If I were asked to define social medicine concisely I should answer: "The study of man within his environment, to give him life and to give it more abundantly."

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THE AGE OF THE MENARCHE

BY

DAGMAR C. WILSON, M.D., M.R.C.P., F.R.C.O.G.
D.P.H.

AND

IAN SUTHERLAND, M.A., D.Phil.

(From the Institute of Social Medicine, Oxford)

During the past century there has been a general tendency for European children and adolescents to grow with increasing rapidity, so that at a given age they are now taller and heavier than children of 50 years ago. This effect is also found in the more privileged classes compared with the less privileged, and has been ascribed to better nutrition (Morant, 1939). Studies of London school-children reflect a similar secular change in growth (Daley, 1948). The possibility that earlier sexual maturity may be associated with this accelerated growth in stature and weight is a matter of some social importance and has led to the present inquiry.

It is generally accepted that the development of sexual maturity is influenced both by heredity and environment and, more directly, by the action of pituitary hormones on the thyroid gland and gonads. H. Hogben, J. A. H. Waterhouse, and L. Hogben (1948), in a noteworthy contribution to the study of puberty, have discussed the salient features concerned in the process of full development. Ellis (1948) has shown that when comparing growth and nutrition in groups of boys and girls the stage of sexual maturity of the individuals concerned is almost as important as their chronological age; he has suggested a simple clinical grading for the use of school medical officers.

The onset of menstruation, now usually referred to as the menarche, represents to the individual girl a very definite point in time, which can be accurately determined retrospectively within a few years of its occurrence. No other aspect of sexual maturation, whether in girls or in boys, is so striking. Thus, although the onset of menstrual periods is only one aspect of a complex developmental process, information regarding it can be obtained quickly and reliably. For these reasons the present study is confined to sexual maturation as exemplified by the age of the menarche.

Observations in many different countries show that groups differ in the average age of the menarche. A number of associations between the age of onset of menstruation and environmental influences have been stressed by several investigators. (1) It has been stated that town girls on an average menstruate earlier than country girls. (2) Associations with height and weight have been demonstrated. (3) It

has been asserted that girls nowadays are menstruating on an average at an earlier age than did their mothers (Kennedy, 1933; Pryor, 1936; Michelson, 1944). The present investigation was planned to consider afresh these three suggestions.

Data

Data were collected from nine secondary girls' schools, of which three are in Oxford City and the other six in Oxfordshire. The schools draw children from a variety of social and economic environments. The information included the present ages, heights, and weights of the children, together with a record of whether their menstrual periods had started, and, if so, of their age at the time of onset. In order to be sure that the samples were representative of the geographical areas served by the schools, children were included only if they had been resident in the area for at least three years preceding the menarche or the date of the inquiry, whichever occurred earlier. At one city school the information was available only for those whose periods had already started. In all, records were analysed for 1,338 girls between the ages of 10 and 19—572 were from city schools and 766 from country schools. Of the total, 604 had not started menstruating when the inquiry was made.

City and Country Schools

The age of onset of menstruation ranged in individual girls from 9 to 18 years. The average age of the menarche among the children who had attained it was 13.23 years. In the three city schools the figure was 13.4 years and in the six country schools 13.09 years. However, in each school a substantial proportion of the girls had not started menstruating, and this fact makes the average ages quoted above dependent upon the age distribution of the children in the various schools. Schools with a higher proportion of older girls will naturally return a higher mean age at the menarche among those whose periods have started. This effect is shown in Table I.

TABLE I.—Age of the Menarche in City and Country Schools

	Average Age of Menarche	Average Age of All Children
City schools	13.40 years	14.03* years
Country schools	13.09 ..	13.70 ..
All schools	13.23 ..	13.83 ..

* Two schools only.

It is evident that the apparently lower age of the menarche in country schools may express no more than the younger average age of the children at those schools. The point was tested explicitly in the following manner. It is possible from the data to calculate for each birth anniversary the percentage of girls who have started menstruating by that age. The information for every girl who has passed the particular birth anniversary, whatever her present age, may be used to contribute to the calculation of this percentage. Table II shows

TABLE II.—Percentages of Children who have Attained the Menarche by Various Ages in City and Country Schools

Age	2 City Schools	6 Country Schools
9	0.0	0.0
10	0.2	0.0
11	0.6	1.0
12	5.6	7.5
13	24.8	29.6
14	64.6	63.3
15	90.8	89.4
16	95.5	95.4
17	100.0	98.2
18	100.0	100.0

such percentages for city and country children. The "median" age of the menarche—that age at which half the girls have started their periods—when estimated graphically is almost identical at about 13.6 years in the two groups. Nor is there

TABLE III.—Numbers, Mean Present Heights (in.) and Weights (lb.) of Children according to Present Age and Age of the Menarche

Age of the Menarche (Years)	Present Age (Years)																														
	10-11			11-12			12-13			13-14			14-15			15-16			16-17			17-18			18 +			All Ages			
	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.	No.	Ht.	Wt.				
		in.	lb.		in.	lb.		in.	lb.		in.	lb.		in.	lb.		in.	lb.		in.	lb.		in.	lb.		No.	Ht.	Wt.			
9-10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
10-11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
11-12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
12-13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
13-14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
14-15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
15-16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
16-17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
17 +	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
All who have menstruated	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
All who have not menstruated	4	57.5	83.7	158	58.0	84.3	220	59.4	87.2	113.6	139	63.0	118.2	212	63.6	117.2	180	64.5	122.3	97	64.5	123.5	39	64.7	128.0	8	64.3	120.3	734	63.8	119.7
Difference of last 2 rows																															
Standard error of difference																															

Metric equivalents: 1 inch = 2.54 cm.; 1 lb. = 454 g.

any suggestion of a greater spread in the age of the menarche among one group of children than among the other. There is thus no apparent difference between the children from town and country in respect of age at the menarche.

Height and Weight

Table III gives the mean heights and weights of all the children studied according to their present age and their age at the menarche. The data for those children whose periods had not started are analysed according to their present age.

The most striking feature of the table is the considerably greater mean heights and weights among those who have menstruated compared with those of the same age who have not. Where weights alone are concerned the frequent plumpness of girls at this phase of life has long been a familiar observation. For children of 11 or 12 the difference in average height is about 3 in. (7.5 cm.) and in weight about 25 lb. (11.3 kg.). For children of 14 or 15 the difference in mean height is about 1½ in. (3.75 cm.) and in weight about 17 lb. (7.7 kg.).

The columns of the table give some indication of the way in which present height and weight depend upon the interval since the menstrual periods started. There seems to be little or no variation in present height according to the interval since the menarche. There is a slight tendency among the younger girls for those who first menstruated recently to have lower weights than girls of the same age who first menstruated earlier. It is quite evident, however, from the figures that growth is much slower after the menarche, and that there must be a considerable spurt in growth shortly before or around the time of onset of the menstrual periods.

Mothers and Daughters

At one of the city schools it was possible to arrange an approach to the mothers of the girls who had already menstruated, and to obtain, in confidence, information regarding the age of the mother at her menarche. The mothers of 54 girls were involved. The mothers of two were dead, and it was not possible to get in touch with the mothers of three others. A brief explanatory questionnaire was posted by the school medical officer to the mothers of the remaining 49 girls and replies were received from the mothers of 41. Mother and daughter were given a common code number by the school authorities and so in each instance the difference between the ages at menarche could be determined. In this way genetic differences were allowed for to some extent.

Table IV shows the distribution of the differences in ages at the menarche. In 16 instances the daughter was older than the mother; in 16 instances the mother was older than the

TABLE IV.—Age of Mother at the Menarche Minus Age of Daughter at the Menarche for 41 Daughters (39 Mothers)

Difference Between Ages at Birthday Previous to Menarche (Mother minus Daughter)	No. of Instances
4 years	1
3 "	1
2 "	7
1 year	9
0 "	8
1 year	6
2 years	2
3 "	2

daughter; and in nine instances the ages at the previous birthday were identical. There is no evidence from this admittedly small sample of any decrease in average age at the menarche.

Discussion

The negative findings in the first and third parts of this inquiry are not necessarily inconsistent with earlier findings. The association between height and weight and the age of the menarche, which appears so clearly from the figures presented here, suggests that nutrition may be an important factor in sexual development, and the adequacy of nutrition could well differ as between town and country or between one generation and the next. In this instance it is doubtful

if considerable differences in nutrition do occur between the children in the various schools, where milk and meals are provided, or in their homes, where the dietary is both uniform and adequate as a result of equitable rationing during the past nine years. The mothers who were approached regarding their own age at the menarche were drawn from favoured social groups, and it is unlikely that the mothers' nutrition differed greatly from that of their daughters. It is unfortunate that the planning of a similar inquiry among mothers in poorer homes would probably be hampered by prejudices associated with the subject.

The figures in Table III confirm the conclusion of Ellis (1948) that the stage of sexual maturity is as important in assessing growth as is chronological age. It is noteworthy that no entry relating to the age of the menarche is at present included in the new school medical record card of the Ministry of Education. If the physical growth of girls is to be adequately assessed this omission will need to be remedied.

Shuttleworth (1937) presents individual growth curves of 10 girls who first menstruated between 10 years 7 months and 11 years 3 months, and of 10 girls with menarche between 14 years 5 months and 15 years 2 months. The first group were on the average taller during the period from $8\frac{1}{2}$ to 12 years of age than those in whom the menarche occurred later. There was a rapid decrease in rate of growth in stature after the menarche. Those whose menarche was later continued to grow after the girls in the earlier group had practically ceased and in the end were taller. Our findings do not confirm this last observation. Table V summarizes the figures of Table III for the 47 girls

TABLE V.—Mean Heights and Weights of Girls aged 17 and 18 According to Age of the Menarche

Age of the Menarche	No. of Girls	Mean Height	Mean Weight
Under 13 years ..	10	64.4 in.	125.4 lb.
13-14 ..	13	64.6 in.	135.7 lb.
14-15 ..	13	64.3 in.	119.9 lb.
15 years and over ..	11	65.1 in.	125.4 lb.
All ages ..	47	64.6 in.	126.8 lb.

aged 17 and 18. There is no consistent tendency for those whose menarche was later to be either taller or heavier than those who first menstruated earlier.

Conclusions

Data concerning the age of the menarche were obtained from 1,338 girls (604 of whom had not yet started their periods), between the ages of 10 and 19, attending three secondary schools in Oxford City and six in Oxfordshire. These schools cater for children from a variety of social and economic environments.

1. No differences in the age of onset of menstrual periods could be detected between children attending the town and country schools. The median age (that at which half of the girls had started menstruating) was 13.6 years. The age ranged in individuals from 9 to 18 years.

2. Girls who have not started menstruating are considerably shorter and lighter than their fellows of the same age whose periods have started. On the other hand, there is little difference in the mean heights and weights of the latter groups when subdivided according to the interval since the menarche. It is concluded that there must be a considerable spurt in growth before or around the age of menarche.

3. The close relation with height and weight means that information on the age of menarche is essential for the adequate assessment of physical growth in adolescent girls.

As yet no provision is made for this information on the Ministry of Education's new school medical record card. This omission should clearly be made good.

4. A small number of mothers of a more favoured social group were compared with their children in respect of the age of menarche. There was no apparent tendency for the children to start menstruating at an earlier age.

5. It is suggested that the negative findings (1) and (4), which fail to confirm the work of earlier investigators, may arise from the comparable nutritional status before or during adolescence, in this country, of the groups involved.

6. There is no evidence that the height and weight of girls aged 17 and 18 is in any way related to the age at which they first menstruated.

We are indebted to the educational and medical authorities and the teaching staffs of nine schools in the City and County of Oxford, to Dr. Isabelle Little in particular, and to the mothers of the girls for their help in obtaining the necessary data.

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OBSERVATIONS ON THE TREATMENT OF INFANTILE GASTRO-ENTERITIS

BY

C. ZAHRA NEUMANN, M.D., D.C.H., M.R.C.P.

(From the Royal Malta University)

The aetiology of infantile gastro-enteritis is still far from clearly understood. In a proportion of cases met with in Malta, especially in our hot summers, the disease is almost certainly of infective origin, but the nature of the causative organisms is a matter of acute controversy, as it has been impossible to incriminate any specific agent except in some cases belonging to the dysenteric, enteric, and salmonella group of diseases. Bacteriological examination of the stools of healthy and sick babies has disclosed no qualitative differences; indeed, some paediatricians have held that gastro-enteritis was not provoked by any specific organism but that it originated from the invasion of territory normally sterile, such as the upper reaches of the small intestine (Moro, 1916; Blacklock *et al.*, 1937). Others have postulated a virus infection and offer as evidence the observation that epidemics of gastro-enteritis and of colds seem often to occur together (Gunn, 1944). From the study of some 400 cases Sevitt (1945) concludes that paracolon and proteus bacilli are responsible for many cases of infantile gastro-enteritis. The disease may not represent a single entity, but may be the resultant of a number of different agents.

An Explanation of the Mechanism of Enteritis

If the rapid and abundant loss of fluid which is the cardinal sign of gastro-enteritis originates from the intestinal vascular plexus it must imply quite an abnormal permeability of the capillaries. Although many factors may contribute to produce this exaggerated leakage, it is probable that histamine ranks high on the list.