Somatotypes among Konyak Naga Males Aged 11-20 Years: A Cross-sectional Study in the District Mon, Nagaland, India

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Abstract

Introduction: Somatotyping is the best numerical method for describing the current morphological information in terms of body shape, size and structure. It is defined as a quantitative description of the present structure and composition of the body. Heath and Carter widely studied somatotype distributions of different populations, including heritability of somatotypes, changes of somatotype in growth and aging, somatotypes in sports and physical performance and medical, behavioural, occupational and other variables associated with somatotype. It is also used to record changes in physique and to estimate gross biological differences and similarities among human beings. Somatotypes vary between population groups as well as during growth in the same population. **Methods:** Present investigation is based on a cross-sectional study conducted on 141 subjects during April 2023 among the Konyak Naga boys aged 11-20 years. Data was collected from different schools of Mon district, Nagaland India using standard techniques and following the defined protocols. Ten convectional anthropometric measurements were taken for analysis of anthropometric somatotyping viz. height, weight, biceps, triceps, subscapular, suprailliac, calf, humerus diameter, femur diameter and calf circumferences. Data was analysed by preparing master table followed by digitization of the data by entering the same into 'MS Excel' worksheet. Some basic analysis was performed in MS-Excel, whereas for further tabulation and analysis the data is transported to SPSS. Finally, the analysis of somatotyping was computed with the help of the formula and method provided by Heath and Carter. **Results:** The findings indicate that there are changes in the somatotyping of Konyak males with increasing age. The respondent whose age is 11-15 year they are belonging to Mesomorphic-Ectomorph type with occupying the designated region in the somatochart (2.67-3.34-3.50, 2.08-3.25-3.76, 2.14-3.39-3.96, 2.05-2.96-3.96 & 2.11-3.73-3.38). Followed by the respondent of 16 to 20 year they belong to the Ectomorphic-Mesomorph region of the somatochart (1.85-4.11-3.21, 2.12-3.41-3.03, 2.06-3.83-2.87, 2.06-3.61-3.50 & 1.42-3.53-3.16). **Conclusions:** It was concluded that majority (64.54%) belong to Mesomorphic-Ectomorph. followed by Ectomorphic-Mesomorph (35.46%) and Ectomorphic-Mesomorph are lowest (35.46%) among the konyak Naga.

Keywords: Konyak Naga, Somatochart, Mesomorphic-Ectomorph, BMI, Correlation

Resumen

Introducción: La somatotipificación es el mejor método numérico para describir la información morfológica actual en términos de forma, tamaño y estructura corporal. Se define como una descripción cuantitativa de la estructura y composición actuales del cuerpo. Heath y Carter estudiaron ampliamente las distribuciones de somatotipos de diferentes poblaciones, incluida la heredabilidad de los somatotipos, los cambios de somatotipo en el crecimiento y el envejecimiento, los somatotipos en los deportes y el rendimiento físico y las variables médicas, conductuales, ocupacionales y otras asociadas con el somatotipo. También se utiliza para registrar cambios en el físico y estimar grandes diferencias y similitudes biológicas entre los seres humanos. Los somatotipos varían entre grupos de población, así como durante el crecimiento en la misma población. **Métodos:** La presente investigación se basa en un estudio transversal realizado en 141 sujetos durante abril de 2023 entre los niños Konyak Naga de 11 a 20 años. Los datos se recopilaron de diferentes escuelas del distrito de Mon, Nagaland India, utilizando técnicas estándar y siguiendo los protocolos definidos. Se tomaron diez mediciones antropométricas convencionales para el análisis de

la somatotipificación antropométrica, a saber, altura, peso, bíceps, tríceps, subescapular, suprailíaco, pantorrilla, diámetro del húmero, diámetro del fémur y circunferencias de la pantorrilla. Los datos se analizaron preparando una tabla maestra seguida de la digitalización de los datos ingresándolos en la hoja de cálculo de "MS Excel". Se realizó un análisis básico en MS-Excel, mientras que para una tabulación y análisis posteriores, los datos se transportaron a SPSS. Finalmente, el análisis de la somatotipificación se calculó con la ayuda de la fórmula y el método proporcionados por Heath y Carter. **Resultados:** Los hallazgos indican que hay cambios en la somatotipificación de los varones Konyak con el aumento de la edad. Los encuestados de 11 a 15 años pertenecen al tipo mesomorfo-ectomorfo y ocupan la región designada en el somatograma (2,67-3,34-3,50; 2,08-3,25-3,76; 2,14-3,39-3,96; 2,05-2,96-3,96 y 2,11-3,73-3,38). Seguidos por los encuestados de 16 a 20 años, que pertenecen a la región ectomórfica-mesomorfa del somatograma (1,85-4,11-3,21; 2,12-3,41-3,03; 2,06-3,83-2,87; 2,06-3,61-3,50 y 1,42-3,53-3,16). **Conclusiones:** Se concluyó que la mayoría (64,54%) pertenece al grupo Mesomorfo-Ectomorfo, seguido del Ectomorfo-Mesomorfo (35,46%) y el Ectomorfo-Mesomorfo es el más bajo (35,46%) entre los konyak Naga.

Palabras Clave: Konyak Naga, Somatochart, Mesomórfico-Ectomorfo, IMC, Correlación

Introduction

The term 'somatotype' was first introduced in 1940s by W.H. Sheldon, Stevens and Tucker, it means the varieties of human physiques. Heath and Carter widely studied somatotype distributions of different populations, including heritibality of somatotypes, changes of somatotype in growth and aging, somatotypes in sports and physical performance and medical, behavioural, occupational and other variables associated with somatotype. It is also used to record changes in physique and to estimate gross biological differences and similarities among human beings Heath & Carter, (1971), Parnell, (1954), Silventoinen et al., (2021), S. Singh, (2007). Somatotype differ between the population as well as growth pattern. Age and sex are two other factors that significantly influence an individual's somatotype in along with genetic reasons Gakhar & Malik, (2002). Somatotyping continued to advance during this time, which contributed to the development of the Heath-Carter method. Somatotype is defined by the Heath-Carter method as a quantitative description of the present structure and composition of the body. Endomorphy, which is defined as a three-number rating and denotes one aspect of the physique, is the definition of body fatness. Mesomorphy is the term for the robustness of the musculoskeletal system in relation to height, and ectomorphy is linearity Carter & Heath, (1990). The somatotype can be used to assess physical changes and evaluate the gross biological variations and similarities throughout the people.It is a tag used in anthropology to identify people. This somatotyping technique is applied to both sexes at all ages and is sensitive to changes in physical characteristics during time. Somatotype has been extensively studied in relation to the talents and levels of competition of both athletes and nonathletesGaray, et al. (1974), (1977). Not only body physique change to change somatotype many other factor like gender, climatic condition, nutrition also environment and genetic factor are affected to change somatotping Carter & Heath, (1990), Garay, et al. (1974), (1977), Heath & Carter, (1971).

Globally, there are many Anthropologist and Sport Scientist conducting various type of study to assess the somatotype in different populations.(Barbieri et al., (2017), Carter & Heath, (1990), Heath & Carter (1971), Nagi et al. (2021), Parnell, (1954), Roy Sarkar & Sil, (2015), Silventoinen et al. (2021), Tsukru & Dkhar, (2021), Vertinsky, (2007). still some population are untouched and somatotyping study are also limited. Hence, this study was undertaken to study the somatotype among the Konyak Naga males of district Mon, Nagaland.

Material Methods

This study was conducted among the Konyak Naga of district Mon, Nagaland. The Naga tribe were defamed as 'Head-hunter' also, although now there is no such practice. According to the Konyaks themselves, they have existence from "time immemorial"; for thousands of years. They and their ancestors roamed on mountains of the region for the search of food and water. They are the last of the tattooed headhunters and the largest of the 16 tribes that the government has recognized. Younger's are adopted the modern culture and Christianity they are stopped or avoid Head-hunting process.

This cross sectional study investigated the 141 boys aged 11-20 years. Data collection was done during April 2023 in the Mon district of Nagaland. Ten convectional anthropometric measurements were used for anthropometric somatotyping such as height, weight, biceps skin fold, triceps skin fold, subscapuar skin fold, suprailliac skin fold, calf skin fold, humerus diameter, femur diameter and calf circumferences Heath and Carter (1967), Carter & Heath, (1990), Singh & Bhasin,(2004).The anthropometric measurement was taken as per standard techniques following Singh & Bhasin,(2004) and for skin fold measurement used Holtain caliper was used. The data was collected as per Helsinki declaration 2008; before entering into the state prior permission and approval was obtained from the

competent authority. The study was approved by the departmental committee. Written consent were obtained from each of the participants or the teacher/parents available during data collection.

The somatotyping component such as endomorphy, mesomorphy and ectomorphy were calculated following Heath and Carter (1967). Further, to assess the relationship between the sib-sib position somatotype and age wise somatotype was undertaken. MS Excel and SPSS softwares were used for tabulation, plotting and analysis of the data.

Results

Table no 1 display the no of sibling wise mean and SD of endomorphy, mesomorphy, ectomorphy among the Konyak Naga boys of Mon district Nagaland. The respondent who are having 1 no. of sibling are *Ectomorhic-Mesomorph* (2.20-3.85-3.41). Moving to the respondent who are having 2 sibling are *Mesomorphic-Ectomorph* (2.17-3.22-3.92).

Table 1. Number of sibling wise mean and SD of endomorphy, mesomorphy, ectomorphy among the Konyak Naga boys of Mon district Nagaland.

No. of Sib.	n	Endomorphy		Mesomorphy		Ectomorphy	
		Mean	SD	Mean	SD	Mean	SD
1	15	2.20	1.02	3.85	1.18	3.41	0.88
2	33	2.17	0.89	3.22	1.15	3.92	1.05
3	24	2.36	0.94	3.54	0.79	3.13	1.15
4	23	1.96	0.99	3.34	0.99	3.79	1.28
5	15	2.01	0.46	3.58	0.55	3.30	0.64
6	11	2.00	0.54	3.66	1.11	3.09	0.47
7	08	1.92	0.63	3.78	0.58	3.28	0.98
8	06	2.41	0.65	3.21	2.41	2.86	1.50
9	05	1.83	0.37	3.93	1.06	3.40	0.87
Total	*141*	*2.12*	*0.83*	*3.50*	*1.06*	*3.48*	*1.07*

After that the respondent who are having number of 3 sibling are Ectomorphic-Mesomorph (2.36-3.54-3.13). respondant who having having the 4 sibling they are belonging to the category of Mesomorphic-Ectomorph (1.96-3.34-3.79) regions of the somatochart. Following the respondant who are having no. of 5,6 and 7 sibling are Ectomorhic-Mesomorph (2.01-3.58-3.30, 2.00-3.66-3.09 & 1.92-3.78-3.28). here after replier who are having the number of 8 and 9 sibling they also belonging the Ectomorphic-Mesomorph region of the somatochart (2.41-3.21-2.86 and 1.83-3.93-3.40). The all respondent are basically belonging to the 2 categories of the region of somatochart. First is the ectomorphic-mesomorph region and second is the mesomorphic-ectomorph region of the somatochart.

Table 2. Age wise mean and sd of endomorphy, mesomorphy, ectomorphy among the konyaknaga boys of Mon district Nagaland

Age	n	Endomorphy		Mesomorphy		Ectomorphy	
		Mean	SD	Mean	SD	Mean	SD
11	16	2.67	1.33	3.34	1.10	3.50	1.21
12	19	2.08	0.45	3.25	0.95	3.76	0.90
13	16	2.14	0.93	3.39	0.76	3.96	1.12
14	14	2.05	0.73	2.96	1.41	3.96	1.11
15	26	2.11	0.92	3.73	0.88	3.38	0.99
16	12	1.85	0.30	4.11	1.41	3.21	0.72

17	16	2.12	0.60	3.41	1.04	3.03	1.24
18	10	2.06	0.47	3.83	0.75	2.87	0.93
19	8	2.06	0.69	3.61	0.79	3.50	0.86
20	4	1.42	1.43	3.53	1.77	3.16	1.23
Total	*141*	*2.12*	*0.83*	*3.50*	*1.06*	*3.48*	*1.07*

Table 2 is evident the age wise mean and SD of endomorphy, mesomorphy, ectomorphy among the Konyak Naga boys of Mon district Nagaland. The respondent whose age is 11-15 year they are belonging to Mesomorphic-Ectomorph region of the somatochart (2.67-3.34-3.50, 2.08-3.25-3.76, 2.14-3.39-3.96, 2.05-2.96-3.96 & 2.11-3.73-3.38).

Followed by the respondent who is 16 to 20 year old they are belonging to the **Ectomorphic-Mesomorph** region of the somatochart (1.85-4.11-3.21, 2.12-3.41-3.03, 2.06-3.83-2.87, 2.06-3.61-3.50 & 1.42-3.53-3.16).
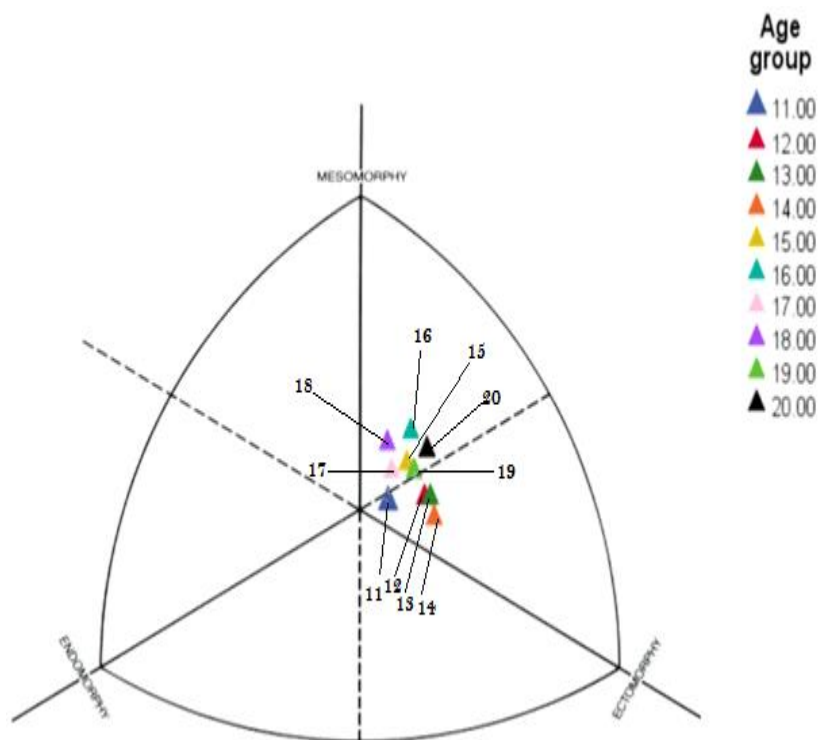

Figure 1. Somatochart displaying mean of somatotype for selected age groups

Changes in the somatotyping of Konyak males have been observed with increasing age. There are two aspect are noticed in the somatotyping table. The first aspect is noticed 11-15 year of the cohort and second is 16-20 year cohort of the konyaknaga males. For better understanding, the somatochart was drawn for the *figure no. 1*

Table 3. Distribution of respondents as per somatotype and correlation between BMI and somatotype.

Somatotype	Number	Mean	SD	Pearson Correlation (r)
Endomorphic	5	21.74	1.20	0.720
Mesomorphic	61	20.06	2.16	0.257*
Ectomorphic	75	17.38	1.70	-0.589**

It has been proved a correlational dependence between BMI and somatotype (0.720,0.257*& -0.589**). The endomorphic people are not significantly correlation between BMIs but the mesomorphic people was significantly correlation between BMIs. Ectomorphic people have the high linearity so these people are highly negatively

significant correlation with BMIs (-0589**). Whereas the average BMI for endomorphic type is 21.74±1.20, the mesomorphic type is 20.06±2.16 and the lowest BMI is for the ectomorphic type 17.38±1.70.

Discussion

Somatotyping of individuals and populations are determined by number of factors viz. age, sex, diet, nutrition, environment, and genetics etc. In the present study it was found that the Naga males of age 11-15 years are displaying **Mesomorphic-Ectomorph** characteristics, whereas respondents of 16 to 20 years of age are displaying **Ectomorphic-Mesomorph** characteristics. These findings corroborate Tsukru & Dkhar, (2021). They found 1.58, 3.75, 2.73 average somatotype (endomorphy, mesomorphy, ectomorphy) among the Chakhesang Naga boys. They were normally Mesomorphic-Ectomorph. They also find out a distinct shift in mean somatotype components with age among males from 8 to 18 years. Similar study was conducted by Lohe et al. (2021) they reported that a small percentage (0.4%) of the boys have been shown to be mesomorphic-endomorphs.
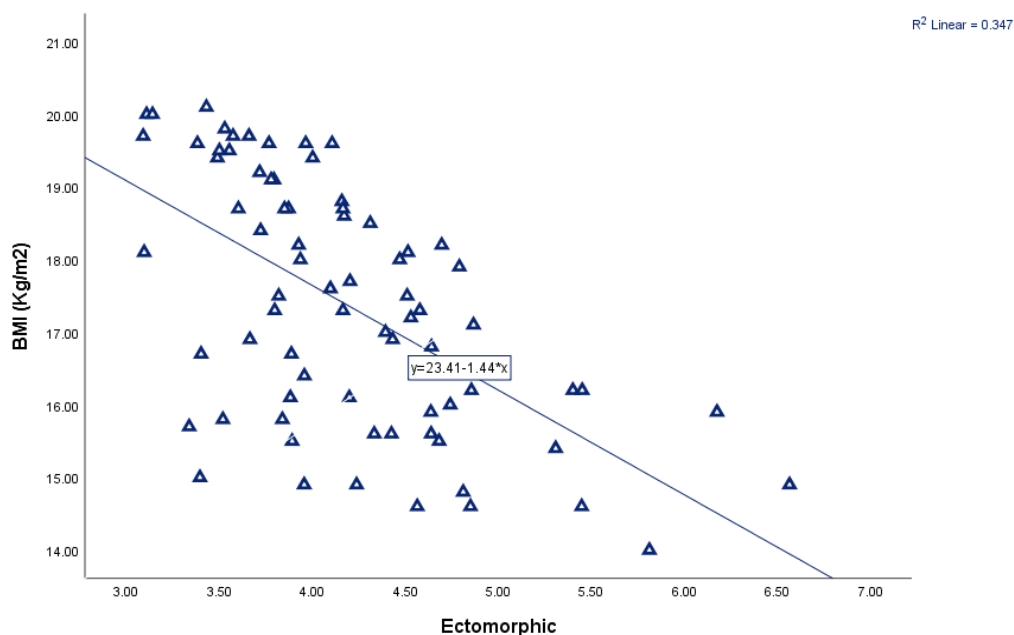

Figure 2. Scattered plot diagram showing correlation between BMI and Ectomorphic component
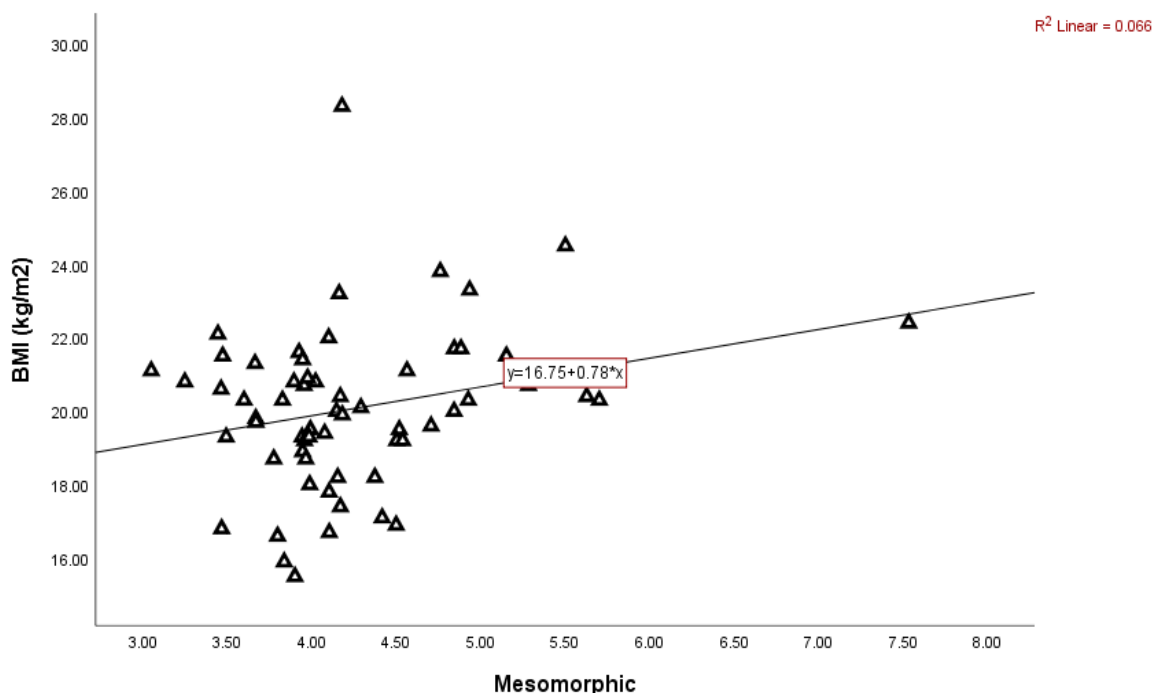

Figure 3. Scattered plot diagram showing correlation between BMI and Mesomorphic component

In all age groups of Bengali boys, five somatotype categories were discovered, including endomorphic-mesomorph, balanced-mesomorph, ectomorphic-mesomorph, mesomorph-ectomorph, and mesomorphic-ectomorph (Roy Sarkar & Sil; 2015). Also investigated the somatotype of Mising adolescent boys as an entire group varied between 1.46 to 3.81 and 3.3. Eight body types were determined using the Heath-Carter approach, where sub-categories of mesomorphy and ectomorphy components were found to be predominate.

The changes in somatotype component according to age were less marked for endomorphy component, whereas mesomorphy and ectomorphy show the significantly difference. In the present study an attempt was made to understand the role of sib-sib position in shaping somatotype. It was found that somatotype component are changing according to the number of sibling and the age of the respondents. A study conducted by Longkumer, (2014) among the Ao Naga boys, it was found that ectomorphic component changed over their ages 7-8 year to 15 years. In another study conducted by Das et al., (2021) they found 11 body types with dominant mesomorphic-ectomorphic components.

Some other study found change in mean somatotype components between the ages of 8-18 years of the boys with increase in endomorphy, but no consistent pattern has been seen (Chandel & Malik, (2012), Das et al. (2021), Lohe et al. (2021), Sarkar & Sil, (2014) Tsukru & Dkhar, (2021). However, they reported notable differences in the mesomorphy and ectomorphy. The non-athletic tribal school boys of West Tripura district were largely mesomorphic.

During infant to childhood and adulthood, height and weight have to increase, hence the body mass index (BMI) is low (Beunen et al. (1992), Chaurasia et al. (2019) Khongsdier, (2005), Thakur & Gautam, (2015). Here an attempt was made to understand the relationship between BMI and somatotype component or somatochart coordinates. Pearson correlation coefficient was found significant for mesomorphy ($r=0.257$) and ectomorphy ($r=-0.589$) components. In case of ectomorphy the correlation is inverse, due to increasing thinness. These correlations corroborate with the findings of Das et al., (2021) and Tsukru et al., (2021). Further, Das et al., (2021) also reported negative correlation ($r=-0.943$) between somatotype and BMIs.

In this way, this study provides a comprehensive understanding about the somatotype among the males (11-20 years, age) of Konynk Naga of district Mon, Nagaland, India. This is first such reporting from the Konynk Naga of district Mon. In spite of somatotyping, the correlation between BMI and somatotype components corroborate previous studies from different Indian population.

Conclusion

It can be concluded that the male of Konyak Naga are characterized by Mesomorphic-***Ectomorph* and *Ectomorphic-Mesomorph.*** Age is an important determinant to shape the body type during the phases of growth. During adolescence (age 11-15 years) they are displaying ***Mesomorphic-Ectomorph*** characteristics; whereas in post-adolescent period (16 to 20 years of age) they change to ***Ectomorphic-Mesomorph***. It can be inferred from the correlation analysis that there is significant relationship between BMI and somatotype components, although it is an inverse relationship.

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Data availability

Full access to data on request.

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Conflicts of Interest

The Authors have no conflict of interest to declare

Informed Consent Statement

All the athletes included in the study provided written informed consent.

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