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RESEARCH ARTICLE

A FIRST LONGITUDINAL GROWTH STUDY OF STATURE AND WEIGHT OF THE SCHOOL CHILDREN FROM JESSORE DISTRICT IN BANGLADESH

Md. Shahjada Ali Nawaz[1], Md. Abu Shahin[2], Md. Abdul Khalek[3] and Md. Ayub Ali[4*]

1. PhD Fellow, Department of Statistics, University of Rajshahi, Rajshahi 6205 and Assistant Professor, JessoreShikkha Board Govt. Model School and College, Jessore, Bangladesh.
2. Lecturer, AgraniSchool &College, RUET, RUET Campus, Rajshahi 6204.
3. Professor, Department of Statistics, University of Rajshahi, Rajshahi 6205.
4. Professor, Department of Statistics, University of Rajshahi, Rajshahi 6205.

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Abstract

Objective: The purpose of this study was to measure longitudinal Anthropometric data in the age interval 6-18 years of the school children of Jessore District in Bangladesh.

Materials: Primary dataon stature and weight were collected longitudinally from 2006 to2018 using two stage random sampling technique.

Methods: Descriptive statistics and their simulated valuesonstature, weight and BMI were calculated. Quantile regression was considered to the longitudinal data to develop growth charts.

Results: The population mean weight (kg) for boys at the age 8 (year) were condensed in 22.20±0.38 whereas for girls that were more condensed in the range 23.06±0.58. While, for boys, at the age 18 year this mean were in 58.80±1.26 little bit fluctuated compared to that in other ages but a little bit scattered range was found for girls at the age 18 year as 53.56±1.54.The stature for age implied that for boys it was smoothly increasing while for girls it was smoothly increasing until age 12.5 but after that age it was increasing with slow motion and also motion with ups and down. The Weight for age shows that the upper 25% of the heavier children continued their strictly increasing patterns both in their stature and weight. About 42% boys and 33% girls showed always underweight in the age range 7-18 years. Only 2% girls and 1% boys showed overweight after age 12.

Conclusion: These results and several growth charts might be used by the medical practitioners as well as the growth scientists.

Introduction:-

The first longitudinal human growth study was recorded that was done by Count PhilibertGue'neau de Montbeillard upon his son during 1759-1777, and then after many researchers concentrated this kind of growth study for different ethnic populations, places and times (Wingerd, 1970; Merrell, 1931; Togo and Togo, 1982; McGregor and Billewiez, 1982; Chinn et al., 1989; Lindgren and Hauspie, 1989; Ashizawa et al., 1994; Kato et al., 1998; Mohammad et al., 1999; Ali and Ohtsuki, 2000; Ali and Ohtsuki, 2001; Leigh, 2001; Ali et al., 2004a, & b; Chiaki

Corresponding Author:- Dr. Md. Ayub Ali
Address:- Professor, Department of Statistics, University of Rajshahi, Rajshahi 6205 Bangladesh.

et al., 2004; Tosellis et al., 2005; Stovitz et al., 2008; Ilayperuma et al., 2010; Johnson et al., 2011; Bjelica et al., 2012; Rahmandad, 2014). Longitudinal growth study helps us to understand the growth status of the children through the growth chart and growth models on longitudinal morphological data. To determine whether a child is overweight or underweight- either of these can indicate a disease, longitudinal measurement of stature (Total Body Stature) and weight provide essential information in performing and evaluating certain lab tests and in calculating dosages of certain medications. The child's size measurements must then be plotted on a growth chart. This is extremely important as it can detect early changes in a child's growth. In the process of growth monitoring and to have the growth documents, regular measurement of a child's size (weight, Stature or length) i.e., longitudinal data should be measured and accumulated. This kind of study is very often in many countries (Wingerd, 1970; Ali and Ohtsuki, 2001;Shahin et al., 2013) but rare in our country Bangladesh (Pervin et al., 2012). While, Pervin et al., (2012) studied only in the age range birth to four years for the children of Rajshahidistrict.The prevalence of obesity is increasing dramatically worldwidein both developed and developing countries (WHO, 2000). Moreover, becausethe problem seems to be increasing rapidly in children as well asin adults, the health consequence of obesity will only be fully apparentin the next decade or so. The longitudinal data of Stature and weight can help us to understand the exact pattern of BMI over time. Some references are available in cross-sectional cases ofBangladeshi population, but rare in longitudinal.

Thus, the purpose of the present study is to collect longitudinal data on statue and weight to quantify them to have the growth pattern, growth chart and BMI of the children from Jessore district in Bangladesh.

Material And Methods:-

In this study area of Jessore District, there are 08 Upazilas. One Upazila is chosen at random and it is found as "JessoreSadar". There are 135 primary schools in JessoreSadarUpazila and they are divided into Urban School and Rural School. Urban area has 35 primary schools and rural area has 100 schools. Three primary schools from Urban and four primary schools from Rural are chosen at random.Children from class I in the year 2006 of every selected school were considered as the sample observations. The study started with 117 children. There was about 24% loss of the sample size. Finally, we have 89 subjects. Longitudinal data on stature and weight, of the school children are measured from rural and urban area for every after six-month duration. All measurements have taken with minimum pressure by instruments. Every measurement was repeated three times and the average value was considered as the data. The study was carried out from 2006 to 2018, by only one person and one method of measuring. Stature was measured on barefoot and upright position using stadiometer. All the children were weighted with school uniform (and the weight of the uniform was subtracted), but heavy materials were taken off (i.e shoes, jacket). The age was accounted by years, months and days. Studies are computerized and data recording are standardized by using Programming in R, SPSS, Microsoft Excel etc. Descriptive statistics of stature and weight were calculated. Different growth charts, e.g., stature for age, weight for age, and weight for stature were constructed through the quantile regression technique.

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of stature in meters. A high BMI can indicate high body fatness. BMI screens for weight categories that may lead to health problems, but it does not diagnose the body fatness or health of an individual.

$$\text{BMI} = \frac{\text{Weight in kg}}{(\text{Height in meter})^2}$$

The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI equal to or greater than 25 is considered as overweight and above 30 is considered as obese. These ranges of BMI values are valid only as statistical categories.

BMI	**Weight Status**
Below 18.5	Underweight
18.5 – 24.9	Normal or Healthy Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

Source: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html

Simulation (we used bootstrap here) technique was applied to the descriptive statistics and BMI to have their values for population estimates. Therefore, using these values we can infer about the population parameters.

Results:-

The longitudinal data on stature and weight of school children aged from 6 to 18 years were collected individually from Jessore district of Bangladesh. Descriptive Statistics of the stature (in cm) by Age of the school boys of the Jessore District are shown in Table 1. This Table shows that the mean values of stature for agewere increased over times. Mean stature of school boys were at about age 7 years 118.94 cm with standard deviation 4.31 cm, 143.32 cm with standard deviation 6.58 cm at about age 12 years and 167.02 cm with standard deviation 4.82 cm at about age 18 years. The estimated mean stature for boys at the age 17 (year) were more stable among the considered age (SE of mean is 0.56). But the estimated mean stature for boys at the age 7 (year) are less stable compared to others ages (SE of mean is 0.88). The distribution of stature at the age 7-10, 12 and 13 were negatively skewed. But the distributions of stature for the rest of the ages were positively skewed. The leptokurtic distributions of stature are observed at the age 8, 14 and 15 ages. The bootstrap technique performed with number of samples was 1000, the estimated means of stature of boys by age were showed more efficient estimate on the basis of bootstrap SE of mean and bootstrap 95% confidence intervals and we can use bootstrap mean value for the population purpose.

The age wise mean of the staturefor girls were also increased over times (Table 2). Mean stature of school girls about age 7 years is 120.46 cm with standard deviation 6.35 cm, about age 12 years is 142.70 cm with standard deviation 5.41cm and about age 18 years it is 155.21 cm with standard deviation 4.38 cm. The estimated mean stature for girls at the age 15 (year) werecondensed in 151.06±0.50, while it was 120.46±1.36 for age 7 little bit fluctuated compared to that for other ages. The distribution of stature at the age 8 and 12 were negatively skewed. The distributions of stature at the age 9, 10, 11, and 13-18 in years were positively skewed. But the distribution of stature at the age 7 is symmetric. The leptokurtic distributions of stature were observed at the ages 8, 9, 11 and 14-18years. Based on bootstrap SE of mean and bootstrap 95% confidence intervals, the estimated means of stature of girls by age were estimated more effectively with 1000 samples.

Table 1:- Descriptive statistics and their bootstrap values of Stature (cm) for the school boys.

Age (year)	N	Mean	SEM	95% CI for Mean		SD	Skewness	Kurtosis	Bootstrap (n=1000)			
										SEM	95% CI for Mean	
				Lower	Upper				Mean		Lower	Upper
7	24	118.94	0.88	117.12	120.76	4.31	-0.16	-0.60	118.94	0.88	117.21	120.70
8	79	123.70	0.63	122.44	124.96	5.62	-0.47	0.20	123.69	0.65	122.43	124.96
9	89	128.54	0.60	127.34	129.73	5.69	-0.25	-0.32	128.52	0.60	127.29	129.64
10	89	133.67	0.63	132.42	134.93	5.96	-0.13	-0.30	133.64	0.62	132.34	134.85
11	78	138.64	0.79	137.07	140.20	6.93	0.05	-0.48	138.60	0.78	137.04	140.16
12	72	143.32	0.78	141.77	144.87	6.58	-0.07	-0.21	143.31	0.80	141.76	144.86
13	69	148.52	0.75	147.02	150.02	6.25	-0.07	-0.23	148.51	0.74	146.96	149.98
14	68	153.62	0.71	152.20	155.04	5.88	0.17	0.10	153.63	0.74	152.12	155.01
15	68	158.16	0.66	156.83	159.48	5.48	0.30	0.02	158.18	0.65	156.86	159.46
16	69	162.23	0.59	161.05	163.42	4.94	0.31	-0.47	162.21	0.57	161.14	163.32
17	68	165.28	0.56	164.17	166.40	4.61	0.50	-0.65	165.30	0.57	164.16	166.40
18	66	167.02	0.59	165.84	168.21	4.82	0.34	-0.75	167.02	0.57	165.91	168.17

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean, CI means confidence interval and SD means standard deviation. Source: calculated by the authors.

Table 2:- Descriptive Statistics and their bootstrap values of Stature (cm) for the school girls.

Age (year)	N	Mean	SEM	95% CI for Mean		SD	Skewness	Kurtosis	Bootstrap (n=1000)			
										SEM	95% CI for Mean	
				Lower	Upper				Mean		Lower	Upper
7	21	120.46	1.36	117.62	123.31	6.25	0.00	-0.71	120.55	1.36	117.97	123.30
8	79	122.86	0.64	121.58	124.13	5.69	-0.02	0.05	122.87	0.64	121.59	124.08
9	88	128.07	0.68	126.73	129.42	6.35	0.28	0.23	128.04	0.70	126.55	129.42
10	87	133.70	0.68	132.35	135.04	6.30	0.13	-0.11	133.70	0.67	132.39	134.99
11	78	138.73	0.68	137.38	140.09	6.01	0.04	0.65	138.70	0.70	137.30	140.08
12	73	142.70	0.63	141.44	143.96	5.41	-0.06	-0.34	142.75	0.65	141.52	144.03
13	67	145.90	0.57	144.76	147.05	4.68	0.04	-0.44	145.91	0.55	144.97	147.09

14	67	148.68	0.51	147.66	149.71	4.19	0.03	0.25	148.68	0.50	147.81	149.73
15	68	151.06	0.50	150.06	152.06	4.13	0.16	0.95	151.04	0.50	150.12	152.16
16	69	152.78	0.52	151.74	153.82	4.33	0.47	1.42	152.80	0.52	151.78	153.86
17	67	153.98	0.54	152.90	155.06	4.42	0.64	1.26	153.94	0.54	152.84	154.93
18	64	155.21	0.55	154.11	156.30	4.38	1.01	1.11	155.19	0.56	154.13	156.40

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean, CI means confidence interval and SD means standard deviation. Source: calculated by the authors.

The age wise descriptive statistics of weight for boys and girls are shown in Table 3 and 4, respectively. Table 3 shows that mean weight of school boys about age 7 years was 20.42 kg with standard deviation 2.36 kg,about age 12 years was 35.21 kg with standard deviation 7.83 kg and about age 18 years, it was 58.80 with standard deviation 10.25 kg. The population mean weight for boys at the age 8 (year) were condensed in22.20±0.38. While, for the age 18 year this mean were in 58.80±1.26 little bit fluctuated compared to that in other ages. The distributions of weight for boysat all ages were positively skewed. The leptokurtic distributions of weight of boys were observed at the age interval 7-10 years. On the basis of bootstrap standard errors of the mean and bootstrap confidence intervals of the 95%, the estimated means of weight of boys by age were found on the basis of 1000 samples and may be considered as the population estimates.

Table 4 shows that mean weight of school girls about age 7 years was 21.51 kg with standard deviation 4.22 kg,about age 12 years was 36.14 kg with standard deviation 8.56 kg and about age 18 years it was 53.56 kg with standard deviation 12.35 kg. The estimated population mean weight for girls at the age 8 year were more condensed in the range 23.06±0.58. A little bit scattered range was found for the estimated mean weight of girls at the age 18 year as 53.56±1.54. The distributions of weight at all ages of girls were positively skewed. The leptokurtic distributions of weight were observed at the age 8, 9, 13 and 16-18 years. Using the bootstrap technique performed with 1000 samples, the estimated mean of weight of girls by age was estimated much more efficiently using bootstrap SE of mean and the bootstrap 95% confidence interval.

Table 3:- Descriptive statisticsand their bootstrap values of weight (kg) for the school boys.

Age (year)	N	Mean	SEM	95% CI for Mean		SD	Skewness	Kurtosis	Bootstrap (n=1000)			
									Mean	SEM	95% CI for Mean	
				Lower	Upper						Lower	Upper
7	24	20.42	0.54	19.31	21.53	2.63	0.72	0.62	20.41	0.53	19.42	21.49
8	79	22.20	0.38	21.43	22.96	3.41	0.28	0.35	22.18	0.38	21.48	22.98
9	89	25.02	0.45	24.12	25.91	4.26	0.83	0.77	25.00	0.43	24.17	25.85
10	89	28.18	0.56	27.07	29.28	5.25	0.95	0.77	28.20	0.57	27.07	29.31
11	78	31.70	0.78	30.15	33.25	6.88	0.70	-0.43	31.73	0.79	30.16	33.20
12	72	35.21	0.92	33.37	37.05	7.83	0.55	-0.66	35.21	0.94	33.42	37.11
13	69	39.65	1.01	37.63	41.67	8.41	0.54	-0.46	39.70	1.04	37.71	41.82
14	68	43.78	1.07	41.64	45.92	8.84	0.59	-0.36	43.80	1.07	41.72	45.99
15	68	47.79	1.13	45.54	50.05	9.32	0.65	-0.26	47.81	1.17	45.57	50.17
16	69	51.80	1.14	49.52	54.07	9.46	0.68	-0.21	51.76	1.15	49.71	54.03
17	68	55.63	1.17	53.29	57.96	9.67	0.68	-0.47	55.61	1.15	53.38	58.03
18	66	58.80	1.26	56.28	61.32	10.25	0.73	-0.58	58.81	1.25	56.43	61.49

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean, CI means confidence interval and SD means standard deviation. Source: calculated by the authors.

Table 4:- Descriptive statistics and their bootstrap values of weight (kg) for the school girls.

Age (year)	N	Mean	SEM	95% CI for Mean		SD	Skew-ness	Kurtosis	Bootstrap (n=1000)			
				Lower	Upper				Mean	SEM	95% CI for Mean	
7	21	21.51	0.92	19.59	23.44	4.22	0.74	-0.13	21.47	0.94	19.67	23.42
8	79	23.06	0.58	21.90	24.23	5.20	0.92	0.02	23.06	0.60	21.88	24.34
9	88	25.71	0.63	24.46	26.97	5.94	0.93	0.09	25.73	0.66	24.53	27.07
10	87	28.99	0.74	27.52	30.46	6.91	0.82	-0.33	28.97	0.74	27.61	30.54
11	78	32.63	0.85	30.95	34.32	7.46	0.73	-0.33	32.61	0.84	31.00	34.25
12	73	36.14	1.00	34.15	38.14	8.56	0.80	-0.35	36.15	1.00	34.26	38.10

13	67	39.76	1.15	37.46	42.06	9.43	0.60	0.04	39.66	1.17	37.31	41.96
14	67	43.61	1.17	41.28	45.94	9.56	0.81	-0.31	43.66	1.18	41.49	45.94
15	68	46.64	1.23	44.18	49.09	10.14	0.86	-0.15	46.65	1.26	44.16	49.07
16	69	49.43	1.30	46.84	52.02	10.78	0.95	0.03	49.41	1.34	46.82	52.02
17	67	51.85	1.40	49.05	54.65	11.49	1.05	0.23	51.86	1.37	49.19	54.81
18	64	53.56	1.54	50.48	56.65	12.35	1.06	0.31	53.51	1.49	50.46	56.29

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean, CI means confidence interval and SD means standard deviation. Source: calculated by the authors.

Age specific BMI with standard error (SEM) and 95% confidence intervals andbootstrappingfor the school boys and girls are shown in Tables 5 and 6, respectively. According to the classifications of BMI, the boys at ages 7 -14 years were indicated 'underweight' but 15-18 years of ages were 'normal weight'. The variation measured by standard error of mean and it indicating that the variation in BMI was increased with the increased of ages for both boys and girls except slightly differ at age 7. However, for girls, at the 7-12 years of ages were indicated 'underweight' but 13-18 years were 'normal weight'. The 'underweight' status for both boys and girls were not good sign of children of Jessore district and that may be occurred due to malnutrition. By using the bootstrap technique on 1000 samples, the estimated means of BMI by age were shown as the more robust from a bootstrap SE of mean as well as bootstrap 95% confidence intervals for both boys and girls. Bootstrap results (Table 5) highlighted that the boys aged up to 12 years were suffering from underweight problem and then after they were normal in weight. The BMI in the age interval 14.5-18.5 years for the boys and the interval 12.5-18.5 for girls attended normal weight but below of their age interval it showed underweight. About 42% boys and 33% girls showed always underweight in the age range 7-18 years. Only 2% girls and 1% boys showed overweight after the age 12 years. In this circumstances, detecting body fatness through the CDC's percentile curve technique will mislead the fact. The same type of results and comments would be made for girls (Table 6).Special attention to the pediatric children should be taken.

Table 5:- Age specific BMI and their bootstrap values for boys.

		Longitudinal Sample Data					Bootstrap (n=1000)			
Age (year)		Mean	SEM	95% CI for Mean			Mean	SEM	95% CI for Mean	
				Lower	Upper				Lower	Upper
7		14.39	0.26	13.85	14.94		14.39	0.27	13.86	15.00
8		14.44	0.17	14.11	14.77		14.44	0.17	14.11	14.77
9		15.07	0.19	14.68	15.45		15.07	0.18	14.72	15.44
10		15.68	0.22	15.23	16.12		15.68	0.22	15.26	16.13
11		16.35	0.29	15.78	16.92		16.35	0.28	15.81	16.90
12		17.00	0.34	16.33	17.67		17.02	0.35	16.37	17.70
13		17.86	0.36	17.14	18.57		17.86	0.36	17.20	18.63
14		18.44	0.36	17.72	19.17		18.41	0.36	17.72	19.16
15		19.02	0.38	18.26	19.78		19.05	0.39	18.31	19.85
16		19.63	0.38	18.86	20.39		19.64	0.39	18.90	20.38
17		20.35	0.41	19.53	21.18		20.38	0.42	19.61	21.24
18		21.09	0.45	20.19	21.99		21.11	0.45	20.23	22.00

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean and CI means confidence interval. Source: calculated by the authors.

Table 6:- Age specific BMI and their bootstrap values for girls.

		Longitudinal Sample Data					Bootstrap (n=1000)			
Age (year)		Mean	SEM	95% CI for Mean			Mean	SEM	95% CI for Mean	
				Lower	Upper				Lower	Upper
7		14.74	0.46	13.79	15.70		14.74	0.46	13.88	15.75
8		15.15	0.28	14.59	15.71		15.15	0.28	14.63	15.69
9		15.54	0.28	14.99	16.09		15.54	0.29	14.96	16.11
10		16.07	0.30	15.46	16.67		16.07	0.30	15.46	16.64
11		16.83	0.35	16.15	17.52		16.82	0.35	16.09	17.53
12		17.64	0.41	16.82	18.46		17.67	0.42	16.86	18.45

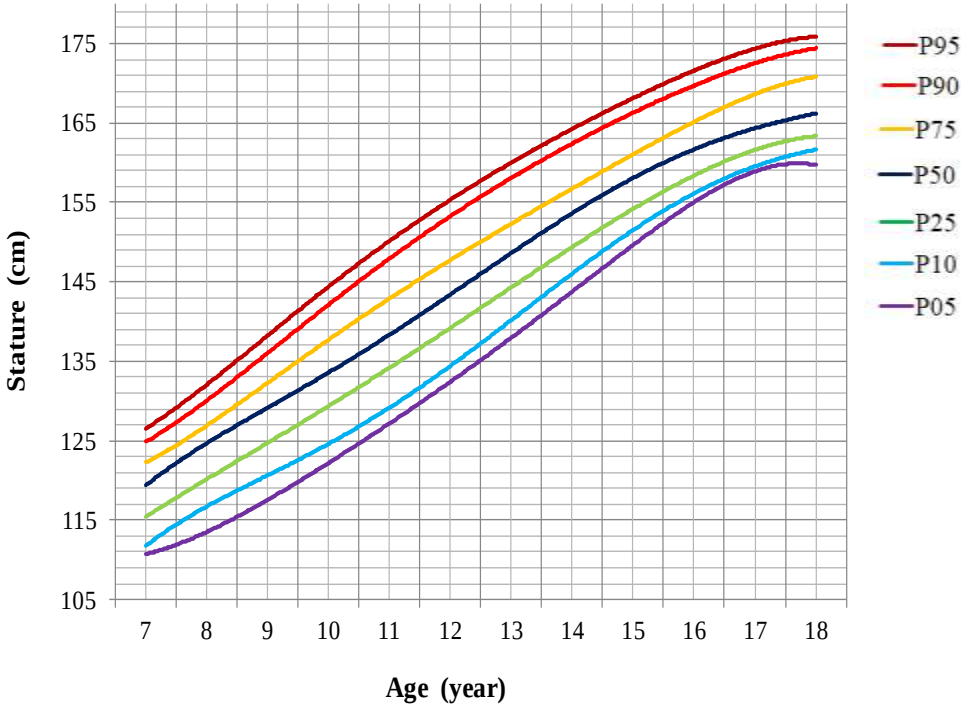
13		18.61	0.48	17.65	19.58		18.61	0.47	17.67	19.55
14		19.68	0.48	18.72	20.63		19.69	0.48	18.79	20.66
15		20.40	0.50	19.41	21.40		20.42	0.50	19.44	21.37
16		21.15	0.52	20.11	22.18		21.13	0.52	20.07	22.13
17		21.85	0.56	20.73	22.96		21.82	0.57	20.72	22.91
18		22.20	0.60	21.00	23.40		22.16	0.61	20.96	23.39

Note: Age 7 years means the age interval from 6.501 to 7.500 years, and so on; SEM means standard error of mean and CI means confidence interval. Source: calculated by the authors.

Seven percentile values 5th, 10th, 25th, 50th, 75th, 90th and 95th for stature and weight of boys and girls from 7-18 years of age were calculated through quantile regression using the software SPSS and percentile charts are constructed using MS-Excel. Each percentile value was smoothed by a polynomial function. Actually, the percentile curve of stature was smoothed with little fluctuation.

Growth charts of stature for age are shown in Figure 1 and 2 for boys and girls, respectively. These figures indicate that within the age of 7-18 years, growth in stature were more or less uniform for both boys and girls but an increasing diversity was observed in the growth of stature of boys for age after 11 years, and for girls after 8 years.Figure 1 indicates that within the age of 7-18 years, growth in stature of boys is more or less uniformly increasing for 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles. At the age of 7 years, stature of boys were 111.10 cm to 126.46 cm, at age of 12 years stature were 131.245 cm to 154.74 cm. and at age of 18 years stature were 159.81 cm and 175.96 cm.

Figure 2 indicates that within the age of 7-18 years, growth in stature of girls were also more or less uniformly increasing for 5th, 10th, 25th, 50th, 75th and 90th percentiles but an increasing diversity was observed in 95th percentile. At the age of 7 years, stature of girls were 109.85 cm to 131.94 cm, at age of 12 years stature were 132.44 cm to 151.44 cm and at age of 18 years stature were 149.125 cm to 166.55 cm. The 50th percentile curve shows at age 7 years, stature of respective boys and girls were119.4 cm and 121.2 cm, and at age 12 years, for boys is 143.35 cm, and for girls it was143.00cm, they were so close. The age at 18 years, the respective stature for boys and girls were 166.25cm and 154.25cm but the minimum stature were observed at age 7 with respective stature for boys and girls were 111.10 cm and 109.85 cm. On the other hand, at 95th percentile curve showed that the maximum stature of boys and girls at age 18 years were175.95 cm and 166.55 cm, respectively. So, boys were about 9 cm taller than girls.



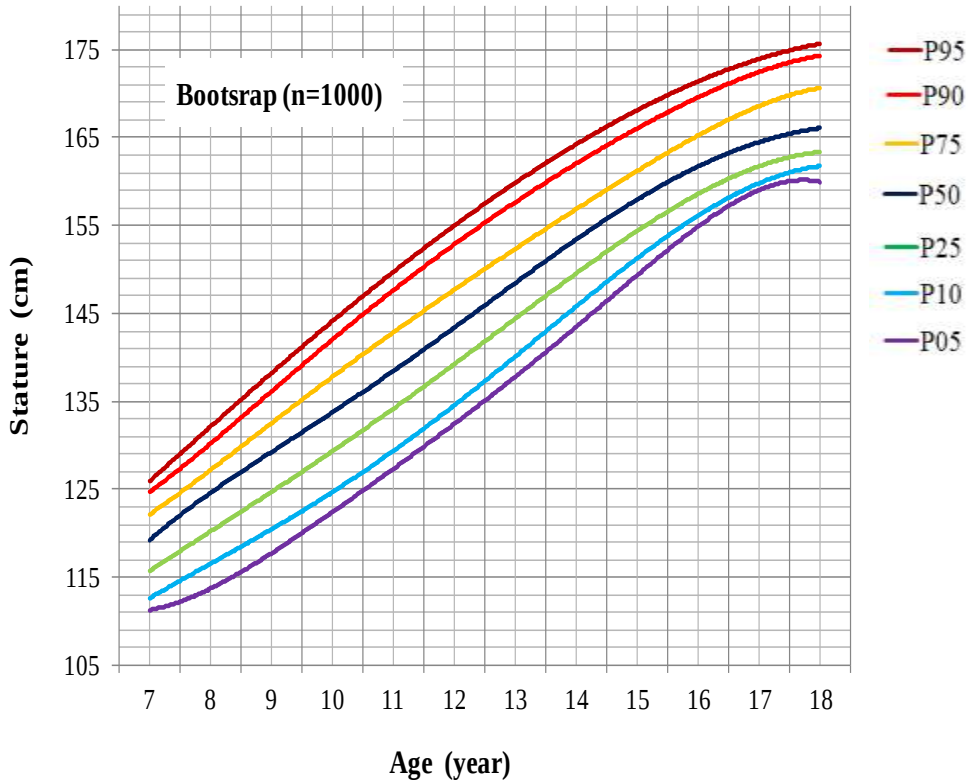
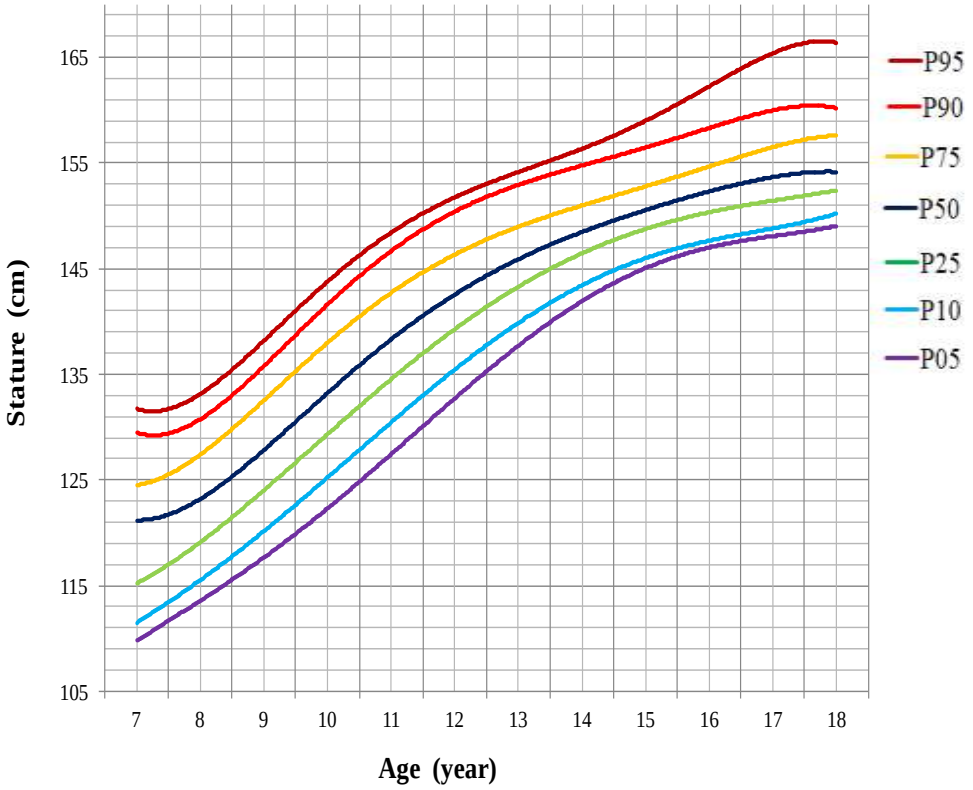


Figure 1:- Growth Chart of Stature for age from the sample data (upper graph) and bootstrap (lower graph) of School Boys. Source: Drawn by the authors.



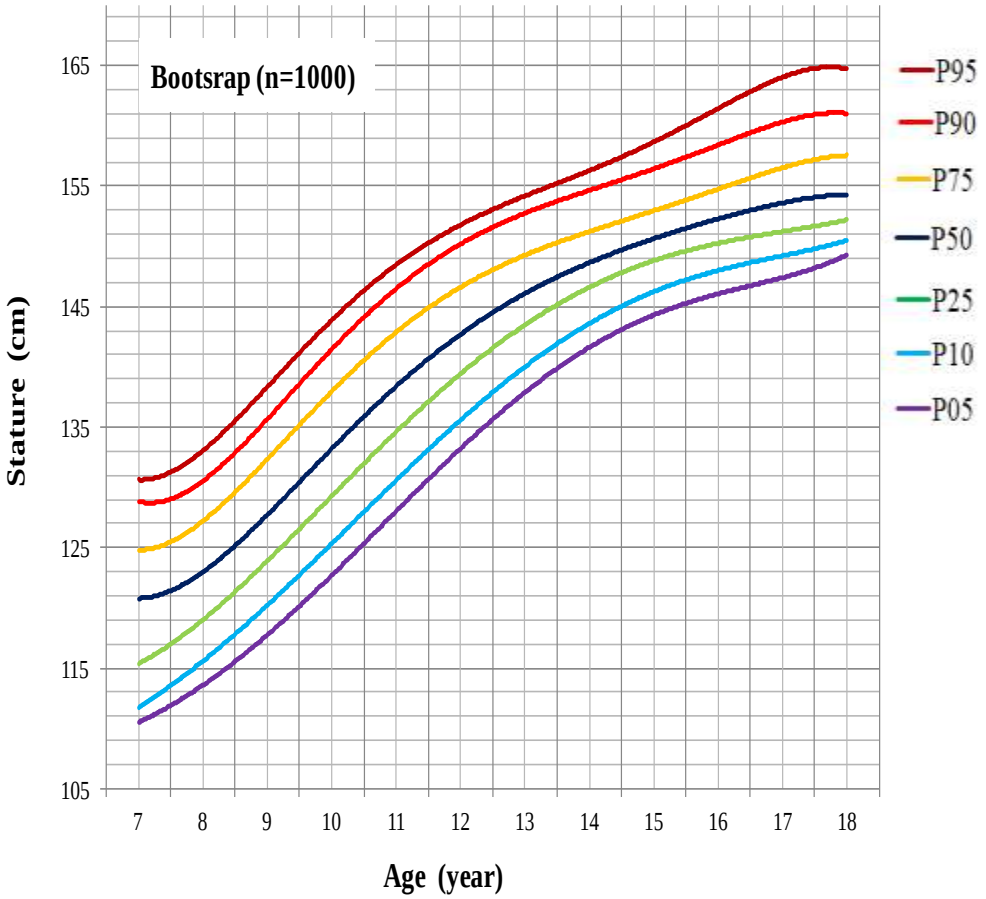


Figure 2:- Growth Chart of Stature for age from the sample data (upper graph) and bootstrap (lower graph) of School Girls. Source: Drawn by the authors.

Growth chart of weight for age of the boys and girls are shown in Figure 3 and 4, respectively. These figures indicate that within the age of 7-10 years, growth in weight were more or less uniform for both boys and girls. But an increasing diversity was observed in the growth of weight of boys and girls at age 10 to 18 years. For boys, the weight were in 15.88 kg to 26.25 kg at age 7 years, in 24.65 kgto50.00 kg at age 12 years and in 46.05 kgto 77.00 kg at age 18 years. For girls, at the age of 7 years weight were in 15.15 kg to 30.35 kg,in 27.05 kg to 52.45 kg at age 12 years and in 38.00 kgto 78.00 kg at age 18 years. The 50th percentile curves show that, at age 7 years, weight of boys was 20.13 kg for girls itwas 20.50 kg, at age 12 years, boys was 33.50 kg and girls was 32.00 kg and at age 18 years, the weight of boys was 56.00 kg and girls was 50.00 kg. But there are slight differences at age 7 and 12 years. Thusthe sexual different in weight was about 6 kg at age 18 years.

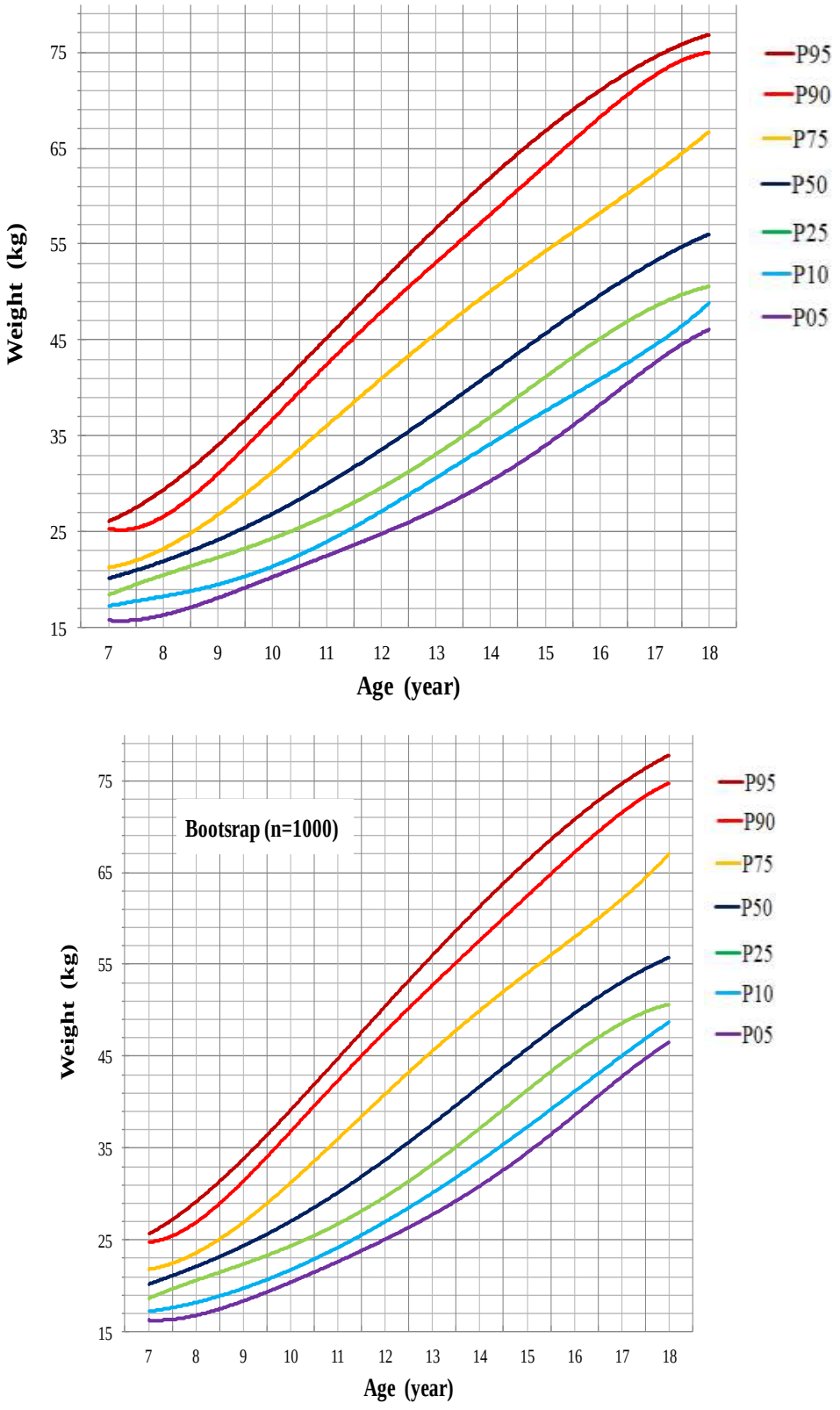


Figure 3:- Growth Chart of weight for age from the sample data (upper graph) and bootstrap (lower graph) of School Boys. Source: Drawn by the authors.

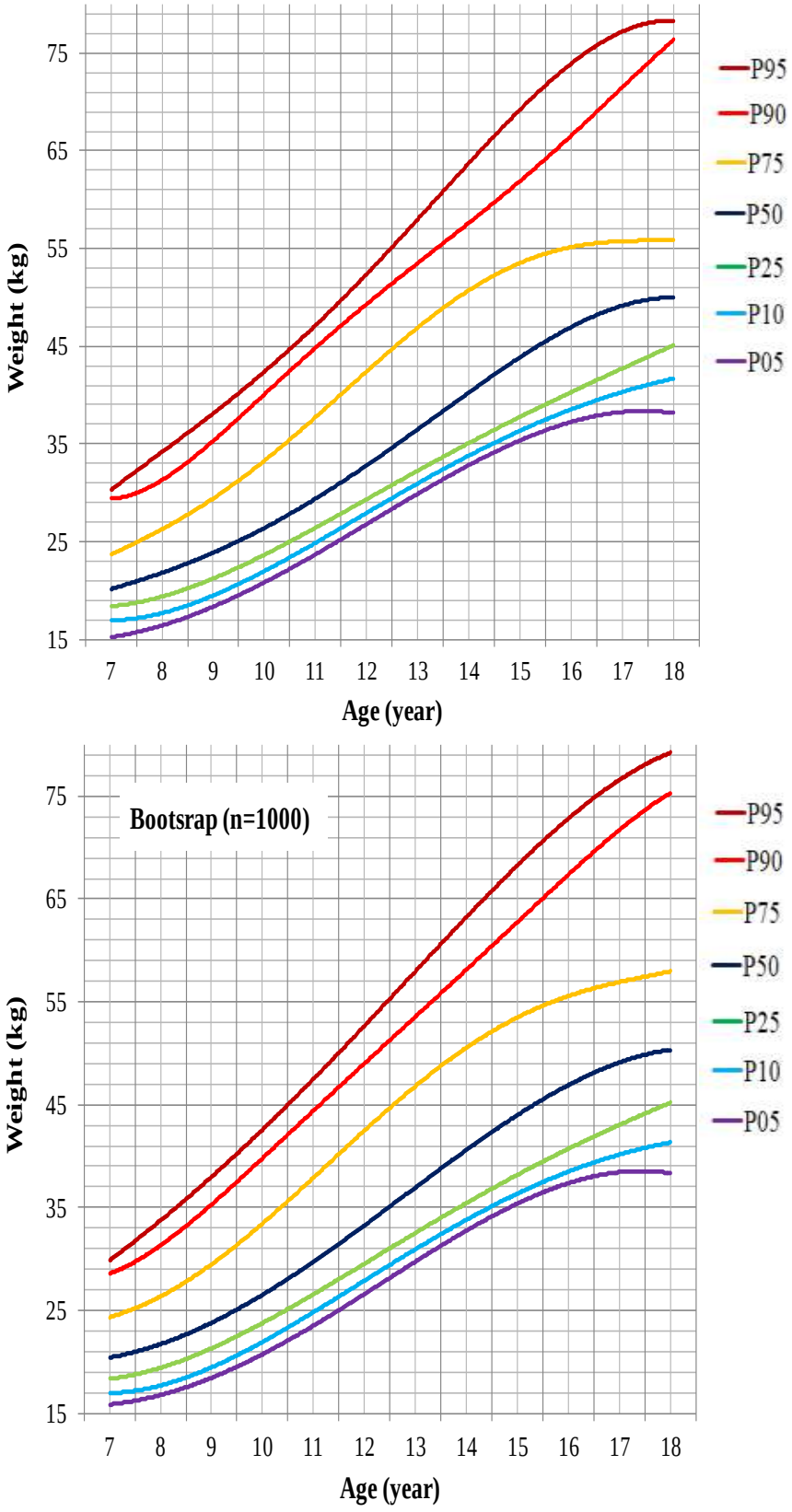
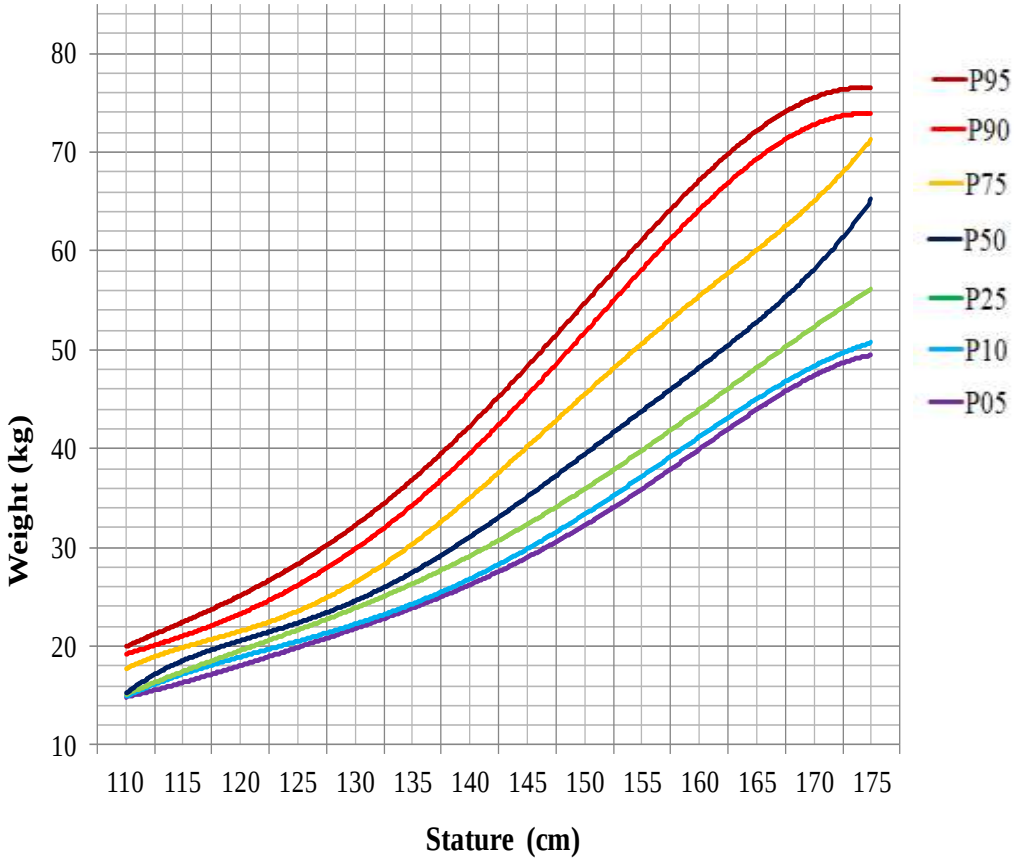


Figure 4:- Growth Chart of weight for age from the sample data (upper graph) and bootstrap (lower graph) of School Girls. Source: Drawn by the authors.

Growth percentile chart of weight for stature is shown in Figure 5 for boys. This figure indicates that within the stature of 110-130 cm, weight were more or less uniformly increasing for 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles. Within the stature of 130-175 cm, weight were more or less uniformly increasing for 5th, 10th and 25th percentiles but an increasing diversity is observed in 50th, 75th, 90th and 95th percentiles. At the stature 110 cm, weight of males were in 15 kg to 20 kg; at the stature of 130 cm, weight were in 22 kg to 32 kg; at the stature of 150 cm, weight werein 33 kg to 55 kg; and at the stature of 175 cm, weight were in 49.5 kg to 78 kg. Growth percentile chart of weight for stature is shown in Figure 6 for girls. This figure indicates that within the stature of 110-140 cm, growth in weight were more or less uniformly increasing for 25th, 50th and 75th percentiles. Within the stature of 140-165 cm, weight were more or less uniformly increasing for 50th, 75th and 90th percentiles but an increasing diversity were observed in 5th, 10th, 25th and 95th percentiles. At the stature of 110 cm, weight of girls were in 15 kg to 20 kg; at the stature of 130 cm, weight were in 21.5 kg to 36.175 kg; at the stature of 150 cm, weight were in 34 kg to 65.625 kg; and at the stature of 165 cm, weight were in 66.5 kg to 84.5 kg . Weight for age shows that the upper 25% of the heavier children continued their stricklyincreasing patterns both in their stature and weight. This implies 25% of the children were getting proper food intake. This research will be knocked the rest of the 75% guardians to take initiatives for improving the dietary plan of their children (Figure 5 and 6). In case of girls, special attention for increasing their weights were noticed after attending their stature 147 cm (Figure 6).



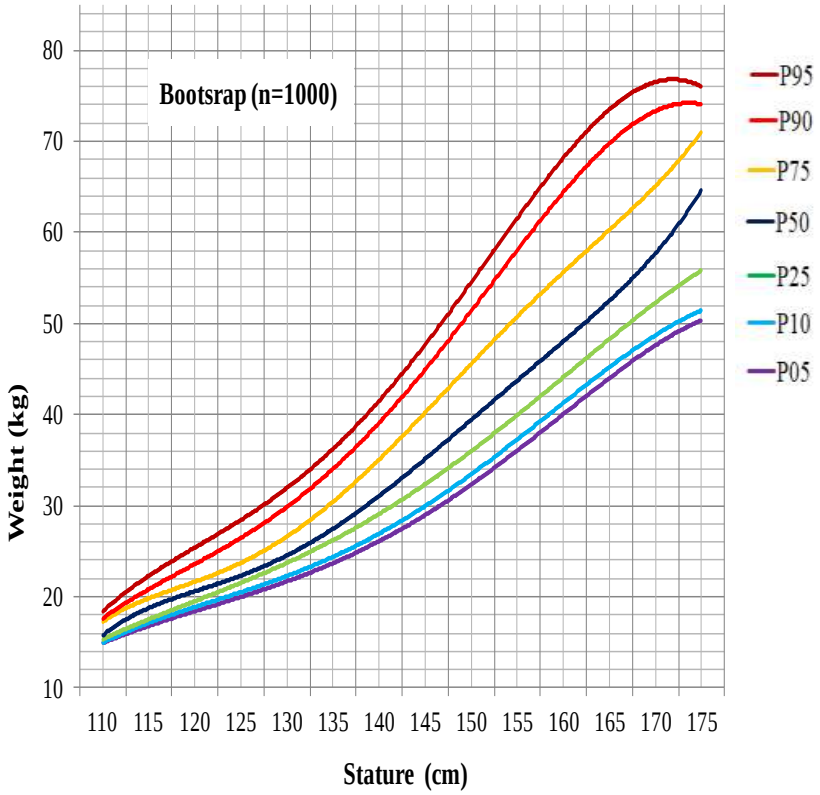
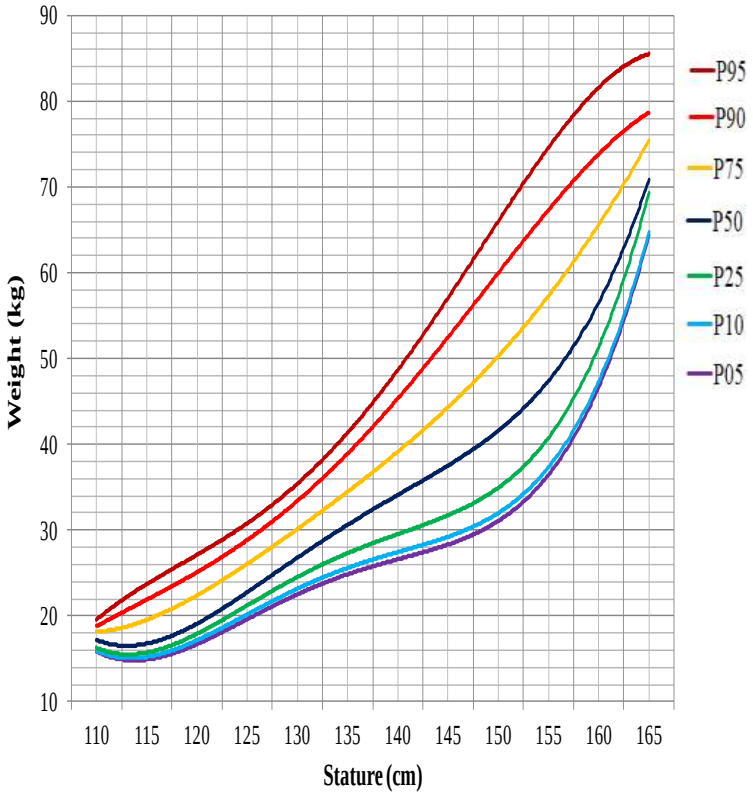


Figure 5:- Growth Chart of weight for stature from the sample data (upper graph) and bootstrap (lower graph) of School Boys. Source: Drawn by the authors.



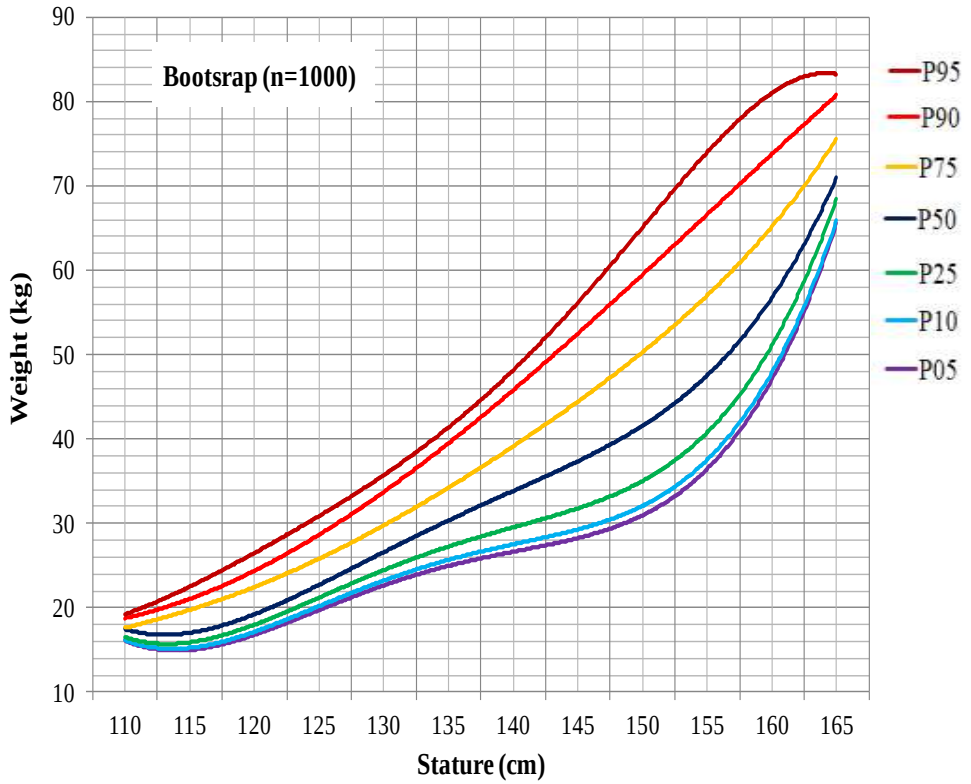


Figure 6:- Growth Chart of weight for stature from the sample data (upper) and bootstrap (lower graph) of School Girls. Source: Drawn by the authors.

Discussion:-

The Stature for age implied that for boys it was smoothly increasing while for girls it was smoothly increasing until age 12.5 but after that age it was increasing with slow motion and also motion with ups and down.

Now, we went to compare stature among Bangladeshi,Isabela (Philippines) and Japanese boys and girls data(Table 7 and 8). Table 7 presented mean, standard deviation (SD) and difference for stature among the Bangladeshi, Isabela (Philippines) and Japanese boys. This table showed that our estimate weremore condensed than Isabela (Philippines) and Japanese data because the standard deviation of our estimate (minimum SD = 4.31 and maximum SD = 6.93) at different ages compared toIsabela (Philippines) (minimum SD = 4.3 and maximum SD = 8.8) and Japanese (minimum SD = 5.1 and maximum SD = 7.8) data. This table also divulged that Bangladeshi boys are taller than Isabela (Philippines) boys but shorter than Japanese boys. This may due to either genetically or environmental impact on growth that may be disclosed by further research.

Table 8 presentsmean, standard deviation (SD) and the differences of stature among the Bangladeshi, Isabela (Philippines) and Japanese girls. This table divulges that our estimate weremoreconsistentthan Japanese and Isabela (Philippines) girls data except age at 7 of Isabela (Philippines) (SD = 3.6). This table also shows that Bangladeshi girls were taller than Isabela (Philippines) girls but smaller than Japanese girls. This may due to either genetical or environmental impact on growth that may be disclosed by further research.

Table 7:- Mean and standard deviations of stature in Isabela (Philipins), Japanese and Bangladeshi boys.

		Isabela Boys			Japanese Boys			Bangladeshi Boys			Difference		
Age (year)		Stature (cm)			Stature (cm)			Stature (cm)			BGD minus ISAB		BGD minus JPN
	N	Mean	SD		Mean	SD		N	Mean	SD	Mean Stature (cm)		Mean Stature (cm)

7	43	111.9	4.3		124.8	5.1		24	118.94	4.31		7.04	-5.86
8	72	115.1	5.3		130.1	5.3		79	123.70	5.62		8.60	-6.40
9	70	120.0	4.5		135.2	5.7		89	128.54	5.69		8.54	-6.66
10	49	122.7	5.8		140.5	6.3		89	133.67	5.96		10.97	-6.83
11	56	129.1	5.5		146.6	7.2		78	138.64	6.93		9.54	-7.96
12	54	132.9	7.3		153.9	7.8		72	143.32	6.58		10.42	-10.58
13	35	138.9	8.1		160.8	7.4		69	148.52	6.25		9.62	-12.28
14	16	141.1	8.8		165.7	6.4		68	153.62	5.88		12.52	-12.08
15	2	142.1	-		168.4	5.8		68	158.16	5.48		16.06	-10.24
16	1	140.4	-		169.7	5.6		69	162.23	4.94		21.83	-7.47
17								68	165.28	4.61		-	-
18								66	167.02	4.82		-	-

Source: Ashizawa et al., (1987) and calculated by the authors.

Table 8:- Mean and standard deviations of stature in Isabela (Philipins), Japanese and Bangladeshi girls.

		Isabela Girls			Japanese Girls			Bangladeshi Girls			Difference		
Age (year)		Stature (cm)			Stature (cm)			Stature (cm)			BGD minus ISAB		BGD minus JPN
	N	Mean	SD		Mean	SD		N	Mean	SD	Mean Stature (cm)		Mean Stature (cm)
7	33	111.1	3.6		124.2	5.2		21	120.46	6.25	9.36		-3.74
8	64	114.7	4.7		129.8	5.6		79	122.86	5.69	8.16		-6.94
9	57	120.9	5.1		135.7	6.2		88	128.07	6.35	7.17		-7.63
10	63	124.6	6.4		142.2	6.6		87	133.70	6.30	9.10		-8.50
11	61	130.3	6.7		148.2	6.3		78	138.73	6.01	8.43		-9.47
12	48	136.5	6.3		152.7	5.7		73	142.70	5.41	6.20		-10.00
13	20	138.6	6.1		155.4	5.3		67	145.90	4.68	7.30		-9.50
14	4	145.5			156.7	5.1		67	148.68	4.19	3.18		-8.02
15	1	150.5			157.2	5.0		68	151.06	4.13	0.56		-6.14
16								69	152.78	4.33	-		-
17								67	153.98	4.42	-		-
18								64	155.21	4.38	-		-

Source: Ashizawa et al., (1987) and calculated by the authors.

Table 9 and 10 present mean, standard deviation (SD) and the differences for weight among the Bangladeshi, Isabela (Philippines) and Japanese boys and girls, respectively. Table 9 shows that the estimated weights were more condensed in the case of Bangladeshi boys than Japanese boys because the standard deviation of our estimate at different ages were minimum than that of Japanese data except very few points. But, on the basis of standard deviation, Isabela (Philippines) boys produced better estimate than Bangladeshi and Japanese boys data. This table also divulge that Bangladeshi boys were heavier than Isabela (Philippines) boys but lighter than Japanese boys.This results are in accord with the results of stature for boys.

Table 10 shows that Bangladeshi girls were heavier than Isabela (Philippines). Bangladeshi girls were shorter and lighter than Japanese girls (Table 7 and 10). On the other hand, Bangladeshi girls weremalnutrient and normal in BMI (Table 6)and also lighter than Japanese girls that may indicate low calorie intake of the Bangladeshi girls.

Table 9:- Mean and standard deviations of weight in Isabela (Philipins), Japanese and Bangladeshi boys.

Age (year)		Isabela Boys			Japanese Boys			Bangladeshi Boys			Difference		
		Weight (kg)			Weight (kg)			Weight (kg)			BGD minus ISAB		BGD minus JPN
	N	Mean	SD		Mean	SD		N	Mean	SD	Mean Weight (kg)		Mean Weight (kg)

7	43	17.9	1.8		25.1	4.0		24	20.42	2.63		2.52	-4.68
8	72	18.8	2.1		28.0	4.8		79	22.20	3.41		3.4	-5.8
9	70	20.7	2.0		31.1	5.8		89	25.02	4.26		4.32	-6.08
10	49	21.8	2.6		34.7	6.8		89	28.18	5.25		6.38	-6.52
11	56	24.5	2.8		39.2	7.9		78	31.70	6.88		7.2	-7.5
12	54	26.8	5.0		44.6	8.8		72	35.21	7.83		8.41	-9.39
13	35	31.0	5.1		50.2	9.2		69	39.65	8.41		8.65	-10.55
14	16	32.5	6.0		55.5	9.4		68	43.78	8.84		11.28	-11.72
15	2	34.8	-		59.0	9.3		68	47.79	9.32		12.99	-11.21
16	1	30.5	-		60.8	8.9		69	51.80	9.46		21.3	-9
17								68	55.63	9.67		-	-
18								66	58.80	10.25		-	-

Source: Ashizawa et al., (1987) and calculated by the authors.

Table 10:- Mean and standard deviations of weight in Isabela (Philipins), Japanese and Bangladeshi girls.

Age (year)		Isabela Girls			Japanese Girls			Bangladeshi Girls			Difference		
		Weight (kg)			Weight (kg)			Weight (kg)			BGD minus ISAB		BGD minus JPN
	N	Mean	SD		Mean	SD		N	Mean	SD	Mean Weight (kg)		Mean Weight (kg)
7	33	17.2	1.8		24.6	3.9		21	21.51	4.22	4.31		-3.09
8	64	18.7	1.9		27.6	4.8		79	23.06	5.20	4.36		-4.54
9	57	21.0	2.9		31.2	5.8		88	25.71	5.94	4.71		-5.49
10	63	22.6	2.8		35.5	6.8		87	28.99	6.91	6.39		-6.51
11	61	25.6	4.5		40.4	7.4		78	32.63	7.46	7.03		-7.77
12	48	29.2	4.3		44.9	7.4		73	36.14	8.56	6.94		-8.76
13	20	32.5	4.8		48.3	7.1		67	39.76	9.43	7.26		-8.54
14	4	37.5	-		50.9	7.1		67	43.61	9.56	6.11		-7.29
15	1	41.5	-		52.3	7.1		68	46.64	10.14	5.14		-5.66
16	-	-	-		-	-		69	49.43	10.78	-		-
17	-	-	-		-	-		67	51.85	11.49	-		-
18	-	-	-		-	-		64	53.56	12.35	-		-

Source: Ashizawa et al., (1987) and calculated by the authors.

Conclusion:-

This was a first longitudinal study of stature and weight during the year2006-2018 of school children of Jeshore District in Bangladesh.Mean stature (in cm) of Jessore school boys in the age interval 7-18 years successively were: 118.94±0.88, 123.69±0.65, 128.52±0.60, 133.64±0.62, 138.60±0.78, 143.31±0.80, 148.51±0.74, 153.63±0.74, 158.18±0.65, 162.21±0.57, 165.30±0.57, and 167.02±0.57. For girls, the successive values of stature (in cm) in the age interval 7-18 years were: 120.55±1.36, 122.87±0.64, 128.04±0.70, 133.70±0.67, 138.70±0.70, 142.75±0.65, 145.91±0.55, 148.68±0.50, 151.04±0.50, 152.80±0.52, 153.94±0.54, and 155.19±0.56. Mean weight of school boys about age 7 years was 20.42 kg with standard deviation 2.36 kg, about age 12 years was 35.21 kg with standard deviation 7.83 kg and about age 18 years, it was 58.80 with standard deviation 10.25 kg. The population mean weight for boys at the age 8 (year) were condensed in 22.20±0.38. While, for the age 18 year this mean were in 58.80±1.26 little bit fluctuated compared to that in other ages. Mean weight of school girls about age 7 years was 21.51 kg with standard deviation 4.22 kg, about age 12 years was 36.14 kg with standard deviation 8.56 kg and about age 18 years it was 53.56 kg with standard deviation 12.35 kg. The estimated population mean weight for girls at the age 8 year were more condensed in the range 23.06±0.58. A little bit scattered range was found for the estimated mean weight of girls at the age 18 year as 53.56±1.54.

The stature for age implied that for boys it was smoothly increasing while for girls it was smoothly increasing until age 12.5 but after that age it was increasing with slow motion and also motion with ups and down.

The weight for age shows that the upper 25% of the heavier children continued their strickly increasing patterns both in their stature and weight. This implies 25% of the children were getting proper food intake. This research will be knocked the rest of the 75% guardians to take initiatives for improving the dietary plan of their children (Figure 5 and 6). In case of girls, special attention for increasing their weights were noticed after attending their stature 147 cm (Figure 6).

The BMI in the age interval 14.5-18.5 years for the boys and the interval 12.5-18.5 for girls attended normal weight but below of their age interval it showed underweight. About 42% boys and 33% girls showed always underweight in the age range 7-18 years. Only 2% girls and 1% boys showed overweight after the age 12 years.Specialattention to the pediatric children should be taken.

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