AGE AT MENARCHE AND SEXUAL MASTURBATION

IN KHARTOUM SCHOOL GIRLS

1978

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AGE AT MENARCHE AND SEXUAL MATURATION IN EHAUROH

1. INTRODUCTION

2a. Problem

A great deal of work had been carried all over the world to estimate the menarcheal age in different nations. Menarche is an important index in evaluating sexual maturity, for this reason much have been written to analyze the factors which triggered the onset of menstruation in a pubertal girl. Many hypothesis had been put forward to explain the relationship of other parameters of growth like increase in body weight, height and appearance of secondary sex characteristics to menarche.

In a developing country like Sudan, it is true that now we should be involved and dealing with acute problems such as malnutrition infectious diseases, epidemics and poverty - limiting endemic diseases, we are by no means excused to lag behind the tremendous advances in science and medicine that exist in the
advanced parts of the world. For this reason I did my thesis to study sexual maturation in a group of Sudanese girls. This is the first study of its kind in estimating menarcheal age in Sudanese girls, using this particular methodology. A former attempt had been done by 9th year medical students in year 1975(1) and 1976(2)

1.2 Objectives of the study

1.2.1 To estimate the average first menarche.

1.2.2 To study sequence of events in sexual maturation as evidenced by the appearance of secondary sex characters.

1.2.3 To study morphologic changes at menarche in respect to height, weight, breast development, pubic and axillary hair.

1.2.4 To provide a reference data about menarcheal age in Sudanese girls that can help pediatricians, gynecologists, gynecologists, sociologists and others who deal with human biology in order to help in:

- diagnosis of precocious puberty.
- Diagnosis of delayed puberty.
DEFINITION OF MENARCHE

Menarche is the first menstrual flow which begins at any time during the period of transition (puberty and adolescence) from childhood to maturity. It is preceded by sequence of events both somatic and psychic, namely the appearance of secondary sex characters, the growth spurt and behavioral changes which take place later in childhood and puberty occasionally as early as 9 years and often as late as 17 years (3) depending upon genetic and environmental factors. There is usually spurt of physical growth that precede menarche the period at maximum body growth immediately precede first menstruation and that growth is virtually complete in from 1 - 3 years after the onset of menarche (3).
The first menstrual flow is one of the many manifestations of puberty and adolescence in the female. It marks the onset of gonadotropic stimulating function of the hypothalamus, shows the beginning of the stabilization of the pituitary ovarian–uterine mechanism, and signals the closing down of the pre-adolescent spurt of growth that has been in progress. (4)

The pituitary–ovarian–uterine function which is reflected in the estrogens and androgens begins from 3–7 years, at about 7 the excretion gradually rises until adolescence supervenes at this time excretion rises very sharply and begins to be cyclic. Estrogen cycles are then established.

It occurs at about the time the breast buds appear and the spurt in height begins the values reached during the cycles increases until some years after menarche (3). However at menarche there is a good correlation between bone age, stages of breast and pubic hair development and steroid hormone level (3).
At puberty, adolescence and menarche, there is increase in growth spurt which is reflected upon height, weight, change of the contour of the pelvis, enlargement of the breasts, thyroid and appearance of secondary sex characters such as pubic and axillary hair.

Girls with early menarche tend to have shorter stature as adults (3). It is found that in all socio-economic groups the girls who had earlier menarche had a greater growth in stature and its component segment (sitting height and lower limb length) and had earlier and faster deceleration of growth and consequently earlier completion of growth than the girls who had later menarche (5). The practical value of prediction of adult height from age at menarche is to treat the very tall girls who are under the effect of excessive growth hormone and somatomedin. Earlier views that the cessation of growth under oestrogen is due to early epiphyseal closure have been shown to be wrong and it was shown to be due to somatomedin.
1.5.2
WEIGHT

Associated with menarche is also an increase in body weight. This phenomenon has been studied by Frich et al and a hypothesis was postulated known as Frich – Revelle Model. This model held that menarche in an individual girl is triggered by a change in metabolic rate brought about by reaching a critical body weight of 47 – 48 Kg (104 lb – 106 lb). However this critical body weight is different for different races.(7)

1.5.3
BREAST BUDS PUBIC HAIR

There is almost fixed relationship between menarche and other apparent morphologic alterations of puberty i.e. the breast buds and the initial crop of pubic hair which are as a rule the first distinctive signs of puberty in the female, make their appearances 2 – 3 years before menarche (3). Actual enlargement of breasts and growth of pelvis including fat pad that alter the contour of the hips occur about one year later. The first appearance of pubic hair precedes by a year or more (3). It becomes more deeply pigmented and coarser throughout adolescence and into
adult life. In approximately 10% of normal girls, pubic hair present before significant hypertrophy of the breast. Initial growth of axillary hair may follow menarche or occur before it. (3)

**FACTORS AFFECTING MENARCHE**

1. **GENETIC FACTORS**

   The genetic factor in growth and sexual development is extremely important but not clearly understood (3). There are definite familial tendencies to early or late onset of adolescence. It is found that there is a fairly high correlation between the times of menarche of mothers and daughters (3), also between sisters, and a very high correlation between identical twins, about 2 months difference in menarcheal age, while among non-identical twins and sisters in 12 months and 12 months and 12.5 months respectively (3). These differences and the fact that distribution of age at menarche in a population is of a Gaussian type that time of menarche is to a considerable extent under hereditary control and depends on action of genes at different loci rather than on any
single allele.

By analogy with other multifactorial characters, it is found that in a population of relatively homogeneous make up like Latin Americans the menar
cenal age is uniform (3).

1.6.2

SOCIOECONOMIC FACTORS

Children from different socioeconomic levels differ in average body size at all ages that have been investigated, the upper groups being always more advanced along the course to maturity (1).

There is almost a general agreement in all studies carried in this field in different nations and races that the social status of the family affect the onset of menarche; being earlier in the upper social class and well to do families.

1.6.3

OTHER FACTORS

Many other factors also affect the onset of menarche, such as diet and nutrition these girls who are well fed will have earlier menarche. Specifically race, climate, geography and one of maternal menarche seem to have minor influence. Malnutrition chronic
and uncontrolled disease, obesity and blindness all tend to delay the appearance of puberty (6).

1.7 CURRENT METHODS IN USE TO ESTIMATE
THE MENARCHEAL AGE (10)

To estimate the age at menarche three methods can be applied:

1.5 PROSPECTIVE METHOD

In which a cohort is followed from a fully pre-menarche state to a fully post-menarche state - a longitudinal programme needing at least 6 years, because of the inherent difficulties this method is the least followed.

1.7.2 The retrospective or recall method requires a cross-section of girls or women to recall the date of onset from which an average is found. This procedure as pointed out by previous writers is error-prone on at least two accounts. The first source lies in inaccuracies of recall. The second comes from an in-built bias which is likely to result in under-
estimating the true mean if the sample contains a proportion of girls who have not reached menarche at the time of enquiry. The former point is recognised in the "rounding off" phenomenon (10), and the latter has been demonstrated empirically by Cottle and Higginson (1961) and Tanner (1962) recommend that the retrospective method be used only when the entire sample has attained menarche before interview.

Further a correction factor for inaccurate memory in older girls and women of plus 0.5 year is suggested by comparison studies. This method was first used in Sudan by 5th year medical students "1, 2". Also part of this thesis is done by this method.

1:7:3 The currently most widely employed and recommended procedure is the status quo method using a probit analysis. It requires a cross-section of girls aged ideal 9 to 17 years, and calls only for subjects' present age and sex. No status as regards onset of menstruation at the time of interview. The rationale is detailed in Finney, but summarized by Cottle and Higginson as follows:
Probit analysis assumes a normal distribution of the population from which the different age samples have been drawn, but calculates the sigmoid accumulative frequency curve from the values of these age samples and transforms this curve into straight line by means of probits. The mean of this distribution corresponds to age at which 50 percent of the girls have attained menarche in the present population not in the sample probit analysis thus avoids the distortion introduced by selection of age groups and estimates the population mean. The standard deviation is the standard deviation of the present normal distribution and is the reciprocal of the slope of the probit line.
CHAPTER II MATERIAL AND METHODS
2.1 LOCATION

This study was carried in Khartoum School Girls in the year 1973. Owing to the fact that there is a limited fund and facilities for this research, I chose Khartoum town only where a group of schools was selected as a clustered sample.

2.2.1 SAMPLE

The sample consisted of 1612 girls age group 9 - 17 years. The sample was drawn from 5 schools, 4 of these schools were elementary, and the 5th school was a secondary school. Each of the elementary school comprise 6 forms where age varies between 6 to 17 years. All children below 8 years were excluded. All the girls in the four elementary schools were included in the study except those pupils who were below 8 years of age or those who did not have a birth certificate or those who were absent that day. In order to cover the higher age groups one form in a secondary school in the same areas was included in the study.
2.2.2 The age at menarche using retrospective method was carried. A sample of 200 females age 17 - 35 years in Khartoum Civil Hospital, who were lady doctors, high school nursing college student and medical students. Each individual was just asked to give the age when she had had the first period.

2.3 QUESTIONNAIRE AND CONDUCT OF SURVEY

A questionnaire form "A" about the exact date of birth (days/month/year) the income of the father and/or mother and the number of the household was written in simple Arabic language and sent to the parents through their daughter. Another Form "B" including informations about school form, the birth date, the socioeconomic status of the parents, whether they are alive or dead, general examination and specific question whether menarche has started or not. This form was filled by the working team, which was consisted of two female doctors and the writer. Usually in the first visit a meeting was held with the staff, to explain to them the objectives of the study and if possible to help and co-operate with the
team, Form A was then given to be distributed to any one class according to the time table. The teacher usually explains to the pupils what is exactly wanted and asks them to bring the filled forms the following day. Having collected these forms, the work was usually started at 8:00 a.m. and finished at 1:30 p.m. Each day about 50 girls were examined. This estimated number of girls examined per day was obtained from a pilot study using 50 girls in an intermediate school whose data was not included in the final analysis.

EQUIPMENTS & MEASUREMENTS

Height and skin thickness was measured by the same doctor all through the survey, while weight recording was taken by the other doctor.

2.4.1 HEIGHT

Height was measured in cm. without shoes. The measuring scale micrometer was fixed to the wall. The sliding headpiece at right angles to the wall which
was then lowered onto the girl's head. The position of the girl was made to be as erect as possible with shoulders, buttocks, and heels touching the wall. The girl was looking straight forward and with the neck stretched. Hair style which would give increase height was re-modeled.

2.4.2 WEIGHT

A checked beam - balance type of scale was used. It has two scales; one is to be fixed, the other is movable. It records in kilograms. The girls were weighed with clothes, but without shoes.

2.4.3 SKIN THICKNESS

The skin fold thickness is measured with the Harpenden skinfold caliper. It has a spring that exports a practically constant tension of 10 gm/mm.
Jaw surface over the measuring range 2 - 40 mm.

The skin over the triceps muscle (mid way between acromial and olecranon processes) is pinched and the caliper is applied. Readings were taken to the nearest 0.1 mm.

2.5 EXAMINATION
GENERAL EXAMINATION

This was regarding general look and fitness of the girl, whether there was asmaus, visible goitre, palpable liver or spleen and the general condition of the heart.

2.5.2 Specific examination of the secondary sex organs, these were include breasts, pubic and axillary hair.

Examination and staging of the breasts were done according to Tanner (1) in which there are five stages started from 0 - 4 stages 0 - pre-adolescent elevation of papilla only.

Stage 1 - bud stage, elevation of breast and papilla as a small round enlargement of areola diameter.
Stage 2 - Further enlargement of breast and areola no separation of their contour.

Stage 3 - Projection of areolar and papilla to form a secondary mound above the level of the breast.

Stage 4 - Mature stage projection of papilla only due to recession of the areola to the general contour of the breast.

The pubic region was examined for the presence or absence of hair. It was during this part of examination that the girl was asked whether she had menstruated or not and if the answer was positive what was the exact date.

Pubic hair was staged according to Tanner 3 but was modified into 3 stages 1, 2, 3. The valve was considered as a triangle with the base towards the inguinal region and apex towards the vagina, which is then divided into 3 portions each portion corresponding to a pubic hair stage.

Stage 1:

Very sparse long downy straight hair spread along both labia, but heavier spread up towards base
Stage II:

Pubic hair become denser and fill both surfaces of labia majora but do not reach the bases of the triangle.

Stage III:

Hair covered both surfaces of vulva extend to the base and give the contour of adult female pubic hair distribution. However these staging is by no means accurate but in a cross-sectional study like this a fairly good idea is obtained. The axillary hair is just recorded whether present or absent.

2.6 COMPUTATIONAL PROCEDURE

Our aim is to estimate the mean age at menarche, first breast bud and pubic hair appearance by probit analysis the computation is as follows:

2.6.1 The first step is to arrange the data into suitable age range. Then each of these take an X value that lies in the middle of its range then.

2.6.2 Find and tabulate (ni) which represents the number of girls in age group i at the time of examination.
2.6.3 Tabulate $r_i$ which represent the number of girls in each group $I$ who had started their period before the examination.

2.6.4 Evaluate the empirical response rate:

$$P_i = \frac{r_i}{n_i}$$

for each $X$.

2.6.5 Obtain the empirical probit of each $P$ from either (Finney 1962 table 1 or Fisher and Yule 1963 Table IX).

2.6.6 Plot the empirical probit against $X$ and draw by eye judgment the regression line.

2.6.7 From the regression read values of $Y$ first approximation to the expected probit at each $X$.

2.6.8 For each $X$ read the weight co-efficient $w_i$ (from either the 2 mentioned tables), multiply by $n_i$ and tabulate.

2.6.9 For each $Y$ and $P$ determine working probit $Y_i$

2.6.10 Form column $mx$ and $my$.

2.6.11 Sum the $mx$ and $my$ for each $x$ and form

$$X = \frac{\sum mx}{\sum m}$$

$$Y = \frac{\sum my}{\sum m}$$
2.6.12 For each \( x \) form \( mx^2 \) and \( mx \), and obtain from the regression \( S_{xx} = \frac{\text{sum}^2}{n} - (\frac{\text{sum}x}{n})^2 \)

\[ S_{yy} = \frac{\text{sum}y^2}{n} - (\frac{\text{sum}y}{n})^2 \]

\[ S_{xy} = \frac{\text{sum}xy}{n} - (\frac{\text{sum}x}{n})(\frac{\text{sum}y}{n}) \]

2.6.13 Find equation \( Y = \bar{Y} + b(x - \bar{x}) \) where \( b = \frac{S_{xy}}{S_{xx}} \)

2.6.14 Select different values of \( x \) and find the corresponding values of \( y \). If the straight line given by these values is not removed from the provisional line, then the computation comes to an end and the estimated median will be

\[ m = \bar{X} + \frac{\bar{Y} - Y}{b} \]
CHAPTER III RESULTS
RESULTS

The data for this study has been grouped into age intervals as shown in Table I. Each of these age groups takes an X value that lies in the middle of its range. Against each X we report the number of girls in that group (n) at the time of examination and the number of girls who had started their period before the examination (r). The statistical analysis starts by finding the proportion (p) of girls who had their period at each age group i.e., \[ p = \frac{r}{n} \]

Calculation proceeds as described in section '2.5'.

3.1 METHODS

Probit analysis yields an estimate median of 13 years 6 months for the age at which a girl may be expected to start her period with 50% chance. This value is arrived at as follows:

\[ X = 167.55 \]

\[ = 13 \text{ years} \quad 11 \text{ month} \]
The regression coefficient $b = 0.0536$

$SE (b) = 0.0136$

The value of $b$ is found to be highly significant at the 1% level ($P < 0.01$). This gives rise to this regression equation:

$$Y = 3.752 + 0.0536 X$$

$$0.0136 t = 3.94 (P < 0.01)$$

To see whether a second cycle of computation is necessary we selected different values of $X$ and substituted them in the regression equation and they give rise to straight line which is not removed from the first line which was drawn by eye and shown in graph No. 1 with SS 1.2 months.

### 3.2 Public Hair

The same technique is applied to the data to find the average age of the first appearance of public hair. The analysis yields an estimate of 12 years 1 month.

For the age of the appearance of first sign of public hair the SS of estimate was found to be 0.0027.

The regression coefficient $b = 0.0463$

$SE (b) = 0.0004$
The value of \( b \) is found to be highly significant

\[ F < 0.01 \]

The regression equation is:

\[ Y = -1.679 + 0.0463 \times (0.0004) \quad (F < 0.01). \]

When we substituted different values of \( X \) in the above equation we obtained a straight line which is not far removed from the first line. This indicates that there is no need for a second cycle of computations. Graph No 3.2.

3.3 **DISCUSSION**

Following the same analysis we arrived at an estimate of 11 years one month for the average appearance with SE of 0.42

\[ b = 0.04 \]

The regression equation

\[ Y = 2.2 + 0.064 \]

\[ SE_b = 0.0039 \]

\( b \) is highly significant \( (F < 0.01) \)

No second cycle of computation is necessary.

The complete set of the results are shown in table (3.2) together with the SE of the estimate.
3.4 HEIGHT AND WEIGHT

An attempt was made to estimate the average height and weight by age from our sample. The result is shown in table (3.3). For this result to have a practical value it was transformed into graphs with the following findings:

3.4.1 As for the height is concerned, the average height for this group (age range 9 - 17 years) lies approximately at 50th percentile of Harvard Standard, as shown in graph No (3.4), tables 3.4, 3.5.

3.4.2 The average weight for the group studied is found to lie closely at the 35th percentile as shown in graph No. (3.5)

3.4.3 The average age at menarche using retrospective method among 1,000 females all above 17 years. The analysis yields 13.0 ± 1.5 years: the data used to find the mean of menarche is shown in table (3.6).
CHAPTER IV DISCUSSION AND CONCLUSION
4.1 \textbf{RESEARCH}

4.2 \textbf{RESULTS}

The average age at menarche among 612 Sudanese School girls was found to be 13.9 ± 0.06 years and a median of 13.6 ± using probit analysis. Since this method is being applied for the first time to estimate menarcheal age in a group of Sudanese girls, comparison to previous existing data is out of the question. However, comparison with other contemporary African data can be done. For example, the average age at menarche in Egypt among three strikingly different socio-economic sectors were estimated by probit analysis as 12.5 ± 0.29 for well-off girls in Cairo, 13.09 ± 0.17 for the middle-class girls in Cairo, 13.69 ± 1.6 for rural agricultural areas. It is clear that the means obtained in this study is quite comparable to the means for the rural agricultural areas in Egypt. While the well-off girls in Cairo have one of the earliest reported means of all populations studied 17. On the other hand, in Nigeria the median age at menarche was from a sample of 2009
Urban and rural Nigerian by the status quo method and calculated by probit. The median age for the urban girls was $13.70 \pm 0.03$ years whilst it was $14.50 \pm 0.09$ years for rural. Since the median in this study is $13.6 \pm 1$ it is quite clear that it is comparable and similar to Nigerian urban median. This might reflect a similarity between economic and possibly environmental conditions which exist among these developing African countries.

4.2.2 RETROSPECTIVE ANALYSIS

A retrospective study had been applied on 200 entirely postmenarcheal female working in the medical field. The analysis showed a mean of $13.6 \pm 1.5$ years with a range of $10 - 18$ years, by the recall method. If we applied a correction weighting of plus 0.5 years which is suggested by Tanner et al. to eliminate the effect of the rounding phenomenon and the inaccuracy of recall/in, the result will be $14.1 \pm 1.5$. So this result is much higher than that obtained by the probit. This difference between the retrospective mean and the probit mean is possibly due to sampling variation and perhaps more importantly to the degree of "rounding off". However this result $13.6 \pm 1.5$ is comparable.
to the mean of 13.7 \pm 1.1\text{ year} obtained by study carried in Khartoum 1976\textsuperscript{2} in a gynecological word in post menarcheal women. Also in Somalia the mean menarcheal age using a recollected age method was found to be 14.7\text{ years}, which is similar to the result obtained in this study with the correction weighting factor applied. In a study carried out in a similar way in Ceylon, the exact date at menarche was forgotten by 19.5\% of the sample but all alleged they remembered the year of age at which it was reached. However cohort analysis gave a higher mean value than probit analysis indicating that some girls recollected wrongly even though special ceremonies attend the event in Ceylon\textsuperscript{20}. As mentioned before the recall method is not an accurate method and tends to give a higher mean for menarcheal age.

4.1.3 SECULAR TRENDS

It is noticed that with better nutrition and improved standard of living girls tend to mature early.
This phenomenon of attaining early maturity has been called a secular trend. This trend has been proved to have taken place in many parts of the advanced world.

In a study done by Bonyo et al. in testing a secular trend in age at menarche, 1,333 women living in Senegal city and its surrounding were examined by applying the birth-year cohort analysis and a cross-sectional probit analysis. The trend towards younger menarcheal ages was consistently observed by both analyses. It started off soon after the Second World War and the speed was 0.11 year for observation period of 1946–1966. Also in Nigeria a secular trend towards earlier menarcheal age at rate of 5–6 month per decade was observed amongst children of the professionally privileged group. This result is consistent with the fact that was stated by Turner concerning secular trend. If we look at table (4.1), we can see that the average menarcheal age is much lower in the Western countries. In the future only if secular trend take place that our mean will be comparable to the contemporary European ones.
4.2.1  
**Breast Development**

In this study it was found the earliest sign of puberty in breast development, all the girls studied, by 12 years one month showed at least breast stage 1 (bud stage). This figure is similar to that obtained by K. Indira et al. '14' in India who found the first sign of puberty in breast appearance at the mean age of 10.56 years for all the group studied approaching 11 years in the lowest socio-economic group.

It is interesting to know that there was no uniformity in the development of both breasts one side of the breast in many occasions started budding before the other breast. In this series of girls studied out of 612 girls 95 girls were in stage I (breast bud, see photograph No. 1) and about 12% of them showed unilateral breast budding either right or left with a greater frequency of the left side. This observation had also been reported by K. Indira et al. '14' who found 20 girls out of total 1,704 girls studied with unequal development of breast, the left breast.
was more advanced than the right in 6 girls and the right breast more than the left in 14. However in this study as mentioned above unequality of breasts was considered only in stage I (breast bud). In the more mature breasts this difference in the size of the two breasts did exist but was not considered.

4.2.2

PUBLIC HAIR

Next to the breast appearance in the sequence of sexual maturation is the initial crops of pubic hair. The average appearance is at 12 years one month. By this age every girl included in this study showed at least pubic hair stage I i.e., very sparse downy long depigmented hair. In a similar study in India the average appearance of pubic hair in school girls was found to be 11.27 years which is not far from the mean obtained in this study.
RELATIONSHIP BETWEEN MENOPAUSE, MENARCHE, PUBIC HAIR AND AXILLARY HAIR

The breast is the earliest external manifestation in the sequence of sexual maturation as it starts about one year before the first appearance of pubic hair and 2.80 before menarche. This latter relationship, i.e., breast appearance and menarche is almost identical to the figure which is obtained by K. Indira et al '90', in which they found that among a group of Indian girls studied. The breast bud appears 2.86 years before onset of menarche. This absolute agreement that the first sign of puberty is breast enlargement and that it appears 2.80 years before menarche in two different races, proves that sexual maturation in girls is a universal phenomenon governed by physical-biological factors to a greater extent rather than being influenced by differences in cultures and economies.

Tanner estimated the time between the appearance of breast bud and the initial crop of pubic hair to be 1-3 years and menarche may occur in the middle
of this cycle. In this study the result agrees with this estimate i.e. the first sign of puberty appeared 2.8 years before menarche. The axillary hair is less important sign of sex maturation. It may either precede or follow menarche.

4.6.3

HEIGHT AND WEIGHT

Height, weight and their relation to menarche can properly be studied only in a longitudinal study. In many works it has been proved that increase in height occurs before menarche '15', while the greatest increase in weight coincides with the appearance of the menarche or occurs shortly afterward.

In this cross-sectional study the average height and weight of these girls are compared with a standard reference such as Harvard.

It was shown: the mean height of these girls when plotted in a graph (No. 3.4) lies closely at 50th centile of Harvard while their weight falls at 25th centile. Considering weight which is an index of nutritional status and possibly constitutional trait, since these girls studied their average height and weight
represent average Japanese standard for both height and weight for the age group studied, and since their weight fell at 25th centile of Harvard, a resort to American reference data for height and weight for clinical purposes seems not appropriate. A local reference for Japanese is recommended.

Other morphologic changes noticed in this study was enlargement of the thyroid gland. There were 6 girls with visible goiters. Clinically there was no signs of either thyrotoxicosis or myxedema and no investigations were done, but they were passed as pubertal goiters. This thyroid enlargement may reflect accentuated growth and possible increase in secretion of thyroid hormones, but as stated by Turner '13' whether at adolescence there is a temporary increase in secretion as slight perhaps be suspected from the thyroid weight curves and from the general release of pituitary hormones at that time is unknown.
CONCLUSION

1. Average Menarcheal age was studied in a group of Sudanese School Girls age range from 9 – 17 years and was found to be:
   a- $13.9 \pm 0.06$ years using probit
   b- $13.8 \pm 15$ years by recall methods among 200 post-menarcheal females working in the medical field age ranges 17 – 35 years.

2. Breast enlargement is the first sign of puberty starts at 11 years one month. Followed by,

3. Pubic hair is 2nd in sequence of sexual maturation appears at 12 years one month.

4. Average height for these age groups studied (612 girls) fall at 50th centile of Harvard standard.

5. Average weight for these age groups studied falls at 25th centile of Harvard.

6. Sudanese local reference standard for height and weight is recommended.
7. The average menarcheal age for the group studied is comparable to current African means.
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<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

**Table 4.2**
<table>
<thead>
<tr>
<th>Method</th>
<th>Average age of onset (Years, Months)</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probit</td>
<td>13, 11</td>
<td>0.06</td>
</tr>
<tr>
<td>Retrospective</td>
<td>13, 0</td>
<td>1.5 years</td>
</tr>
<tr>
<td>Breast stage</td>
<td>11, 1</td>
<td>0.004</td>
</tr>
<tr>
<td>Pubic Hair</td>
<td>12, 1</td>
<td>0.0027</td>
</tr>
</tbody>
</table>
### Table 2.2

**SHOWS DATA USED TO DRAW AVERAGE HEIGHT AND WEIGHT GRAPHS**

<table>
<thead>
<tr>
<th>Age Interval</th>
<th>Average Height</th>
<th>Average Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 - 9.99</td>
<td>136.18</td>
<td>27.67</td>
</tr>
<tr>
<td>10 - 10.99</td>
<td>136.23</td>
<td>30.35</td>
</tr>
<tr>
<td>11 - 11.99</td>
<td>143.41</td>
<td>33.21</td>
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<tr>
<td>12 - 12.99</td>
<td>151.62</td>
<td>36.37</td>
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<tr>
<td>13 - 13.99</td>
<td>155.25</td>
<td>42.26</td>
</tr>
<tr>
<td>14 - 14.99</td>
<td>155.67</td>
<td>45.63</td>
</tr>
<tr>
<td>15 - 15.99</td>
<td>162.33</td>
<td>49.54</td>
</tr>
<tr>
<td>16 - 16.99</td>
<td>162.33</td>
<td>52.7</td>
</tr>
<tr>
<td>Age Interval</td>
<td>Average Height for group studied</td>
<td>Centile Harvard</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>9 - 9.99</td>
<td>136.18</td>
<td>75</td>
</tr>
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<td>10 - 10.99</td>
<td>136.28</td>
<td>50</td>
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<tr>
<td>11 - 11.99</td>
<td>135.41</td>
<td>50</td>
</tr>
<tr>
<td>12 - 12.99</td>
<td>155.25</td>
<td>25</td>
</tr>
<tr>
<td>13 - 14.99</td>
<td>155.87</td>
<td>10</td>
</tr>
<tr>
<td>14 - 15.99</td>
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</tr>
<tr>
<td>15 - 16.99</td>
<td>164.7</td>
<td>50</td>
</tr>
</tbody>
</table>

* Due to a very low no. of girls in this age group.
GRAPH NO. 3.1

MENARCHE

EMPIRICAL PROBIT

92 107 122 137 152 167 182 197 212

AGE IN MONTH
GRAPH NO. 3.2

PUBLIC HAIR

IMPRICAL PROBIT

AGE IN MONTH

92 107 122 137 152 167 182 197 212
HISTOGRAM SHOWING RELATIONSHIP BETWEEN MENARCHE, PUBIC HAIR, AND BREAST BUD, IN THE GROUP STUDIED
GRAPH NO. 35

CHART OF WEIGHT COMPARED WITH HARVARD STANDARD

WEIGHT OF THESE AGE GROUPS LIES CLOSELY AT 25TH. SENTILE
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ACKNOWLEDGEMENT

Thanks to God who enlightened my way.

My deepest gratitude to Dr. Mohamed Ibrahim Ali Omer, head of Department of Paediatric and Child Health whose meticulous supervision, care and advice made possible writing this thesis.

My thanks to Dr. Manira Abdalla and Dr. Azzam Hitaly who helped me by carrying the anthropometric measurement all through the survey.

I am grateful as well to Dr. Abdalla Sharif Al Ghalal in the Department of Statistics, Faculty of Economics, University of Khartoum, who helped me in the statistical analysis. Thanks to all the headmistresses, teachers and pupils in the schools in which we conducted the survey for their utmost co-operation and help.
I thank Mr. Hassan Mohammed Salih, the driver who was with us all through. Finally my deep sense of gratitude to Miss Farida Abdalla Ibrahim, the Secretary of the Department of Medicine, who most patiently typed this thesis.

I also thank my sister Dr. Ismaila, who sent me all the reference papers from Edinburgh, U.K.

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University of Khartoum, 
1980.