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# Age at Menarche And Its Prediction In the Well-Off Northwest Indian Girls

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ABSTRACT The median age at menarche in well-off Northwest Indian girls from Chandigarh, 12.62 SD 1.02 years and its mean age 12.50 SD 1.15 years in a subsample (girls who were negative at the first and positive at the second examination) agree well with other Indian reports of menarcheal age in high socio-economic group. But, this is lower than that of the London girls (13.00 years). Factors that control age at menarche are many. The cause for this low median age at menarche in the well-off Northwest Indian girls appears to be their advanced tempo of skeletal maturation. On the basis of RUS bone age, the median age at menarche is 13.72 SD 1.02 years RUSBA and the mean age of the subsample is 13.14 SD 0.96 Years RUSBA. The prediction equation of age at menarche for Northwest Indian girls employing RUS bone age and the chronological age (BA-CA) is as under:

Age at menarche = 14.437 + (-.746) (BA-CA) RSD 1.113 years.

## INTRODUCTION

Menarche - the first menstruation, is a well defined milestone that denotes the functional development of the female reproductive system, although a few initial cycles are anovulatory. It is a clear indication of puberty and much of the adolescent growth spurt has already passed by the time of its onset. Keeping in view its biological and clinical significance, the present study reports the age at menarche in the well-off N.W. Indian girls and the method of its prediction.

## SUBJECTS AND METHODS

The sample for this study consisted of 473 girls ranging in age from 8 to 16 years, who were attending high fee paying public schools preferred by the well-off section of Chandigarh population. Using the statusquo method, every girl was asked to state whether she had experienced menstruation. Those who did not understand were explained in detail and answers in the form of 'Yes' and 'No' were recorded for every respon dent with a clear understanding of the confider tiality of the response. While the chronologi ages (dates of birth) of all the respondents wer correctly known and were also verified from th school records and the parents, their RUS bor ages were determined from the standard han wrist radio-graphs taken the same day accordir to the TW2 method (Tanner et al., 1975).

The frequency of positive responses was cla sified according to both chronological and bo ages into age groups such that gave whole ye as the mid point, *e.g.* 5.5 to 6.49 and 6.5 to 7. and so on. The median ages at menarche acco ing to both chronological and RUS bone ag were calculated using the maximum likeliho method of Probit analysis (Finney, 1962). T mean age at menarche of a subsample of gi whose response was negative but became p itive after a lapse of about a year, was also c culated by adding half of the time inter between the two responses to the age at f response.

## PREDICTION

Prediction equation between the independent variable BA-CA i.e. the difference between RUS bone age and the respective chronological age and the dependent variable CA (chronological age) was evolved using the linear regression equation $Y = a+bx$, where 'Y' is predicted age at menarche, 'x' is the difference between bone age and chronological age (BA-CA) and 'a' and 'b' are the regression coefficients.

## RESULTS AND DISCUSSION

The youngest girl who experienced menstruation was 9.85 years old. Her radius, ulna and the short bone age (RUSBA) was 11.25 years. The oldest girl who had not experienced menstruation was 15.75 years old and her bone age was 13.64 years, indicating that skeletal maturity advancement/retardation affected the onset of menarche.

The median chronological age at menarche (Table 1) calculated by probit analysis was 12.62 years with a standard deviation of 1.02 years. According to RUS bone age, the oldest girl who had not started menstruating was 15.53 years old, who was chronologically 15.4 years old. The median RUSBA at menarche 13.72 SD 1.02 years, was advanced by 1.1 years compared to CA median age.

**Table 1: Age at menarche in the well-off N.W. girls**

| *Years* | *Chronological age* | | | *RUS bone age* | | |
|---|---|---|---|---|---|---|
| Median | 12.62 | SD | 1.02 | 13.72 | SD | 1.02 |
| Mean | 12.50 | SD | 1.15 | 13.14 | SD | 0.96 |

Further, the mean ages at menarche on chronological as well as RUS bone age bases were 12.50 SD 1.15 years and 13.14 SD 0.96 years respectively. These are very close to the calculated median ages especially on CA basis and the difference of about 0.6 years RUSBA found between the median and mean bone ages at menarche seems to be due to the faster tempo of RUS bone age in these subjects as it is approximately equal to the SD of the mean RUS bone age advance in these subjects between the two occasions.

A recent report on the age at menarche in the higher socio-economic group (Singh and Malhotra, 1986) carried out in the same region (Patiala, Punjab) also gave similar median CA ($12.54 \pm 0.13$ years, but lower than 13.21 years reported by the I.C.M.R. (1984) for their class I category.

Apart from the direct hormonal influences, the factors that control and regulate the age at menarche in adolescent girls are numerous (Johnston, 1974), and the correlation between other developmental parameters and menarche are found to be high and positive (Nicolson and Hanley, 1958).

Associations between body physique and age at menarche have also been reported. Generally, obese adolescent girls are found to be early matuerers (Hammer et al., 1972). It may be mentioned that Chandigarh girls had larger mean skinfolds and also were skeletally more advanced compared to their British age peers (Pathmanathan, 1989). In the latter, median age at menarche is reported to be $13.0 \pm 0.3$ years CA (Tanner, 1973). There are, of course, many other factors that are known to cause variations in age at menarche. Role of these factors has been discussed in detail by several workers (Johnston, 1974; Roberts, 1969; Eveleth and Tanner, 1976; Roberts, et al., 1977).

Therefore, the age at menarche may be affected by a set of factors which may be selective in their action in different populations. Eveleth and Tanner (1976) pointed out that the Northwest -Southeast European difference is mainly genetic in nature. And it is perhaps not a mere coincidence that the age at menarche in urban Sri Lankan Tamil girls, from Jaffna, the ancestors of whom had migrated from Tamil speaking areas of South India about 2000 years ago, was very close to that of urban Madras girls (Prakash and Pathmanathan 1984).

It is interesting that within India also regional

/ethnic differences in the age at menarche have been reported (I.C.M.R., 1984; Roberts et al., 1977; Ghai, 1977). How much of this variation is really due to ethnic and not due to nutritional/socio-economic factors is not clear. However, the age at menarche reported by Ghai (1977) as 12.44 ± 0.11 for hill Rajput girls of Kulu is less than reported for several Indian populations, including the one in the present study. But, the menarchael age for public school girls of Chandigarh (high socio-economic group) was found to be 12.65 SD 1.69 years (Talwar et al., 1987).

The well known phenomanon of children achieving greater size and maturing earlier - the secular trend in the age at menarche (Tanner, 1973) may be occuring in India too, as Singh and Malhotra (1988) have shown that median age at menarche reduced from 12.90 ± 0.64 years (in 1974) to 12.54 ± 0.13 years (in 1986) in girls of upper socio-economic group at Patiala, Punjab - a town not far from Chandigarh.

In the present study, the chronological median age at menarche 12.62 SD 1.02 years is lower than that of the British girls' 13.00 ± 0.3 years (Tanner, 1973). Although the role of climate in altering the age at menarche was proposed in older reports (Ellis, 1950; Wilson and Sutherland, 1950, 1953), according to Roberts (1969) it was a minor influence. However, the slightly lower age at menarche, in the present sample, compared to the London one is due to the comparatively advanced tempo in skeletal maturation in the well-off N.W. Indian girls, which in turn might be influenced by the tropical/subtropical climate in N.W. India (Pathmanathan, 1989; Prakash and Pathmanathan, 1991).

## PREDICTION OF AGE AT MENARCHE

In a number of clinical and social situations it becomes necessary and desirable to predict the age at menarche for treatment and reassurance. Prediction of age at menarche achieves greater accuracy when skeletal age is also incorporated with chronological age (Marshall, 1974).

Thus, in order to improve the prediction of age at menarche by incorporating bone age, assuming that "age at menarche, in girls with any given value of (BA-CA), had a gaussian distribution about the regression line, with a mean represented by the corresponding age on the vertical axis and a standard deviation equal to the residual standard deviation about the regression" (Marshall and de Limongi, 1976), a simple regression of age at menarche on RUS bone age minus chronological age (BA-CA) was computed for the present sample which is represented in figure 1.

In the present data, the negative and high correlation between the BA-CA and age at menarche is expected (observed value : r = -0.545, $p<0.001$). The regression coefficient 'b' of Y (age at menarche) on X(BA- CA) is -0.746 ± 0.11 and the constant 'a' is 14.437. Therefore, the equation derived from the regression becomes, age at menarche = 14.437 + (-0.746) (BA-CA) RSD 1.113 years.

With reference to this prediction equation (Fig. 1) if the BA-CA of a girl is -1 year then her probable age of menarche is 15.2 years. However, ± 2 RSD range lies between 17.35 and 12.95 years. Thus, a girl who was negative at CA 11.35 years with BA-CA = + 2.05 years at that time (A in figure 1) would start menstruating at any time as she is within the ±2 RSD limits for her BA-CA category. Her predicted age at menarche is 12.92 years (A'). She was positive when she was 12.09 years old. The time lapse between the two examinations was 0.742 years. Since the exact age when she had her first menstruation could not be known, her most probable age at menarche was 11.35 + 0.742/2 = 11.70 years (A"), i.e. at -1 RSD range.

The BA-CA of girl B at the time of first examination was -1.774 years. And her chronological age was 14.534 years. She also would start menstruating at any time as she is only slightly below -1 RSD, like the girl A. Her predicted age at menarche is 15.8 years B'. She was positive at the second examination when her chronological age was 15.263 years. Thus her probable age at menarche was 14.534 +0.742/2 = 14.9 years (B") i.e. slightly above the -1 RSD range.

Girl C whose BA-CA was -2.1 years at her

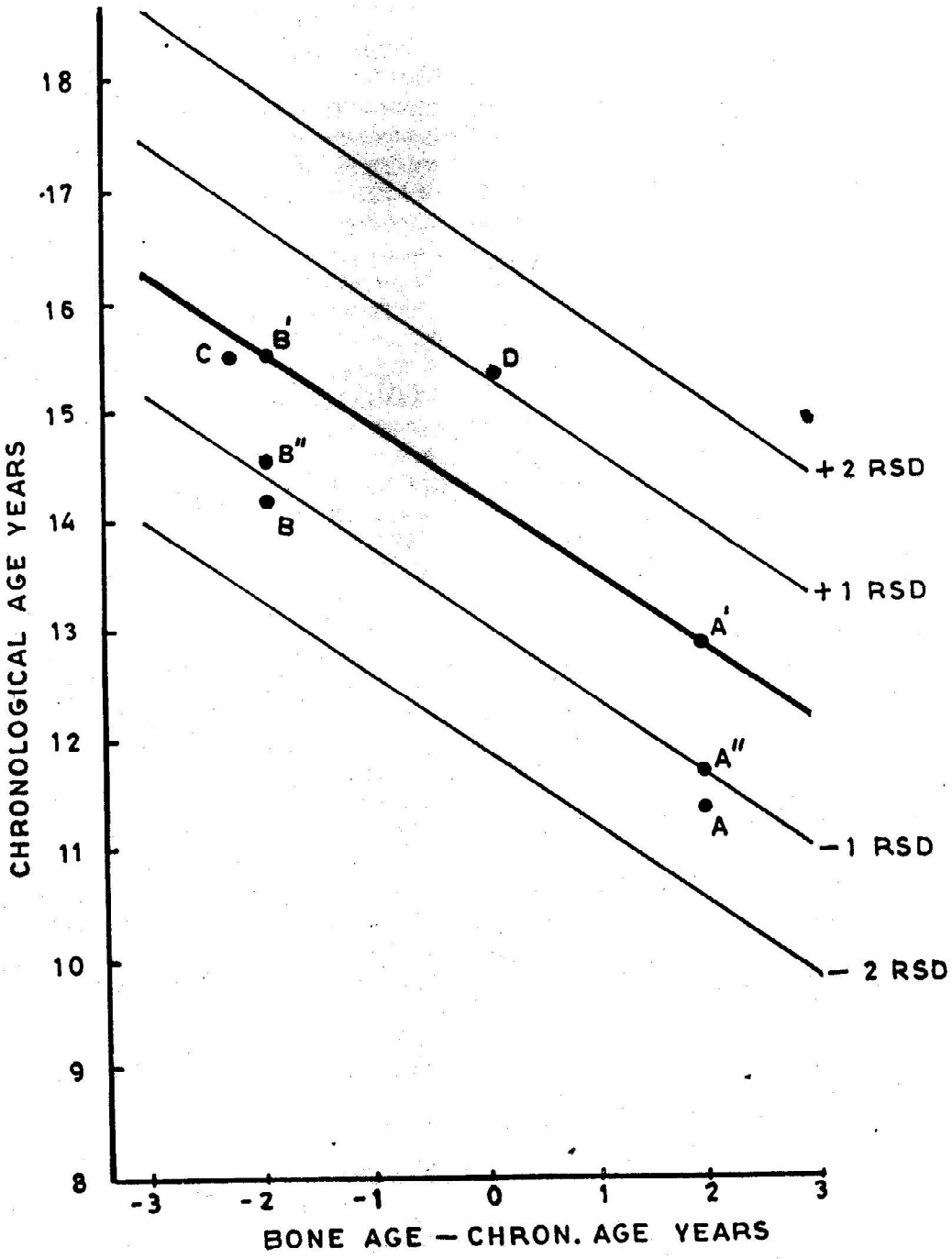


Fig.1. Regression (with residual standard deviations) of age at menarche on (BA-CA)

chronological age 15.75 years and was negative, would probably have started menstruating at 16 years.

Girl D, whose BA-CA was + 0.2 years, was chronologically 15.5 years old, i.e. above + 1 RSD limit. She would have started menstruating at any time thereafter but before she would have crossed 16.45 years (upper limit for her BA-CA category).

In the light of the discussion and the evidence presented here it is hoped that the prediction equation for the age at menarche in the NW Indian girls will be gainfully utilised by the gynaecologists and the research workers in the field of female adolescentology.

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