

## Mean Age of Menarche in Trinidad and Its Relationship to Body Mass Index, Ethnicity and Mothers Age of Menarche

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**Abstract:** Menarche is the first menstrual period. It is the final event in the physical manifestation of gonadal development. A study in Europe found that the median age of menarche was 12 years and 11 months and that by the tenth year, 0.8% of the girls had their first menses, while the figure for the eleventh and twelfth years were 3.6 and 21.7% respectively. A Geneva study found that menarche was present in 50% at the age of 12.75 years. This study reported that, in the periods 1955-1980, the age of puberty has decreased by 0.5%, while the decrease between the periods 1965-1980 was 0.25%. Studies in the 70s and 80s found that African American girls were taller, heavier and maturing earlier than white girls of their age. Early menarche was observed in some of the girls by the age of 11 years, while all the girls were menstruating at the age of 15 years. Precocious puberty was defined as puberty before the age of eight years, while delayed puberty was defined as the absence of breast budding before the age of 14. However some pediatricians have concluded that the onset of breast development before the ages 7-8 years in white girls and between the ages of 6-7 years in African American girls may be part of the normal variation in the timing of puberty. It had been suspected that the decrease in the age of puberty is due to improved standard of living. However endocrine-disrupting chemicals from environmental pollutants are now seriously implicated as major factors in early puberty, while the ethnic factor has also been recognized. In this study, 489 students aged 15-17 selected from secondary schools from different areas of Trinidad were used. The data was collected through a questionnaire and the primary variable measured was the age of onset of menses. It also contained information on the ethnicity of the respondents. The heights and weights of the students were also measured. Results showed that, the mean age of menarche for Trinidadian girls was 11.71 years  $\pm$ 1.18. It also showed that the mean age for Blacks was 11.67 $\pm$ 1.29, while that of Indians was 11.65 $\pm$ 1.08. The mixed races' mean, was 11.87 $\pm$ 1.09. No significant difference was found in the mean age of menarche between Blacks and East Indians. The result also showed a decrease in the age of menarche with increased BMI. The mean age of menarche of the mothers of the students sampled was 12.57 years, which is significantly higher than that of their daughters. This is consistent with recent findings, which reported that the mean age of menarche has been decreasing over the years in all societies.

**Key words:** Mean age of menarche in Trinidad and Tobago

### INTRODUCTION

Menarche is the final event in a developmental process called puberty, which is a physical manifestation of the hormonal changes in the hypothalamic-pituitary-gonadal axis. The hypothalamic-pituitary-gonadal axis is minimally stimulated by placental hormones during fetogenesis. The effect of this stimulation is minimally manifested during infancy. After this period of mild gonadotropic

hormone releasing hormone (GnRH) secretion in fancy, the reproductive axis usually enters into a period of relative, but not absolute quiescence, until late childhood, when pubertal maturation occurs<sup>[1]</sup>. Increase in pulsatile release of GnRH is essential for the onset of puberty. Recent studies suggest that during the pre-pubertal period, an inhibitory neuronal system suppresses the release of GnRH and that during the subsequent maturation of the hypothalamus, this prepubertal inhibition of the hypothalamus is removed,

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allowing the adult pattern of pulsatile release of GnRH. It is suspected that gamma-amino butyric acid (GABA) is the neurotransmitter responsible for inhibiting GnRH release before puberty<sup>[2,3]</sup>.

The age of menarche has been decreasing over decades in all races. A study in the United States (US) showed that the mean age of menarche has decreased from 12.75 to 12.54 years within the period of 25 years, and that black girls had a lower mean age of menarche than white girls<sup>[4,5]</sup>. In a different study, it was reported that by the 11<sup>th</sup> year of age 28% of African American girls had had their menarche while only 13% of white Americans had had their first menses. It was also reported that by the age of 12, 68% of African American girls, and 35% of their white counterparts have had their menarche<sup>[6]</sup>. A similar study in Britain showed that the mean age of menarche was 12 years 11 months<sup>[7]</sup>, while another study in the Netherlands showed that between 1985 and 1997, the mean age of puberty has decreased from 11 years to 10.7 years<sup>[8]</sup>. Precocious puberty is defined as the onset of pubertal development before the age of eight<sup>[7,8,9-12]</sup>. The incidence of precocious puberty is higher in certain ethnic groups and some cases may be familial. The familial group is characterized by a significantly lower maternal age at menarche<sup>[13]</sup>. Children who migrated from developing countries to Sweden, Netherlands, France, Italy and Belgium, had early puberty<sup>[14-18]</sup>.

Improved nutrition has been implicated as one of the causes of earlier puberty among immigrants to industrialized countries. However the very high incidence of premature thelarche in Puerto Rican girls has now been associated with endocrine disrupting chemicals, found in pesticides and plastics. These chemicals are reported to possess oestrogenic and antiandrogenic activities<sup>[19]</sup>. The estimated incidence of premature thelarche in Puerto Rican girls was found to be 18.5 times higher than the average. In these girls significantly high levels of phthalates and their major metabolites were identified in 68% of patients with premature thelarche, while less than 1% of controls had high levels of these chemicals<sup>[20]</sup>. The evidence of environmental chemicals as chemical disrupting agents has been reported<sup>[21]</sup>, while the effect of estrogenic agents on pubertal growth and maturation of the reproductive system has been reported in rhesus monkeys<sup>[22]</sup>. Endocrine-disrupting chemicals from the environment are now recognized as one of the causes of reduced age of menarche in girls migrating to industrialized countries<sup>[23]</sup>.

Obese girls, irrespective of their ethnic origin, have earlier age of puberty than control girls<sup>[4,24-26]</sup> and at a given age, taller and heavier girls have a higher

probability of having menarche than do short and thin girls. This has been associated with increased levels of leptin in obese children. It has been reported that chronic elevation in peripheral concentrations of leptin increased serum levels of both daytime and nighttime bioactive leutinizing hormone (LH), at a significantly younger age, than in control females. The earlier rise in LH in leptin-treated females was associated with an earlier increase serum oestradiol and occurrence of menarche. This demonstrated that chronic elevation in serum leptin concentration advances the nocturnal increase in serum LH as well as other parameters of female puberty<sup>[27]</sup>. It was also reported that body weight exceeding 60 kg or a BMI of >20 kg has no or little effect on menarche<sup>[8]</sup>. However, it has been recently reported that girls with early menarche, tended to have higher BMI than girls with average or later menarche. It was therefore suggested that increases in relative weight are consequent, rather than determinant of the age of menarche<sup>[28]</sup>.

The mean age of onset of menarche is clinically important because it establishes the baseline for determination of precocious and delayed puberty, both of which could result from a pathology in the hypothalamic-pituitary-gonadal axis. Precocious puberty had been defined as the onset of menarche before the age of eight years, while delayed puberty was defined as the onset of menarche after thirteen years of age<sup>[8]</sup>. However it is now recognized that the transition from childhood to reproductive competency of adulthood occurs across a wide range of ages in normal, healthy adolescents<sup>[1]</sup>. The mean ages of menarche in various population groups have been reported<sup>[29,30]</sup>.

The mean age of menarche for US girls has decreased from 12.75 years to 12.54 years within the last twenty five years<sup>[4,5]</sup>, while the present mean age of menarche for most European girls is about 12.9 years<sup>[29,30]</sup>.

A similar study on the mean age of menarche between 1965 and 1985 in Indians showed that the mean age of menarche was 12.9 years in Madras and 12.5 years in Punjab. The same study found that the mean of menarche for African girls in Somalia was 13.1 years, and that of Nigeria was 13.3 years<sup>[29,30]</sup>. In the same study the figures for USA (all areas), was 12.8 years, North-East England 13.4 years, London 13.0 years, Paris 13.0 years, and Sydney 13.0 years. This shows that, while the mean age of menarche of Africans girls was similar to European girls, Indian girls have slightly lower mean age of menarche, when compared with Caucasians. The same study also found that the mean age of menarche for European descendants in

USA was 12.8 years while that of African descendant's was 12.5 years, suggesting a general decrease in the age of menarche among descendants to the USA. It is therefore suggestive that the decrease could not be due to improved nutrition only, as had been suspected<sup>[29,30]</sup>.

The values used to determine the mean age of menarche in Trinidad are based on the studies done in the United States of America. However the ethnic make-up of the two countries is not similar.

The aim of this investigation was to establish a database for the mean age of menarche in Trinidad. It is hoped that this will be a step towards establishing a database for the Caribbean region.

## MATERIALS AND METHODS

**Data collection:** Data was collected from the female population aged 14-17 years through cluster sampling of schools according to geographical location, incorporating stratified random selection. Random table selection was used to select the secondary schools used for this study. These geographical zones were allocated by the Ministry of Education, covering the whole country. In order to obtain the age range for the study (14-17 years), students in forms 4 and 5 were used. A minimum of 50 students participated from each school. The study was reviewed and approved by the Ethics Committee of the Faculty of Medical Sciences, The University of the West Indies, Saint Augustine Campus.

Data was collected through a questionnaire, distributed to the participants of the study. The primary variable measured was the age of onset of menses. The age of onset of menarche was approximated to the nearest year. Other variables collected were ethnicity, and BMI. The mothers of the participants were also included in the study.

The questionnaire was conceived de novo and was pre-tested. Sensitive and personal issues were carefully considered. Another questionnaire was designed for the mothers who participated in the study. The students completed their questionnaires and returned them the same day while their mothers were returned a week later. The completed questionnaires from the students were treated confidentially. Parents, teachers, and other students were not allowed access to the information contained in each completed questionnaire. Standardization of height measurement was done using the specifications of World Health Organization (31). Test measurements were taken by two individuals, and a coefficient of 0.5 cm was found between them. Standardization of measurement of weight was done using two electronic scales.

**Analysis of data:** The sample size utilized, based on the primary question of this study, was determined using a method for a descriptive study with a continuous variable. A confidence level of 95% was set using a confidence interval of 0.5 years. The standard deviation (2.837) was obtained from a previous study of similar objective. The type 1 error ( $\alpha = 0.05$ ), was used in the calculation of the initial sample size. The sample size was then calculated as 447. The sample fraction was calculated as 0.2465%; therefore no correction factor was required. The sample size was rounded up to 500 subjects.

Analysis of BMI was done by grouping the students according to international standards. Those whose BMI was less than 20, those between 20 and less than 25, those between 25 and less than 30 and those greater than 30. Designations such as underweight, normal weight, overweight and obese were not used.

The data obtained from the questionnaire were imputed into Epi Info (CDC Atlanta version 6.04) and analyzed by the SPSS programme. The age of menarche was averaged for all girls who had their menses giving a mean age for onset of menses. Relationships between age at menarche and ethnicity, BMI, and mothers mean age of menarche were sought. An ANOVA table was generated which utilized t-test and F test (more than two variables). This gave a p value for the variables studied. Where the F test revealed a significant difference between groups a post hoc (ph) evaluation followed. This included a Tukey HSD to designate which variables were significantly different.

## RESULTS AND DISCUSSION

The sample size of this experiment was 500 and the response rate was 96%. Four of the girls had not had their first menses at the time, while two of them refused to answer the questions. Thus the mean age of menarche was calculated for 495 girls who participated in the exercise. Of this number, 212, representing 42.30%, were of African origin, 174, representing 34.7%, were East Indians. Ninety nine of the respondents, representing 19.80%, were classified as mixed, while three were Asians, and one was Caucasian. Six of the respondents, did not know their ethnic origin.

The mean age of menarche for all girls sampled was 11.71 years  $\pm 1.18$  (Table 1).

There were no significant differences, between the mean ages of menarche for Blacks (11.67,  $\pm 1.29$ ), East Indians (11.63,  $\pm 1.08$ ) and mixed (11.87,  $\pm 1.09$ ) races ( $p = 0.597$ ). The sample sizes of Asian and Whites were

Table1: Mean age of menarche by ethnic group

Ethnicity	Mean age of menarche (years)	O. of participants (N)
Blacks	11.67	212
East Indian	11.65	174
Mixed	11.87	99
Asians	12.00	3
White	12.00	1

Mean value not significant at  $p < 0.0597$

Table 2: Mean age at Menarche by BMI

BMI	Mean age at Menarche (years)	Number	Percentage (%)
<20	11.97	233	48.84
20.00-24.99	1.54	183	37.58
25.00-29.99	11.35	52	10.68
>30.00	11.42	19	3.90

Mean value is significant at  $p < 0.001$

very small when compared with Blacks and East Indians sampled (Table 1).

A significant difference was found between BMI groups ( $p < 0.000$ ). Eight girls refused to take weight and height measurements which were required to calculate BMI. The result showed that the age of menarche decreased up to the BMI of 30, but tended to increase after that value (Table 2).

The mothers who responded to the questionnaire were 67 in number (13.4%). The mean age of menarche for the mothers was 12.57 years. The mean age of menarche for the girls and mothers were compared using a paired t-test. There was significant difference between the mean age of menarche for the mothers (12.57 years) and the girls (11.71) years ( $p < 0.000$ ).

In this study the mean age of menarche for Trinidadian girls was found to be 11.71 years. It is clear from these figures that the mean age of menarche of Trinidadian girls is lower than those of US and European girls. It will therefore be inaccurate to use the US and European standards in Trinidad.

It was also found that the mean age of menarche of girls of African descent was 11.67 years while that of girls of East Indian descent was 11.65 years. Genetic influence has been reported to have a major contribution on age at menarche<sup>[32]</sup>. It has been recently reported that age of onset of menarche has strong genetic influence, and that menarche was seven months earlier in girls with AA genotype with estrogen receptor alpha (ER alpha), but occurred eleven months later in girls with combined ER alpha, ER beta genotype<sup>[33]</sup>. The decline in the age at menarche in US girls has been attributed to increase in childhood obesity. It was reported that girls with early menarche tended to have significantly higher BMI than girls with average or later menarche. It was however, also noted that these differences did not emerge until after menarche. It was therefore suggested that increases in relative weight are a consequent, rather than determinant of the age at

menarche, and that secular changes in BMI and in the mean age at menarche, could be independent phenomenon<sup>[28]</sup>. In this investigation it was also found that the BMI of the girls was related to the age of onset of menarche (Table 2). This is consistent with findings which reported that BMI is a contributing factor in the age of onset of puberty<sup>[1,8,24-26]</sup>

It was also found that the mean age of menarche for mothers was higher (12.57 vs. 11.71 years) than that of their daughters, a further manifestation of the decline of the age of menarche over the years. In the US, the average age at menarche was reported to have declined from 12.53 years to 12.34 years over a ten year period<sup>[34]</sup>. It had been suspected that the decline in the age of menarche over the years was due to improved standard of living. However recent studies have implicated endocrine disrupting chemicals in the environment as being responsible for this trend<sup>[19,21-23]</sup>. Girls with high levels of lead in their blood had delayed menarche in US while exposure to dichlorodiphenyl trichloroethane (DDT), has been reported to decrease the age of menarche<sup>[35-36]</sup>.

From this investigation, we established that the mean age of menarche in Trinidad is 11.71 years  $\pm$  1.18. We also established that the mean age was not significantly different between Blacks and East Indians (11.67,  $\pm$ 1.29 vs. 11.65,  $\pm$ 1.08). This should form the baseline for further studies, involving larger groups, and possibly involving more Caribbean countries.

## CONCLUSION

The result of this experiment shows that the mean age of menarche in Trinidad is 11.71  $\pm$  1.18. It also showed that the mean age for black Trinidadians (11.67  $\pm$  1.29) was not statistically significant with that of Indo Trinidadians (11.65  $\pm$  1.08). The result also showed that girls who reached menarche at younger ages had higher BMI. It further confirmed that the mean age of menarche has been decreasing over the years.

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