	89	9	12	7	82	9
2	66	9	62	8	75	7	16	10	58	6
3	52	7	47	6	68	7	17	10	59	6
4	53	8	62	8	76	8	10	6	100	11
5	76	11	78	10	81	8	13	8	119	13
6	62	9	85	11	77	8	13	8	89	10
7	51	7	40	5	85	8	15	9	65	7
8	72	10	81	10	105	10	14	9	101	11
9	53	8	54	7	97	10	20	12	79	8
10	36	5	56	7	80	8	16	10	47	5
11	57	8	58	7	81	8	8	5	44	5
12	64	9	71	9	96	10	10	6	87	9

Table 8 :Correlation between various aspects of age and month of menarche of mothers and their daughters. Data for Merida by Wolanski et al (1993);, data for Progreso by Rojas (1994)

S. No.	*Correlation between*	*Merida'89*		*Progreso'93*	
		r	*n*	*r*	*n*
1.	Month of birth of mothers and their daughters	-.062	249	-.026	779
2.	Age at menarche of mothers and their daughters	.187*	205		
3.	Month at menarche of mothers and their daughters	.278*	117		
4.	Month of birth and at menarche of daughters	.165**	452	.067*	779
5.	Month of birth of mother and at menarche of daughters	.035	213	.012	779

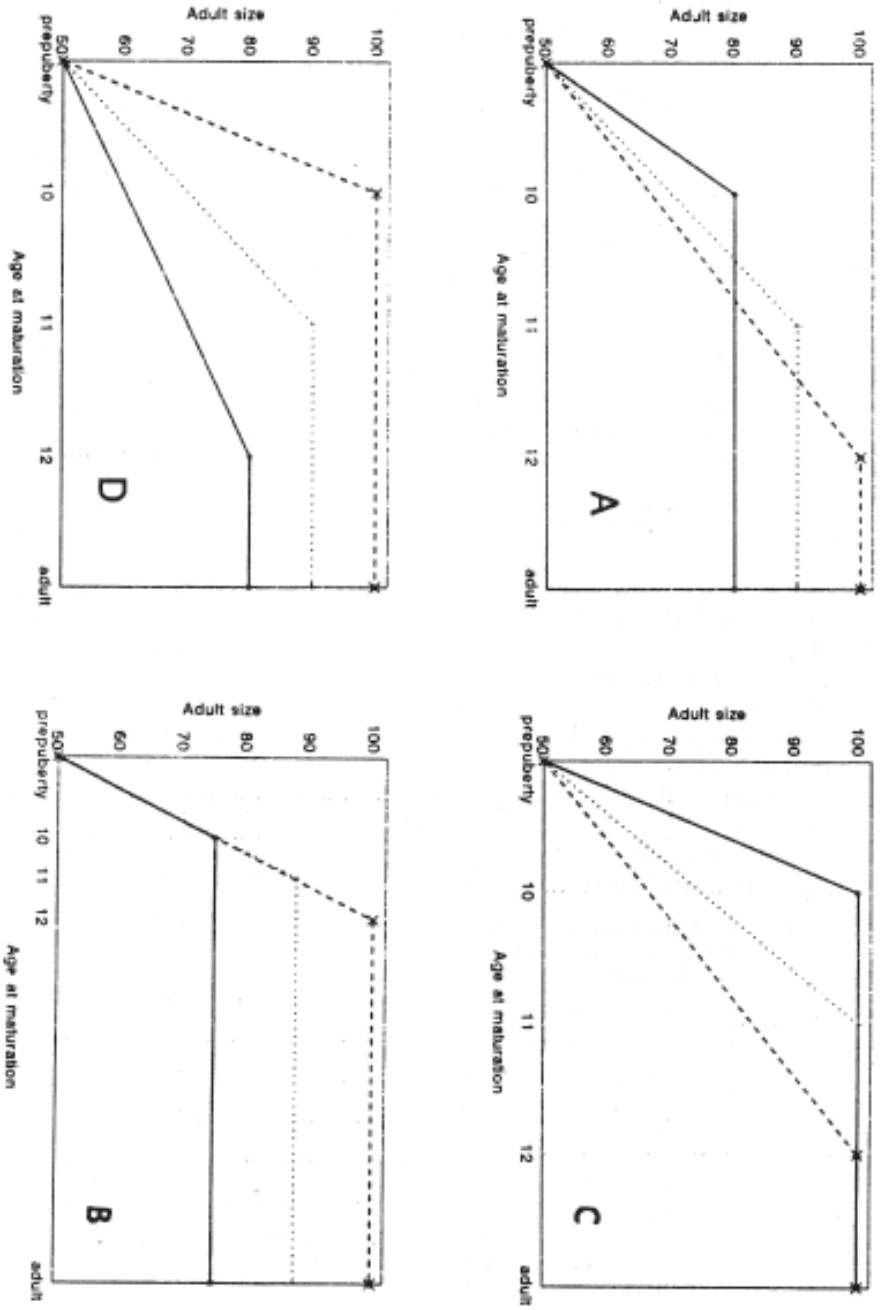

Fig. 3. Possible general patterns of relations between growth and stabilization of adult size

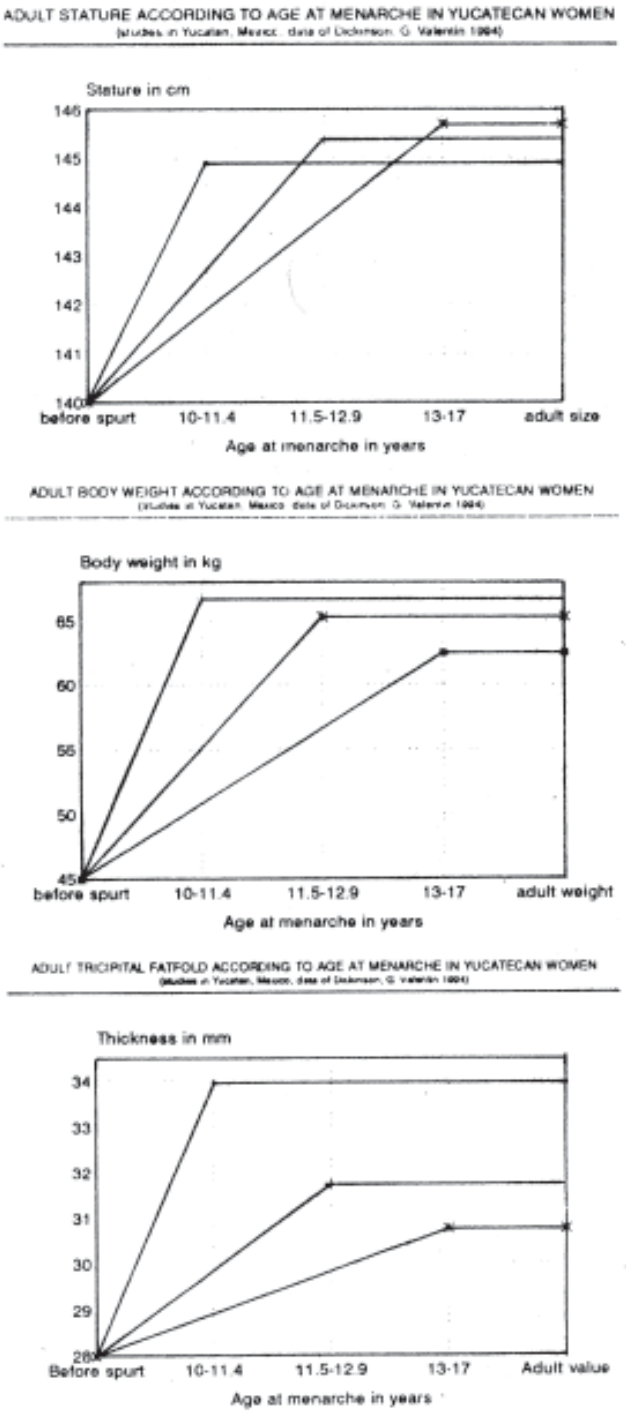

Fig. 4. Adult body height, weight and tricipital fatfold thickness according to age at menarche in Progreso women (data of Dickinson, Valentin 1994)

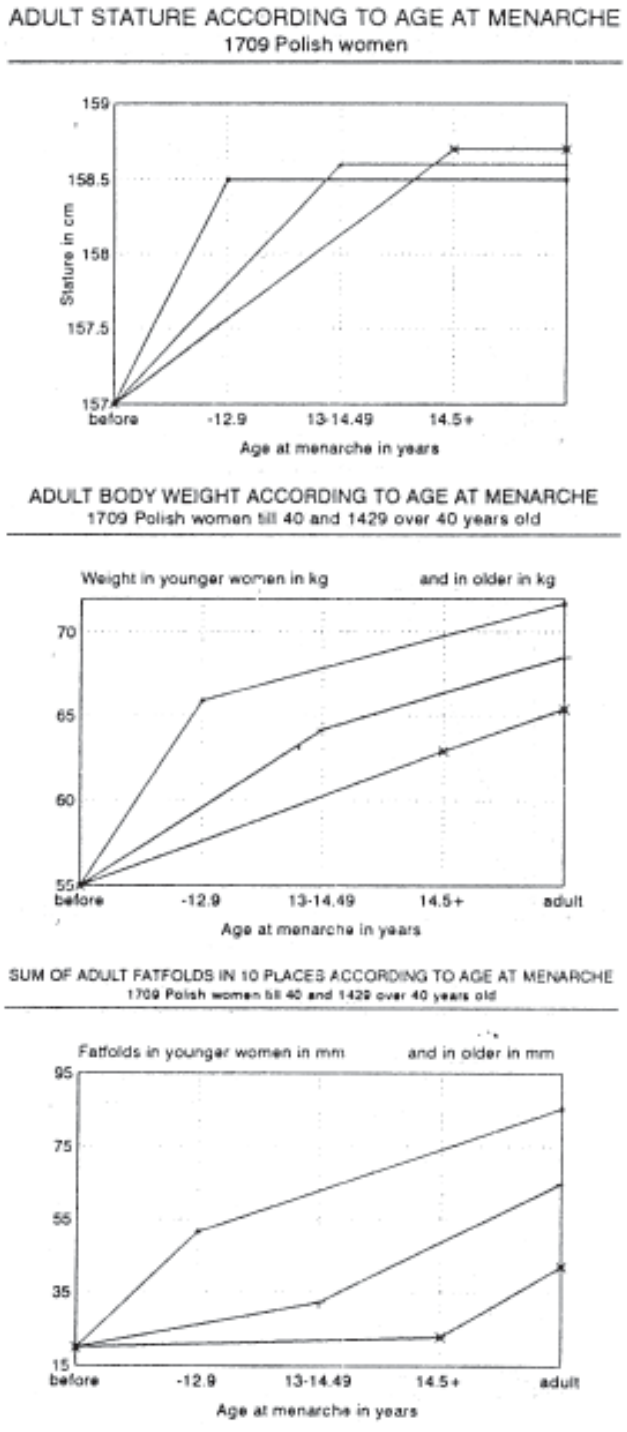

Fig. 5. Adult body height, weight and tricipital fatfold thickness according to age at menarche in Polish women (data of Wolanski, unpublished)

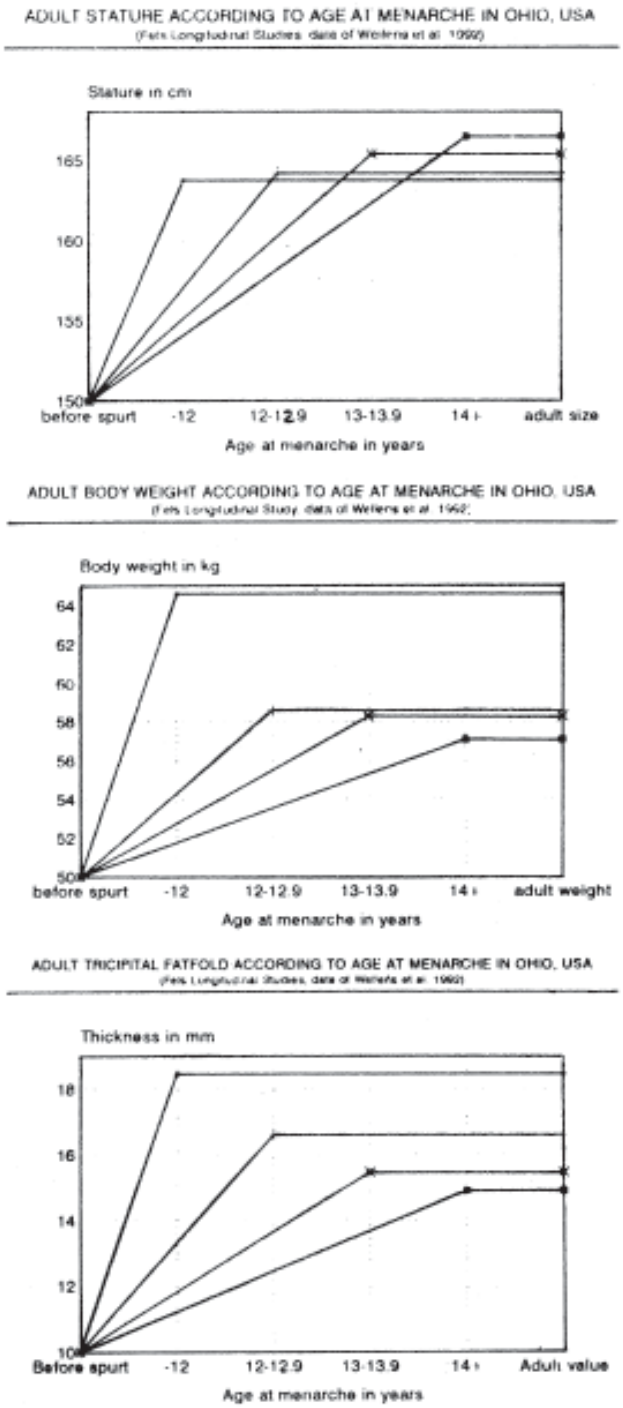

Fig. 6. Adult body height, weight and tricipital fatfold thickness according to age at menarche in Ohio (USA) women (data of Wellens et al., 1992)

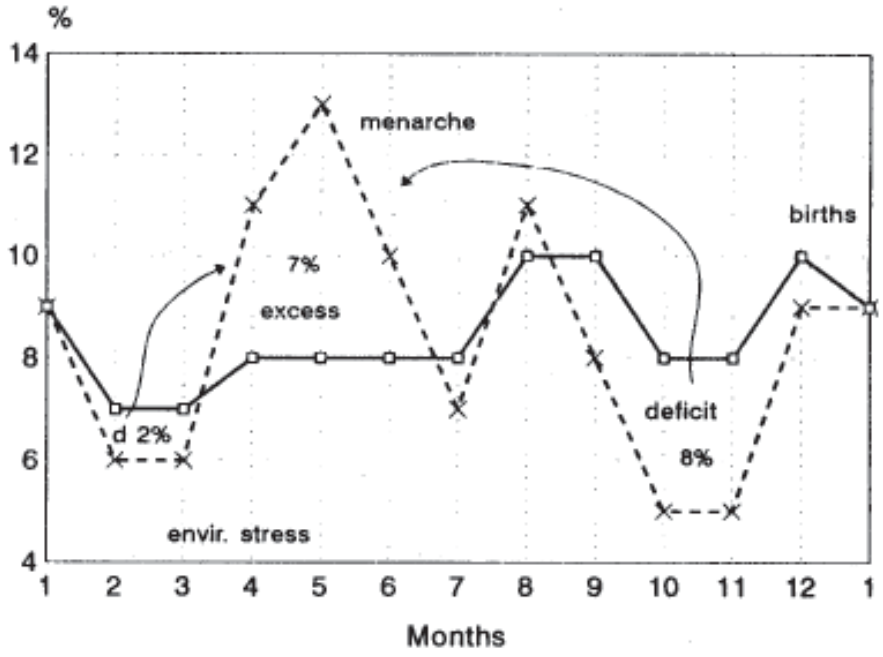

Fig. 7. Month of birth and at menarche of Progreso girls. In May is observed peak frequency and in months April-June excess of frequency in relation to births

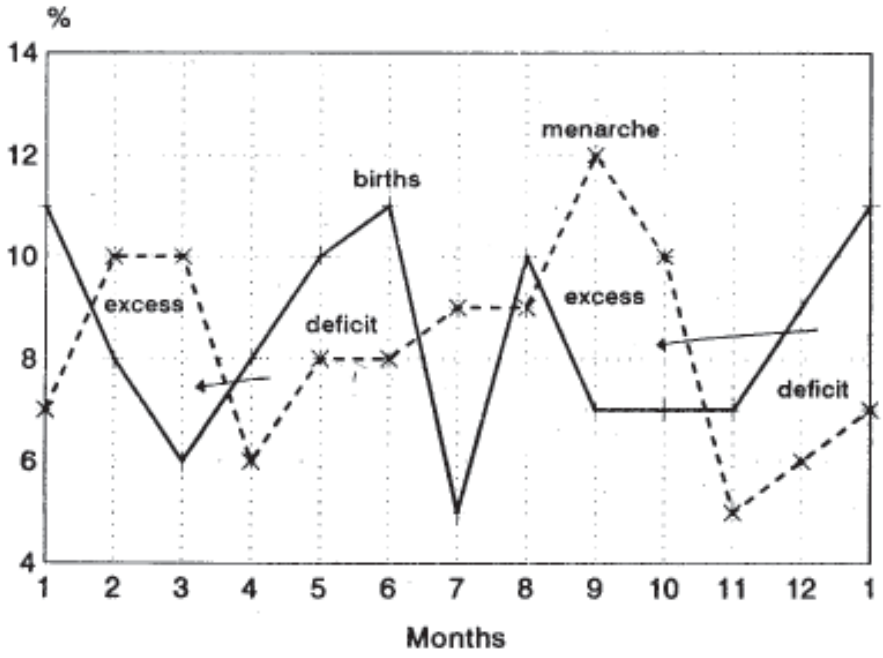

Fig. 8. Month of birth and at menarche of Progreso mothers

(Fig. 9). A distribution is almost Gaussian and peak value is more or less at or near month of birth. Four-five months from birth months to both sides exists others, much smaller, peaks of frequency of occurrence of menarche.

Girls born in January and September show the main peak 3-4 months after month of birth - this means in December-January and April-May, which means retardation of menarche (Fig.10). The deficit of frequency is 1-2 months after birth and 1-2 before peak value. The distribution of most cases shows retardation of menarche in relation to month of birth.

Girls born during the rainy season (June, July, August) accelerated in maturation in relation to month of birth, with peak frequency of 1-3 months before month of birth (Fig. 11).

Girls born in March and October-December show irregular shifts: several (mostly three) months with high frequency of menarche (Fig.12).

2. Shift in Birth Months and Menarche Months

In the Progreso population between the fathers' birth month and mother's birth month distribution exists similarities, but in daughters peak value is about 3 months later (Fig. 13). This means that the most frequent month of conception in the parental generation was August and September while in the daughter generation is November and December. The same is seen when women were divided into born till 1960 and after 1974. This phenomenon (shift in month of birth) is not observed in other Mexican populations namely rural Zapotecs from Oaxaca (Fig. 14).

DISCUSSION

Progreso girls and their mothers studied in 1993 mature rather early in comparison with other Central and South American populations (Table 9). Some published data are, however, probably not correct due to errors in calculation of mean age. In Kelley (1991) a reported mean age of 10 should be considered 10.5 since actual age of menarche may fall anywhere between 10.0 and 10.99.

In comparison with studies of mothers and their daughters and older data it is evident that there exists a secular trend manifested by acceleration of age at menarche.

This paper supports the thesis (Kowalska et al., 1963 a, b; Valsik and Stukovsky, 1965), that menarche in girls occurs most frequently in the month of their birth. Probably a decisive factor in the occurrence of menarche is not only environmental stress during puberty, but also season at birth. Probably girls born in some month are more sensitive on some factors, especially during sexual maturation. It may be that it depends on characters of conception and pregnancy. The above relationships look like some regularities and should be checked in other populations.

There may be, as we suggested years ago (Wolanski et al., 1981) and supported in more recent studies (Wolanski et al., 1994), a relationship between the biorhytms of mothers and their daughters. Still we can not find a kind of this dependence.

Shift in an expected menarche month was related to environmental stress (37.4% girls matured in the dry and hot 3 months, *versus* 22% who were born in these months, and 25% of a random distribution). The main stimulating factor is probably solar radiation (7.5 hours per day in May, against 5.5 in December - Fig.15), and a mechanism related to increase of vitamin and hormonal level in an organism (Grzegorszczak et al., 1983). Sensitivity of girls manifested by occurrence of menarche (and by more general symptoms) was dependent on season of birth. It might be related to the season of conception and pregnancy.

We observed shifts in births, and probably as a consequence, shifts in month at menarche. Both are related to the seasons of the year, but not exclusively (Kowalska et al., 1963a, b; Valsik, 1965). Because climate has not changed, living conditions or other factors must have influenced birth frequency. According to information of F. Guri (1994) the state started mass vaccinations in the late 60s' and beginning of 70s'. Women born in the some month after this campaign survived to adulthood. As we know newborn babies are at greater risk in some seasons of the year. In the mothers' generation therefore, babies born in June and October may have died more frequently, than in the next gen-

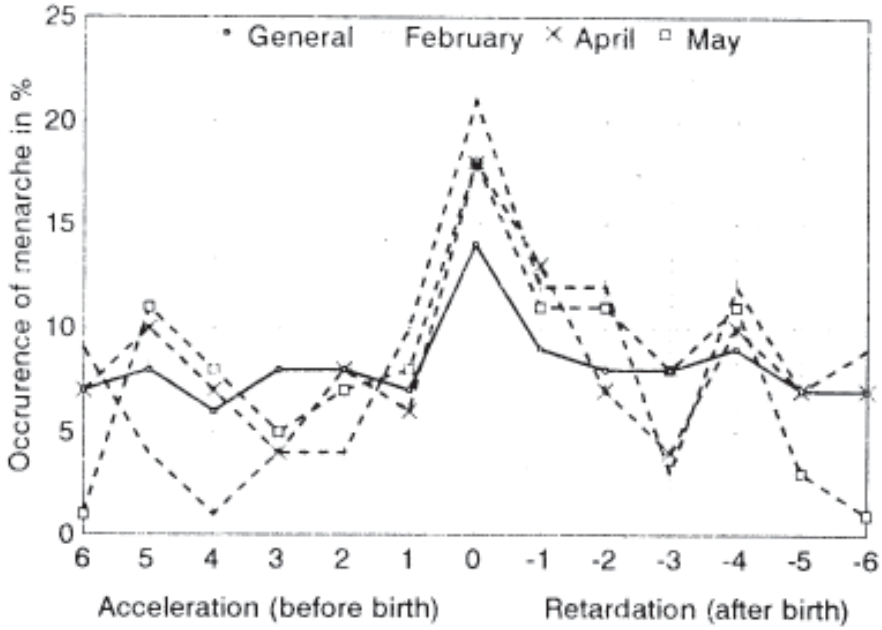

Fig. 9. Frequency of menarche in month of birth (0) and months before and after this term in February, April and May

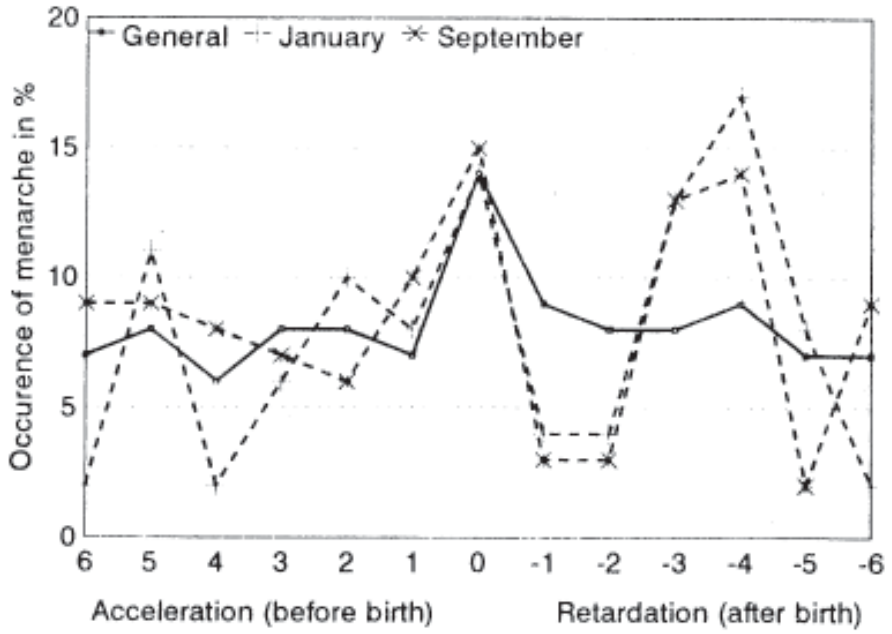

Fig. 10. Frequency of menarche in month of birth (0) and months before and after this term in June, July and August

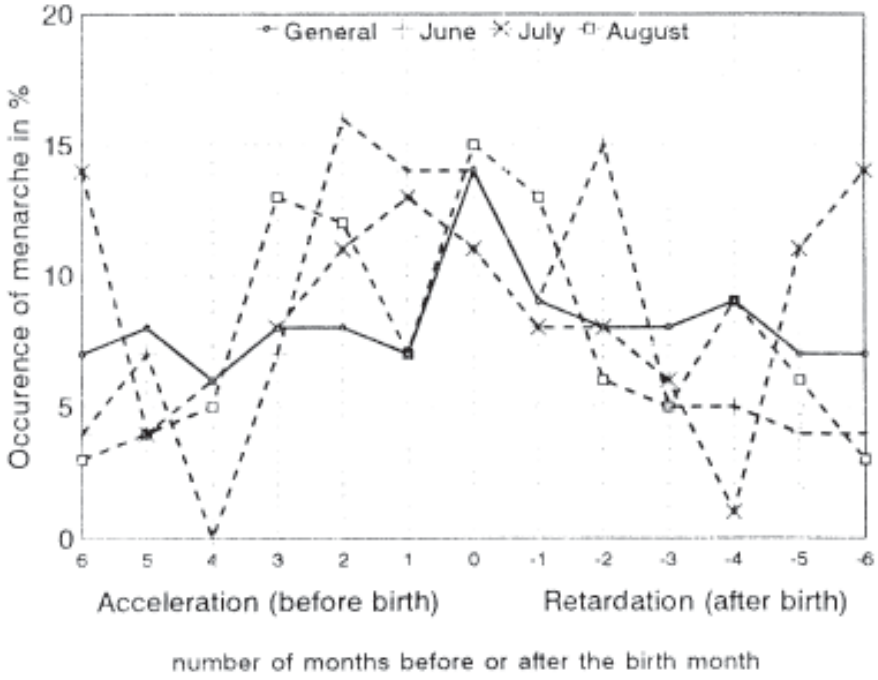

Fig. 11. Frequency of menarche in month of birth (0) and months before and after this term in January and September

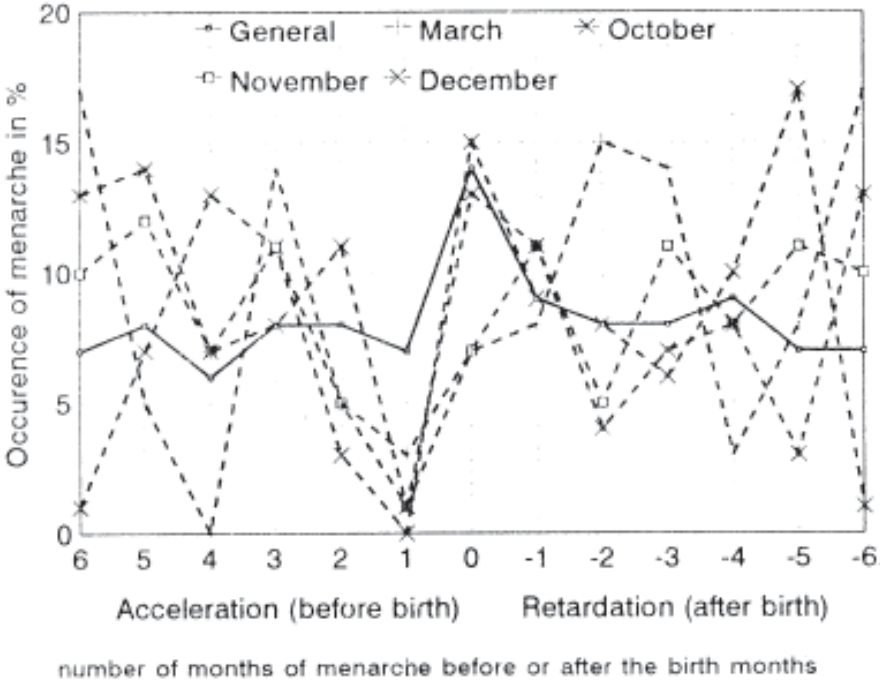

Fig.12. Frequency of menarche in month of birth (0) and months before and after this term in March, October and December

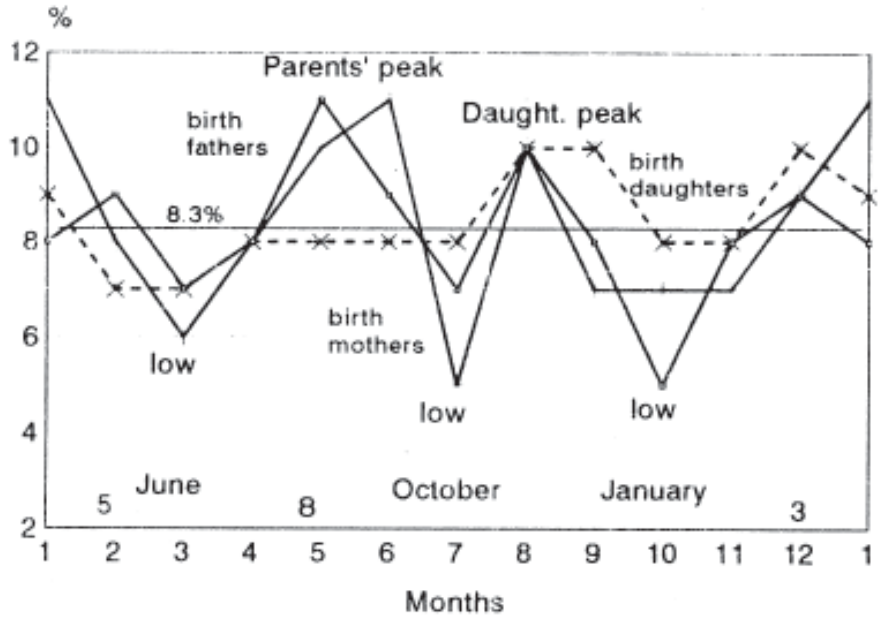

Fig. 13. Month at birth in fathers and mothers and in daughters from Progreso

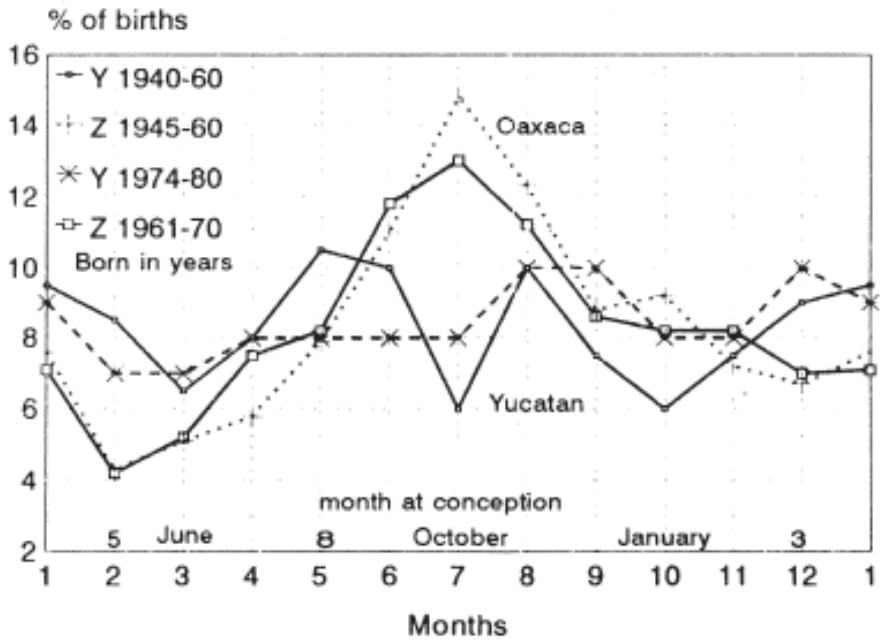

Fig.14. Month at birth in subjects born in 1940-60 in town Progreso and 1945-60 in Zapotec rural community in Oaxaca, and born in 1974-80 in Progreso and 1961-70 in Oaxaca

Table 9 : Age at menarche in some Central and South American girls. Legend: SD = standard deviation (if in parentheses = standard error), No. = number of girls, NW = data of Wolanski; Carabobo* and Caracas* in Venezuela, Havana in Cuba, if not mention country means Mexico

Population (Author and year of publication)	*Mean*	*SD*	*No.*
Guatemala, rural Maya (Sabharwal et al., 1966)	14.5		218
Oaxaca, valley (Malina et al., 1980)	14.50		258
Oaxaca, valley (Malina et al., 1980)	14.48	(0.34)	328
Oaxaca, urban colonia, low class (Malina et al., 1980)	14.45	(0.45)	160
Oaxaca, urban and rural colonia (Malina et al., 1977)	14.27	1.69	
Oriente, Cuba (Pospisilova-Zuzakova, Valsik,1965)	13.50		
Cuba, rural (Jordan et al., 1974)	13.3		
Havana - whites (Pospisilova-Zuzakova, Valsik, 1965)	13.05		
Havana -mulattos (Pospisilova-Zuzakova, Valsik, 1965)	13.02		
Santiago, Chile, upper class (Rona, Pereira, 1974)	12.96	(0.19)	140
Yucatan, rural Maya (Steggerda, 1941)	12.91	(0.13)	42
Havana - black (Pospisilova-Zuzakova, Valsik, 1965)	12.89		
Carabobo*, lowest class (Farid-Coupal et al., 1981)	12.86	(0.12)	320
Merida, urban, mothers, both Maya (NW et al., 1993)	12.85	1.46	47
Merida, urban (Diaz, 1964)	12.83	1.00	736
Merida, Mestizo (Steggerda, 1941)	12.81	(0.12)	83
Guatemala, urban, upper class (Sabharwal et al., 1966)	12.8		218
Havana, Cuba (Jordan et al., 1974)	12.8		
Villa de Xochimilco, D.F. (Diaz el al., 1968)	12.76	1.22	
Mexico City, D.F., urban (Pena, 1970)	12.75	1.32	
Carabobo*, state, all class (Farid-Coupal et al., 1981)	12.68	(0.08)	995
Merida, urban (Diaz, 1967)	12.61	1.44	
Merida, urban, all mothers (NW et al., 1994)	12.60	1.55	235
Santiago, Chile, all class (Rona, Pereira, 1974)	12.60	(0.12)	354
Merida, urban, mothers, both non-Maya (NW et al., 1993	12.59	1.55	125
Sao Paulo, Brazil, upper class (Hegg & Levy, 1977)	12.56		3109
Progreso families'93, mothers (Wolanski, 1994)	12.56	1.58	147
Merida, Venezuela, city, all c.(Limongi et al., 1979)	12.55	(0.09)	535
Mexico City, urban (Ramos, 1963)	12.53	1.08	1608
Yucatan, rural Mayan (Kelley, 1991), probably 13.22	12.52	1.12	111
Progreso, mothers of school girls'93 (Wolanski, 1994)	12.51	1.64	533
Caracas*, urban, lower middle class (Limongi, 1977)	12.42	(0.09)	957
Tampico-Altamira, rural (Pena, 1970)	12.41	1.64	42
Progreso, mothers of school girls'89 (Wolanski, 1994)	12.41		66
Merida families'93, mothers (Wolanski, 1994)	12.39	1.47	141
Merida, urban daughters, Maya (Wolanski at al, 1993)	12.38	1.19	91
Merida, urban mothers, non-Maya (Wolanski et al., 1993)	12.36	1.51	72
La Plata, Argentina, urban (Lejarraga et al., 1980)	12.35	(0.05)	6494
Carabobo*, middle class, (Farid-Coupal et al., 1981)	12.34	(0.11)	88
Santiago, Chile, low & middle c. (Rona, Pereira, 1974)	12.30	(0.16)	214
Santiago, Chile, all class (Rona, Pereira, 1974)	12.60	(0.12)	354
Caracas, Venezuela, nonmanual (Farid-Coupal et al., 1981)	12.3		
Progreso, school girls'89 (Wolanski et al., 1993)	12.24		135
District Federal, Mexico (Pena, 1970)	12.19		182
Merida families'93, daughters (Wolanski, 1994)	12.14	1.34	80
Progreso school girls'93 (Wolanski, 1994)	12.11	1.36	1010
Merida, urban, all daughters'89 (Wolanski et al., 1993)	12.09	1.36	473
Merida, urban,daughters mixed'89 (Wolanski et al.,1993)	12.05	1.42	151
Tampico, urban (Pena, 1970)	12.03	1.28	162
Caracas, Venezuela, middle class (Limongi, 1977)	12.00		
Caracas, urban, upper+upper middle c.(Limongi, 1977)	11.97	(0.04)	399
Merida,urban, daughters, non-Maya'89 (Wolanski et al.,1993)	11.98	1.38	227
Merida, urban Maya (Kelley, 1991), probably 12.38	11.88	1.12	188

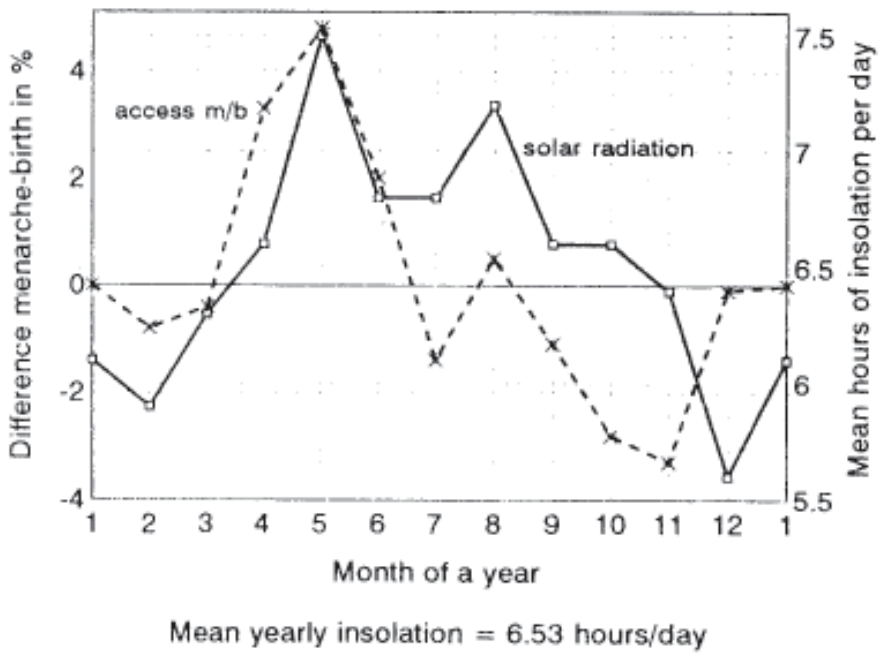

Fig. 15. Differences in per cent between occurrence of births and occurence of menarche in girls from Progreso and mean number of hours of solar radiation in various months

eration. It is possible to check this problems on the basis of civil registers before and after the vaccination action.

CONCLUSIONS

Girls that mature earlier are shorter in adult age, but are heavier and have more abundant adipose tissue.

Girls mature more frequently than randomly in the month of their birth. It is especially true for girls who were born in February, April and May. Girls born during the rainy season (June, July, August) are accelerated in maturation in relation to month of birth. Girls born in January and September are retarded in maturation, also in other cases there is a tendency to retardation of menarche in relation to month of birth, even if the distribution of month at menarche is non-regular.

Shift in an expected menarche month was related to environmental stress. The main stimulating factor is probably solar radiation, and mechanism related to increase of vitamin and hormonal level in organism. Sensitivity of girls manifested by occurrence of menarche (and by more general symptoms) was dependent on season of birth. It might be related to the season of conception and pregnancy.

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