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AGE AT MENARCHE, TREND AND ENVIRONMENT IN A RURAL SAMPLE OF NORTH-ITALIAN WOMEN

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Abstract: *Our study explores some interrelations of environmental conditions with the age at menarche in a rural sample of 1202 women born between 1900 and 1969 in two villages of Emilia-Romagna region (North-Italy). A decrease in the age at menarche was evident during the first 7 decades of this century. This decrease was stronger in rural environments than in urban one. An evident influence on maturation was exerted by the pre-puberal activity of the subject and the socioeconomic environment (tested through father/mother activities). The age at menarche of girls of our sample was also influenced by the familly size.*

Key words: *Menarche; Environment; Secular trend.*

Introduction

Adverse environmental factors can cause growth retardation in man. The type and degree of the response of the organism depends above all on the length of exposure time to these adverse factors. The determinants of growth performance were grouped for practical purposes in two major categories (Ferro–Luzzi 1984): direct determinants (food intake and infectious diseases) and indirect determinants, which are all those conditions (income, family size, overcrowding, etc.) that affect the direct determinants. Although the genetic control of the timing of growth is demonstrated in the best way by the heritability of menarcheal age (Tanner 1981), nevertheless the last trait too is influenced by environmental conditions. As evidence of this influence, we can mention the decrease in age at menarche during the last century. It is probable that there are many causes for the secular trend (from improved nutrition to natural selection and increased heterosis). As regards the trend in menarcheal age, in particular, the improvement of environmental quality may be the most powerful factor (Johnston 1974).

The present study explores changes of age at menarche in girls from the country during this century, and relations between age at menarche and some indirect determinants.

Materials and Methods

The analysis was performed by means of retrospective method on 1202 women born between 1900 and 1969 in the boroughs of Medicina (737) and Castel bolognese (465). Both boroughs are in the vicinity of the town of Bologna, seat of local government in Emilia-Romagna region (North Italy). The principal economic activity in both the boroughs, at the beginning of the century, was agricultural, followed by handcrafts and by industry.

The research includes women living in the above mentioned villages and in the rural hamlets of the two boroughs. The women were interviewed in their houses and were

encouraged to remember the date of the first menstruation with precision, eventually helping them to associate this event with other contemporaneous ones.

The secular trend of age at menarche was represented through straight lines according to the least squares method on the basis of mean values of the trait for each birth decade. The statistical comparisons among subsamples (formed respectively on the basis of subject activity in pre-puberal age, parents activity, order of birth) were carried out through a test of equality of group means: ANOVA. Moreover a pairwise t-test between every pair of groups were computed and accompanied by Bonferroni probabilities. The Bonferroni's multiple T is a simultaneous test of the hypotheses relative to comparisons (the level of significance depends upon the number of comparisons) (Camussi et al. 1986).

Results

A change in age at menarche had taken place during the first 70 years of this century (Table 1). The trait variability (SD) is decreasing from the beginning of the century to the last decades considered, slowly at first and then rapidly. The constant anticipation of age at menarche of girls living in Medicina and Castel Bolognese is pointed out by the course of the regression lines in Fig. 1. In the same figure and with comparative intent we also reported the course of the regression line in a town sample from Bologna (Benassi Graffi et al. 1980) restricted to 1037 women born after 1900 (on a total sample of 1811 women born after 1850). There is an increase in angular coefficient from rural villages |0.22| to Bologna |0.25|. The coefficients of determination are very similar in rural and urban samples.

Table 1. **Age at menarche with regard to birth decades**

Decades	N	Mean	SD
1900 – 09	27	13.74	1.62
1910 – 19	125	13.73	1.78
1920 – 29	239	13.56	1.76
1930 – 39	218	13.21	1.52
1940 – 49	202	12.91	1.49
1950 – 59	273	12.50	1.29
1960 – 69	118	12.77	1.17

If we take into consideration firstly the relation between age at menarche and type of activity of the subject in pre-puberal age, a difference in age at menarche greater than 1.5 year resulted between the groups with non-manual activity (students) (n=540, $\bar{x}$=12.31, SD=1.24, Range=9–17) and with manual activity (n=317, $\bar{x}$=14.08, SD=1.49, Range=9–19). The mean values of age at menarche in relation to the different activities of subjects are reported in Table 2. The higher values in age at menarche may be found in farmers and factory workers; with a mean age at menarche superior of about 2 years in comparison to students. The last group has also a lesser variability of the trait and a decrease in the minimum of the range. ANOVA showed a significant difference among groups in age at menarche. F-value was greater than the tabular one, then we can refuse the null hypothesis (H_0:$\mu_1=\mu_2=...\mu_p=\mu$) with an error probability: $P < 0.0001$. The pairwise t-test (with separate variances) resulted always significative, except in the comparison: farmers/craftswomen.

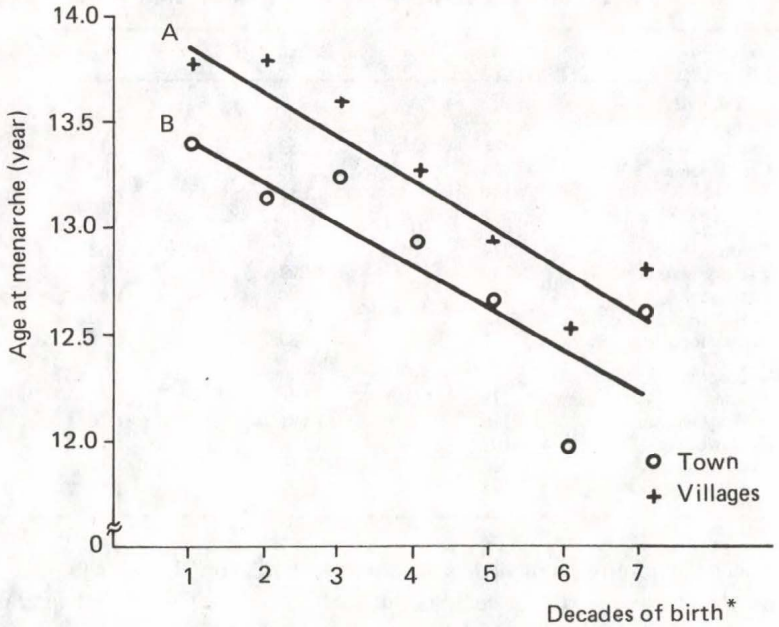

Fig. 1: Trend of age at menarche in town and in villages. –
Villages A : $y = 14.06 - 0.22x$, $r^2 = 0.89$; Town B : $y = 13.74 - 0.25x$, $r^2 = 0.85$
*The numbers from 1 to 7 correspond to decades of birth from 1900–09 to 1960–69.

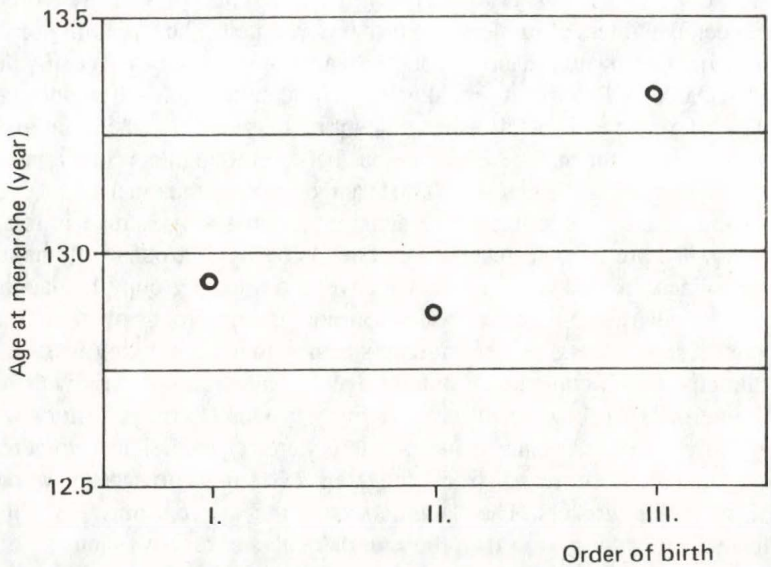

Fig. 2: Relationship between age at menarche and order of birth

Table 2. **Relationships between age at menarche and work**

Type of activity	N	Mean	SD
Subject's activity			
Farmer	118	13.84	1.52
Factory worker	74	14.63	1.39
Craftswoman	125	13.96	1.45
Student	540	12.31	1.24
Father's activity			
Farmer	374	13.33	1.62
Factory worker	282	12.97	1.73
Craftsman	236	12.80	1.43
Office worker	52	12.76	1.40
Professional man	24	12.37	1.08
Mother's activity			
Farmer	279	13.44	1.66
Factory worker	176	13.06	1.76
Crafswoman	102	12.62	1.30
Office worker	29	12.29	1.18
Home-worker	392	12.90	1.51

The socioeconomic environment has an important role on the growth. We wonder whether one socioeconomic factor such as the work activity of the father may exert an influence on menarcheal age. We considered a first simple division of our sample in two groups: daughters of manual workers asnd daughters of non manual workers. A greater precocity resulted in the second group of girls (n=76, $\bar{x}$=12.64, SD=1.31, Range=10–17) than in the first one (n=892, $\bar{x}$=13.07, SD=1.62, Range=9–19). In particular there was a greater precocity in daughters of office workers and professional men than in daughters of factory workers and farmers (Table 2), with a difference of 0.96 year in age at menarche between daughters of farmers and professional men. The variability of the trait was lesser in daughters of non-manual workers than of manual ones. The F-value was significant ($P < 0.0001$). Pairwise t-test always showed significant differences between the daughters of farmers and of all other categories of workers. The Bonferroni test resulted highly significant in the comparison between daughters of farmers and, respectively, daughters of craftsmen ($P < 0.001$) and of professional men ($P < 0.01$).

A similar trend is also noticeable if we consider the age at menarche in relation to mother's activity. We prefer to neglect the comparison between groups with manual and non-manual activities. In this case, in fact, we have also a third group (the daughters of home-workers) and there is a numerical disproportion among groups owing to the short numerical consistency of the group of daughters of non-manual working women. So let us proceed directly to the comparison among ages at menarche of girls with mothers belonging to one of the following different activity groups: farmers, factory workers, craftswomen, office workers, home-workers (there weren't professional women; Table 2). The age at menarche decreases from daughters of farmers to factory workers, to craftswomen, to office workers. The daughters of home-workers must be considered apart: they have mean values lower than those of daughters of craftswomen and of office workers. The "home-worker" category probably gathers women of very different socio-economic conditions, from unemployed women to wives of professional men. The

noticeable variability of this group in the age at menarche of daughters is an ulterior evidence of that (their range, 9–19, is equalized only by the range of the factory workers daughters). From the ANOVA a highly significant F-value ($P < 0.0001$) resulted, while the probability values of Bonferroni confirmed significant differences in the mean age at menarche between the daughters of home-workers and farmers ($P < 0.001$), between the daughters of farmers and craftswomen ($P < 0.001$), between the daughters of farmers and office workers ($P < 0.001$), between the daughters of factory workers and office workers ($P < 0.05$).

In order to assess the weight of other family influences, the age at menarche was analyzed in relation to the order of birth of the subject (Fig. 2). Some differences in menarcheal age are noticeable proceeding from the first-born or second-born daughters to the daughters born as third or more. The F-value computed on these data gave a $P = 0.033$. The Bonferroni probabilities associated to the pairwise t-test did not gain a level of statistical significance lower than 0.05.

Discussion and Conclusion

A secular trend in age at menarche was evident in Europe and in other countries of the world (U.S.A., Australia, etc.). In particular for Italy we observed a secular trend toward earlier menarcheal age in population of Bologna during a previous research (Benassi Graffi et al. 1980). With this paper we show that the phenomenon took place in the neighbouring rural villages, too. In the last environment in fact there was a mean decrease in age at menarche of 1.7 months every ten years (about 1 year in 70 ears, as a whole). This change was greater than the analogous phenomenon in Bologna, where the age at menarche decreased 1.4 months every decade (about 10 months during the same period of 70 years). In spite of the greatest ten years rate modification in rural environment, delayed ages at menarche resulted in rural villages in comparison with town also in the last decades examined; nevertheless the difference between the mean values of the two environments was reduced from 4.6 months in the first decade of this century to 2.5 months in the last decade.

Inheritance exerts a direct effect upon the age at menarche. A correlation of $r = +0.32$ for mother/daughter pairs (only $r = +0.26$ for sister/sister pairs) was pointed out by a previous research (Gualdi Russo, Veronesi Martuzzi 1983) carried out in the same area (Castel Bolognese). The correlations between mother and daughter are indicators of a definite but not preponderant family influence; only 10–15% of the total variance may be justified by genetic variation (Johnston 1974). There is a large evidence of environmental influence on age at menarche. In particular the onset would be highly sensitive to deficiencies in the diet. Malnutrition in prepuberal period slowed theonset of menarche by an average of 24 months, as it was observed in a research carried out in Alabama, U.S.A. (Dreizen et al. 1967). The greater frequency in the onset of menarche during the spring (32.6%) in our sample (the summer in some villages of Poland, Wolanski 1967) corresponds to the general course of growth, that is more rapid in spring and summer (especially as regards stature) and it has perhaps been connected with a larger vitamin intake (through fruits and vegetables) and, in general, with a more changing diet. In our sample the summer (27.4%), the winter (25.2%) and the autumn

(14.7%) were the following seasons of appearance of the first menstruation. This course kept constant in every decade of birth.

Since girls of the higher socio-economic levels are believed more precocious than girls of the lower levels (data still not confirmed in some countries: Nkiama et al. 1986, Vercauteren and Susanne 1986) we took into consideration in our study the socioeconomic conditions of girls. In this context we observed an earlier maturation and a lesser variability of the trait in the students group in comparison with other groups of girls carrying on manual work during the prepuberal age. The social changes and the decrease in work load during a premature age are probably jointly liable factors in the secular trend toward earlier age at menarche. The frequency of students changed from 14.3% in girls born in the first decade of the century to 95.9% in girls born in 1960–69. At the same time the percent of working girls decreased: the girls involved in agricultural work passed from 42.9% (1900–09) to 0.0% (1960–69). On the other hand the actual early age at menarche and compulsory education up to 14 (as from 1963–64) make work in pre-puberal age difficult. Although country children could be occasionally involved in agricultural work. The pre-puberal activity of the subject would not only be an indirect determinant as indicator of social level, but also a direct determinant. Growth can be delayed in fact as a consequence of the energetic expenditure and of physical effort in intense pre-puberal activity.

In relation to occupation of the father, we observed a more precocious age at menarche in daughters of non-manual workers (office workers and professional men) compared with daughters of manual-workers. In relation to the phenomenon of secular trend we also observed the changed frequency of these occupations during the 70 years examined. The frequency of farmer fathers passed from 57.1% for girls born in the first decade to 22.9% in the last decade. A stronger decrease (about 1/3 of the initial value) took place for the craftsmen frequency, which passed from 28.6% (fathers of girls born in the first decade) to 9.0% (in the last decade). The percent of factory workers kept constant, while the percent of white-collar workers increased from 0.0% (first decade) to 13.3% (last decade).

Examining relationships between age at menarche of daughters and mother's activity, we observed an analogous lesser earliness in the daughters of women engaged in agriculture and of factory workers than in daughters of office workers. Intermediate values in the mean of menarcheal age and a greater variability (in comparison to daughters of office workers) were observable in daughters of homeworkers, a category that is probably mixed from a socioeconomic point of view. The social changes, as from the beginning of XXth century, involved a gradual decrease in the number of women who work in agriculture from 42.9% (for mothers of girls born in the first decade) to 16.0% (last decade). The "homeworker" occupation remained the prevailing job during all the period considered (the frequency passed from 35.7% for mothers of girls born in 1900–09 to 45.0% in 1960–69). The frequency of factory workers remained constant in this period and the one of office workers was always very low and present only beginning from mothers of girls born after 1930 (it passed from 1% to 7.7% in the last decade).

Rate of maturation and growth present direct associations with family size (Tanner 1981). We have no news on real size of the families of provenance of our subjects.

However, we took into consideration an indirect parameter: the order of birth. A small increase in age at menarche in relation to the increasing order of birth was pointed out in our sample. We know that the family size surely decreased from the beginning of the century. This decrease involved, as a concomitant factor, a very low frequency of girls born as third (or more) in the last decade (22.2%) than in the first one (71.4%). In a complementary way there was an increase in the frequency of first born girls in the last decade (46.0%) compared with the first one (14.3%) and of second born girls in the last decade (37.7%) compared with the first one (14.3%).

The ecosensitivity of the trait considered is well documented in rural populations of our study in relation to some socioeconomic factors. Probably the same factors are responsible for differences between rural and urban populations, in addition to selective migration, level of physical activity, etc. Moreover the secular trend may be almost in part explainable in the context of deep social and economic changes (as some of the traits we considered showed) and would be a consequence of the elimination of factors that delay the growth and maturity.

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