

Physical Growth among Adolescent Rongmei Naga of Manipur, India

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ABSTRACT

Background: Growth study of children is proxy to health of any population. Growth status of a child is a reflection of the overall health of the society, hence growth assessment is considered as the best way to evaluate the health and nutritional of the children. The growth and development of a child is influenced by both- genetic and environmental factors.

Aims and Objectives: This paper tries to assess the growth of stature, sitting height, body weight, head length and breadth in terms of annual increment among children aged 11-19 years of Rongmei Naga tribe of Manipur state of Indian Union

Material and Methods: Data was collected by door to door survey methods during Dec 2016 to Jan 2017 using anthropometer rod, weighing machine and spreading caliper. The data was collected in a semi-structured scheduled. The samples were from Tarung Village of District West Imphal of Manipur State. A total 61 boys and 53 girls were measured to achieve the goal.

Results: There were differences in growth between boys and girls of Rongmei Naga, but boys were observed to be less growth than girls in most cases.

Discussion: Analysis of growth data based on anthropometric measurements shows that mean values of height were observed to be lower than the standard mean values of height of the same age groups of WHO. . The present study indicates that there is no sexual dimorphism among Rongmei Naga adolescents in height vertex, body weight, sitting height, head length and head breadth (barring a few exceptions). This is a very unique finding as it is in contradiction to the worldwide studies which show majority of the populations has sexual dimorphism in these measurements.

Conclusion: It can be concluded that the mean values of anthropometric measurements (Body weight, height, sitting height, maximum head length and head breadth,) increase with the age, but at different rate at the different age levels. The difference in pattern of growth among male and females was found to be non-significant.

Keywords: Sexual dimorphism, Stature, Body Weight, Head length, Head Breadth, t-test.

INTRODUCTION

Growth status of a child is a reflection of the overall health of the society and growth assessment is considered as a best way to evaluate the health and nutrition among the children. It is influenced by the genetic and environmental factor. The most important environmental factor which regulates growth is nutrition. A child having adequate and balanced nutrition as per the stages of development exhibits normal growth. If adolescents are well nourished, they can make optimal use of their skills, talents and energies.

In organisms growth is a biological phenomenon which can be determined by the factor like dietary habits, genetics, environment, hormonal chemistry and socio-economic condition. The nutritional status of the population can be measured by measuring the child growth. In children there is high level of nutritional requirement because they are undergoing the period of rapid growth. Good quality diet at this age is vital, as unavailability of certain key nutrients for a given age could result in physical and mental retardation that may be permanent.

In spite of the introduction of sophisticated and modern techniques for the evaluation of nutritional status and body composition of individuals, the techniques of anthropometry are still being considered to be the most useful in the population surveys (Ulijaszek and Strickland, 1993)

Globally, there are many scholars are working for the assessment of Physical growth and development among the populations of both tribal and non-tribal (Gautam & Thakur. 2009, Thakur and Gautam. 2014, Khongsdier 2005, Bose & Chakraborty 2005)

Longkumer (2013) conducted a study among Ao Naga of Nagaland and found that children who lived in an urban area, the girls were taller than boys at the younger age groups except at 14 and 15 years where the boys were taller. As for weight, the girls were heavier than boys at 10 to 14 years.

Warjri (2016) found in his study that Khasi boys are generally taller than girls across ages except at adolescence from 11 to 12 years where girls are taller than boys. The differences between the sexes are statistically significant after 14 years of age; the estimate values for adult height are 157.5 in males and 152 in females.

But the growth study among the Rongmei Naga tribe is not found; therefore this study is an attempt to understand the growth pattern of the Rongmei Naga Adolescents. Hence the objective of this study includes assessing the growth status by the using anthropometric measurements. Simultaneously to find out the variation of annual growth rate during the age from 11 to 19 years, As well as to compare the growth pattern of different anthropometric measurement between boys and girls of Rongmei Naga. And finally, to compare it with WHO.

MATERIAL AND METHOD

This study was carried out among Rongmei Naga adolescents (from the age 11 to 19 years), data was collected through door to door survey method from Dec 2016- Jan 2017 and due care was taken. The anthropometric measurements were taken with all possible cautions maintaining uniformity and accuracy, according to the standard technique suggested by Singh and Bhasin (1968). Semi structured schedule was used to collect the information about socio-demographic status, family background and other information.

The sample consist of **114 individual (61 Boys and 53 Girls)** representing almost the same socio-economic status, diet and family background. Only those boys and girls were included in this study, who have accurate date of birth. The sample was collected from Tarung Village, Imphal West District Manipur.

The subjects were carefully selected and due care was taken to include only those children who were physically and mentally normal and did not suffer from any kind of illness, which may affect their normal process of growth. Informed consent was taken from the respective subjects. And to understand the sex difference in body weight of boys and girls independent t-test was executed in SPSS.

Area and People

Manipur is one of the seven sister states of the North Eastern Region of India. It is an isolated hill-grit state stretching between Longitudes 93.03°E and 94.78°E and Latitudes 23.80°N and 25.68°N; bounded on the north by Nagaland, on the west by North Cachar hills and Cachar districts of Assam, on the east by Myanmar and on the southwest by Mizoram (Wikipedia 2018).

Imphal West District is one of the sixteen districts of Manipur state in northeastern India. As of 2011 it is the most populous district in the state. Imphal west is one of the districts where the field work was carried out lies at the latitudes of 24° 49' N and longitudes 93°54' E, comprising an area of 558 km². It is surrounded by Imphal east district in the east Thoubal district in the south east, Bishnupur district in south and Senapati district in the west to north. The population of Imphal west district were 514,683. Tarung is one of the villages situated in Imphal west district, Rongmei Naga population are prominently inhabited there.

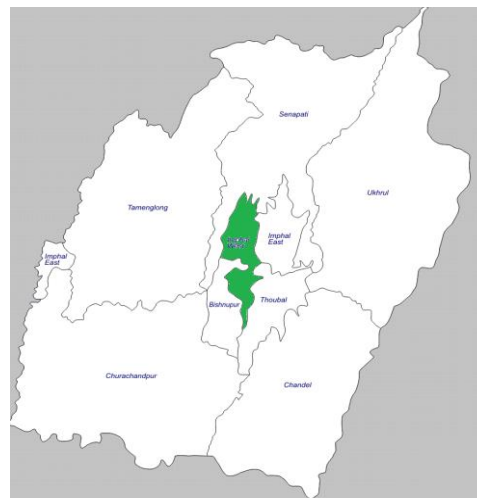
The Naga tribe of North-Eastern states of Indian union are widely distributed and having different clan. Rongmei Naga is one of them, which are found in Manipur state also. The Naga tribe is known for their furious and violent behavior towards the aliens. During British regime in India they never surrendered. They fought with British army and never defeated. Once, they were famous as head-hunters. Killing enemy or aliens and displaying their head in front of their hut (typical house) was symbol of bravery in Naga society. Beside that their habitat is also inaccessible and located in difficult terrain. Hence very few studies among Naga tribe are available. Now the scenario has changed. Many of Naga students, you may find in different universities, IITs and

IIMs of India. They had buried the skulls and skeletal remains hunted by their ancestors. But at same time, the problem of insurgency has been taken place. And, it is still difficult to reach among them. Hence, the present investigation is limited to small sample. The present findings indicate that the Naga children are lagging behind in Growth and development alike other Indian tribes and non-tribal children.

The samples were from Tarung Village of District West Imphal of Manipur State. Still agriculture is main occupation.



Map 1 Manipur in India



Map 2 Imphal West District in Manipur

RESULTS

In the present study, an assessment of growth status and the adolescents belonging to Rongmei Naga tribe of Manipur but living in the same geography area was carried out. Growth trend of 5 anthropometric measurements (Body weight, body height, sitting height, head length and head breadth) during the age of 11 to 19 years of the Rongmei Naga boys and girls are being described in terms of age, mean values of the particular anthropometric measurement, standard deviation and rate of annual increment. There were differences in growth between boys and girls belonging to the Rongmei Naga tribe.

Height vertex is an addition of total length of four parts named skull, vertebrae, pelvis and legs. Environment and genetics both affect height as well as nutrition also play an important role. The highest annual increment was noticed between the ages 11-12 years (5.2%), followed by age ranging from 16-17 years (3.3%) for boys. Among girls the highest increment was noticed between the ages 14-15 years (4.2%). Boys are comparatively short in height up to 11-12 years of age, after the 12 year of age boys are taller than the girls. In the year of 13 to 16 girls are again taller, after the age of 17 boys overtake girls. (Fig 2). But interestingly all these differences are non-significant statistically and it can be inferred from that there is no sex difference in growth of height vertex among the Rongmei Naga tribe of Manipur.

Table 1: Mean, Standard Deviation and t-test of Body height, weight of Boys and Girls of Rongmei Naga of Manipur

Age	Height (cm)				t-value	Weight (kg)				t-value
	Male		Female			Male		Female		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
11	136.1	11.3	144.4	6.3	-1.757	34.4	5.41	40	6.26	-1.997
12	143.3	10.2	145.6	6.8	-0.425	35.4	6.89	41.45	3.52	-1.818
13	145.3	4.8	144.6	5.3	0.216	36.62	8.79	43.08	7.66	-1.238
14	146.2	10.2	145.7	9.6	0.108	37.61	6.79	42.52	5.13	-1.698
15	149.8	13.2	151.9	8.1	-0.404	44.71	10.78	44.90	2.55	-0.058
16	151.2	12.4	152.5	11.6	-0.181	45.5	8.51	45.84	3.32	-0.087
17	156.2	13.6	149.1	6.3	1.151	46.21	11.36	43.46	7.49	0.495
18	152.2	7.6	149.8	5.2	0.537	46.15	14.58	45.11	1.00	0.141
19	158.3	3.0	151.8	6.9	1.935	47.93	3.02	47.61	8.37	0.082

All t-value are non-significant ($p>0.05$)

Table 2: Mean, Standard Deviation and t-test of sitting height of Boys and Girls of Rongmei Naga of Manipur

Age	Sitting Height (cm)				t-value
	Male		Female		
	Mean	SD	Mean	SD	
11	71.2	6.1	76.0	2.1	-2.116
12	73.9	5.0	80.2	5.6	-1.8
13	77.7	6.1	75.8	5.2	0.529
14	74.2	4.0	77.2	3.4	-1.6
15	77.5	7.3	80.1	4.0	-0.959
16	77.4	7.1	77.8	7.2	-0.122
17	81.7	9.0	77.6	4.2	0.986
18	80.2	6.8	80.3	4.1	-0.039
19	77.2	2.7	82.2	4.2	-2.118
All t-value are non-significant (p>0.05)					

Table 3: Mean, Standard Deviation and t-test of head length and head breadth of Boys and Girls of Rongmei Naga of Manipur

Age	Head Length (cm)				t-value	Head Breadth (cm)				t-value
	Male		Female			Male		Female		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
11	16.6	1.4	15.7	0.5	1.628	14.4	0.9	14.4	0.9	3.887*
12	16.7	1.4	15.8	0.5	-0.012	14.5	0.6	14.5	0.6	1.678
13	17.5	0.6	16.5	1.3	1.42	14.7	0.5	14.7	0.5	1.689
14	17.0	0.7	16.6	1.4	0.71	14.7	0.7	14.7	0.7	2.238*
15	17.3	1.3	17.0	1.0	0.63	14.9	0.8	14.9	0.8	1.206
16	17.0	1.0	17.1	0.8	-0.069	14.9	1.2	14.9	1.2	0.689
17	17.2	0.2	17.2	0.9	-0.166	15.0	0.3	15.0	0.3	1.169
18	17.8	0.9	17.1	0.3	1.425	14.8	0.7	14.8	0.7	0.33
19	18.5	0.3	16.6	1.1	3.697*	14.6	0.6	14.6	0.6	0.98
* asterisk mark t-value are significant (p<0.05)										

Body weight is considered as a main anthropometric measurement to evaluate physical growth and nutrition status of an individual. It can be seen (fig.1) that mean value of weight increased steadily from 11-14 years. The annual increment of body weight is displayed in Table 1. It is apparent that a maximum annual increment for weight occurred in the age of 14-15 years (15.88%) among boys whereas among girls the maximum annual increment was found in the age of 14-15 years (5.59%). In the age 11 to 16 years girls are heavier than the boys and after the age of 16, the boys become heavier than girls, which continue up to age of 19 years. In early age the gap between mean weight of boys and girls were large and after the age of 15 the difference is small. To understand the sex difference in body weight of boys and girls independent t-test was executed in SPSS which was found to be non-significant for all ages 11-19 years. It can be inferred that there is no sex difference in growth of body weight among the Rongmei Naga tribe of Manipur.

Sitting height is an addition of trunk, neck and head segments. Among the Rongmei Naga boys and girls, the annual increment for sitting height was greatest between 16-17 years (5.5%) followed by 12-13 years (5.1%) for boys whereas in case of girls, the maximum annual growth was noticed in the years of 11-12 years (5.5%), followed by 14-15 years (3.7%). In the age of 11 and 12 years, the girls have more sitting height but after the age of 13 the trend of growth of sitting height is not consistent. (Fig. 3). The t-values in sitting height of boys and girls are non-significant statistically and hence it can be concluded (from table 3) that there is no sex difference in sitting height among the Rongmei Naga tribe of Manipur.

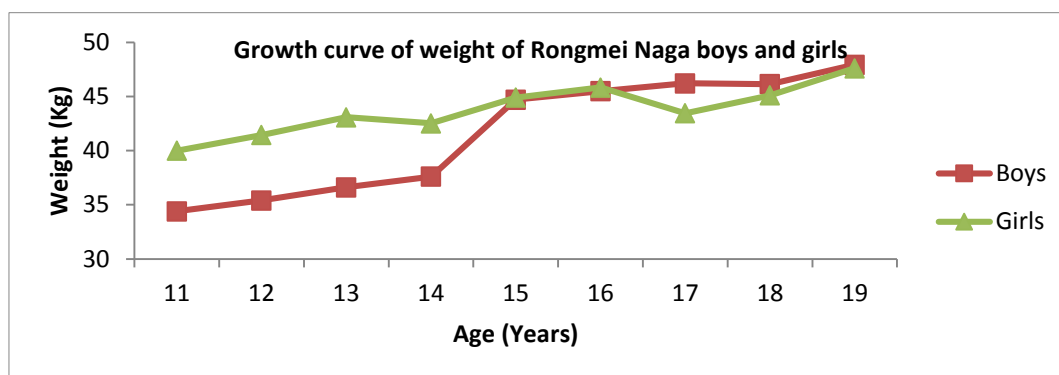


Figure 1 Mean body weight between boys and girls of Rongmei Naga of Manipur

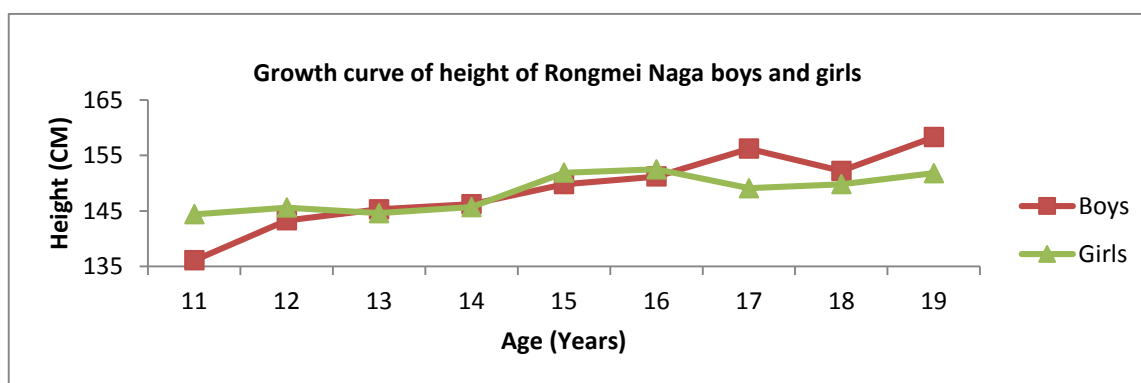


Figure 2 Comparative graph of Body height between boys and girls of Rongmei Naga of Manipur

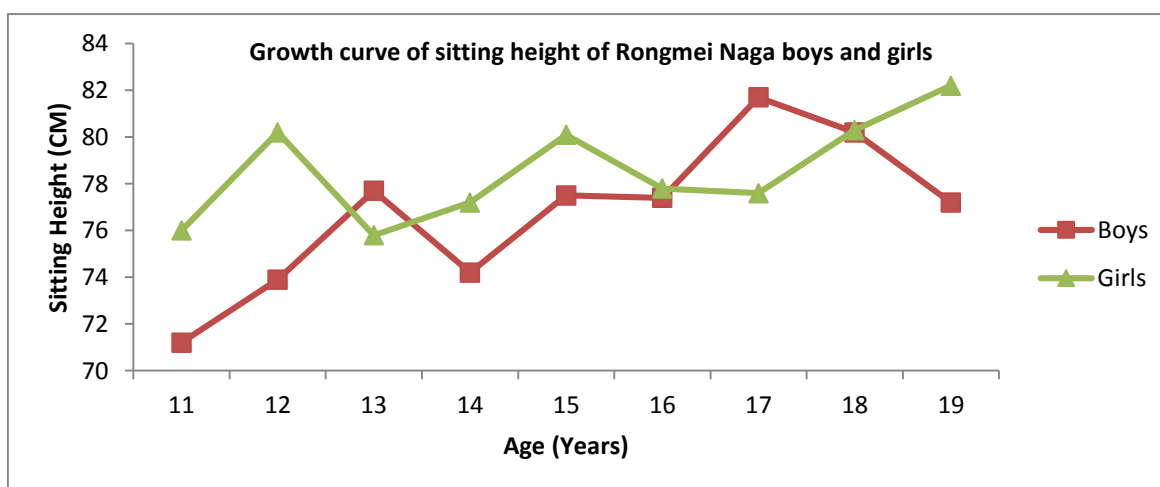


Figure 3 Mean sitting height between boys and girls of Rongmei Naga of Manipur

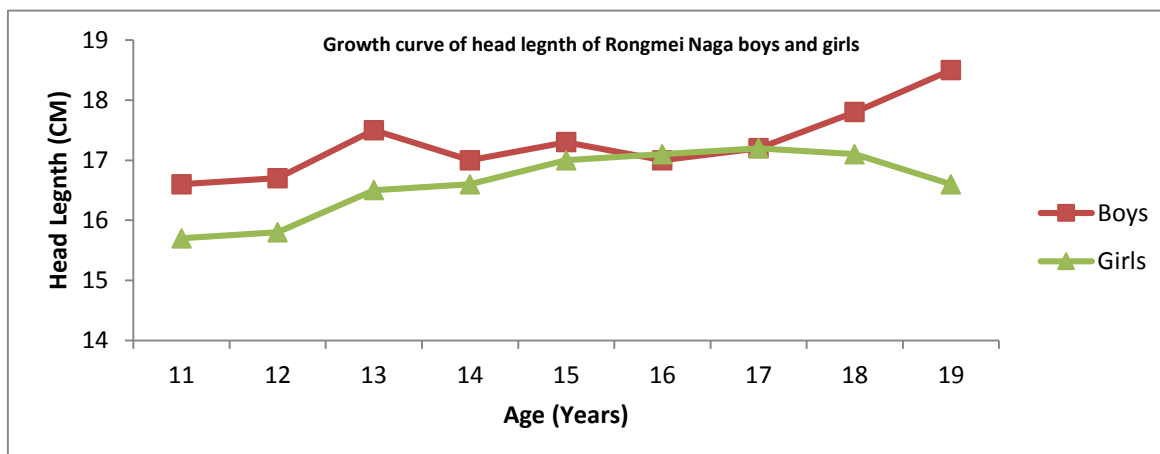


Figure 4 Mean head length between boys and girls of Rongmei Naga of Manipur

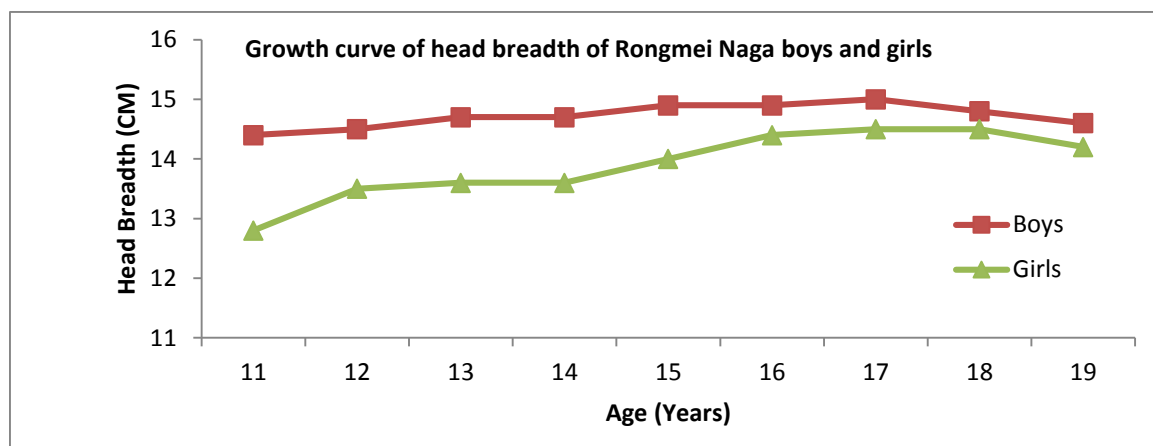


Figure 5 Mean head breadth between boys and girls of Rongmei Naga of Manipur

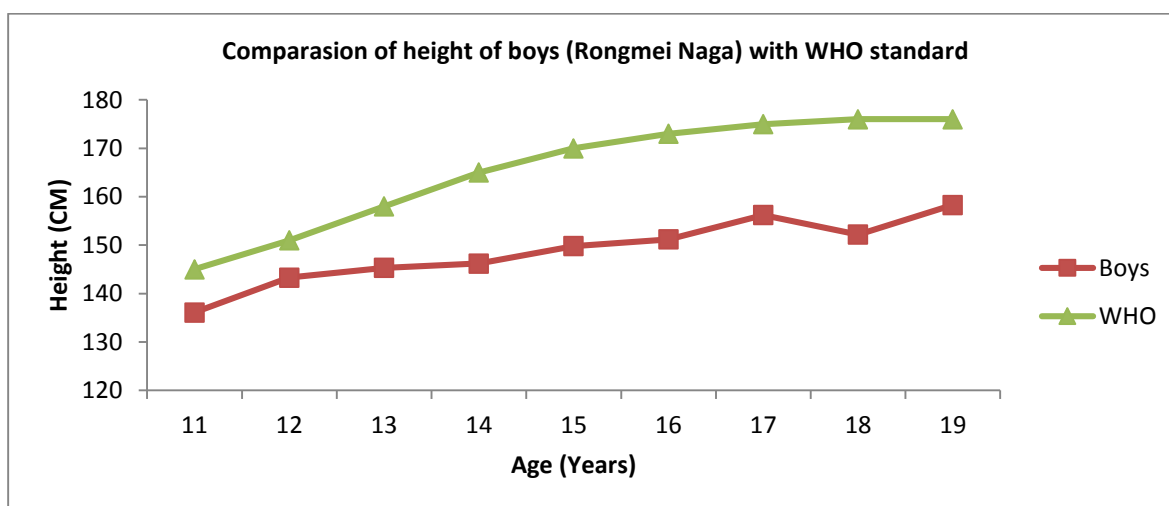


Figure 6 Comparison of height of boys with WHO standard

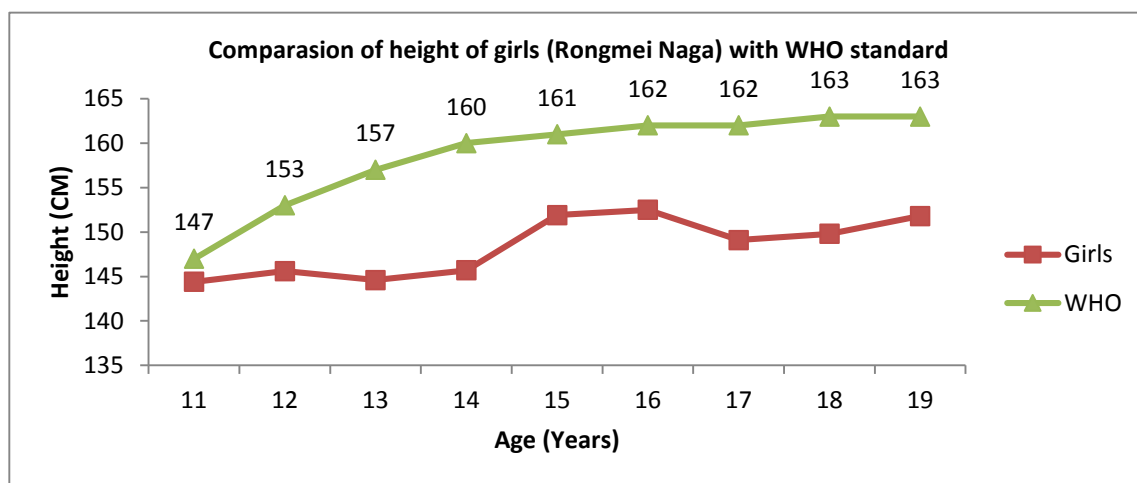


Figure 7 Comparison of height of girls with WHO standard

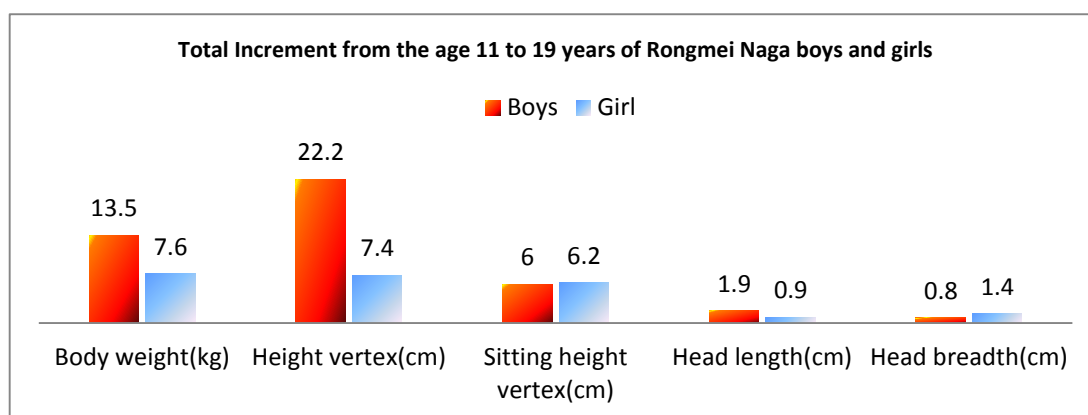


Figure 8 Total Increment of Body weight, height, sitting height, head length and head breadth from the age 11 to 19 years of Rongmei Naga boys and girls

Growth of **head length** almost completes till the age of six. In this study during 12-13 years of age (4.7%) maximal increment in head length was observed among boys and the second highest increment (3.4%) was noticed in the age of 18 to 19 years. Among the girls, maximum increment in head length was noticed in the age of 12-13 years of age (4.4%) and followed by 14-15 years of age (2.4%). Head length of girls was smaller than boys in the age of eleven to sixteen but in earlier ages the gap between the head length of boys and girls was large and nearing the age of sixteen the gap of head length become narrower but in the age of 16 and 17 mean values of the head length were almost the same and after the age of seventeen girls again have lower mean value of head length than the boys (Fig. 4). The t-values being non-significant indicate that (table 3) there is no sex difference in head length among the Rongmei Naga tribe of Manipur except for the age of 19 years the t-test was found significant.

Almost 70-80% of growth of head and brain is achieved before the age of 5-6 and after age of 5-6 very slow growth can be seen. The finding reveals that mean values of the **head breadth** increases

with age. The annual growth (1.3%) can be seen for the ages 12-13 years and 14-15 years in boys. Among girls the maximum annual growth is noticed in the age of 11-12 years (5.4%), followed by the age of 14-15 years (2.9%). Results show that difference of the mean of head breadth between boys and girls was larger in earlier ages but gradually the gap became narrower (Fig. 5). Significant sex difference of head breadth among the Rongmei Naga adolescents can be seen only in the age of 11 and 14 years (table 3).

Total increments (from 11 to 19 years) of height vertex, body weight and head length of boys were higher than girls. And total increments of sitting height and head breadth of girls are slightly more than the boys.

DISCUSSION

The present study indicates that there is no sexual dimorphism among Rongmei Naga adolescents in height vertex, body weight, sitting height, head length and head breadth (barring a few exceptions). This is a very unique finding as it is in contradiction to the worldwide studies which show majority of the populations have sexual dimorphism in these measurements (Reddy et. al., 2000; Wamani et. al., 2007; Longkumer, 2013; Fledderjohann et. al., 2014 Corsi, 2015; Warjri, 2016; Thakur, 2017; Aurino, 2017; Spencer et. al. 2018).

Sexual dimorphism can be an indicator of the wellness of a population. Smaller sex differences may be an indication of population living under stressful conditions, probably nutritional and/or environmental (Schreider, 1950; Ruff, 2002; Holle, 2006; Lawrence et. al., 2009).

Growth and nutritional status of children is mirror of socio-economic status of the population. Hence, there are significant numbers of growth studies undertaken by various investigators all over the world. India is not lagging behind in this respect; still studies on growth and development of north-eastern tribal children are very few. Further, there is no any such study on Rongmei Naga tribe.

Khongsdier et al. (2005) reported that among Khasi tribe of Meghalaya about 26 %, 62 % and 12 % of the children were in the BMI categories of underweight, normal and overweight, respectively. Gaur et. al. (1995) highlighted that, the overall growth performance of the rural Meitei children was poor as compared to well-nourished Indian children. Warjri (2016) reported among the Khasi tribe of Meghalaya that boys are generally taller than girls across ages except at adolescence from 11 to 12 years where girls are taller than boys. The findings of present investigation corroborate the findings of Warjri (2016) in this respect. They also found that differences between the sexes are statistically significant after 14 years of age among Khasi but on the other hand among the Rongmei Naga there is no sex difference for the body weight and height vertex; the estimated values for adult height are 157.5 in males and 152 in female. Girls are heavier than boys at the age of 12 years of age. It is further observed that boys are significantly heavier than girls and are statistically significant, except at the age of 15 years. In the present investigation it was found

contrary; the mean value of height for the boys is 148.7 and for the girls the mean value of the height was observed 148.3 which very low comparatively.

Some of the remarkable growth studies among Naga tribes include Longkumer (2013). He studied the Ao Naga children of urban area and reported that the girls were taller than boys at the younger age groups except at 14 and 15 years where the boys were taller and no significant difference was revealed between boys and girls for the prevalence of underweight and overweight. In the present analysis girls are also slightly taller than boys however there is no sex difference.

Study conducted by Khongsdier et.al (2003) showed that about 60%, 29%, and 6% of these boys were below -2 Z scores of the US National Center for Health Statistics (NCHS) references in respect of height for age, weight for age, and body mass index for age, respectively. The present findings indicate that the Naga children are lagging behind in growth and development alike other Indian tribes. Singh et. al. (1987) reported that the Gaddi children of Himachal Pradesh possess smaller amounts of adipose tissue at almost all the ages during the growth period when compared to Punjabis. Reddy et. al. (2000) studied the Sugali boys and girls of Andhra Pradesh and reported that they are shorter and lighter than well-to-do Indian standards. The median heights and weights of Sugali boys and girls fall below the 5th percentile of NCHS standards. In present study too, the Rongmei Naga children are lagging behind from International standards.

Mitra et. al. (2002) studied the Kamar boys and girls of Chhattisgarh and compared the data with other tribes of India. The Kamar children (both boys and girls) have lower weight and height; the difference was found significant, for almost all ages. Kamar boys showed higher anthropometric values than girls.

Similarly, Chakrabarty et. al. (2008) studied the Shabar adolescents in Orissa and reported a high prevalence of growth retardation and chronic under-nutrition. Ahirwar et al (2015) studied Bharia PVTG (Primarily vulnerable Tribal Group) of Madhya Pradesh and compared the findings with Kamar children of Chhattisgarh and reported that the Indian tribe are lagging behind from international reference (NCHS). Furthermore, delayed growth was found among the children aged 16 years and onward. Although the Bharia boys show almost similar growth pattern as other contemporary populations.

Among the non-tribal population, a different study has been conducted in order to understand the growth pattern like; Vashisht et. al. (2005) has observed in his study that the Garhwali girls of Uttarakhand were comparable with rural Indian girls in their growth status. Garhwali girls are lighter as compared to well-nourished Indian girls and American girls. Present investigation also corroborates the same. Srivastava et. al. (2012) have reported most of the school-age slum children in Bareilly, Uttar-Pradesh (UP), India had a poor nutritional and growth status. Furthermore regarding nutritional status, prevalence of stunting and underweight was highest in age group of 11 to 13 years. Thakur et. al. (2014) studied central Indian children and highlighted that boys are

lighter in body weight and shorter in stature than the reference population (NCHS) and they also reported that 6.3% of boys were stunted, 4.3% were underweight and 3% were undernourished.

In the light of above discussion, it can be summarized that the Rongmei Naga children of Manipur are lagging behind in growth from International standards alike other contemporary tribal and non-tribal children of North-eastern states and other parts of Indian sub-continent.

Conclusion

The growth status of adolescent girls and boys of Rongmei Naga was evaluated with the help of anthropometric measurements, namely, weight, height, sitting height, head length and head breadth.

The study highlights the prevalence of low growth rate among Rongmei Naga adolescents (age of 11-19 years) as compared to international data of WHO. However the growth patterns of girls are slightly better than boys in most of the age groups, as apparent from line graph Figure 6 and 7.

There are many factors and conditions which may affect growth during adolescence including climate, nutrition, level of physical activity, and chronic illnesses.

It can be concluded that the mean values of anthropometric measurements (Body weight, height, sitting height, maximum head length and head breadth,) increase with the age, but at different rate at the different age levels. The difference in pattern of growth among male and females was found to be non-significant.

REFERENCES

- Ahirwar A and Gautam RK (2015).** Growth pattern among Bharia boys- A tribe of Patakot, Chhindwara (MP), India. *Human Biology Review*, 4 (3), 221-235.
- Aurino E (2017).** Do boys eat better than girls in India? Longitudinal evidence on dietary diversity and food consumption disparities among children and adolescents. *Econ Hum Bio*; 25:99–111.
- Basu A, Mukherjee DP, Dutta PC, Bose DK, Basu MP, Ghosh GC, Kumar GD and Huq F (1994).** All India Anthropometric Survey: North Zone Basic Anthropometric Data, Vol. I: Madhya Pradesh. Calcutta, Anthropological Survey of India.
- Bose K and Chakraborty F (2005).** Anthropometric characteristics and nutritional status based on body mass index of adult Bathudis: a tribal population of Keonjhar District, Orissa, India. *Asia Pacific Journal of Clinical Nutrition*, 14: 80–82.
- Chakrabarty S and Bharati P (2008).** Physiological growth and nutritional status of Shabar Tribal adolescents of Orissa, India: A cross-sectional study. *Mal J Nutr*, 14(1): 101-112.

- Corsi DJ, Gaffey MF, Bassani DG and Subramanian SV (2015).** 'No Female Disadvantage in Anthropometric Status among Children in India: Analysis of the 1992–1993 and 2005–2006 Indian National Family Health Surveys', *Journal of South Asian Development* 10.2: 119–47.
- Fledderjohann J, Agrawal S, Vellakal S, Basu S, Campbell O, Doyle P, Ebrahim S and Stuckler D (2014).** Do Girls have a Nutritional Disadvantage compared with Boys? Statistical Models of Breastfeeding and Food Consumption Inequalities among Indian Siblings, *PLOS One* 9.9: e107172.
- Gaur R and Singh NY (1995).** Growth profile of rural Meitei children of Manipur state of India. *International Journal of Anthropology*, 10(4): 189-197.
- Gautam RK and Thakur R (2009).** Biosocial Correlates of Nutrition and Chronic Energy Deficiency among Adult Females of two Ecological Zones in Madhya Pradesh and Uttarakhand, India. *Mal J Nutr* 15(2): 137 - 153, 2009.
- Holle G. (2006).** Patterns of Sexual Dimorphism from Birth to Senescence, *Coll. Antropol.* 30, 3: 637–641.
- Khongsdier R (2005).** BMI and morbidity in relation to body composition: A cross-sectional study of a rural community in North-East India. *British Journal of Nutrition*, 93(1), 101-107.
- Khongsdier R and Mukherjee N (2003).** Growth and nutritional status of Khasi boys in Northeast India relating to exogamous marriages and socioeconomic classes," *American Journal of Physical Anthropology*, vol. 122, no. 2, pp. 162–170.
- Khongsdier R and Mukherjee N (2003).** Growth and nutritional status of Khasi boys in north-east India relating to exogamous marriages and socio-economic classes. *American Journal of Physical Anthropology*, 122(2): 162–170.
- Lawrence MS, Mia VG and Julia R (2009).** Environmental influences on human growth and development: Historical review and case study of contemporary influences, *Annals of Human Biology*, 36:5, 459-477
- Longkumer T (2013).** Physical growth among Ao Naga children of Nagaland, Northeast India, *Journal of Anthropology* Vol. 2013 6 Pages.
- Longkumer T (2009).** Physical Growth and Nutritional Status among Ao Naga Children of Nagaland, Northeast India. *Journal of Anthropology*, Volume 2013, Article ID 291239.
- Mitra M, Kumar PV, Ghosh R and Bharati P (2002).** Growth patterns of the Kamaras-a primitive tribe of Chhattisgarh, India. *Collegium Antropologicum*, 26(2): 485-499.
- Reddy PY and Rao AP (2000).** Growth pattern of the Sugalis—a tribal population of Andhra Pradesh, India. *Ann Hum Biol*, 27(1): 67-81.
- Ruff CB (2002).** Variation in human body size and shape. *Annu Rev Anthropol* 31:211–232.

- Schreider E (1950).** Geographical distribution of the body-weight body-surface ratio. *Nature* 165:286.
- Singh IP and Bhasin MK (2004).** *A Manual of Biological Anthropology* Kamla-Raj Enterprises, 538 pages, Delhi.
- Singh S P and Sidhu LS (1987).** Subcutaneous tissue growth in boys of Gaddi tribe, Himachal Pradesh, India. *Anthropologischer Anzeiger*, 45: 165-173.
- Spencer PR, Sanders KA and Judge DS (2018).** Growth curves and the international standard: How children's growth reflects challenging conditions in rural Timor-Leste. *Am J Phys Anthropol*;165(2):286-298.
- Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP and Kumar B. (2012).** Nutritional Status of School Age Children- A Scenario of Urban Slums in India. *Arch Public Health* 70 (8).
- Thakur R and Gautam RK (2014).** Prevalence of undernutrition among School going boys (5-18 years) of a Central Indian city (Sagar). *Human Biology Review*, 3 (4), 364-383
- Thakur R and Gautam RK (2017).** Pre and post pubertal growth difference among boys and girls of 5-18 years of age: A cross sectional study among central Indian Population. *Human Biology Review*, 6 (2), 164-187.
- Ulijaszek SJ and Strickland SS (1993).** *Nutritional anthropology: Prospects and perspectives in human nutrition*. Oxford University Press, Oxford: 147-148.
- Vashisht RN, Krishan K and Devlal S (2005).** Physical growth and nutritional status of Garhwali girls. *Indian Journal of Paediatrics*, 72: 573.
- Wamani H, Astrom AN, Peterson S, Tumwine JK and Tylleskar T (2007).** Boys are more stunted than girls in sub-Saharan Africa: A meta-analysis of 16 demographic and health surveys. *BMC Pediatrics* 7, 7-17.
- Warjri BC (2016).** Assessment on growth pattern of Khasi children in the state of Meghalaya, India. *International Journal of Research in Medical Sciences*. Mar; 4(3):936-941.
- Wikipedia (2018).** https://en.wikipedia.org/wiki/Northeast_India [accessed on 12.09.2018]
- World Health Organization (1995).** Physical status-the use and interpretation of anthropometry, Report of the WHO Expert Committee. Technical Report Series No.854, Geneva, World Health Organization, 1995; 263-311.