

A Study on Age at Menarche of School Going Girls in Bangladesh

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Abstract The aim of this research is to study age at menarche of school going girls in Bangladesh. For this purpose, the data is acquired from Nilphamary Government Girls High School of the classes of five, six, seven and eight during 1st June-30th June, 2008. In this study, it is to investigate the pattern of age at menarche of total respondents and the pattern of height, weight and body mass index by the age of the respondents in accordance with menarche and non-menarche. The age range of the respondents was between 10 to 14 years. Chi-square test and logistic regression analysis are employed in this paper. This study also displays the association of age at menarche with socio-demographic variables of respondents. It is realized from the association that early menarche for school going girl's height, weight, father income, body mass index, time spent by watching television and father educational qualification were highly significant but mother educational qualification, mother occupation, father occupation, number of siblings, order of birth, time spent by playing and mother time spent were insignificant. In logistic analysis, it was found that only height, weight and time spent by watching TV were significant which have positive effects on age at menarche.

Keywords Age at menarche, Chi-square test, Logistic regression analysis, Model validation technique

1. Introduction

Menarche is a part of complex process of physical and emotional development of a girl. The cyclical release of blood, mucous in certain other substances per vagina from uterus in the reproductive span, that is, ages of 15 to 49 years of life of the female at standard period of about 28 days is called menstruation. The cyclic production of humor that culminates in the release of a mature egg, that is, ovum, is called the menstrual cycle and the first menstrual cycle is called menarche. Menarche is the first menstrual period, or first menstrual bleeding of the female of human beings. From both social and medical perspectives menarche is influenced by both genetic and environmental factors, especially nutritional status. The average age of menarche has declined over the last century but the magnitude of the decline and the factors responsible remain subjects of contention.

Age at menarche is an important indicator of future diseases. Early onset of menarche is a well-established risk factor for breast cancer[1]. It might also increase the risk of heart disease[2]. Late menarche may, however, be positively associated with the risk of developing Alzheimer's disease [3]. Age at menarche may also affect reproductive function. Early menarche may be a marker for reproductive fitness or,

at least, a marker for the onset of childbearing years[4]. In consequence, early menarche is the main cause of high fertility as well as high mortality. Changes in mean age at menarche over time may underlie the changing patterns of these diseases. On the other hand, not every girl follows the typical pattern, and some girls ovulate before the first menstruation. Although unlikely, it is possible for a girl who has engaged in sexual intercourse shortly before her menarche to conceive and become pregnant, which would delay her menarche until after the birth. This goes against the widely held assumption that a woman cannot become pregnant until after menarche.

Since the 18th century secular trends in age at menarche have been described. Results from Western countries are consistent in their descriptions of decreasing age at menarche over time in cohorts of women born prior to 1940[5]. The results from later cohorts are less consistent, no changes, increases[6] and decreases all having been reported[7]. With respect to especially Bangladeshi populations, some researchers[8-10,4] have studied nutritional status and age at menarche, age at menarche and postmenarcheal growth and age at menarche and marriage.

Therefore, the main objectives of this research paper are addressed below:

- i) To study the secular patterns in age at menarche, height, weight, and body mass index (BMI) of school going girls of Nilphamary district in Bangladesh.
- ii) To investigate the relation between menarcheal age and anthropometric measures and socio-demographic variables.

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This paper is organized into five sections that is addressed in the followings:

First section is introduction in which background of the study, review of literature and objectives of this study are briefly described. Section two contains data and data source of this study. Methodology is discussed in section three in which Chi-square test, logistic regression analysis and model validation technique are shortly narrated. Results and discussions are discussed in section four. Section five contains the conclusion of this research. References are placed at the end of this manuscript.

2. Data Source of This Study

The data of 248 sample unit was collected from Nilphamary Government Girls High School in Bangladesh of the classes of five, six, seven and eight during 1st June- 30th June, 2008 by purposively. By through questionnaire age at menarche, menstrual disturbance and socio- demographic characteristics of the respondents were collected at the time of data collection.

3. Methodology

3.1. Chi-square Test

In this paper, Chi-square test is used to find out the association of menarche with socio-demographic variables.

3.2. Logistic Regression Analysis

The logistic regression analysis is one of the most important methods for the successful application in all discipline of knowledge. This method is very useful for identifying various risk factors in case of qualitative outcome variables. Cox[11,12] has developed linear logistic regression model. The logistic regression model can be used not only to identify risk factors but also to predict the probability of success. This model expresses a qualitative dependent variable as a function of several independent variables, both qualitative and quantitative[13]. The dependent variable (Y) used in this logistic model is classified in the following way:

$$Y = \text{Age at menarche} = \begin{cases} 1, & \text{if causes of menarche is yes} \\ 0, & \text{otherwise} \end{cases}$$

The explanatory variables employed in this model are presented in the respective table.

3.3. Model Validation Technique

The cross validity prediction power (CVPP) is applied to weigh up the accuracy and consistency of the model. The algebraic formula for CVPP is addressed by

$$\rho_{cv}^2 = 1 - \frac{(n-1)(n-2)(n+1)}{n(n-k-1)(n-k-2)}(1-R^2).$$

In which n is the number of classes, k is the number of explanatory variables in the fitted model and the cross-validated R is the correlation between observed and predicted values of the dependent variable[14]. The shrinkage

and contraction of the model is the positive value of $\lambda = (\rho_{cv}^2 - R^2)$; where ρ_{cv}^2 is CVPP & R^2 is the coefficient of determination of the model. $1 - \lambda$ is the stability of R^2 of the model. Closer the value of λ to zero, the better is the prediction. The estimated CVPP related to their R^2 and information on model fittings are presented in the result and discussion section. CVPP was employed as model validation test by Islam [15,16] and Islam et al.[17,18].

4. Results and Discussion

4.1. Background Characteristics of the Respondents

Background characteristics of the respondents are important to know the characteristics or nature of the data before performing any statistical analysis. In order to see the nature of the characteristics of data, frequency distribution and graphical representation could be very useful due to the goal of this study. For this, we perform necessary frequency tables presented below.

In Table 1, it is found that 15.3% respondent are in class five, 40.7% respondent are in class six, 25.4% are in class seven and 18.5% are in class eight.

Table 1. The frequency distribution of the respondents by class

Class	Frequency	Percent	Cumulative Percent
5	38	15.3	15.3
6	101	40.7	56.0
7	63	25.4	81.5
8	46	18.5	100.0
Total	248	100.0	

From the Table 2 it is realized that 19 respondent's year of birth is 1994, which is 7.7%. 49 respondent's year of birth is 1995, which is 19.8%. 82 respondent's year of birth is 1996, which is 33.1%. 76 respondent's year of birth is 1997, which is 30.6%. 22 respondent's year of birth is 1998, which is 8.9%.

Table 2. The distribution of the respondents by year of birth

Year of birth	Frequency	Percent	Cumulative Percent
1994	19	7.7	7.7
1995	49	19.8	27.4
1996	82	33.1	60.5
1997	76	30.6	91.1
1998	22	8.9	100.0
Total	248	100.0	

It is observed in Table 3 that 82.7% respondents are Muslim and 17.3% are Hindu. We obtain from the Table 4 that 2.4% respondent has 1 number of siblings. 37.9% respondent has 2 and 3 number of siblings. 11.7% respondent has 4 numbers of siblings. 6.9% respondent has 5 numbers of siblings and 6.9% respondent has 8 numbers of siblings.

Table 3. Frequency distribution of the respondents by religion

Religion	Frequency	Percent	Cumulative Percent
Islam	205	82.7	82.7
Hindu	43	17.3	100.0
Total	248	100.0	

Table 4. The frequency distribution of the respondents by number of siblings

Number of siblings	Frequency	Percent	Cumulative Percent
1	6	2.4	2.4
2	94	37.9	40.3
3	94	37.9	78.2
4	29	11.7	89.9
5	17	6.9	96.8
6+	8	3.2	100.0
Total	248	100.0	

In Table 5, it is seen that 40.3% respondents are spent time with there mother less than 3 hours. 36.3% respondents spent time with there mother 3 to 7 hours. 23.4% respondents spent time with there mother more than 7 hours. We get 136 respondents are spent one hour time by playing, which is 54.8%. 70 respondents are spent 2 hour time by playing, which is 28.2%. 9 and 2 respondents are spent time 3 and 5 hour respectively, which is 3.6% and 0.8% respectively. 31 respondents are not like playing, there percentage is 12.5%.

Table 5. The frequency distribution of the respondents by mother time spent

Time (hours)	Frequency	Percent	Cumulative Percent
<3	100	40.3	40.3
3-7	90	36.3	76.6
7+	58	23.4	100.0
Total	248	100.0	

Table 6. The frequency distribution of the respondents by time spent for playing

Time (hours)	Frequency	Percent	Cumulative Percent
0.00	31	12.5	12.5
1.00	136	54.8	67.3
2.00	70	28.2	95.6
3.00	9	3.6	99.2
5.00	2	0.8	100.0
Total	248	100.0	

It is observed from the Table 7 that 25 respondents are not like watching TV, which is 10.1%. 90 respondents are spent one hour by watching TV, which is 36.3%. 102 respondents are spent two hours by watching TV, which is 41.1%. 20 and 11 respondents are spent 3 and 4 hours by watching TV respectively, which is 8.1% and 4.4% respectively.

Table 7. The frequency distribution of the respondents by time of watching television

Time (hours)	Frequency	Percent	Cumulative Percent
0.00	25	10.1	10.1
1.00	90	36.3	46.4
2.00	102	41.1	87.5
3.00	20	8.1	95.6
4.00	11	4.4	100.0
Total	248	100.0	

It is indicated that 22 respondent's age is 10, which is 8.9%. 76 respondent's age is 11, which is 30.6%. 82 respondent's age is 12, which is 33.1%. 49 respondent's age is 13, which is 19.8%. 19 respondent's age is 14, which is 7.7% from the Table 8. In Table 9, we find that 127-131 cm height

is 4 numbers of respondents, which is 1.6%. 132-136 cm height is 15 numbers of respondents, which is 4.4%. 137-141 cm height is 16 respondents that is 6.5%. 142-146 cm height is 34 number of respondents, which is 13.7%. 147-151 cm height is 67 respondents which is 27%. 152-156 cm height is 83 respondents (33.5%). 157 and more cm height is 13.3%. We realize from the Table 10 that 20.6% respondent's weight is 41-45 (in kg), which is maximum and 2.4% respondent's weight is above 51, which is minimum.

Table 8. The frequency distribution of the respondents by age

Age	Frequency	Percent	Cumulative Percent
10	22	8.9	8.9
11	76	30.6	39.5
12	82	33.1	72.6
13	49	19.8	92.3
14	19	7.7	100.0
Total	248	100.0	

Table 9. Frequency distribution by height

Height (cm)	Frequency	Percent	Cumulative Percent
127-131	4	1.6	1.6
132-136	11	4.4	6.0
137-141	16	6.5	12.5
142-146	34	13.7	26.2
147-151	67	27.0	53.2
152-156	83	33.5	86.7
157+	33	13.3	100.0
Total	248	100.0	

Table 10. Frequency distribution of respondents by weight

Weight	Frequency	Percent	Cumulative Percent
21-25	13	5.2	5.2
26-30	31	12.5	17.7
31-35	48	19.4	37.1
36-40	78	31.5	68.5
41-45	51	20.6	89.1
46-50	21	8.5	97.6
51+	6	2.4	100.0
Total	248	100.0	

It is seen from the table that 148 (59.7%) respondents are passing their menstruation situation and 100 (40.3%) respondents are not passing this situation. We get 1 respondent's age at menarche is 8, which is 0.4%. 2 respondent's age at menarche is 9 that is 0.8%. 30 respondent's age at menarche is 10 (12.1%). 45 respondent's age at menarche is 11, which is 18.1%. 49 respondent's age at menarche is 12 (19.8%). 18 respondent's age at menarche is 13 (7.3%) as well as 3 respondent's age at menarche is 14, which is 1.2%. Moreover, age distribution of non menarche students is presented in Table 13.

Table 11. The frequency distribution of the respondents by menarche (yes/no)

Menarche	Frequency	Percent	Cumulative Percent
Yes	148	59.7	59.7
No	100	40.3	100.0
Total	248	100.0	

Table 12. The frequency distribution of the respondents by age at menarche

Age at menarche	Frequency	Percent	Cumulative Percent
9	3	1.2	2.7
10	30	12.1	22.3
11	45	18.1	52.7
12	49	19.8	85.8
13	18	7.3	98.0
14	3	1.2	100.0
Total	148	59.7	

Table 13. The frequency distribution of the age of non menarche students

Age	Frequency	Percent	Cumulative Percent
10	21	21.0	21.0
11	44	44.0	65.0
12	29	29.0	94.0
13	6	6.0	100.0
Total	100	100.0	

In Table 14, it is found that maximum number of respondents (29%) belong to 9000-13000 income group where as minimum number are in the age group 21000 and above.

Table 14. The frequency distribution of the respondents by father income

Income (In Taka)	Frequency	Percent	Cumulative Percent
<5000	39	15.7	15.7
5000-9000	61	24.6	40.3
9000-13000	72	29.0	69.4
13000-17000	41	16.5	85.9
17000-21000	21	8.5	94.4
21000+	14	5.6	100.0
Total	248	100.0	

From the table we get 192 respondent's body mass index (BMI) is below 18.5, which means that 77.4% are under weight. 56 respondent's BMI is 18.5-24.99, which indicates

22.6% belongs to normal weight. It is observed from the Table 16 that mean height is higher in age 13, which is 151.467 and mean height is lowest in age 10 (142.471). Mean weight is highest (42.053) in age 14 and mean weight is lowest in age 10, which is 30. Mean BMI is highest in the age 14, which is 18.428 and mean BMI is lowest in age 10, which is 15.072. The mean height, weight and BMI of total respondents are 149.08, 37.180 and 16.927 respectively.

Table 15. The frequency distribution of the respondents by BMI

BMI (kg/cm ²)	Frequency	Percent	Cumulative Percent
<18.5	192	77.4	77.4
18.5-24.99	56	22.6	100.0
Total	248	100.0	

It is apprehended from the following table of menarche students that mean height is highest (152.459) in age 13 and mean height is lowest (149.68) in age 10. Mean weight is highest in age 13, which is 42.698 and mean weight is lowest in age 10, which is 30. Mean BMI is highest in age 14, which is 18.535 and mean BMI is lowest in age 10, which is 13.358. The mean height, weight and BMI of total menarche respondents are 151.816, 41.5 and 18.008 respectively.

From the Table 18 it is comprehended that non-menarche students mean height is highest (146.882) in age 12 and mean height is lowest in age 10, which is 142.119. Mean weight is highest in age 12, which is 33.862 and mean weight is lowest in age 10, which is 30. Mean BMI is highest in age 14 that is 15.724 and mean BMI is lowest in age 10, which is 14.778. For total non-menarche respondents, mean height, weight and BMI are 145.034, 32.350 and 15.325 respectively.

Table 16. Mean values and standard deviations in height, weight and body mass index by age of total number of respondents

Age	Number of respondent	Height (cm)		Weight (kg)		BMI	
		Mean	SD	Mean	SD	Mean	SD
10	22	142.471	7.556	30.00	5.912	15.072	2.511
11	76	147.688	7.405	36.184	7.417	16.791	2.149
12	82	150.325	6.146	38.317	5.497	16.598	2.446
13	49	151.467	4.965	41.347	6.434	17.936	2.508
14	19	150.796	7.723	42.053	4.503	18.428	1.932
Total	248	149.082	7.027	37.810	7.022	16.927	2.473

Table 17. Mean values and standard deviations (SD) in height, weight and BMI by age of menarche students

Age at menarche	Number of respondents	Height		Weight		BMI	
		Mean	SD	Mean	SD	Mean	SD
10	1	149.68	-	30.00	-	13.358	-
11	32	150.971	5.278	41.156	5.815	18.017	2.069
12	53	152.208	5.544	40.755	4.918	17.623	2.242
13	43	152.459	3.819	42.698	5.54	18.344	2.028
14	19	150.796	7.723	42.053	4.503	18.553	2.169
Total	148	151.816	5.358	41.5	5.341	18.008	2.169

Table 18. Mean values and standard deviations (SD) in height, weight and body mass index by age of non-menarche students

Age	Number of non-menarche students	Height		Weight		BMI	
		Mean	SD	Mean	SD	Mean	SD
10	21	142.119	7.555	30.000	6.058	14.778	2.341
11	44	145.299	5.762	32.568	6.307	15.347	2.137
12	29	146.882	5.762	33.862	3.270	15.724	1.605
13	6	144.356	6.704	31.666	3.386	15.157	0.481
Total	100	145.034	7.269	32.350	5.494	15.325	1.986

Table 19. Mean difference between menarche and non-menarche in monthly income, number of still birth, order of birth, mother time spend, time spend in play, time spend in watch TV, age, height, weight and BMI

Variable	Menarche			Non-menarche			Mean difference
	N	Mean	SD	N	Mean	SD	
Father income	148	12537.16	7000.51	100	9765.00	4022.32	2772.162
No. of still birth	148	2.89	1.04	100	2.99	1.19	-0.10
Order of birth	148	1.9459	1.0991	100	1.9500	1.2822	-0.0041
Mother time spend	148	5.4122	4.0321	100	5.2000	3.6735	0.2144
Time spend in play	148	1.3041	0.7158	100	1.2000	0.8762	0.1041
Time spent in TV	148	1.7500	0.9680	100	1.3900	0.8396	0.3600
Age	148	12.32	0.980	100	11.20	0.84	1.12
Height (cm)	148	151.8165	5.3583	100	145.034	7.2699	6.7825
Weight (kg)	148	41.5000	5.3408	100	32.3500	5.4945	9.15
BMI	148	18.0083	2.1688	100	15.3259	1.9861	2.6824

Table 20. Chi-square value and significant level of some demographic and socio-economic variables for age at menarche

Characteristics	Chi-square value		P-value	d.f.	Significant level
	Calculated value	Tabulated value			
Height	52.965	5.991	0.000	2	Significant
Weight	84.096	5.991	0.000	2	Significant
Father income	11.020	5.991	0.004	2	Significant
BMI	39.092	3.841	0.000	1	Significant
Time spent by watching TV	3.922	3.841	0.048	1	Significant
Father educational qualification	4.722	3.841	0.030	1	Significant
Mother educational qualification	1.534	3.841	0.215	1	Insignificant
Number of siblings	0.842	5.991	0.656	2	Insignificant
Time spend by playing	0.540	3.841	0.463	1	Insignificant
Order of birth	1.194	5.991	0.550	2	Insignificant
Father occupation	0.327	3.841	0.567	1	Insignificant
Mother occupation	0.002	3.841	0.964	1	Insignificant
Mother time spend	0.550	5.991	0.760	2	Insignificant

The following table exhibits the mean differences in father income, number of still birth, order of birth, mother time spent, time spent in playing, time spent by watching TV, age, height, weight and body mass index in case of menarche and non-menarche respondents. The mean difference explained that father income was larger for menarche students than that of non-menarche students. Number of still birth and birth order were not significantly related to menarche and non-menarche situation. Mother time spent, time spent by playing and time spent by watching TV were larger than that of non-menarche respondents. The mean differences in age, height, weight and BMI of menarche were some what larger than those of non-menarche respondents.

4.2. Association

The contingency analysis investigated the degree or strength of association together the dependency criterion between the selected variables. Examination of association is performed by means of contingency table that is displayed in Table 20. Demographic and socio-economic variables are responsible for early menarche. We see from the table that in case of causes of early menarche for school going girl's height, weight, father income, body mass index time spent by watching television and father educational qualification are highly significant and mother educational qualification, mother occupation, father occupation, number of siblings, order of birth, time spent by playing and mother time spent are insignificant.

4.3. Logistic Regression Analysis

The results of logistic regression analysis are demonstrated in Table 21. The table exhibits that only three variables out of six explanatory variables are statistically significant and the rest of the variables are statistically insignificant. A brief description of the significant variables is given below:

One of the most important factors for menarche is height. The estimated regression co-efficient for height group 136-145 cm and for height group 146 cm and above are 1.236 and 1.853 respectively, which means it has positive impact on menarche. The odds ratio belongs to the height groups 136-145 and 146+ cm are 3.441 and 6.378 respectively. It is indicated that 3.441 and 6.378 times higher risk of menarche than that of height group 126-135 cm. From this table it is realized that the estimated regression co-efficient for weight groups 31-40 kg and 40+ kg are 1.374 and 3.490 respectively that is positively affect on menarche. The odds ratio for the weight groups 31-40 kg and 40+ kg are 3.950 and 32.779 respectively which indicated that 3.950 and 32.779 times higher risk of menarche than that of weight groups 21-30 kg. The estimated regression coefficients for time spent by watching TV of the respondents above one hour is 0.586 which indicated that it has positive effect on menarche. The odds ratio for above one hour time spent by watching TV is 1.797. It is indicated that the risk of menarche for above one hour time spent by watching TV 1.797 times higher than that of under one hour.

In the fitted logistic model, it is provided that $R^2=0.598$, $\rho_{cv}^2=0.579493$, and shrinkage coefficient (λ) = 0.018507137.

From these statistics, it is seen that the shrinkage coefficient is very small. Moreover, the stability of R^2 of the model is more than 99%. Hence, it is concluded that the model is better fit.

Table 21. Logistic regression estimates for age at menarche with demographic and socio-economic variables

Variables	B	Significance (p-value)	Odds ratio
Height:			
126-135cm (R)	-	0.016	1.00
136-145cm	1.514	0.060	4.545
145cm+	2.213	0.009	9.144
Weight:			
21-30kg (R)	-	0.000	1.00
31-40kg	1.374	0.015	3.950
40kg+	3.490	0.000	32.779
Father Income:			
<10000 (R)	-	0.725	1.00
10000-20000	-0.242	0.531	0.785
20000+	7.013	.623	1111.519
Time spent by watching TV:			
<1hr (R)	-	-	1.00
1hr+	0.586	0.092	1.797
Father's educational qualification:			
HSC (R)	-	-	1.00
HSC and Above	0.172	0.657	1.187
Constant:	-3.394	0.000	0.034
Cox and Snell's R square=0.598			
$\rho_{cv}^2 = 0.579493$, Shrinkage coefficient (λ) = 0.018507137			

Note: R indicates reference category.

5. Conclusions

In the present study, it is found that the mean age at menarche of Bangladeshi school going girls of classes five, six, seven and eight was 12.32. This study exhibited that the father monthly income of menarche respondent's was high than the non menarche respondent's father monthly income. The mean difference between menarche and non-menarche respondent's father income was 2772.622. It was displayed that the menarche students were much spent their time by watching TV and by playing and the mean difference is 0.3600 and 0.1041 respectively. The mean difference between height, weight and BMI was 6.7825, 9.15 and 2.6824 respectively, that means the taller students reached menarche earlier than the shorter girls and the heavier girls reached menarche earlier than the thinner girls and also getting larger BMI girls reached earlier than that of lower BMI girls. Height, weight, father income, BMI, time spent by watching television and father educational qualification were highly significant with the association of early menarche for school going girls. Finally, the logistic regression analysis showed that height, weight and time spent by watching TV of the respondents had positive effects on age at menarche.

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