CHAPTER-VII

SUMMARY

The present study is an anthropometric study based on cross-sectional investigation of the growth and nutritional status of the Pnar adolescents in the Jaintia Hills district of Meghalaya. The study is conducted on both the boys and girls aged 8 to 18 years in the three villages of Mookaiaw, Shangpung and Mootyrchiah located in the Laskein Community Block Development of Jaintia hills. A total of 923 individuals comprising of 417 boys and 506 girls have been measured. The data obtained from the villages, were by visiting the house to house visits. Each subject measured on 14 anthropometric variables, i.e., the weight, height, sitting height, biacromial diameter, chest circumference, waist circumference, hip circumference, mid-upper arm circumference, calf circumference, biceps, triceps, subscapular, suprailiac and calf skinfold.

To each and every subject some necessary information have been taken like socio-economic status of the family, food habits, observable clinical deficiencies and the general information on the subject from the parents or the informant. All the subjects were apparently physically and mentally healthy and belonging to the different socio-economic families. The data collected were analysed on the descriptive statistics, in order to arrive at the suitable interpretation. T-test was also applied in order to fine out the differences (if any) in the pattern of growth for various anthropometric variable between age groups and sexes of the present study. The chi-square was also used for the categorical values and proportion where ever present. Univariate analysis of variance was used in order to check the influence of the socio-economic factors on the anthropometric variables. Logistic regression was used separately for both boys and girls on the different factors to check the association of them on the undernutrition. The nutritional status of the subjects was revealed by the LMS method of z-score on the BMI for age, height for age and weight for age. The cut-off points were taken as >-2 the normal, for undernutrition the cut-off of <-2 to-3 as the moderate and <-3 the severe. The BMI, height and weight were compared with WHO and CDC percentiles. The PB1 model was also used in order to find out the biological parameters such as adult height, peak height, age at peak height and rate of velocity.

The present data were also compared with the Indian populations of plain tribal the Shabar of Orissa (Chakrabarty and Bharati, 2008), the North Eastern populations of Assamese Muslims (Begum and Choudhury, 1999), Khasi of Meghalaya (Das et. al., 2010), Niam Khasi boys and Khasi non-hybrid (NHB) girls (Khongsdier and Mukherjee, 2003, 2003), and also with the national data of ICMR (ICMR, 1989).

The major findings of the present study are as follow:

Growth Pattern

Weight: The weight of the subjects had shown an increasing gain with increasing age groups from 8 to 18 years in both the sexes. In boys, the weight was slightly heavier than the girls in age groups 8 to 9 years then proceeded to be lighter from 10 to 15 years and started to be heavier again from 16 to 18 years. While comparing between the sexes, it can be seen from the figure: 2.2 and table: 2 that, the growth rate of girls are better than the boys in the young ages that is 9 to 11 years, 13 years and also at later stage of 18 years, whereas in other ages the boys have better weight increment than the girls.

On smoothening the data through the fourth degrees of polynomial and the first degree of its derivatives, the boys showed an adult weight of 51.30 kg, the peak weight of 33.43 kg at the age of 12.50 years with a velocity rate of 3.72 kg/year; where as in girls an adult weight of 47.04 kg, peak weight of 27.76 kg at the age of 10.50 years and the velocity rate of 3.26 kg/year, this predicted that, the boys have yet to achieve the adult weight and the girls has already achieved at the age of 18 years, it can also be said that the adolescent growth spurt of the weight shows respectively at the age of 12.5 years and 10.5 years in the boys and girls (figure: 2.2).

Height: A similar growth pattern also occurred with the height where the subjects have also got an increasing height gradually with respect to age in both the sexes. The height of the boys was shorter from age groups of 8 to 13 years and started to be taller from age groups 14 to 18 years to the girls. In comparison between boys and girls, it can be seen that, the boys growth rate is higher than the girls in all the ages,

except at the age groups 10 and 18 years where the girls has slightly higher than the boys.

On smoothening the data through the model of Preece and Baines, it is predicted that, in boys, an adult height of 160.64 cm, peak height of 148.44 cm at the age of 14.08 years and velocity rate of 6.95 cm/year can be attained, this shows that, the boys' height (160.64 cm) at the age of 18 years has not reached the adult height and the adolescent growth spurt occurred at 14.08 years; whereas in girls the model predicted an adult height of 150.22 cm, peak height of 139.43 cm at the age of 12.44 years and the velocity rate of 5.48 cm/year, this shows that the girls height (150.36 cm) has also reached the adult height by the age 17 years and the growth spurt occurred at the age of 12.44 years (figure: 3.2).

Sitting Height: Besides the weight and height, sitting height also has displayed an increasing growth gradually from age groups of 8 to 18 years in both sexes. In boys, the sitting was slightly shorter at the age group of 8 years and 10 to 14 years, however it was increasing in the age group of 9 years and 15 to 18 years when compared to that of the girls. While comparing, the growth rate of the boys was advanced in the age groups of 9, 12 and 14 to 17 years where as in other age groups was decreasing to the girls'.

The sitting height of the boys predicted by the model that the adult sitting height was 86.67 cm, the peak sitting height of 76.58 cm at the age of 13.75 years and the velocity rate 3.34 cm/year, this shows that, the boys sitting height (84.87 cm) has not yet reached the adult sitting height by the age of 18 years and the growth spurt has occurred by the age of 14 years. In girls, the predicted values shown by the model that the adult sitting height was 80.37 cm, the peak sitting height of 72.48 cm at the age of 12.03 cm and the velocity rate of 2.85 cm/year. This also shows that, the girls at the age of 18 years were almost to reach the adult sitting height and the growth spurt has already occurred by the 13 years (figure: 4.2) of age.

Biacromial Diameter: The subjects had shown an increasing biacromial diameter gradually from 8 to 18 years of age except at the age groups of 16 and 17 years where the girls showed a slightly decreased biacromial diameter. While

comparing, the growth rate of the boys was advanced in the age groups of 9, 12-14 and 16-17 years where as in the other age groups was decreasing to the girls'.

The biacromial diameter of the boys predicted by the model revealed that the adult biacromial diameter of 37.30 cm, the peak biacromial diameter of 32.34 cm at the age of 13.91 years and the velocity rate at 2.00 cm/year can be attained. This shows that the boys have not reached the adult biacromial diameter by the age of 18 years. And the growth spurt has reached by the age of 14 years, whereas in girls, the biacromial diameter predicted the adult biacromial diameter of 34.27 cm, peak biacromial diameter of 30.86 cm at the age of 12.66 years and the velocity rate of 1.32 cm/years. This shows that the girls have reached the adult biacromial diameter by the age of 18 years and the growth spurt occurred before reaching the 13 years of age.

Chest Circumference: The chest circumference of the subjects has shown a broader chest girth gradually in both the sexes except at the age group of 18 years in boys. In boys, the chest circumference was broader in the younger age groups of 8 to 9 years and also at the age group of 17 years, whereas, the girls had broader chest girth in all the other age groups studied. When compared, the growth rate of the boys advanced in the later age groups of 14-17 years where as in the other age groups was decreased to the girls'. It was observed from figure: 6.2 and table: 6 that the peak growth occurred at the age groups of 13 years in both boys and girls.

Waist Circumference: The waist circumference of the subjects was shown to be broader in both sexes gradually but, except at the age groups of 10 years and 18 years where the boys show slightly decreased circumference. When compared, the growth rate of the boys advanced in the age groups of 11 and 14-17 years where as in the other age groups was decreasing to the girls'. It was observed from figure: 7.2 and table: 7 that the peak growth occurred at the age group of 16 years in boys and 13 years in girls.

Hip Circumference: The subjects had shown a broader hip circumference gradually in both the sexes except a slight decrease in the age group 17 years of the girls and the girls' hip circumference was broader than the boys in all the age groups from 8 to 18 years. It appeared that the peak growth of boys and girls occurred at the age groups of 15 years and 13 years respectively.

Mid-Upper Arm Circumference (MUAC): A bigger mid-upper arm circumference in both the subjects occurred gradually in all the age groups except 18 years and 16 years in boys and girls respectively. It was also evident from the table 9 and figure 9.1 that the girls had bigger arm circumferences than the boys in the age groups of 8-15 years and also at the age groups of 18 years, although at the age of 16 and 17 years the boys had surpassed by having a bigger arm circumference than the girls. When compared, the growth rate of the boys was advanced only in age groups of 11-12, 14 and 16-17 years where as in the other age groups was decreasing to the girls'. It was observed from figure: 9.1 and table: 9 that the peak growth occurred at the age groups of 16 and 13 years in the boys and girls respectively.

Calf Circumference: The subjects had shown a bigger calf circumference gradually in both the sexes as the age increases except in the age group of 18 years in boys, 12, 16 and 17 years in girls. It is also seen that the boys had a smaller calf circumference than the girls but after the age of 16 years onward the boys showed bigger calf circumference than the girls. While comparing, the growth rate of the boys was advanced only in age groups of 12, 14, 16 and 18 years where as in other age groups was decreasing to the girls'. It was observed from figure: 10.1 and table: 10 that the peak growth occurred at the age group of 11 and 13 years in boys and girls respectively.

Biceps Skinfold: The accumulation of biceps skinfold in boys and girls shown to be different in both sexes in all age groups, in which the boys were showing a lesser deposition of fat at the higher age groups whereas a higher fat deposit at the higher age groups in girls. While comparing, the growth rate of the boys was advanced only in age groups of 9, 11, 15, and 17 years where as in other age groups was lesser to the girls'. It was observed from figure: 11.1 and table: 11 that the peak accumulation of fat occurred at age groups of 11 and 16 years in boys and girls respectively.

Triceps Skinfold: The subjects had shown that, the accumulation of fat in triceps was also going differently in both the sexes in all the age groups in which the boys were showing more or less a similar deposition of fat in all age groups from 8 to 18 years. In case of girls, there was a gain in deposition of fat from 8 to 18 years of age, except at the age groups of 12 and 17 years where a lesser fold was deposited. When

compared, the rate of fat accumulation in boys was advanced only in age groups of 11-12 years and 16-17 years whereas in other age group was lesser to the girls'. It was observed from figure: 12.1 and table: 12 that the peak accumulation of fold occurred at age groups 11 and 13 years in boys and girls respectively.

Subscapular Skinfold: The accumulation of fat in subscapular of the subjects was going different in both the sexes with an increasing age groups, the girls has got a high rate of fat accumulation in the age groups of 12-15 and 18 years than the boys. It appeared that, the peak accumulation of fat in boys and girls occurred at age groups 17 and 13 years respectively.

Suprailiac Skinfold: The subjects had shown that, the accumulation of suprailiac skinfold was going different in both sexes, but with gaining of fold as the age goes on increasing except the age groups 10 and 18 years among the boys, where a slightly lesser fold was shown, and the girls have got higher fold to that of the boys in all age groups. When compared, the growth rate of boys was advanced only in age groups of 15-17 years whereas in other age group was reducing to the girls'. It was observed from figure: 14.1 and table: 14 that the peak accumulation occurred at the age groups of 15 and 18 years in boys and girls respectively.

Calf Skinfold: The subjects had shown that the accumulation of calf skinfold was going differently in both sexes. In girls, it was gaining with increasing age groups except at age 12 years and 17 years where the skinfold was slightly lesser. However, in boys there was a slightly higher and lesser in calf skinfold from 8 to 18 years of age. While comparing, the accumulation rate of boys was advanced only in the age groups of 11-12 years and slightly in 16-17 years whereas in other age groups was decreasing to the girls'. It was observed from figure: 15.1 and table: 15 that the peak accumulation of fat occurred at the age groups of 11 and 13 years in boys and girls respectively.

Nutritional Status:

Table: 16.1, had shown that the BMI for age has a high normal condition (88.73% and 91.50%) than the wasting conditions (11.27% and 8.50%) in all the age groups of boys and girls respectively. The wasting conditions has shown more in boys (11.27%) than in girls (8.50%) and the severe condition (2.64% and 1.38%) was less

than the moderate condition (8.63% and 7.12%) and showed no significant differences between the boys and girls (χ^2=2.690, df=2, p>0.05). In higher age groups from 16-18 years in boys and 15-18 years in girls no severe condition were occurred and in 16-17 years all the girls were in normal condition.

Table: 16.2, had shown that most of the boys were stunted in the age groups of 8-12 years and 17 years and an equal prevalence of normal and stunting conditions in the age groups of 15 and 18 years, the moderate stunting (39.09%) was higher than the severe condition (14.63%) and in overall the boys were more prone to the stunting condition than the normal condition (53.72% and 46.28%). In girls the subjects were stunted in the age groups of 8-9 and 13-17 years, the prevalence of moderate stunting (36.16%) was higher than the severe condition (13.64%) of stunting and the age group of 15 years was free from the severe condition of stunting, in overall almost half of the girls were subjected to stunting condition (49.80%) than the normal condition (50.20%). The stunting condition in boys was higher than the girls and the height for age of the boys and girls showed no significant difference (χ^2=1.373, df=2, p>0.05) between them.

Table: 16.3, had shown that in boys the subjects were underweight in the age groups of 8-10 and 12 years, an equal prevalence of normal and underweight condition in the age groups of 13 years and from the age groups of 14-18 years the normal condition was higher than the underweight condition. The moderate underweight (29.97%) was higher than the severe condition (17.27%) in all the age groups except the age group of 8 years and in overall the normal condition was a little highly occurred than the underweight conditions (52.76% and 47.24%). In girls the subjects were underweight only in age groups of 8 years and from 9-18 years the normal condition was higher than the underweight condition, the moderate underweight was higher than the severe condition in all the age groups except the 15 years which showed an equal condition of underweight categories, in overall the girls were in a normal weight (63.64%) than the underweight condition (36.36%) and the underweight condition in boys (47.25%) was higher than the girls (36.36%). The weight for age of the boys and girls showed a significant difference (χ^2=10.582, df=2, p<0.01) between them.

The clinical signs of nutritional status such as oedema, keratomalacia, bitot's spot, pale conjunctiva, epiphyseal enlargement, rickets and ichthyosis have been observed on each and every boy and girl taken for the measurements, they are appear to have no deficiency signs on the deficiencies signs taken in the study, which are the signs of deficiencies of vitamin A, vitamin D, vitamin C and iron.

The influencing of the socio-economic factors on nutritional status

Influence of mother's occupation

In BMI for age (table: 17.1), the normal conditions (88.97% and 91.70%) were higher than the wasting conditions (11.03% and 8.30%) in both the boys and girls respectively. In boys, the moderate condition is shown to be higher than the severe condition in all the categories of occupation except in dependent mothers where severe condition (5.50%) was higher than moderate condition (3.66%) and in business mothers, there was no severe condition (0.00%). In girls, the moderate condition (6.92%) was higher than the severe condition (1.38%) and in business and agriculture an equal condition of wasting conditions appeared of 3.33% and 2.08% in moderate and severe respectively. The influence of mother's occupation in boys has a significant effect (χ^2=20.666, df=8, $p<0.05$) where as in girls no significance (χ^2=5.068, df=8, $p>0.10$) has occurred.

In the case of height for age (table: 17.2), in boys, mothers with an occupation of service (51.33%), business (62.96%) and agriculture (55.56%) showed a high influence in the normal conditions than the stunting conditions (48.67%, 37.04% and 44.44%) respectively whereas the boys subjected to mothers of daily wage and dependent occupations have a low normal condition (36.59% and 44.95%) and the stunting conditions were higher (63.41% and 55.05%). It was observed that the mother's occupation has significantly influence on height for age (χ^2=14.164, df=8, $p<0.10$). In girls, the normal condition displayed higher influence in the business (63.34%), agriculture (54.17%) and dependent (52.55%) than the stunting conditions of 36.33%, 46.83% and 47.45% respectively whereas to service and daily wage the stunting condition (53.12% and 52.15%) showed higher than normal condition (46.88%

and 47.85%). The influence of categories of mother's occupation on height for age was not significantly affected (χ^2=12.980, df=8, p>0.10).

In the case of weight for age (table: 17.3), a higher normal condition (53.48% and 63.83%) than the underweight conditions of moderate (29.26% and 23.91%) and severe condition (17.26% and 12.26%) in both boys and girls had occurred respectively except the dependent mothers (48.62%) in boys. The effect of the mother occupations in the weight for age was not significantly influenced in both boys (χ^2=7.427, df=8, p>0.10) and girls (χ^2=8.992, df=8, p>0.10).

Influence of mother's education

In case of BMI for age (table: 18.1), in both boys and girls the normal condition (88.97% and 91.70%) had overtaken the wasting conditions of moderate condition (8.39% and 6.92%) and severe condition (2.64% and 1.38%) respectively. The influence of the mother education showed a significant in boys (χ^2=15.934, df=6, p<0.05) and in girls no significant (χ^2=3.611, df=6, p>0.10) had occurred.

In the case of height for age (table: 18.2), the normal condition has shown higher by the illiterate (51.69%), secondary (51.71%) and tertiary (55.77%) education in girls whereas in boys only by illiterate (52.48%) education, the moderate condition (38.61% and 35.77%) was higher than the severe condition (14.87% and 13.83%) in both boys and girls respectively. The influences of the mother education on height for age have no significant differences in boys (χ^2=6.183, df=6, p>0.10) as well as in girls (χ^2=8.890, df=6, p>0.10).

In the weight for age (table: 18.3), a higher normal condition in all levels of mother's education (63.83%) than the underweight conditions of moderate (23.91%) and severe (12.26%) have been observed in the girls, whereas in boys it has displayed the same i.e., a higher normal condition (53.48%) than the underweight conditions of moderate (29.26%) and severe (17.26%) but in the secondary (48.73%) and tertiary (48.00%) education a low normal condition occurred and the underweight conditions have shown to be higher (51.27% and 52.00%). The influence of the mother's education on the nutritional index of weight for age was not significantly affected (χ^2=6.795, df=6, p>0.10) in boys and (χ^2=4.215, df=6, p>0.10) girls.

The influence of household income

In the case of BMI for age (table: 19.1), in both the boys and girls has shown a higher normal condition (88.97% and 91.70%) than the wasting condition (11.03% and 8.30%) and the moderate condition (8.39% and 6.92%) was higher than the severe condition (2.64% and 1.38%). The low income group has shown higher normal condition (90.38% and 95.04%) in both the boys and girls, and the least by middle income group (87.27%) in boys and high income group (86.32%) in girls. The influences of the different categories of income on the conditions of BMI for age were not significant in boys (χ^2=2.053, df=4, p>0.10) and showed a significant difference in the girls (χ^2=9.034, df=4, p<0.10).

The height for age (table: 19.2), of the subjects has shown a lower normal condition (46.52% and 50.40%) than the wasting condition (53.48% and 49.60%) in both boys and girls respectively. The distribution of the income categories on the different conditions of the height for age was not significantly influenced in both the boys (χ^2=5.159, df=4, p>0.10) and girls (χ^2=1.915, df=4, p>0.10).

In the case of weight for age (table: 19.3), the normal condition (53.48% and 63.83%) has shown to be higher than the moderate (29.26% and 23.91%) and severe (17.26% and 12.26%) conditions in both the boys and girls respectively. The distribution of the income categories on the different conditions of weight for age has come to be known that, no significant influence occurred in both boys and girls respectively (χ^2=1.096, df=4, p>0.10 and χ^2=0.507, df=4, p>0.10).

The influence of family size

In the case of BMI for age (table: 20.1), the normal condition (88.97% and 91.70%) is shown to be higher than the wasting conditions (11.03% and 8.30%) in both the boys and girls respectively. The distribution of the family size on the BMI for age was significantly affected in boys (χ^2=21,021, df=8, p<0.10) and no significant influences in girls (χ^2=3.012, df=8, p>0.10).

In the case of height for age (table: 20.2), in boys, the normal condition has shown only by small (53.79%) family size, whereas in the other categories the stunting conditions (53.48%) were higher than the normal (46.52%) and the moderate condition

(38.61%) was higher than the severe condition (14.87%). In girls, the normal condition is observed only with the family size of small (52.82%), large (56.96%) and largest (100.00%), whereas in the smallest and average family size the stunting conditions were higher than the normal condition (40.91% and 47.30%) respectively. The influence of the family size was not showing a significant on the height for age in boys (χ^2=8.282, df=8, p>0.10), whereas in girls the influence of the family size showed a significant (χ^2=21.180, df=8, p<0.01) difference.

In weight for age (table: 20.3), the influence of family size showed a high normal condition in all the categories except the smallest (43.75%) and largest (20.00%) family size in the boys. The distribution of family size on the weight for age was not significant in both the boys (χ^2=10.646, df=8, p>0.10) and girls (χ^2=6.892, df=8, p>0.10).

Influencing of socio-economic factors on anthropometric variables

In all categories of factors, the anthropometric variables showed a pattern of growth which increase from younger to the older age groups, but in all the factors in between age groups a decreased growth was occurred, the following has given only on the effects which shown the significances on the different anthropometric variables.

Influence of mother's occupation

The weight (table 21.1), in boys showed no significant differences by the effect of occupations (p>0.05). In girls, the significant difference has shown by the agriculture to all the categories of occupation in the age groups of 8 years (F=2.765 and p<0.05, table: 21.1.1).

The height (table 21.2) showed no significant differences in the different age groups of the boys (p>0.05). In girls, the significant difference occurred between the agriculture and all the different occupations in age group 8 years (F=3.270 and p<0.05, table: 21.2.1) and 14 years (F=2.895 and p<0.05, table: 21.2.2) between the service, agriculture and dependent.

The sitting height in boys and girls showed no significant differences by the effect of occupations in different age groups ($p>0.05$, table 21.3).

In biacromial diameter, the occupations have not shown any significant difference in the age groups of boys and girls ($p>0.05$, table 21.4).

In chest circumference, there were no significant differences showed by the effect of occupations in different age groups of both boys and girls ($p>0.05$, table 21.5).

The waist circumference (table 21.6), showed a significant difference in boys between agriculture, service, daily wage and dependent and also between service and daily wage occupation in age groups of 10 years ($F=3.760$ and $p<0.05$, table 21.6.1), and in girls in 12 years between agriculture and all the occupations and also between daily wage and dependent ($F=3.172$ and $p<0.05$, table 21.6.2).

The hip circumference, showed no significant differences in all the age groups of both boys and girls ($p>0.05$) (table 21.7).

The MUAC in both boys and girls showed no significant differences by the effect of occupations in all age groups ($p>0.05$, table 21.8).

The calf circumference, in boys showed a significant difference between agriculture and all occupations in the age groups of 10 years ($F=2.778$ and $p<0.05$, table: 21.9.1) in boys and in girls, no significant differences have observed in all age groups of girls ($P>0.05$, table 21.9).

The biceps skinfold (table 21.10), in boys showed no significant differences in all age groups ($p>0.05$). In girls, the significant difference was observed in the age groups of 14 years ($F=4.167$ and $p<0.05$, table: 21.10.1) between occupations of service and daily wage.

The triceps skinfold (table 21.11), in both boys and girls showed no significant differences in all the age groups ($p>0.05$).

The subscapular skinfold (table 21.12), in both boys and girls showed no significant differences in all the age groups ($p>0.05$) effected by the mother's occupation.

The suprailiac skinfold (table 21.13), in both the boys and girls, have shown no significant differences in the effect of mother's occupation in all age groups ($p>0.05$).

The calf skinfold (table 21.14), in both the boys and girls, have shown no

significant differences in the effect of mother's occupation in all age groups ($p>0.05$).

Influence of mother's education

The weight in boys showed a significant difference in the age group 15 years ($F=3.712$ and $p<0.05$, table: 22.1.1) between secondary and illiterate, primary and tertiary educated mothers. In girls, significant differences were observed in age groups of 13 years ($F=4.179$ and $p<0.05$, table: 22.1.2) between secondary and all categories of education and 14 years ($F=3.390$ and $p<0.05$) between illiterate and secondary and tertiary education (table 22.1.3).

In height, there were significant differences observed in different age groups of boys and girls ($p>0.05$).

The sitting height has showed significant differences in the girls which are at the age groups of 11 years ($F=2.988$ and $p<0.05$, table: 22.3.1) and 12 years ($F=3.043$ and $p<0.05$, table: 22.3.1) between tertiary and all categories of education, and illiterate and secondary respectively.

The biacromial diameter in boys has shown no significant difference in all ages ($p>0.05$, table 22.4). While in girls a significant difference was noted in the age group of 11 years ($F=3.178$ and $p<0.05$) between tertiary and all categories of education (table 22.4.1).

The chest circumference in boys showed no significant difference in all age groups ($p>0.05$, table: 22.5). In girls, a significant difference occurred in age groups of 11 years ($F=3.709$ and $p<0.05$, table 22.5.1) between tertiary and all categories of education.

The waist circumference has shown no significant differences in all age groups on the effect of the categories of mother's education ($p>0.05$). However in girls, the significant difference occurred in age group of 14 years ($F=3.159$ and $p<0.05$, table 22.6.1) between tertiary, secondary and illiterate education.

The hip circumference of boys, has shown no significant difference occurred in all age groups of boys ($p>0.05$). In girls, significant differences have observed (table 22.7) in age groups of 11 years ($F=3.085$ and $p<0.05$ table 22.7.1) between primary, secondary and tertiary education, 13 years ($F=2.909$ and $p<0.05$, table 22.7.2) between

illiterate and secondary and 14 years (F=2.910 and p<0.05, table 22.7.3) between illiterate, primary and secondary education.

In both sexes, the MUAC has got no significant differences in all age groups of boys (p>0.05, table 22.8).

The calf circumference in boys showed a significant difference in the age group of 15 years (F=5.177 and p<0.05, table: 22.9.1) between secondary and illiterate, primary and tertiary education. But in girls, a significant difference occurred in age groups of 13 years (F=3.499 and p<0.05), between secondary, illiterate and primary education (table: 22.9.2).

The biceps skinfold, in boys showed a significant difference in the age group of 16 years (F=5.932 and p<0.05, table 22.10.1) between tertiary, illiterate, primary and secondary education. In girls, the significant differences were observed between tertiary, secondary and primary in age group of 10 years (F=2.948 and p<0.05, table 22.10.2) and 14 years (F=3.721 and p<0.05, table 22.10.2) between secondary and illiterate.

The triceps skinfold (table 22.11) in boys, showed a significant difference in the age group of 16 years (F=3,228 and p<0.05, table: 22.11.1) between illiterate, primary and secondary education. In girls, no significant differences have seen in all age groups of girls (p>0.05).

The subscapular skinfold (table 22.12), in boys, has shown a significant difference occurred between illiterate and secondary education in the age group of 15 years (F=3.665 and p<0.05, table: 22.12.1). In girls, no significant differences were seen in the age groups affected by the mother educations (p>0.05).

The suprailiac skinfold (table 22.13), in boys, showed the significant differences in age groups of 13 years (F=4.267 and p<0.05, table 22.13.1) between illiterate, tertiary, primary and secondary education, and 16 years (F=3.879 and p<0.05, table 22.13.2) between tertiary, illiterate and secondary education. In girls, the significant differences showed by educations in the age group of 10 years (F=4.351 and p<0.05) between illiterate and secondary mothers, and also between primary, secondary and tertiary, and 11 year (F=3.277 and p<0.05) between primary, secondary and tertiary.

The calf skinfold (table 22.14), in boys, showed a significant difference in the age group 16 years ($F=3.397$ and $p<0.05$, table: 22.14.1) between illiterate, primary and secondary, and also between illiterate and tertiary. In girls, the significant difference was shown by the effect of educations between illiterate and secondary, and secondary and tertiary in the age group of 14 years ($F=4.450$ and $p<0.05$, table: 22.14.2).

Influence of household income

The effect of different groups of household income on weight (table: 23.1), in boys, have shown significant difference only in the age 15 years ($F=3.672$ and $p<0.05$, table: 23.1.1) between the MIG and LIG. In girls, the significant difference occurred in age groups of 12 years ($F=3.197$ and $p<0.05$, table: 23.1.2) between the HIG and MIG and 14 years ($F=5.666$ and $p<0.05$, table: 23.1.3) between the HIG, MIG and LIG.

The height (table: 23.2), showed a significant difference in girls between the LIG and HIG in the age group of 14 years ($F=6.621$ and $p<0.05$, table: 23.2.1) and the LIG and MIG in 16 years ($F=4.449$ and $p<0.05$, table: 23.2.2), whereas in boys, there were no significant differences in all age groups ($p>0.05$).

The sitting height (table 23.3), in boys, showed no significant differences ($p>0.05$). In girls, a significant difference was found in the age group of 14 years ($F=5.126$ and $p<0.05$, table 23.3.1) between the HIG and LIG.

The biacromial diameter (table 23.4), showed a significant difference in the age group of 15 years ($F=4.916$ and $p<0.05$, table: 23.4.1) between the MIG and LIG was observed. However, in girls, a significant difference was seen in the age group of 14 years ($F=3.597$ and $p<0.05$, table: 23.4.2) between LIG to HIG and MIG.

The chest circumference was observed a significant difference in boys, in the age groups of 15 years between the LIG and MIG, HIG ($F=5.029$ and $p<0.05$, table: 23.5.1) and 17 years ($F=6.324$ and $p<0.05$, table: 23.5.2) between the HIG, LIG and MIG. While in girls, a significant difference was seen only between the LIG and HIG, MIG in the age group 14 years ($F=4.965$ and $p<0.05$, table: 23.5.3).

The waist circumference (table 23.6), observed no significant difference in any age groups of boys, whereas, in girls it was noted in age groups of 9 years ($F=6.4.980$

and p<0.05, table: 23.6.1) and 14 years (F=3.586 and p<0.05, table: 23.6.2) between HIG and LIG.

The hip circumference (table 23.7), in boys, showed a significant difference was observed in income groups of MIG and LIG in the age group of 15 years (F=7.255 and p<0.05, table 23.7.1). In girls, significant differences were observed in age groups of 12 years between HIG and LIG (F=4.713 and p<0.05, table 23.7.2) and 14 years in HIG and LIG (F=4.217 and p<0.05, table 23.7.3).

The MUAC showed no significant differences by income groups in all age groups (p>0.05) of boys. In girls, a significant difference was shown in the age group 14 years between HIG and LIG (F=6.603 and p<0.05, table 23.8.1).

The calf circumference (table 23.9), in boys, showed a significant difference in the age groups of 15 years (F=3.748 and p<0.05, table 23.9.1) between the MIG and LIG. In girls, a significant difference was also observed in the age groups of 12 years (F=3.694 and p<0.05, table 23.9.2) between HIG and LIG.

The accumulation of fat in biceps (table 23.10), of boys, showed a significant difference in the age groups of 15 years (F=7.534 and p<0.05, table 23.10.1) between the HIG and LIG. In girls, the significant difference was observed in the age groups of 14 years (F=5.776 and p<0.05, table 23.10.2) between the LIG, HIG and MIG.

The accumulation of fat in triceps (table 23.11), in boys, showed the significant differences in the age groups of 12 years (F=3.591 and p<0.05, table 23.11.1) between LIG and MIG, and 15 years (F=3.520 and p<0.05, table 23.11.2) between LIG and HIG. However in girls, a significant difference was also observed in the age groups of 12 years (F=4.415 and p<0.05, table 23.11.3) between the MIG and LIG.

In the subscapular skinfold (table 23.12) a significant difference was observed in the age group of 15 years between the HIG and LIG (F=6.382 and p<0.05, table 23.12.1).While in girls, a significant difference was occurred in the age groups of 14 years between LIG, HIG and MIG (F=8.305 and p<0.05, table 23.12.2).

The accumulation of fat in Suprailiac, in boys, showed significant differences in the age groups of 13 years between HIG, MIG and LIG (F=4.598 and p<0.05, table 23.13.1), 15 years (F=3.873 and p<0.05, table 23.13.2) between HIG and LIG and 17 years (F=3.357 and p<0.05, table 23.13.3) between HIG and LIG. In girls, no

significant differences ($p>0.05$) were observed in different age groups shown by the income groups (table 23.13).

The accumulation of fat in calf (table: 23.14), in boys, observed no significant differences in all age groups of boys ($p>0.05$). In girls, the significant differences were observed between LIG and MIG in 9 years ($F=3.629$ and $p<0.05$, table: 23.14.1), and LIG and HIG in 14 years ($F=5.887$ and $p<0.05$, table: 23.14.2).

Influence of family size

The weight (table 24.1), occurred no significant differences in all the age groups of boys ($p>0.05$). In girls, the significant difference was observed in age groups of 14 years ($F=3.499$ and $p<0.05$, table: 24.1.1) between smallest, average, large and largest family size, and also between average and small family size.

The height (table 24.2) in boys, observed no significant difference in age groups of boys ($p>0.05$). In girls, a significant difference was observed in the age groups of 14 years ($F=4.138$ and $p<0.05$, table: 24.2.1) between the smallest family sizes and all the categories of family size.

The sitting height (table: 24.3), in boys, showed a significant difference in the smallest family size to all the groups of family sizes in the age groups of 14 years ($F=4.274$ and $p<0.05$, table: 24.3.1) and in girls no significant difference occurred in the boys ($p>0.05$).

The biacromial diameter (table 24.4), in boys, observed no significant differences in all the age groups by family sizes ($p>0.05$). In girls, significant differences were shown in age groups 11 years ($F=3.495$ and $p<0.05$, table: 24.4.1) between large, small and average family sizes, and 14 years ($F=2.873$ and $p<0.05$, table: 24.4.2) between smallest, average and largest, and also between small and largest family sizes.

The chest circumference (table 24.5), in boys, showed no significant differences in different age groups shown by effect of family sizes ($p>0.05$). In girls too, the significant differences were observed in the age groups of 11 years ($F=3.880$ and $p<0.05$, table: 24.5.1) between large, small and average family size, and 14 years

(F=3.171 and p<0.05, table: 24.5.2) between largest, small and smallest family size and also average and smallest family size.

The waist circumference (table 24.6) in boys showed no significant differences in age groups by family sizes (p>0.05). Whereas, in girls, there were significant differences in the age groups of 10 years (F=2.964 and p<0.05, table: 24.6.1) between small and average, and also largest and all the family sizes, 14 years (F=3.251 and p<0.05, table: 24.6.1) between smallest, average, large and largest family sizes and also between small and largest family sizes, and 17 years (F=3.775 and p<0.05, table: 24.6.1) between average, small and large family sizes.

The hip circumference (table 24.7) in boys showed that the family sizes had no significant differences in different age groups of boys (p>0.05), while in girls, the significant differences were observed in family sizes of average and large in the age groups of 11 years (F=4.278 and p<0.05, table: 24.7.1), 13 years (F=4.278 and p<0.05, table: 24.7.2) in smallest, small, average and large family sizes, and 14 years (F=3.419 and p<0.05, table: 24.7.3) in the smallest and all the family sizes, and also between small and average.

The MUAC (table 24.8), in both the sexes has shown no significant differences in all age groups (p>0.05).

The calf circumference (table 24.9) has got no significant differences occurred in all age groups of boys (p>0.05), and in girls it was occurred in the age groups of 10 years (F=2.776 and p<0.05, table: 24.9.1) between average, small and large family sizes.

The accumulation of fat in biceps (table 24.10) of girls, has shown the significant differences in the age groups of 14 years (F=2.630 and p<0.05, table 24.10.1) between the small and average family sizes and 17 years (F=2.915 and p<0.05. table 24.10.2) between the smallest, small and large family sizes, and no significant difference occurred in age groups of the boys (p>0.05).

The accumulation of fat in triceps (table 24.11) of the subjects was not showing any significant effect of the family sizes in all the age groups of the boys and girls (p>0.05).

The accumulation of fat in subscapular (table 24.12), in both the sexes has shown no significant differences by the effect of family sizes ($p>0.05$).

The accumulation of fat in suprailiac (table 24.13), in boys, showed a significant difference in the large, small and average family sizes in the age groups of 17 years ($F=3.914$ and $p<0.05$, table 24.13.1). In girls, the significant differences were occurred in age groups of 10 years ($F=3.192$ and $p<0.05$, table 24.13.2) between largest, smallest and average family sizes and also between small and average family sizes, 11 years ($F=4.422$ and $p<0.05$, table 24.13.3) between large and average family sizes, 12 year ($F=5.111$ and $p<0.05$, table 24.13.4) between small, average and large family sizes and 15 years ($F=3.266$ and $p<0.05$, table 24.13.5) between the small and large family sizes.

The accumulation of fat in calf (table 24.14) of boys, showed a significant difference in the age groups of 12 years ($F=5.706$ and $p<0.05$, table 24.14.1) between smallest family size and all family sizes. Whereas in girls, a significant difference was seen in age groups of 14 years ($F=2.929$ and $p<0.05$, table 24.14.2) between the small and average family sizes.

The distribution of growth between the two consecutive age groups and between the sexes in the same age group considering in term of statistical significance was shown as follow:

The distribution of growth differences in boys between the age groups (table: 25) had shown highly statistical significance in the age groups of 10-11 years followed sequentially by age groups of 13-14, 15-16, 8-9, 12-13, 14-15, 16-17, 11-12 and lastly by 9-10 years. There were no growth differences in the age groups of 17-18 years. Of all the measurements, the ponderal and linear measurements especially the weight, biacromial diameter, height and sitting height showed the highly significant differences in growth in all age groups, followed by the growth girths sequentially shown significant differences by the chest, hip, waist, calf and lastly by mid-upper arm circumference, and the least by skinfold thicknesses where the highest is shown by subscapular, triceps, suprailiac and lastly by biceps and calf skinfold.

The distribution of growth differences in girls between the age groups (table: 26) had shown highly statistical significance in the age group of 12-13 years followed sequentially by age groups of 10-11, 8-9, 9-10, 14-15, 17-18, 13-14, 11-12 years and lastly by 15-16 years. There was no growth difference in the age groups of 16-17 years. Of all the measurements the ponderal and linear measurements sequentially by the weight, biacromial diameter, height and sitting height have got highly statistical significant differences in growth of all age groups followed by growth girth sequentially shown a high significance by the hip, muac, chest, calf and lastly by waist circumference, and the least by skinfold thicknesses where the highest shown sequentially by subscapular, triceps, suprailiac, biceps and lastly by the calf skinfold.

The distribution of growth differences in age groups between boys and girls (table: 27) had shown highly statistical significance in the age group of 10 years followed sequentially by age groups of 17, 16, 13, 18, 15, 14, 11, 12, 8 years and lastly by 9 years. Of all the measurements, the skinfold thicknesses have got highly statistical significant differences in growth of all age groups which were contributed highly by triceps, subscapular, calf, biceps and lastly by suprailiac skinfold followed by the growth girths of the hip, chest, muac, calf and lastly by waist circumference, and the least by the ponderal and linear measurements of weight, height, sitting height and lastly by biacromial diameter.

Mean Z-Score

The mean z-score in boys was found to be normal (>-2) in the age groups of 8-18, 14-15 and 13-17 years in the BMI for age, height for age and weight for age respectively, whereas in other age groups, the indices were found to be ‘undernutrition’ (<-2) (table: 28 and figure: 16).

The mean Z-Score in girls was found to be normal (>-2) respectively in the age groups of 8-18 years, 10-13 and 17 years, and 10-18 years in the BMI for age, height for age and weight for age whereas in the other age groups, they were found to be ‘undernutrition’ (<-2) in the different indicators (table: 28 and figure: 17).

The significant differences of Z-Score in different age groups of boys and girls, and also between boys and girls in the same groups are shown as follow:

According to BMI for age (table: 28), in boys, there were no significant differences occurring except in age groups of 17-18 years and 16-17 years of normal and moderate condition respectively, and there were no subjects of age groups 12, 13, 16, 17 and 18 years in severe condition. In girls, a highly significant difference occurred in normal condition of the age group 12-13 years, there were no subjects in age groups of 15, 16, 17, and 18 years in moderate condition of wasting, and in severe condition there were no subjects found of wasting except the age groups of 11 and 12 years.

The height for age (table: 29) of the subjects had shown that in boys, there was a significant difference in the age groups of 12-13 years of normal condition and 14-15 years in moderate condition of stunting, no significant differences occurred in the age groups of severe condition. In girls, a significant difference occurred in the age groups of 11-12 years and 8-9 years in normal and moderate category respectively and there were no significant differences which occurred in severe conditions of stunting.

The t-test of the weight for age (table: 30) has shown that in boys, there were significant differences in the normal condition of the age groups of 11-12 and 12-13 years and no significant differences occurred in all the age groups of underweight conditions. Similarly, in the girls also no significant differences occurred in all the age groups of the normal and underweight conditions.

The t-test between the boys and girls (table: 31) had shown that in the BMI for age, a highly significant difference occurred in age groups of 13, 14 and 18 years, and a significant difference in age groups 15 and 16 years in normal category, and also no significant differences in the wasting conditions. In height for age, a significant difference occurred in the age groups of 8, 10, 12, 15 and 16 years in normal condition, and also in age groups of 9 and 14 years in moderate condition of stunting, there was no significant difference occurring in severe condition. In the weight for age, a highly significant difference occurred in the 18 years, and a significant difference in the 10, 11, 13, and 14 years in normal category, and also a significant difference in the 10 and 15 years of age in moderate and severe conditions respectively.

Influences of different socio-economic factors and age on the undernutrition of the boys and girls:

Wasting

It is seen from the table (table: 32.1) that, the wasting was not significantly associated in boys with the socio-economic factors and age, whereas in girls it had shown a negative association in age (B=-0.376 ± 0.077, p<0.05) and income (B=-0.610 ± 0.077, p<0.05). The age groups of 8 years (B=2.819 ± 1.083, p=0<0.05) and 9 years (B=2.228 ± 1.115, p=0<0.05) showed a positive association and the prevalence of wasting of 16.754 times in 8 years (CI=2.007-139.867, p<0.05) and 9.283 times in 9 years (CI=1.044-82.555, p<0.05) when compared to the highest age group. The income of the HIG showed a positive association (B=1.281 ± 0.482, p<0.05) and the prevalence of 3.601 times (CI=1.399-9.269, p<0.05). After adjusting, the age in girls still showed the significant association. It evidently implied the need of proper attention in the low age groups or the preadolescence age groups (table: 32.2).

Stunting

Table 33.1, had shown no significant association of different factors and the stunting condition of both boys and girls (p>0.05), except the age in boys, where a negative association was shown (B=-0.084 ± 0.033, p<0.05) with 0.920 times (CI=0.862-0.981, p<0.05) of prevalence of stunting. But no particular age was associated with stunting (p>0.05), this could be the reason of the genetic influences in each and every age group (table: 33.2).

Underweight

The underweight of the subjects (table: 34.1) showed a significant association in age groups of both boys and girls (p<0.05) and socio-economic factors have not shown any significant association (p>0.05). In overall, the boys showed a negative association (B=-0.138 ± 0.034, p<0.05) and it has got 0.871 times (CI=0.815-0.931, p<0.05) prevalence of underweight, and age groups of 8 years (B=1.218 ± 0.511, p<0.05), 10 years (B=1.167 ± 0.497, p<0.05) and 12 years (B=0.990 ± 0.467, p<0.05) showed the positive association and have got respectively 3.379 times (CI=1.240-9.207, p<0.05), 3.214 times (CI=1.214-8.510, p<0.05) and 2.693 times (CI=1.079-6.719, p<0.05) prevalence of the underweight. The girls too, showed a negative association (B=-0.118

± 0.032, p<0.05) and 0.889 times (CI=0.835-0.947, p<0.05) prevalence of the underweight, and the 8 years (B=1.259 ± 0.466, p<0.05) showed the positive association and 3.523 time (CI= 1.412-8.789, p<0.05) prevalence of the underweight. Even after adjusting the odd ratio (OR), the prevalence of underweight by age was still noticed, thus it can be said that, the underweight in the present study need the proper attention in these age groups of 8-18 years (table: 34.2).

The BMI of the present Study has revealed as follow:

The BMI (table: 35), in boys, showed a normal (>18.5) from age groups 16-18 years and a low (<18.5) from 8-15 years, whereas in girls (figure: 18.2 and table: 35), they too showed a normal BMI (>18.5) from 14-18 years and a low (<18.5) from 8-13 years (table: 35), but the BMI of girls was higher than the boys from 10-18 years and a low in 8-9 years compared to that of the boys.

The BMI, height and weight of the present study were compared with the percentiles of the WHO and CDC, and the following has revealed:

While comparing (table: 35, figure: 18.1 and figure: 18.2), to the reference percentiles of the WHO and CDC at the 10^{th} and 50^{th}, it was found that the boys were above the 10^{th} percentile and below the 50^{th} percentile except the 10 years at the 10^{th} percentile of the WHO percentile which showed lower to that, and the girls' BMI showed above the 10^{th} percentiles except the 8 years of age and below the 50^{th} percentile of the WHO and CDC.

In height, the subjects showed to be stunted under the 5^{th} percentile of the WHO and CDC percentile (figure: 19.1. figure: 19.2 and table: 35).

Whereas in the weight, the boys were shown underweight below the 5^{th} percentile in age groups of 8-14 years and from 15 to 18 years they were above the 5^{th} percentile and below the 10^{th} percentiles (figure: 20.1 and table: 35), whereas in girls they were underweight below the 5^{th} percentile in age groups of 8-10 years and 12 years and above the 5^{th} percentiles in age groups of 11 years and 13-18 years and lying below the 10^{th} percentile except 13 years which showed more than that (figure: 20.2 and table: 35).

The present data were also compared with the Indian populations of plain tribal the Shabar of Orissa (Chakrabarty and Bharati, 2008), the North Eastern populations of Assamese Muslims (Begum and Choudhury, 1999), Khasi of Meghalaya (Das et. al., 2010), Niam Khasi boys and Khasi non-hybrid (NHB) girls (Khongsdier and Mukherjee, 2003, 2003), and also with the national data of ICMR (ICMR, 1972). The available age groups of the compared data were from 8 to 18 years except the Shabar and Khasi of Meghalaya from 10-18 years and 11-17 years respectively in both boys and girls. The different observations on the different available parameters on both boys and girls was shown in a tabulated form and figures and revealed as follow:

The mean weight of the present study was compared with the mentioned populations and it was found that the present study showed lighter than the Shabar boys at the age 10 and 11 years in boys and 10 years in girls thereafter, the present study was heavier in all age groups; while in comparison to the ICMR data, they were also heavier in all age groups except the 8 years in both boys and girls and 10 years with the boys only; to Assamese Muslims, they were lighter in weight in age groups 8-15 years and 8-14 years in boys and girls respectively and becoming heavier in older age groups; to Niam Khasi boys, the present study was having a lighter weight in the age 8-10 and 13 years, and becoming heavier in the later age groups of 11-18 years. (table: 36, figure: 21.1 and figure: 21.2).

Table: 37, figure: 22.1 and figure: 22.2 have showed a comparison of the mean height where the present study displayed in all age groups of both boys and girls a shorter height to the Assamese Muslims and the ICMR data; whereas to the Shabar boys, they were also shown a shorter stature in age groups of 10-11 years and 15 years but a taller stature in older age groups from 16-18 years and a similar height in the age groups of 13-14 years. A similar trend of height was also observed in the girls, where the present girls were showing a shorter stature in all age groups than the Assamese Muslims and ICMR, whereas, to the Shabar the present study showed shorter in younger ages from 10 to 13 years thereafter the present study was taller from 14 to 18 years; to Niam Khasi boys and NHB Khasi girls, the present study showed taller in all age groups 8-18 years.

The sitting height of the present study was advanced in growing taller to the boys and girls of Shabar; and also to the NHB Khasi girls, the present girls were having a taller sitting height in all age groups 8-18 years. However, the present boys were shorter from age groups of 8-16 years and 8-13 years, and taller in 17-18 years and 14-18 years than the boys of Assamese Muslims and ICMR data respectively (table: 38, figure: 23.1). Where as in girls, in comparison with the Assamese Muslims were shorter in age groups of 8-14 years and taller in older age groups of 15-18 years; while to the ICMR data the girls were shorter from age groups of 8-10 and 12 years and becoming taller in 11 and 13-18 years of age (figure: 23.2, table: 38).

The chest circumference in boys (table: 39, figure: 24.1 and figure: 24.2) of the present study was found to display a broader chest girth compared to the ICMR data in all the age groups from 8-18 years, however it was also observed to be smaller to the Assamese Muslims in all the age groups of 8-18 years except at the age 17 years where the present study showed a slightly broader chest girth. Whereas, the present study has a smaller chest girth than the Shabar boys on younger ages of 10-11 years but bigger chest girth as they grow older from 12-18 years of age. Like the same growth differences in boys, even the present girls also showed a smaller chest girth in all the age groups compared to the ICMR data and the Shabar but when compared to the Assamese Muslims it was smaller in the younger age groups from 8-14 years and broader in older age groups from 15-18 years.

The comparison in the waist circumference of the present study with the Shabar plain tribal boys and girls showed that, the present study has bigger waist circumference in both sexes in all the compared age groups (table: 40, figure: 25.1 and figure: 25.2).

The comparison table and figures (table: 41, figure: 26.1 and figure: 26.2) in the hip circumference of both boys and girls of the present study had shown a superior circumference to the Shabar in all age groups from 10-18 years except the 10 years of the present girls where a slightly small circumference was observed.

Table: 42, figure: 27.1 and figure: 27.2 have shown the comparison in between the mean MUAC, and found that the present study has a smaller circumference to the Khasi boys in all age groups of 11-17 years, except the age group of 11 years in boys;

whereas, in girls, they were shown to have a higher circumference than the Khasi except the 17 years of age. To the Assamese Muslims, a smaller MUAC was shown in all age groups except age 17 years in boys and 18 years in girls where a slightly bigger MUAC was shown; while comparing with the Shabar, the present boys were shown an advanced MUAC in age groups of 11-14 and 16-18 years and a smaller in age groups of 10 and 15 years, where as in girls, an almost an advanced MUAC to the Shabar girls in all the age groups from 11-18 years except at 10 years of age.

The comparison of the calf circumference between the boys had shown that, the present study has a bigger circumference in the age groups of 9, 11, 13-14 years and 16-18 years compared to the Assamese Muslims, whereas when compared to the other age groups a smaller calf circumference was observed; while, when compared to the Shabar, a smaller calf observed in age groups of 10 and 13 years and a bigger calf to the unmentioned age groups was observed. In girls, when compared to the Shabar, they possessed a bigger calf circumference in all age groups from 11-18 years except 10 and 12 years of age, whereas when compared to the Assamese Muslims a bigger calf circumference was observed in age groups 9-18 years except at the age group of 8 and 12 years (table: 43, figure: 28.1 and figure: 28.2).

The mean biceps skinfold of the present study in both boys and girls was found to be in an advanced thickness skinfold when compared to the Shabar boys and girls respectively in all age groups from 10-18 years (table: 44, figure: 30.1 and figure: 30.2).

The mean triceps skinfold of the present study displayed a thicker accumulation of fat in all age groups of 11-18 years in both boys and girls except 10 years of age where a smaller fold were shown in comparison to the Shabar; whereas when compared to the Khasi of Meghalaya they showed a smaller fold in all age groups of 11-17 years in both boys and girls (table: 44, figure: 31.1 and figure: 31.2).

The comparison of the subscapular skinfolds in boys (table: 46 and figure: 32.1) have shown that the present boys had a low accumulation of fat when compared to the Shabar boys in all age groups of 10-18 years. However in girls (table: 46 and figure: 32.2), the present study also shown a low accumulation of fat in all age groups when compared to Shabar girls except the 18 years of age.

The comparison of the suprailiac skinfold between the present study and the Shabar (table: 47, figure: 33.1 and figure: 33.2) was found to be having a lesser accumulation of fat in age groups 10-16 years and more in the late age groups of 17-18 years in the boys, where as in girls a fold thickness was also observed to be lesser in the age groups of 10-15 years and 17 years and more in the age groups of 16 and 18 years.

CONCLUSION

The present study had shown a growth pattern of increase in all the variables from 8-18 years in both the boys and girls. The growth rate of the girls showed a decreasing growth from 16-17 years and started growing again from 18 years which can be said that this could be the starting point of adulthood in them, but in boys it was not so, the adolescence period still persisted with a decelerated growth. The growth difference of the boys and girls in the consecutive age groups is shown to be higher by the ponderal and linear measurements then comes the growth girths and lastly by the skinfold measurements, but the growth differences between the boys and girls in the same age groups contributed in an opposite way where the skinfold is shown to be higher then comes the growth girth and the least by the ponderal and linear measurements and the growth spurt of the girls was earlier than the boys in all the variables except the chest circumference which shows the same.

The nutritional status of the present study has a higher normal condition than the wasting condition, but in the case of boys the wasting condition is higher than the girls in the higher age groups, though the wasting condition persisted but it was not shown to be in the severe condition. The subjects were shown stunting in both the boys and girls and the boys were more prone than the girls. The boys had shown a normal condition of slightly higher than the underweight condition. In girls they have a high normal condition than the underweight condition and they showed a better nutrition than the boys.

The clinical signs of the nutritional status of the subjects have been observed on each and every boy and girl taken for the measurements, they are apparently observed to have no deficiency signs on some clinical deficiencies signs like oedema, keratomalacia, bitot's spot, pale conjunctiva, epiphyseal enlargement, rickets and

ichthyosis included in the study, which are the signs of deficiencies of vitamin A, vitamin D, vitamin C and iron.

The nutritional status of the present study when checked with the influence of the socio-economic factors was shown that: the mother's occupation has a significant effect in boys in the BMI for age and height for age except the weight for age whereas in girls no significant occurred in all the indicators of nutritional status. This has shown that the need of occupational mothers which indirectly may lift the poverty of the household, play an important role in raising the proper growth and nutrition of the subjects in the studied area as it has shown in boys.

The mother's education seems to be the clear influence though it is not very clear when we look at the BMI for age, the subjects were having a high normal condition of nutrition when compared to the wasting conditions on the higher education levels than the low education levels, but in the height for age, we saw a high influence of the low educational levels on both the boys and girls, this could be one of the reason that the present study showed a stunted condition in both boys and girls, which it could be difficult for an illiterate mother to reach a proper care of growth and better nutrition of her children, and again, looking into the weight for age of the subjects we could see that the girls were having a high normal condition than the boys in all the levels of education, but in the boys it was not so, where the high levels of education were showing a low normal condition this also could be another reason where the girls would have a better nutrition than the boys because even the low level of mother's education could contribute to the normal weight of the girls.

The household income of the subjects had shown a high normal condition in BMI and weight for age and low normal condition in height for age. But the influence of the income was not significantly shown, because even the LIG contributed to the high normal condition in the case of the boys, but it was not so in the case of the girls. This could be another reason where the girls would have a better and meaningful contribution of nutrition to that of the boys, where it can be said that the HIG have a better chance of getting enough requirements of nutrients.

In the case of family sizes, the BMI for age has shown a significant difference effected in boys and no significance in the girls, while in the height for age a

significance in the girls and no significance in the boys whereas to the weight for age no significance in both the sexes have occurred, this has shown that in the smallest family as it is expected that it should have a better growth and nutrition in the subjects, but it was not so since most of the smallest family sizes were the families of a single parent which could be difficult for a single parent to provide the better facilities to the children, this would be another reason which has made the growth of the adolescents to fall under 'undernutriton'.

The nutritional status of the present study when checked with the influence of the socio-economic factors has shown that the growth of the children indicates a clear trend of increasing from the younger age groups to the older age groups but in between the age groups a low trend of decrease is observed in all the levels of socio-economic factors from the lower to the higher levels. Even in the family sizes, the small or the smallest family size do not have a good trend of increase; this could be the reason of the low profile of the socio-economic factors.

It can be said that the wasting in the girls has proved to be associated with the age and income especially in the younger age groups of 8 and 9 years and the high income groups, which shown that the HIG do contribute to the wasting condition of the girls; whereas the stunting condition showed a significant association in the age of the boys and no particular age group of the boys showed on it, it might be of the influence of genetic factor where the socio-economic factors showed no significant association on it. The underweight of the present study showed the significant association in both the sexes, where it has occurred more in the younger age groups and become lesser after approaching the higher age groups.

The present study on comparing to the WHO, CDC percentiles reference data was shown to have a wasted growth at the 50^{th} percentiles, stunted at the 5^{th} percentile in both the boys and girls and underweight at the 10^{th} percentile in both the sexes except the 13, 15, 16 and 18 years in girls and 15 years in boys.

The present study was compared with other populations, it was found that the present study has shown a lacking of growth in many variables as in weight, height, sitting height, etc., except in some higher age groups as in case of weight, waist circumference and biceps skinfold.

It is expected that if the areas where the present study was conducted could have a better facility of amenities such as the proper drinking water, supplementary foods, better sanitation and proper hygienic condition and also better socio-economic condition, we can say that the present study can be compared to the other affluent populations, even at the present time they appeared to be comparable with the ICMR data which are the national reference data of the adolescents, and it was found that the present study does not have any observable sign of nutritional deficiency as was observed on the clinical signs included, and lastly we can say, may be because of the ethnic variations, the subjects appeared to be stunted, wasted and underweight when compared to the international reference data. So, it would be appropriate to have a regional reference data which could be comparable to the local population.