MALNUTRITION, MENARCHE AND MARRIAGE IN RURAL BANGLADESH

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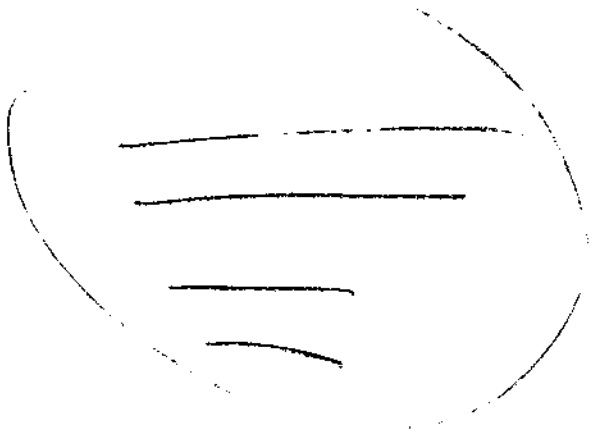

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The age of menarche in developed countries has declined in the last hundred years. The reasons attributed for this decline have included improved diets, lowered rates of infection and improved environmental and sanitary conditions (Tanner, 1968, Cagas and Riley, 1970). Numerous studies in both technologically advanced and developing countries have focused on the variables affecting the onset of menarche. None of these studies however, have examined menarche in relation to worsening external conditions and the affect adverse changes can have on the onset of menarche.

Bangladesh offers an unique opportunity for the study of such a situation because in the time since the War of Liberation (1971), the socioeconomic condition of the country has declined. For the past 5 years, there has generally been a decreasing per capita dietary intake. Chen and Choudhury (1975a) estimated that per capita intake of calories declined from 1715 in 1960-1965 to 1680 in 1965-1970 and 1618 in 1970-1974; and average per capita protein intake declined from 43.4 gm in 1960-1965 to 42.5 gm in 1965-1970, 40.6 gm in 1970-1974. The quality of protein consumed has also decreased during this period. Using FAO/WHO standards adjusting for body weight, climate, activity, and allowances for lactation and pregnancy, Chen (1975b) calculated that the minimal consumption needed would be 1600 calories and 40 gm protein. These calculations illustrate that if available food is distributed among the population according to needs, all would just have sufficient intake. However, as was shown in the National Nutritional Survey of 1962-1964, more than half of the rural population consumed less than their calorie and protein requirements. (Nutrition Survey of East Pakistan, 1966). This study was conducted more than 10 years ago when more per capita food was available. It is probable that due to the worsening economic conditions, the disparity in distribution is even greater at present,

with an even larger proportion of the rural poor, consuming levels of food less than the minimum standards.

Environmental conditions have not improved for the most part since liberation. The prevalence of infection and disease has resulted in mortality rates similar to those observed a decade ago. There have been fluctuating increases in the mortality rate noted in 1971-1972 and 1974-1975, in the first case due to the famine caused by the war and in the second due to famine caused by flooding and subsequent crop failure (Curlin et al.,1976 ; Chowdhury, 1976). These two severe crises led to increases in the crude death rate by almost 40%. An especially relevent statistic is that mortality among the female age group 5-9 years increased by 100% during both crises. This represents only the easily quantified extent of the damage caused. The effect on morbidity and growth of children can only be estimated. Whether the onset of menarche has also been affected is of interest because of its correlation to nutritional status.

The relationship of nutritional status with menarche has been postulated by many, though its effects are still not clearly understood. Tanner reviewed the literature on earlier maturation and noted the extent of the role that nutrition plays. In countries where the age of onset of menarche has decreased in the last 100 years by 2 1/2 - 3 1/2 years (Norway, Germany, Sweden, etc.) there has been an increasing trend in height and weight, with children now averaging one year younger for the same height and weight of those observed 30-40 years age (Tanner, 1968). In Britain during the past century, the age of menarche has fallen nearly four months per decade (Trowell, 1975).

In Denmark during the middle of the 19th century, mean age of menarche was reported as 16.3 and 17.4 years (Ravn, 1850 and Hannover, 1865 as reported by Bojlen and Bentzon, 1968). Norway, England, and Poland experienced mean ages of menarche during the early 1900's of 15-16 years (Bojlen and Bentzon, 1968, and Tanner, 1962). This decreasing trend in age of menarche has also been observed in the US by Engle (1934) who reported a mean age of menarche of 13-14 in 1934-1940, and by Reed and Stuart (1950) who reported an average age of menarche in 1947 of 12.8. The present age of menarche in the U.S. is estimated at between 12 to 13 years (Zacharias et al., 1976).

This trend of declining age of onset of menarche, has not been observed in impoverished nations where nutritional status has remained inadequate due to unfavourable socioeconomic conditions. Madhavan (1965), estimated the mean age of menarche in urban and rural areas of India at 12.76 years (urban) and 14.16 years (rural) in Madras; and 13.24 (urban) and 14.42 (rural) in Kerala. Since socioeconomic conditions are usually enhanced in urban areas, such a discrepancy as this often occurs in developing countries. In an urban area of Lucknow (India), mean age of menarche was reported by Koshi as 14.1 years (Koshi et al., 1970). Foll studied girls in Assam (India) and Burma and reported an average age of menarche of 13.21 and 13.25 respectively (Foll, 1961). Burrell et al., reported an average age of menarche for South African Bantus of 15.02 for those classified as not poor and 15.42 for those classified as poor (Burrell et al., 1961).

The suggestion that differences in nutritional status have been responsible for the lowering of the age of menarche is supported by several studies

which examined nutritional status in relation to menarche status. A recent study of Indian girls in Uttar Pradesh reported that girls of better nutritional status who received diets higher in calories and protein showed earlier menarche (Bhalla and Srivastava, 1974). Kralji - Cercek (1956) studied Slovian girls and found that girls with diets rich in protein reached menarche 1.55 years later than those with diets composed mostly of carbohydrates (14.1 years compared to 12.65 years). Hillman et al., (1971) obtained data on 2992 U.S. women aged 18-25 years and reported a high correlation between present nutritional status and age of menarche. In a 10 year prospective study of sexual development in American girls age 8-10, Zacharias et al., (1976) related onset of menarche to body build. They reported a significant positive correlation between the ponderal index, a function of height and weight, and age of menarche. It is suggested that a girl's age of menarche is more closely associated to her shape than to her size; late menarche is associated with thinness and early menarche with heaviness. Dreizen et al., (1967) observed in a U.S. study that well nourished girls had an average age of menarche of 12.43, compared to 14.45 among poorly nourished girls.

Few of the above investigations have attempted to explain how nutritional status relates to onset of menarche. Frisch has developed a method of estimating a minimal weight for height necessary for the onset of menarche (Frisch, 1972, Frisch, 1974, Frisch, 1976). She hypothesizes that menarche is determined by a critical body composition of fat as a percentage of body weight.

MATERIALS AND METHODS

This paper was prepared utilizing the initial interview data from a prospective study on onset of menarche conducted by the Cholera Research Laboratory in Matlab, Bangladesh.

The Cholera Research Laboratory (CRL) was established in Dacca, Bangladesh in 1960 to develop, improve and demonstrate measures for the prevention and eventual eradication of cholera. An essential component of this program involved controlled field trials of cholera vaccines. Villages of Matlab Thana, Comilla district, located in the south-central area of Bangladesh, were selected for these studies. The basic design of these field trials involved taking a complete census in the villages under study and assigning an unique identifying census number to every individual.

As of March 1966, a total population of 112,000, residing in 13 villages, was included in the field surveillance area. Subsequent to this date, the field staff has been maintaining a registration system for births, deaths, and migrations, in addition to carrying out regular surveillance for diarrheal diseases. Apart from these registration activities, censuses were conducted in 1970 and 1974 to update the registration information for these 132 villages. An additional 101 villages were added to the registration system in 1968, however in order to provide greater accuracy in determination of ages, we confined this study to the 1966 census population.

The 1974 census data for the 132 villages was used as the sampling frame for this study. The study was designed to interview over 1000 girls aged 10 to 20 years, irrespective of their marital status. A purposeful pick

of 13 villages was chosen to provide a larger proportion of Hindus than normally found in this population. A list was prepared of girls aged 8-18 in the 1974 census residing in 13 villages. The initial survey conducted in March, 1976, obtained information on 1155 girls whose ages at the time of the study were 10-20 years.

At the initial interview, retrospective information on marital and menarchial status, and age and date of onset of menarche was obtained by local female field assistants. Height (cm), weight (kg.), and arm circumference (cm), were measured at the girls' homes. These interviews are being repeated at monthly intervals for one year for girls who have not reached menarche, in order to provide prospective data on the relationship of nutritional status to the onset of menarche.

Age data used in this study were taken from the 1974 census. The ages in 1974 were determined by adjusting upwards the ages given in the 1966 census. For children born in 1966 or after, birth registration certificates were used for the determination of ages. The sampled females in this study were 0 to 10 years old in 1966. One of the methods used to check the ages of the children in the 1966 census involved asking intervals between births, and adding these intervals to the ages of the youngest infant.

The following points reflect the extent of bias in the study population with respect to age. Girls who were born in 1966 or later, have little chance of being misclassified by over reporting their ages because their dates of births were registered. Thus the probability of having subjects younger than 10 years in our study is minimal. In the 1966 census, girls who were aged 0-4

(who now are aged 10-14) may have been under enumerated, an occurrence observed in the National Census and in other surveys of Bangladesh, because of social factors related to the low status of girl children (Muniruzzaman, 1966). However there is little likelihood of excessive under or over reporting of their ages. Ages of girls reported as 5-10 in 1966 (now 15-20) may be biased since unmarried females of the 10-14 year age group in 1966, might have under-reported their ages because of social stigma associated with being unmarried, and thus have been misclassified in the 5-9 age group. Some of the girls now classified 15-20, thus may in fact be older than their estimated ages.

RESULTS

Information on both status quo and retrospective data are used in the analysis of this paper. Table 1 shows the distribution of girls by age, religion and percentage attaining menarche. Few have attained menarche by age 13, and only one fifth of girls aged 14 have reached menarche. When classified by religion, both Muslims and Hindus show similar patterns with respect to their menstrual status by age. The derived median age of menarche, calculated from this table is 15.8 for Muslims and 16.0 for Hindus. Median age here is expressed as the point at which fifty percent of the girls start menstruating ($X:F(x)=.5$).

In order to obtain an estimated mean age of menarche, probit analysis was also used (Finney, 1964). This analytical technique is appropriate since the data approximate a normal distribution, conforming to the conditions for use of probit. The mean age of menarche using this technique is estimated

at 15.65 for Muslims and 15.1 for Hindus. The probit regression equations were:

$$Y_1 = 5.65 + 0.67\ X_1 \text{ (Muslim)}$$

$$Y_2 = 5.83 + 0.68\ X_2 \text{ (Hindu)}$$

These equations illustrate that Muslims and Hindus have similar coefficients and near equal ages of menarche.

Table 2 shows the distribution of girls by age, body weight, and percentage that have reached menarche. This table clearly reflects that both age and weight are related to the proportion reaching menarche. When age is controlled for, the prominent effect of weight on menstrual status is evident. When weight is controlled for, the relationship of age is less striking, though still positively correlated to menstrual status. Overall, 98% of the girls whose weights were 40 kg. or greater had reached menarche, compared to only 1% of those weighing less than 30 kg.

In Table 3, the proportion reaching menarche is presented as the dependent variable for the two independent variables of height and weight of girls aged 10 to 20 years. When body weight is controlled for, height shows little relationship to the proportion reaching menarche. However when height is controlled for, weight shows a significant relationship to the percent of girls attaining menarche. Again, body weight seems to be one of the most important factors for the determination onset of menarche.

Table 4 shows the seasonal pattern of onset of menarche. Half of the girls who attained menarche reported doing so in the months of November through February. These are the months of winter season when food prices are low and

staples such as rice abundantly available in Bangladesh (Chen et al., 1974). It is possible that the nutritional status of the population improves at this time, leading to necessary increases in body weight for the initiation of menarche.

Table 5 presents the cumulative percent distribution of girls who attained menarche by their year of birth and age of onset of menarche. This table illustrates that those who were born in 1960 or earlier, have a different distribution of onset of menarche than the cohort born after 1960. Those who were born after 1960 exhibit a cumulative distribution of onset of menarche parallel to their older cohort, though shifted later by at least one year. The average age of menarche for the cohort born in 1961 or later will be at least one year greater than the older cohort if this pattern continues. This younger group (1961 - 1966 cohort) was 5 to 10 years old when they experienced the famine of 1971 - 1972 and were 8-13 years old when they were subsequently confronted by another severe famine in 1974 - 1975. During the 1971 to 1975 period, Bangladesh faced war, post-war inflation, floods, and famines which resulted in an economic crises for the country. These events may have helped to produce a deterioration in the nutritional status of these girls who were just approaching puberty. More than half of the cohort of girls born before 1960 had already attained menarche by 1971, and thus the effect of a deterioration of nutritional status would not be evidenced by the characteristic of onset of menarche for them. Other biological parameters, such as regularity of cycles, however, may have been negatively affected.

Table 6 gives the distribution of girls by age, religion and percent ever married. No girls were found to be ever married by age 12 for Muslims and by age 13 for Hindus. By age 20, nearly 80% of the Muslims and slightly over 70% of the Hindus were evermarried. Median age of marriage derived from this table was calculated as 17.4 years for Muslims and 18.6 years for Hindus. Earlier studies in Matlab reported average age at marriage as 12.9 in 1961 and 15.9 in 1968 (Aziz et al., 1970).

These data suggest that there has been an upward trend in the median age of marriage in Matlab since 1961. It is also evident that the median age of marriage for Muslims is 1.5 years higher and for Hindus 2.5 years higher than their respective median ages of menarche.

Table 7 illustrates the relationship of marriage with menarche, controlling for age. It indicates that the proportion of ever married girls is much higher among those who have attained menarche than among those who have not. For menarcheal girls, the proportion ever married increases as age increases, a phenomenon true for both Muslims and Hindus. However, for non-menarcheal girls, the proportion ever married is low for all age groups and shows only a slight increase as age increases. None of the premenarchial Hindu girls are married regardless of age. This leads one to suspect that onset of meanrche is a determining variable in the custom of marriage, both for Muslims as well as Hindus.

The age bias has been referred to earlier. The use of the ages given in the 1966 census, adjusted by adding 10 years to determine present ages, has probably prevented a large degree of age bias for girsl presently 10-14. However, girls who were aged 10-14 in 1966 may have been reported as 5-9 because they were premenarcheal and thus appeared immature, or because they were unmarried. Thus the present age group 15-19 may contain some girls of this type who in fact are older. The single year age distribution shown in Table 1 apparently reflects little of this type of bias.

Another bias that may be effecting the data is that of outmigration. Girls of earlier menarche are more likely to migrate-out due to marriage, and thus our sample may contain a disproportionate number of girls who are premenarchial. However, during the period 1974-1976, 26 girls moved out of the area to marry and 30 migrated-in because of marriage.

The most significant bias that may be affecting the data is that of unmarried girls not admitting to having reached menarche. Viewing such problems before hand, the researchers developed an interview technique to check hesitant or negative responses. In cases where respondents refused to answer or hesitantly answered "No" or "I don't know", when questioned about menstrual status, such responses were checked by asking mothers, grandmothers or friends of the respondent. Because of the close contact and lack of privacy experienced by villagers, other family members are likely to know whether a girl has reached menarche.

In order to estimate the extent to which this third type of bias is operating, we assumed that all girls age 18 should have reached menarche. Out of 39 unmarried girls aged 18 six reported not having menstruated. All 46 married girls aged 18 had menstruated. Assuming these six girls have incorrect responses, the maximum estimate of incorrect response is 15% (6/39).

Body weights for these girls range from 26.9 kg. to 34.9 kg. The mean body weight of the menarcheal girls aged 18 is 42.7 kg. (S.D. $\pm$ 5.9). The weights of 4 of these nonmenstruating girls were below 2 standard deviations of the mean. Thus according to their weight classification, they are not likely to have reached menarche.

Frisch has proposed a method of estimating minimal percentage body weight as fat (17%) for onset of menarche to occur. Only one of the six girls qualifies for menarche according to Frisch's criterion. Thus we estimate the extent of bias for unmarried menarcheal females who respond incorrectly to vary from 1/39 (2.6%) using Frisch's method; 2/39 (5.1%) based on the standard deviation; or the maximum 6/39; (15.4%). The median age of menarche resulting from the maximum bias would be 15.7, only slightly less than the median age of 15.9 observed for the total sample.

The use of retrospective data offers another bias that could significantly affect conclusions made about the increasing age of menarche. If older girls are consistently more likely to give a younger age of menarche than they actually experienced, the difference noted amohg girls above and below age 15 would be lessened. We are unable to estimate the extent of this bias, however other researchers have, with encouraging results. Damon et al., (1969) found no significant difference between recalled age of menarche (after 19 years) to that observed, though there was a trend of stating earlier menarche as later and later menarche as earlier. In similar study, Damon and Bajema (1971) reported that the age of menarche was recalled 2 years earlier than the actual event. They however conclude that recalled age of menarche is accurate enough for epidemiological purposes. It is interesting to note among South African Bantus, Kark (1943) observed that older girls reported a later age of menarche than younger girls, She suggests this difference was due to inaccurancy of recall. If this were the case in our sample, the older girls would have resumed menses even earlier than that reported.

CONCLUSIONS

(1) In recent years in a rural area of Bangladesh, the age of onset of menarche has increased.

(2) This increase seems to be associated with malnutrition caused by the war, post-war inflation, floods and famines during the period 1971 through 1975.

(3) Body weight is one of the most important factors associated with age of onset of menarche.

(4) There exists a seasonality of onset of menarche with a peak in winter.

(5) Age of marriage among this rural population has increased and may be associated with the increasing age of menarche.

(6) Since both age of menarche and age of marriage have increased, it may be expected that fertility among females age 15-19 will decrease in the future if this pattern continues.

TABLE 1

PERCENT DISTRIBUTION OF RESPONDENTS WHO HAVE ATTAINED MENARCHE BY RELIGION AND AGE

	Muslim		Hindu		Total	
Age	Number	Percent Attained Menarche	Number	Percent Attained Menarche	Number	Percent Attained Menarche
10.5	62	0.0	32	0.0	94	0.0
11.5	86	0.0	45	0.0	131	0.0
12.5	87	0.0	36	0.0	123	0.0
13.5	99	2.0	44	6.8	143	3.5
14.5	91	19.8	44	22.7	135	20.7
15.5	87	36.8	27	29.6	114	35.1
16.5	91	74.7	48	68.7	139	72.7
17.5	47	87.2	41	80.5	88	84.1
18.5	59	93.2	26	92.3	85	92.9
19.5	35	94.3	11	100.0	46	95.7
20.5	43	100.0	14	100.0	57	100.0

TABLE 2

DISTRIBUTION OF RESPONDENTS BY AGE, BODY WEIGHT AND MENSTRUAL STATUS

Age	Weight(Kg.)	Attained Menarche			Percent Attained Menarche
		Yes	No	Total	
10–13	30	1	456	457	0.0
	30–34	1	22	23	4.3
	35–39	1	7	8	27.3
	40+	2	1	3	
14–15	30	3	102	105	2.9
	30–34	10	49	59	16.9
	35–39	31	29	60	51.7
	40+	24	1	25	96.0
16–17	30	3	15	18	13.5
	30–34	20	24	44	45.5
	35–39	71	11	82	86.6
	40+	81	2	83	97.6
18–20	30	1	3	4	25.0
	30–34	11	5	16	67.7
	35–39	46	0	46	100.0
	40+	122	0	122	100.00

TABLE 3

DISTRIBUTION OF RESPONDENTS (AGE 10 - 20) BY WEIGHT, WEIGHT AND MENSTRUAL STATUS

Height (cm)	Weight (kg.)	Attained Menarche Yes	No	Total	Percent Attained Menarche
140	30	6	559	565	1.1
	30-34	10	20	30	33.3
	35-39	19	2	21	88.0
	40+	3	1	4	
140+	30	2	17	19	10.5
	30-34	32	80	112	28.6
	35-39	130	45	175	74.3
	40+	226	3	229	98.7

TABLE 4

DISTRIBUTION OF RESPONDENTS WHO HAVE ATTAINED MENARCHE BY SEASON OF ONSET

	Number	Percentage
January - February	107	27.4
March - April	58	14.9
May - June	42	10.8
July - August	33	8.5
September - October	64	16.4
November - December	86	22.0
Total	390	100.0
Unknown	38	

TABLE 5

CUMULATIVE PERCENT OF RESPONDENTS WHO ATTAINED MENARCHE BY AGE OF ONSET AND BY YEAR OF BIRTH

Year of Birth	Age of Onset of Menarche										Number of Females
	10	11	12	13	14	15	16	17	18	19	
1956	3.5	5.3	12.3	21.1	43.9	52.6	77.2	89.5	96.5	100.0	57
1957	0	4.4	8.7	19.6	30.4	45.7	67.4	71.7	89.1	95.7	46
1958	0	1.2	8.2	12.9	27.1	44.7	68.2	83.5	92.9	-	85
1959	2.3	3.4	9.1	22.7	29.6	48.9	71.6	85.2	-	-	88
1960	0	2.9	10.1	20.1	36.0	53.2	72.7	-	-	-	139
1961	0	1.7	4.4	8.8	20.1	34.2	-	-	-	-	114*
1962	0	.7	1.5	7.4	20.7	-	-	-	-	-	135
1963	0	.7	1.4	3.5	-	-	-	-	-	-	143
1964	0	0	0	-	-	-	-	-	-	-	123
1965	0	0	-	-	-	-	-	-	-	-	131
1966	0	-	-	-	-	-	-	-	-	-	94

* In one case age of onset menarche was not reported.

TABLE 6

PERCENT DISTRIBUTION OF EVER MARRIED RESPONDENTS BY RELIGION AND AGE

	Muslim		Hindu		Total	
Age	Number	Percent Ever Married	Number	Percent Ever Married	Number	Percent Ever Married
10.5	62	0.0	32	0.0	94	0.0
11.5	86	0.0	45	0.0	131	0.0
12.5	87	0.0	36	0.0	123	0.0
13.5	99	2.0	44	0.0	143	1.4
14.5	91	9.9	44	6.9	135	8.9
15.5	87	12.6	27	7.4	114	11.4
16.5	91	36.3	48	18.8	139	30.2
17.5	47	51.1	41	36.6	88	44.3
18.5	59	57.6	26	46.2	85	54.1
19.5	35	60.0	11	72.7	46	63.0
20.5	43	79.1	14	71.4	57	77.1

Median Age of Marriage for Muslims 17.4

Median Age of Marriage for Hindus 18.6

TABLE 7

PERCENT DISTRIBUTION OF EVER MARRIED RESPONDENTS BY MENSTRUAL STATUS, RELIGION AND AGE

Menstrual Status	Age	Muslim		Hindu		Total	
		Number	Percent Ever Married	Number	Percent Ever Married	Number	Percent Ever Married
Not Attained Menarche	10-13	332	0.3	154	0.0	486	0.2
	14-15	128	4.7	53	0.0	181	3.3
	16-17	29	8.6	23	0.0	52	5.0
	18-20	6		2		8	
Attained Menarche	10-13	2	28.8	3	23.8	5	27.4
	14-15	50		18		68	
	16-17	109	49.5	66	36.4	175	44.6
	18-20	131	67.9	49	61.2	180	66.1

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