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# Anthropometric Somatotype among the Adolescent Boys of a Tribal Population in India

Nutsolu Lohe[1], Thejazhano Nagi[1], Ngaranmi Marei[1] and Vivoto Tsukru[1]*

[1]*Department of Anthropology, North-Eastern Hill University, Shillong-793022, Meghalaya;* *Corresponding author: <tsukruvivo@gmail.com>

KEYWORDS

Somatotype, Endomorphy, Mesomorphy, Ectomorphy, BMI, Mising tribe, Assam

ABSTRACT

*This study aimed to determine the somatotype and BMI, as well as investigate the somatotype variations in relation with age and BMI among the adolescent boys of Mising tribe. A cross-sectional sample of 278 adolescent boys was collected from five villages of Dhemaji district of Assam, a state in northeast India. Body mass index (BMI) was calculated for each subject. Heath-Carter method of somatotyping was employed to evaluate the somatotype characteristics of Mising adolescent boys. Descriptive statistics for all the ten anthropometric measurements employed in somatotyping show increasing trend with age. The mean BMI was found to be 18.37 kg/m2. The mean somatotype of the individuals was 1.46-3.81-3.3. Our findings showed mesomorph-ectomorph as the dominant type among the Mising boys. The somatoplots of mean somatotypes fall in the mesomorph-ectomorph at age 10+ to 15+ years, and from age 16+ to 18+ years the somatoplots were distributed in the ectomorphic mesomorph category. The age-wise comparison was tested using t-test. Results revealed that BMI values were found gradually increasing with age. Significant variations were observed in endomorphy and ectomorphy. Endomorphy tends to increase with age whereas ectomorphy tends to decrease with the advancement of age in a fluctuating pattern. Somatotype variations in relation with BMI presented significant values.*

## Introduction

Somatotype is the quantification of the present shape and composition of human body. It represents the external bodily outlook which conveys a meaning of the totality of morphological features of the human physique (Singh *et al*., 2007). Somatotype is expressed in a three-number rating representing endomorphy, mesomorphy and ectomorphy components respectively, always in the same order. Endomorphy is the relative fatness, mesomorphy is the relative musculo-skeletal robustness, and ectomorphy is the relative linearity or slenderness of a physique (Carter, 2002).

The method of somatotyping is used as a means of assessing body shape (Bailey *et al*., 1982). Somatotypes vary between population groups as well as during growth in the same population (Singh and Sidhu, 1980). During the growth stage, somatotype variation is markedly observed between individuals of different age groups belonging to the same population (Kaul *et al.,* 1996; Kalichman and Kobyliansky, 2006). The somatotypes of individual children undergo significant changes during childhood and adolescence that provide useful information about the growth status and the timing and rate of sexual maturation (Beunen *et al*., 1987; Hebbelinck

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*et al*., 1995; Toselli and Grupioni, 1999; Kaur and Singh, 2008).

Studying the variation in body size and physique has long been the interest of biological anthropologists as the knowledge of somatotype provides broader insights in understanding growth patterns, health, physical performance, degree of environmental adaptation, changes in the body as a consequence of ageing, and the contributions of genetics and bio-social factors in determining body physique. The variations in the physique between populations in different regions are of much importance because these together with geographical and other environmental factors seem to underlie the cultural differences between populations of different regions (Dkhar, 2005). It is also important to note that the body mass index (BMI) and somatotype are considered as two universally accepted indicators of changes in human body, and have shown associations in studies of growth and development (Manrique *et al*., 2019). In addition, recent studies have shown significant association of somatotype components with BMI among adolescents (Manrique *et al*., 2019; Merdzhanova *et al*., 2018; Merdzhanova, 2020).

India has wide diversification in terms of ethnicity, and so, it is important to investigate and report variations occurring in human body during growth at community levels. Numerous studies have documented changes in somatotype during adolescence among different Indian populations belonging to varied geographical and ethnic background (Singh and Sidhu, 1980; Singh and Bhasin, 1990; Singh and Singh, 1991; Handa *et al*., 1995; Gakhar and Malik, 2002; Ghosh and Malik, 2004; Bhasin and Jain, 2007; Kaur and Pathak, 2014). Various studies on somatotype of adolescents of different tribal groups have also been conducted in northeast India (Longkumer, 2004; Dkhar, 2005; Singh, 2011; Sarkar and Sil, 2014, 2015; Tsukru and Dkhar, 2021). Yet, there is a dearth of anthropometric data, particularly somatotyping among children and adolescents from this region of the country. So far, to the best of our knowledge, no reported work on anthropometric somatotyping among the adolescents of Mising tribe could be traced in related literature.

Hence, keeping in mind the importance of understanding variations in body physique during growth and the void of anthropometric somatotyping among the Mising adolescents, the present study was conducted with a major aim to determine changes in somatotype components during adolescence, as well as investigate the somatotype variations in relation to BMI among the Mising adolescent boys of Dhemaji district, Assam.

## Materials and methods

The Mising also known as Miris is one of the major ethnic groups of north-east India and the second largest tribe in Assam, after the Bodos. The Mising as they would love to be called are probably the mixture of East Asian and South Asian sub-race of the Mongoloid stock. The present study was conducted in five villages' viz., Borola, Uriamguri, Chengelisuti, Rajgarh, Abotani, which fall under Dhemaji district in Assam, India. Prior to conducting the fieldwork, consent was obtained from the Headmen of the respective villages covered for the present study. Since all the participants were less than 19 years of age, consent was obtained from the participants' parents and school Principal or Headmaster for those participants who were measured at their respective schools.

Data was collected from a cross-sectional sample of 278 adolescent boys ranging in age from 10 to 18 years. Ten anthropometric measurements were taken on each individual to calculate the somatotype in accordance with the internationally accepted standards (Martin and Saller, 1957; Steward *et al*., 2011). Measurements included were height, weight, bi-condylar humerus, bi-condylar femur, biceps girth, calf girth, skinfold at triceps, skinfold at sub-scapula, skinfold at supra-iliac and skinfold at calf. Date of birth was collected and the decimal age was calculated following Tanner *et al*. (1969). BMI was calculated using the formula, body weight (kg)/stature ($m^2$). Anthropometric somatotyping was calculated using Heath and Carter's method (1967). Individual somatotypes of Mising adolescent boys were classified into thirteen categories following Carter's classification (Carter, 1980).

The statistical computations were done using MS-Excel software (version 2010) and IBM developed software SPSS (version 26.0). Descriptive statistics in the form of mean and standard deviation were computed. Independent-samples t-test has been employed for comparative purpose. Linear regression analysis was used to assess the effect of somatotype components on BMI for Mising adolescent boys.

## Results

*Table 1: Descriptive statistics of anthropometric measurements in Mising adolescent boys, by age*

| Anthropometric measurements | | Age (years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 10+ | 11+ | 12+ | 13+ | 14+ | 15+ | 16+ | 17+ | 18+ |
| | | n=29 | n=30 | n=30 | n=31 | n=31 | n=29 | n=32 | n=34 | n=32 |
| Height (cm) | $\bar{X}$ | 128.48 | 136.11 | 140.33 | 147.84 | 157.02 | 157.80 | 160.70 | 162.30 | 162.42 |
| | SD | 6.94 | 6.65 | 8.68 | 7.21 | 5.82 | 5.65 | 5.52 | 5.80 | 5.96 |
| Weight (kg) | $\bar{X}$ | 25.20 | 28.60 | 31.43 | 38.74 | 46.48 | 48.55 | 52.22 | 56.03 | 54.92 |
| | SD | 4.00 | 4.32 | 4.32 | 5.82 | 7.66 | 7.50 | 5.14 | 7.07 | 6.75 |
| Triceps skinfold (mm) | $\bar{X}$ | 5.56 | 5.82 | 5.14 | 5.31 | 5.28 | 5.12 | 6.24 | 6.14 | 6.28 |
| | SD | 1.64 | 2.16 | 1.34 | 1.24 | 1.87 | 1.69 | 2.06 | 2.08 | 2.26 |
| Sub-scapula skinfold (mm) | $\bar{X}$ | 4.26 | 4.59 | 4.28 | 4.97 | 5.83 | 6.64 | 7.62 | 7.94 | 8.84 |
| | SD | 1.19 | 1.54 | 0.83 | 1.23 | 1.57 | 2.09 | 2.57 | 2.10 | 2.35 |
| Supra-iliac skinfold (mm) | $\bar{X}$ | 3.57 | 3.94 | 3.62 | 4.26 | 4.60 | 5.05 | 5.69 | 6.10 | 6.75 |
| | SD | 1.05 | 1.60 | 1.03 | 1.04 | 2.44 | 1.83 | 1.91 | 2.55 | 2.73 |
| Calf SF (mm) | $\bar{X}$ | 6.57 | 6.96 | 7.40 | 8.42 | 8.18 | 7.24 | 8.70 | 8.78 | 8.09 |
| | SD | 1.65 | 1.91 | 2.37 | 1.90 | 2.86 | 1.97 | 2.38 | 3.04 | 3.09 |
| Bi-condylar humerus (cm) | $\bar{X}$ | 5.29 | 5.56 | 5.81 | 6.11 | 6.55 | 6.53 | 6.74 | 6.77 | 6.72 |
| | SD | 0.42 | 0.38 | 0.43 | 0.40 | 0.34 | 0.32 | 0.37 | 0.45 | 0.27 |
| Bi-condylar femur (cm) | $\bar{X}$ | 7.76 | 8.13 | 8.13 | 8.61 | 8.85 | 8.58 | 8.67 | 8.93 | 8.90 |
| | SD | 0.42 | 0.47 | 0.47 | 0.46 | 0.48 | 0.52 | 0.93 | 0.40 | 0.50 |
| Biceps girth (cm) | $\bar{X}$ | 17.27 | 17.92 | 18.36 | 19.96 | 21.64 | 22.61 | 23.34 | 23.65 | 24.01 |
| | SD | 1.47 | 2.50 | 1.32 | 1.63 | 1.69 | 2.22 | 2.53 | 1.65 | 1.90 |
| Calf girth (cm) | $\bar{X}$ | 25.14 | 26.34 | 27.42 | 29.89 | 31.35 | 31.46 | 32.53 | 33.07 | 32.90 |
| | SD | 1.72 | 2.17 | 2.03 | 2.02 | 2.21 | 3.11 | 3.41 | 2.04 | 2.11 |

Background information in terms of descriptive statistics of anthropometric measurements across different age groups is presented in Table 1. It clearly shows a gradual increase in the mean of almost all the ten anthropometric measurements with increase in age. However, there is less or no increment in the mean readings of the anthropometric measurements from age 17+ years to 18+ years as compared to other age groups and remains more or less the same. Comparing age group 10+ years and 18+ years, there is a prominent increase in the mean of all the anthropometric measurements involved in somatotyping.

*Table 2: Descriptive statistics of BMI and somatotype components in Mising adolescent boys, by age*

| Age (years) | N | BMI | Endomorphy | Mesomorphy | Ectomorphy | Somatotype Category |
|---|---|---|---|---|---|---|
| 10+ | 29 | 15.19 ± 1.49 | 1.05 ± 0.44 | 3.96 ± 0.58 | 3.63 ± 1.11 | Mesomorph-Ectomorph |
| 11+ | 30 | 15.43 ± 1.92 | 1.16 ± 0.59 | 3.71 ± 0.73 | 4.16 ± 1.64 | Mesomorph-Ectomorph |
| 12+ | 30 | 15.93 ± 1.41 | 1.01 ± 0.33 | 3.64 ± 0.94 | 4.07 ± 1.31 | Mesomorph-Ectomorph |
| 13+ | 31 | 17.63 ± 1.54 | 1.20 ± 0.33 | 3.88 ± 0.63 | 3.53 ± 0.88 | Mesomorph-Ectomorph |
| 14+ | 31 | 18.74 ± 1.96 | 1.33 ± 0.60 | 3.76 ± 0.61 | 3.55 ± 0.90 | Mesomorph-Ectomorph |
| 15+ | 29 | 19.42 ± 2.33 | 1.47 ± 0.50 | 3.69 ± 0.72 | 3.25 ± 1.13 | Mesomorph-Ectomorph |
| 16+ | 32 | 20.19 ± 1.35 | 1.85 ±0.75 | 3.77 ± 1.14 | 2.98 ± 0.76 | Ectomorphic Mesomorph |
| 17+ | 34 | 21.23 ± 2.06 | 1.85 ± 0.66 | 3.92 ± 0.86 | 2.59 ± 1.03 | Ectomorphic Mesomorph |
| 18+ | 32 | 20.77 ± 1.85 | 2.04 ± 0.73 | 3.98 ± 0.83 | 2.81 ±0.96 | Ectomorphic Mesomorph |
| All ages | 278 | 18.37 ± 2.84 | 1.46 ± 0.67 | 3.81 ± 0.81 | 3.38 ± 1.20 | Mesomorph-Ectomorph |

Table 2 presents the age-wise statistics of mean BMI and somatotype components in Mising adolescent boys. The mean BMI value of all ages is 18.37 kg/m$^2$. Mean BMI values slightly increase from age 10+ years to 12+ years, and increase more rapidly from age 13+ years to 17+ years, thereafter decrease from age 17+ years to 18+ years. The maximum and minimum BMI value was recorded at age 17+ years and 10+ years respectively. The mean somatotype of Mising adolescent boys at age 10+years is 1.05-3.96-3.63 and at age 18+ years is 2.04-3.98-2.81. The mean somatotype is 1.46-3.81-3.38. The maximum and minimum mean values of endomorphic component was seen at 18+ years (2.04±0.73) and 12+ years (1.01±0.33) respectively. Maximum mean mesomorphic rating (3.98±0.83) was found at 18+ years, and minimum rating (3.64±0.94) at 12+ years. Maximum mean ectomorphic rating (4.16±1.64) was found at 11+ years and the minimum (2.59±1.03) at 17+ years of age. With the advancement in age, there is a gradual increase in endomorphy component and a decrease in ectomorphy component, while mesomorphy seems to be dominantly distributed throughout adolescent stage (Figure 1).

*Table 3: Age-wise comparison (t-test) of somatotype components in Mising adolescent boys*

| Age group comparison | BMI | | Endomorphy | | Mesomorphy | | Ectomorphy | |
|---|---|---|---|---|---|---|---|---|
| | t-values | p-values | t-values | p-values | t-values | p-values | t-values | p-values |
| 10+ vs. 11+ | -0.526 | 0.601 | -0.834 | 0.408 | 1.435 | 0.157 | -1.439 | 0.156 |
| 11+ vs. 12+ | -1.159 | 0.251 | 1.239 | 0.220 | 0.330 | 0.743 | 0.219 | 0.828 |
| 12+ vs. 13+ | -4.468 | 0.001** | -2.183 | 0.033* | -1.154 | 0.253 | 1.897 | 0.063 |
| 13+ vs. 14+ | -2.470 | 0.016* | -1.069 | 0.289 | 0.720 | 0.474 | -0.079 | 0.937 |
| 14+ vs. 15+ | -1.227 | 0.225 | -0.964 | 0.339 | 0.429 | 0.670 | 1.164 | 0.249 |
| 15+ vs. 16+ | -1.590 | 0.117 | -2.364 | 0.021* | -0.338 | 0.736 | 1.094 | 0.278 |
| 16+ vs. 17+ | -2.402 | 0.019* | 0.020 | 0.984 | 0.612 | 0.542 | -1.731 | 0.088 |
| 17+ vs. 18+ | 0.962 | 0.340 | -1.097 | 0.277 | 0.077 | 0.939 | -0.901 | 0.371 |
| 10+ vs. 18+ | -12.843 | 0.001** | -6.336 | 0.001** | 0.266 | 0.791 | 3.081 | 0.003* |

**p<0.05 **p<0.01*

Table 3 presents the age-wise comparison of the mean somatotype components in Mising adolescent boys. Mean BMI value of age 13+ years is significantly greater ($p<0.01$) as compared to age 12+ years. Similarly, age 14+ years showed significantly higher value ($p<0.05$) as compared to age 13+ years. Again, age 17+ years showed significantly higher value (p<0.05) as compared to age 16+ years. Overall, when we compare age 10+ years and 18+ years, age 10+ years showed significantly higher value (p<0.01) when compared to age 18+ years which suggests that BMI values increase with age among these adolescent boys. Endomorphic component showed significantly higher value (p<0.05) in age 13+ years as compared to age 12+ years, also significantly greater (p<0.05) in age 16+ years versus 15+ years. Overall, when we compare age 10+ years and 18+ years, endomorphic component is significantly greater (p<0.01) in age 18+ years as compared to 10+ years. On the other hand, ectomorphic component is significantly greater (p<0.05) in age 10+ years as compared to 18+ years.

*Table 4: Distribution of somatotype categories in Mising adolescent boys, by age*

| Age (years) | Somatotype categories* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 10+ | 3 (10.0) | - | - | 14 (48.0) | - | 7 (24.0) | - | 5 (17.2) |
| 11+ | 4 (13.0) | - | - | 11 (37.0) | - | 3 (10.0) | - | 12 (40.0) |
| 12+ | 1 (3.3) | 1 (3.3) | - | 15 (50.0) | - | 6 (20.0) | 1 (3.3) | 6 (20.0) |
| 13+ | 2 (6.5) | - | - | 12 (39.0) | - | 11 (36.0) | - | 6 (19.4) |
| 14+ | 1 (3.2) | - | - | 7 (23.0) | 1 (3.2) | 13 (42.0) | - | 9 (29.0) |
| 15+ | 3 (10.0) | 1 (3.4) | - | 7 (24.0) | 2 (6.9) | 9 (31.0) | 7 (24.0) | - |
| 16+ | 4 (13.0) | 2 (6.3) | - | 5 (15.7) | 4 (13.0) | 10 (31.0) | - | 7 (21.9) |
| 17+ | 10 (29.0) | 1 (2.9) | - | 4 (12.0) | 6 (18.0) | 8 (24.0) | - | 5 (14.7) |
| 18+ | 4 (13.0) | - | 2 (6.2) | 5 (16.0) | 4 (13.0) | 9 (28.0) | - | 8 (25.0) |
| All ages | 32 (11.0) | 5 (1.8) | 2 (0.6) | 80 (29.7) | 17 (5.9) | 76 (27.1) | 8 (3.0) | 58 (20.9) |

*Notes: 1= Balanced Mesomorph, 2= Balanced Ectomorph, 3= Mesomorph-Endomorph, 4= Mesomorph-Ectomorph, 5= Endomorphic mesomorph, 6= Ectomorphic mesomorph, 7= Endomorphic Ectomorph, 8= Mesomorphic Ectomorph*
**percentage frequencies are given in parentheses*

Distribution of Mising adolescent boys in various somatotype categories indicated a substantial concentration around mesomorphic and ectomorphic components, irrespective of age (Table 4), as also evident in the somatochart (Figure 2). A considerable percentage of Mising adolescent boys (29.7 per cent) were found to be Mesomorph-Ectomorph, followed by Ectomorphic Mesomorph (27.1 per cent) and Mesomorphic Ectomorph (20.9 per cent). Sub-categories of mesomorphy and ectomorphy components are dominant among the Mising adolescent boys (Figure 3).

*Table 5: Effect of somatotype components on BMI among the Mising adolescent boys*

| Dependent variable | Predictors | β-coefficients | t-values | Significance level |
|---|---|---|---|---|
| BMI | Endomorphy | 0.351 | 10.041** | p<0.001 |
| | Mesomorphy | -0.117 | -3.279* | P<0.05 |
| | Ectomorphy | -0.688 | -17.170** | p<0.001 |

The result of linear regression analysis of somatotype components on BMI is presented in Table 5. It shows that BMI was significantly influenced by all the three somatotype components i.e., endomorphic (p<0.001), mesomorphic (p<0.05) and ectomorphic (p<0.001). It is also observed that BMI was positively influenced by endomorphic component, which indicates that there is a tendency to increase in BMI with increase in endomorphic component. On the other hand, the negative β-coefficient of mesomorphy and ectomorphy on BMI suggests that BMI decreases with increase in mesomorphy and ectomorphy components. Our results have revealed significant association between somatotype components and BMI thus suggesting that BMI influence and shape the body physique of an individual.

## Discussion

The somatotype characteristics of Mising adolescent boys showed co-dominance of both mesomorphic and ectomorphic components of physique over endomorphy. Endomorphic component tends to increase slightly with age. Mesomorphic component remained more or less the same with increase in age. In the ectomorphic component, there is a fluctuating increase and decrease across different ages, however, tended to decrease more with the advancement of age. Thus, the three components of body physique do not vary on regular basis with age. Similar finding by other studies are Bhasin and Singh (1992), Kumar et al. (1997), Longkumer (2014) and Tsukru and Dkhar (2021).

Significant variations were observed in mean BMI values among the Mising adolescent boys, i.e., it shows increasing trend with age. Younger Mising adolescent boys have mesomorph- ectomorph body type thereafter, somatotype ratings tend to increase in endomorphic component and decrease in ectomorphic component with advancement in age thus indicating towards ectomorphic mesomorph. The decrease of the third component (ectomorphy) in late adolescence may be related not only to the development and widening of the skeleton but also to the increase in fat that takes place at these ages (Claessens et al., 1986). Since endomorphy refers to relative fatness and ectomorphy is largely based on the height/weight relationship, this may be related to the increase in BMI with age which further confirms the fact that BMI influence body physique. Our finding on the impact of somatotype on BMI is in line with recent studies conducted on the Peruvian (Manrique et al., 2019) and Bulgarian (Merdzhanova et al., 2018) adolescents.

When the individual somatotypes of Mising adolescent boys were grouped into somatotype categories, a small segment (0.6 per cent) falls under mesomorph-endomorph which was found only in age 18+ years. Four somatotype categories were found in all the ages of Mising adolescent boys, viz., balanced mesomorph, mesomorph-ectomorph, ectomorphic mesomorph and mesomorphic ectomorph. None of the participants were found to fall under five somatotype categories, viz., balanced endomorph, endomorph-ectomorph, mesomorphic endomorph, ectomorphic endomorph and central. The highest category was mesomorph-ectomorph (29.7 per cent) which showed similarity with the studies carried out by Longkumer (2014) among the Ao Naga boys, and Sarkar and Sil (2015) among Tripuri tribal boys. Higher incidence of occurrence of the Mising boys in various somatotype categories in higher age groups show that as age increases, the body physique of the boys become more diverse. Furthermore, mesomorph-ectomorph is a dominant pattern in younger adolescent boys, while, as age increases, ectomorphic mesomorph category becomes dominant.

Mising adolescent boys predominantly fall under mesomorph-ectomorph indicating towards a linear-muscular type of physique, thus reflecting their linearity or slenderness. Our results suggest that on average Mising adolescent boys possess higher muscle mass and less fat mass. Greater mesomorphic ratings could be attributed to physical activity including domestic work, cycling and getting involved in agriculture-related activities during non-schooling hours at a very young age, which was found to be very common among this community. As a consequence, they take more protein-rich diet as an adaptive measure to cope up with the physical activity demand in their daily activities, thereby, developing a greater tendency towards a linear-muscular body physique. The tendency towards high ectomorphic ratings could be due to higher energy expenditure as compared to energy intake in their diets or other genetic factors. Similar predominance of linear-muscular body physique were reported in neighboring populations such as Meitei boys of Manipur (Gaur, 1999), Pnar boys of Meghalaya, (Dkhar, 2005), Ao Naga boys (Longkumer, 2014) and Chakhesang Naga boys (Tsukru and Dkhar, 2021) of Nagaland and Tripuri tribal boys of Tripura (Sarkar and Sil, 2014). This is probably because most of the tribal populations of northeast India belong to low socio-economic background living in laborious environment. Under such harsh and laborious environmental conditions, evolutionary forces like natural selection can play an imperative role in the protection of predominant muscular body physique amongst geographically and ethnically diverse populations as a process of adaptation during the course of evolution (Lohe and Ghosh, 2021).

## Conclusion

The overall mean of somatotype of Mising adolescent boys was 1.46-3.81-3.3. Following the Heath-Carter method, eight body types were identified where sub-categories of mesomorphy and ectomorphy components were found dominant. This overall result revealed that the individuals have mesomorph-ectomorph somatotype i.e., linear-muscular type of physique. Factors such as socioeconomic status, physical activity, climatic condition, dietary pattern, genetic variations could be the underlying factors of higher incidences of musculoskeletal development and leanness in these Mising adolescent boys. However, future study covering more area and taking into account such factors would provide a more detailed study regarding age differences and the effect of different bio-social factors on the variation of body physique of Mising adolescent boys.

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***Contribution of authors*** *- NL and VT analyzed the data and drafted the manuscript. TN analyzed the data and edited the manuscript. NM collected the data and edited the manuscript.*

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## References

Bailey, D.A., Carter, J.E.L., and Mirwald, R. L. (1982). "Somatotypes of Canadian men and women". *Human Biology*, 54(4):813-828.

Beunen, G., Claessens, A., Lefevre, L., Ostyn, M.,Renson, R., and Simon, J. (1987). "Somatotype as related to age at peak velocity and peak velocity in height, weight and static strength in boys". *Human Biology*, 59(4): 641-655.

Bhasin, M. K., and Jain, S. (2007). "Biology of the tribal groups of Rajasthan, India: body mass index as an indicator of nutritional status". *Anthropologist*, *9(*3):165-175.

Bhasin, M.K., and Singh, L.P. (1992). "A study of anthropometric somatotype in two altitude population Bodhs and Baltis of Ladakh, Jammu and Kashmir, India". *Journal of Human Ecology*, 3(1):35-38.

Carter, J.E.L. (2002). *The Heath–Carter Anthropometric Somatotype: Instruction Manual*. Surrey: Canada

Claessens, A.L., Beunen, G., and Simon, J. (1986). "Stability of anthroposcopic and anthropometric estimates of physique in Belgian boys followed longitudinally from 13 to 18 years of age". *Annals of Human Biology*, 13(3):235-244.

Dkhar, J. W. (2005). "Somatotypes among the Pnar boys of Meghalaya". *Bulletin of Anthropology* Dibrugarh University, 33: 84-92.

Gakhar, I., and Malik, S. L. (2002). "Age changes and sex differences in somatotypes among Jats of Delhi". *Anthropologist, 4(2)*:115-125.

Gaur, R., Singh, S.G., and Lakhanpal, M. (1999). "Somatotypes of urban Meiteis of Imphal, Manipur". *Anthropologist*, 1(4):235-240.

Ghosh, S., and Malik, S. L. (2004). "A comparative study of age changes in somatotypes of Brahmin and Rajput boys of Sundarnagar, Himachal Pradesh". *Anthropologist,*6(1):19-23.

Handa, N., Karir, B.S., and Kaul, S. (1995). "Somatotype change during adolescence in Jat Sikh boys of Chandigarh". *Journal of Indian Anthropological Society*, *30*:85-88.

Heath, B.H., and Carter, J.E. L. (1967). "A modified somatotype method". *American Journal of Physical Anthropology*, 27(1): 57-74.

Hebbelinck, M., Duquet, W., Borms, J., and Carter, J.E.L. (1995). "Stability of somatotypes: a longitudinal growth study in Belgian children followed from 6 to 17 years". *American Journal of Human Biology*, 7(5): 575-588. <https://doi.org/10.1002/ajhb.1310070505>

Kalichman, L., and Kobyliansky, E. (2006). "Sex- and age-related variations of the somatotype in a Chuvasha population". *Homo J Comp. Hum. Biology*, 57(2): 151-162.

Kaul, S., Karim, B. S., and Nand, N. (1996). "Somatotype variation in India". In L. S. Sidhu, S. P. Singh (Eds.), *Human Biology: Global Developments*, pp. 61-82. Ludhiana: USG Publishers and Distributors.

Kaur, G., and Singh, S. (2008). "Somatotypic variations with age in institutionalized and control adolescents". *Journal of Biological Anthropology*, 3(1): 1-10.

Kaur, T., and Pathak, R. K. (2014). "Somatotype variation in relation to sexual maturation of adolescent girls of Sirmaur District, Himachal Pradesh". *Journal of Life Science*, *6(1-2)*: 41-45.

Kumar, V., Kapoor, A. K., and Tiwari, S. C. (1997). "Physical activity and somatotype evaluation of the Bengali Kayastha boys of Delhi". *Indian Journal of Sport Science and Physical Education*, 9(1-2): 41-51.

Linares-Manrique, M., Hernández-Gallardo, D., Arencibia-Moreno, R., Rojas-Cabrera, M., Macedo-Figueroa, J., and Linares-Girela, D. (2019). "Somatotype, BMI, and sexual dimorphism in adolescent school sports players in Peru". *Sustainability*, 11:1-12. <https://doi.org/10.3390/su11226224>.

Lohe, N., and Ghosh, S. (2021). "Variation and association of body physique with nutritional status in adult Mising population of Assam". In J. R. Ghosh and J. Sen (Eds), *Nutrition And Health Among Indian Tribes With Special Reference To Eastern India*, pp. 305-320. New Delhi: Serials Publications Pvt. Ltd.

Longkumer, T. (2014). "Physical activity and somatotypes among Ao Naga boys". *The Anthropologist*, *17(*2):669-675.

Martin, R., and Saller, K. (1957). *Lerbuch der Athropologie*. Stuttgart: Gustav Fischer Verlag.

Merdzhanova, E., Petrova, G., and Lalova, V. (2018). "Evaluation of the students' (5th – 8th grade) somatotype and body mass index Plovdiv". *Trakia Journal of Sciences*, 16(l): 220-222. <https://doi.org/10.15547/tjs.2018.s.01.044>

Merdzhanova, E., Petrova, G., and Lalova, V. (2020). "Analysis of adolescents' (11-14 years old) somatotype in Plovdiv, Bulgaria". *J of IMAB*, 26(1):3005-3010. <https://doi.org/10.5272/jimab.2020261.3005>

Sarkar, S. R., and Sil, S. (2014). "Somatotype of Tripuri tribal adolescent boys (Aged 8 to 16 Years) of Tripura, North-East India". *Biolife*, 2(4): 1365-1370.

Sarkar, S.R., and Sil, S. K. (2015). "Body physique in Bengali adolescent boys from west Tripura district, Tripura, India". *Int. J. Bioassays*, 4(3): 3684-3688.

Singh, L. D. (2011). "Somatotypes of the affluent and non-affluent Meitei boys of Manipur, India". *Anthropologist*, 13(1): 9-16.

Singh, L. P., and Bhasin, M. K. (1990). "Somatotype changes in adolescence among Dogras of Jammu and Kashmir, India". *Journal of Human Ecology*, 1(2): 169-174.

Singh, L.P., and Singh, S.P. (1991). "Physical growth and anthropometric somatotype of Rajput and Brahmin boys of Chamba District, Himachal Pradesh". *Journal of Human Ecology*, 2(2): 121-126.

Singh, S.P., and Sidhu, L. S. (1980). "Changes in somatotypes during 4 to 20 years in Gaddi Rajput boys". *Zeitschriftfür Morphologie und Anthropologie*, *71(*3):285-293.

Singh, S.P., Singh, P., Malhotra, P., and Sidhu, L. S. (2007). "Somatotypes of high altitude Spitian boys". *Journal of Human Ecology*, 22(2): 129-133.

Stewart, A., Marfell-Jones, M., Olds, T., and De-Ridder, H. (2011). "International standards for anthropometric assessment". *International Society for the Advancement of Kinanthropometry*. Lower Hut*t*, New Zealand.

Tanner, J.M, Hiernaux, J., and Jarnan, S. (1969). "Growth and physique studies". In J. S. Weiner and J. A. Lourie (Eds), *Human Biology- A Guide to Field Methods*, pp. 315-340. Oxford: Blackwell Scientific Publication.

Toselli, S., and Gruppioni, G. (1999). "Study of somatotype in Italian children aged 6-10 years". *International Journal of Anthropology*, 14(2): 135-146.

Tsukru, V., and Dkhar, J. W. (2021). "Age changes in somatotypes among the Chakhesang Naga boys of Dimapur District, Nagaland". In S. Sengupta and D. Dutta. (Eds), *Human Diversity in North-east India: Bio-Anthropological approaches*, pp. 219- 230. Delhi: Kalpaz Publications.

# Figures

*Figure 1: Somatotype components amongst Mising adolescent boys, by age*

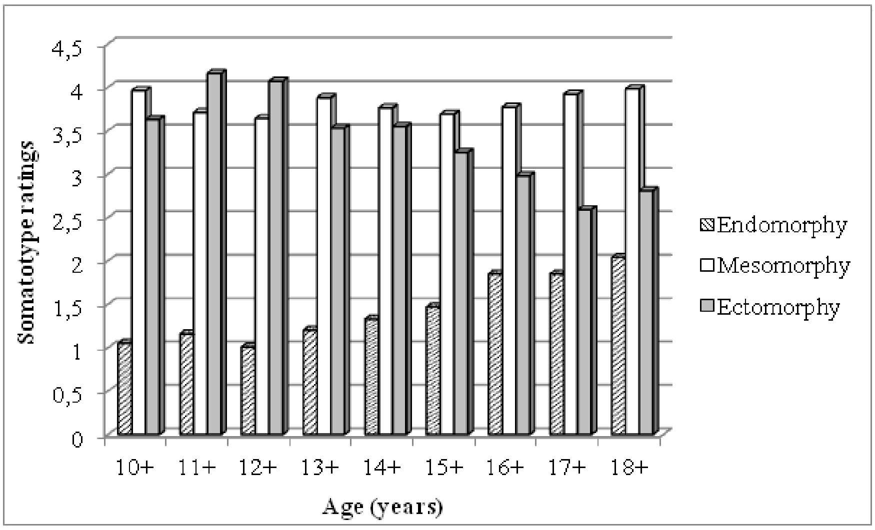


*Figure 2: Somatochart of Mising adolescent boys, by age*

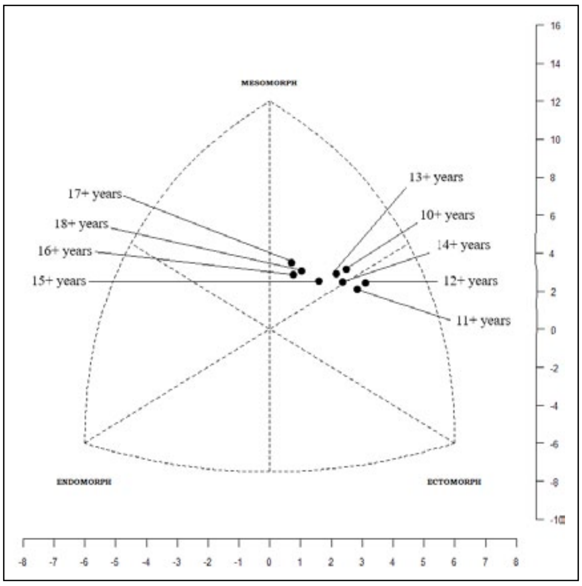


*Figure 3: Distribution of Mising adolescent boys in different somatotype categories*