International Journal of Physical Education, Sports and Health 2021; 8(3): 374-379

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2021; 8(3): 374-379

www.kheljournal.com
Received: 19-03-2021
Accepted: 21-04-2021

Vivoto Tsukru
Department of Anthropology, North-Eastern Hill University, Shillong, Meghalaya, India

Venekholu Khesoh
Department of Anthropology, Kohima Science College Autonomous, Jotsoma, Nagaland, India

Johnsly Well Dkhar
Department of Anthropology, North-Eastern Hill University, Shillong, Meghalaya, India

Dhruba Kumar Limbu
Department of Anthropology, North-Eastern Hill University, Shillong, Meghalaya, India

Khriekemhie-u K Mary
Department of Anthropology, Kohima Science College Autonomous, Jotsoma, Nagaland, India

Corresponding Author:
Vivoto Tsukru
Department of Anthropology, North-Eastern Hill University, Shillong, Meghalaya, India

Body physique and nutritional status of Naga wrestlers: A case study of the Chakhesang tribe of Nagaland, India

Vivoto Tsukru, Venekholu Khesoh, Johnsly Well Dkhar, Dhruba Kumar Limbu and Khriekemhie-u K Mary

DOI: https://doi.org/10.22271/kheljournal.2021.v8.i3f.2110

Abstract
The present study was conducted among the Chakhesang wrestlers and the controlled group of Phek district, Nagaland. This study aims to describe the variation in body physique and nutritional status of the traditional Naga-style wrestlers and the controlled group. Altogether, 52 each prominent wrestlers and non-wrestlers aged between 18 and 34 years were included in the present study. Heath-Carter method of somatotyping was employed to determine body physique. Nutritional status was determined using BMI classification for the Asian population given by WHO. Significant variations at different levels of probability were observed in all the anthropometric measurements included in the present study between the wrestlers and the controlled group. Significant variations were also found in BMI ($p<0.01$), endomorphy ($p<0.01$), mesomorphy ($p<0.05$) and ectomorphy ($p<0.01$). Wrestlers are generally mesomorph-ectomorph and the controlled group is ectomorphic-mesomorph. High percentages occurrence of overweight (38.5%) and obesity (53.8%) was observed among the wrestlers. Despite the coexistence of under nutrition and over nutrition, nutritional status of the controlled group is relatively good. In both the studied groups, age effect on body physique and BMI was observed. Further, it was observed that both the endomorphy and mesomorphy components show increment with the increase in BMI levels, whereas, ectomorphy decreases as BMI increases.

Keywords: Naga wrestling, body physique, nutritional status, Chakhesang, Nagaland

Introduction
'Naga wrestling' or 'Naga-style wrestling' is an indigenous game played by the menfolk of Tenyimi Naga tribes of Nagaland and Manipur during the lean period of an agricultural cycle. There is no weight or age category in this style of wrestling as these tribes consider the game as a portrait of masculinity, irrespective of size or age. Naga wrestling is one of the most participated and well preserved cultural traits among the Tenyimi Nagas. Traditionally, wrestling was played as a means of conflict resolution between individuals, families, clans or villages under the watchful eyes of elders. One's opponent is addressed as *khrietho-u* (beloved friend), signifying that the game is not just about the showcase of strength and power, but also, about the spirit of friendship and brotherhood. However, with the advent of Christianity and the formation of Nagaland Wrestling Association (NWA), wrestling bouts were organized in a more standardized manner in the early 1970s. Nonetheless, the gamesmanship remains the same and wrestling bouts are still religiously practised with the wrestlers following a certain unwritten cultural codes of conduct to maintain the purity of the game.

Once considered a major health issue only among the developed countries and affluent societies, overweight and obesity have now become a global epidemic. The prevalence of overnutrition in low and middle-income countries, particularly in urban settings [1] has increased dramatically in recent years. North-East India is no exception in this transition. Based on the National Family Health Survey (NHFS-III) data, Bharati *et al.* [2] have reported the prevalence of overweight and obesity among the adults of both sexes (percentages of male and female are separately given in parentheses) in all the eight states of the region *viz.*,

Arunachal Pradesh (9.5%, 11.0%), Assam (7.0%, 11.2%), Manipur (11.8%, 16.6%), Meghalaya (7.4%, 7.7%), Mizoram (13.4%, 11.6%), Nagaland (8.9%, 10.4%), Sikkim (16.6%, 19.6%) and Tripura (6.5%, 9.1%). Further, other studies in this field have reported a high prevalence of under nutrition among different adult [3, 4] and adolescents [5] tribal and non-tribal populations of this region of the country. Thus, like other parts of India, populations of North-East India belonging to diverse ethnic groups are also facing the double burden of both undernutrition and overnutrition.

Somatotyping is the quantification of human body shape and its composition which is modeled in the form of a three-number rating scale. This three-number rating represents endomorphy (relative fatness), mesomorphy (relative musculoskeletal robustness) and ectomorphy (relative linearity or slenderness) components respectively, always in the same order [6]. Somatotyping of athletes suggests the presence of a typical physical prototype across age and competitive level among athletes which can be useful to coaches during their selection processes and talent identification in clubs and regional/national teams [7]. Somatotype characteristics are influenced by nutrition and physical performance [8]. It is therefore apparent that variations in morphological characteristics do exist between the athletes and the controlled group of the same ethnic population. Studying this variation in body size and physique has long been the interest of physical anthropologists and scientists from other related disciplines as it helps in understanding the health, nutritional status, degree of environmental and ecological adaptation of a population. From the time of the inception of the somatotyping method and its modifications by the likes of Sheldon, Carter, Heath and their associates, the importance of studying body physique in relation to sports was widely recognized and numerous studies have been reported in different disciplines. On the somatotype studies of the wrestlers in India, Kapoor and Singh [9] reported among the Indian wrestlers and Olympic wrestlers, Madhavan [10] among the adolescent wrestlers of Kerala, while, Choudhary *et al.* [11] showed the somatotype distribution of sportsmen specializing in different events including wrestling. In North-East India, very few anthropological studies have been conducted on sports *viz*., Dkhar [12] on male footballers of Meghalaya, Blah [13] on female basketball players of Meghalaya, Devi [14] on female weightlifters of Manipur and Devi and Singh [15] on footballers of Manipur. So far, to the best of our knowledge, no reported work could be traced among wrestlers in this region of the country in general and the Naga style wrestling in particular.

Keeping in mind the current research trends, the importance of somatotype in sports, the ever-increasing prevalence of overnutrition and the void in anthropological research related to sports science in North-East India, the present study was conducted to report the variation in somatotype characteristics and nutritional status between Chakhesang wrestlers and the controlled group.

Samples and Methods

Study area and sample size

The present study was conducted among Chakhesang Naga wrestlers and non-wrestlers (controlled group) belonging to the Chakhesang tribe of Phek district of Nagaland during the period between December 2018 and February 2019. This period was the peak season for wrestling tournaments in Nagaland, one of the states in North-East India. Chakhesang Nagas are one of the major tribes of Nagaland inhabiting the hills of Phek district. A total of 52 prominent wrestlers from the eight villages' *viz*., Thenyizu, Chetheba, Chesezu, Khulazu Basa, Khulazu Bawe, Thipuzu, Kikruma and Phüsachodü villages belonging to Chakhesang tribe were selected and measured for the present study. The reason for selecting Chakhesang wrestlers was their dominance at the state level wrestling tournaments. For the controlled group, Chesezu village of Phek district was randomly selected. The subjects for the controlled group were purposively selected; given the criteria that they have never wrestled professionally or out of passion.

Methods

Heath-Carter method (1967) of anthropometric somatotyping [6] was employed for computing the somatotype ratings. This method incorporates the use of ten anthropometric measurements *viz*., 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. The somatotype component values obtained were plotted on a somatochart for graphical presentation. Measurements were taken using standard techniques given by Weiner and Lourie [16]. Care was taken to ensure that measurements were taken from apparently healthy and normal subjects without any congenital disorders. Data on date of birth was collected from each subject and the decimal age was calculated using the decimal age calendar [17].

Nutritional status was determined using the formula- BMI = Weight (kg) / Height (m^2). The World Health Organization (WHO) regional office for the Western Pacific Region along with the International Association for the Study of Obesity (IASO) and the International Obesity Task Force (IOTF) has recommended a BMI of 23.0 kg/m^2 as a cut-off value for determining overweight in Asian populations. Accordingly, the BMI classification for adult Asian population [18] was used in the present study. All the statistical analyses presented in this paper were computed using SPSS software (version 20) for windows.

Results

Descriptive statistics of anthropometric variables used in somatotyping, BMI, somatotype components and t-values between the wrestlers and the controlled group are illustrated in Table 1. The wrestlers have higher mean readings compared to the controlled group in all the anthropometric measurements taken for the present study. Variation in all the measurements is statistically significant. The significance level of bi-condylar humerus and bi-condylar femur was at $p<0.05$, while, the remaining eight measurements involved in somatotyping were significant at $p<0.01$. Mean BMI of wrestlers and the controlled group was 27.29 kg/m^2 and 22.02 kg/m^2 respectively. This difference in BMI readings between the two groups is significant ($p<0.01$). Regarding somatotype components, significant difference was observed in all the three components *viz*., endomorphy ($p<0.01$), mesomorphy ($p<0.05$) and ectomorphy ($p<0.01$).

Table 1: Descriptive statistics and t-values of anthropometric characteristics among Naga wrestlers and controlled group

Anthropometric Measurements	Wrestlers N=52		Controlled N=52		t-values
	Mean	SD	Mean	SD	
Height (cm)	173.08	4.64	168.44	5.44	4.68**
Weight (kg)	81.85	14.21	62.73	11.13	7.64**
Bi-condylar Humerus (cm)	7.41	0.71	7.12	0.61	2.22*
Bi-condylar Femur (cm)	9.69	0.90	9.28	0.85	2.40*
Mid-Upper Arm Girth (cm)	31.12	4.02	27.89	2.96	4.66**
Calf Girth (cm)	38.83	4.08	36.00	3.58	3.75**
Triceps Skinfold (mm)	10.52	3.80	6.25	2.54	6.74**
Sub-Scapula Skinfold (mm)	19.02	7.06	11.38	4.61	6.54**
Supra-Illiac Skinfold (mm)	14.49	6.03	7.01	4.00	7.45**
Calf Skinfold (mm)	9.34	3.10	6.25	2.80	5.33**
BMI (kg/m^2)	27.29	4.41	22.02	3.16	6.99**
Endomorphy	4.15	1.04	2.37	0.84	7.88**
Mesomorphy	5.31	1.54	4.48	1.41	2.34*
Ectomorphy	1.18	0.63	2.43	0.81	5.81**

* $p < 0.5$; ** $p < 0.01$

Table 2 reveals that the somatotype characteristics of both the wrestlers and the controlled group are predominantly mesomorphic. The mean somatotype ratings of the wrestlers and the controlled group are 4.15 – 5.31 – 1.18 and 2.37 – 4.48 – 2.43 respectively. With advancing age, a regular pattern of increase in endomorphy and a decrease in ectomorphy is found, indicating that, the senior wrestlers are fatter than the younger wrestlers. However, no regular trend of increase in mesomorphy was observed. Among the controlled group, mesomorphy remains dominant across all age groups. Trends in age difference in somatotype components in this group are by and large similar to the wrestlers. A regular pattern of increase in endomorphy and mesomorphy component was observed; however, no regular pattern of decrease was found in ectomorphy.

Table 2: Somatotype components among Naga wrestlers and controlled group

Age groups (years)	Wrestlers			
	N	Endomorphy Mean ± SD	Mesomorphy Mean ± SD	Ectomorphy Mean ± SD
18-22	16	3.35 ± 0.94	4.92 ± 1.38	1.70 ± 0.58
23-28	20	3.79 ± 0.97	5.55 ± 1.44	1.35 ± 0.78
29-34	16	5.31 ± 1.20	5.47 ± 1.80	0.50 ± 0.51
All Ages	52	4.15 ± 1.04	5.31 ± 1.54	1.18 ± 0.63
Age groups (years)	Controlled			
	N	Endomorphy Mean ± SD	Mesomorphy Mean ± SD	Ectomorphy Mean ± SD
18-22	14	2.04 ± 0.52	4.01 ± 1.06	2.67 ± 0.68
23-28	23	2.09 ± 0.64	4.45 ±1.25	2.85 ± 1.01
29-34	15	2.98 ± 1.37	4.57 ± 1.93	1.78 ± 0.73
All Ages	52	2.37 ± 0.84	4.48 ± 1.41	2.43 ± 0.81

Using the component dominance method [6], findings of the present study were grouped into thirteen different categories based on the areas of the two-dimensional somatochart (Table 3). Wrestlers are grouped into six different categories while the controlled group is divided into nine different categories. All the wrestlers included in the present study were grouped in the subcategories of mesomorphy and endomorphy. On the other hand, the controlled group exhibits substantial distribution in the subcategories of all the three somatotype components. The average component dominant somatotype of wrestlers is mesomorph-endomorph (Figure 1), while, the controlled group falls in the ectomorphic mesomorph category (Figure 2).

Table 3: Somatotype component dominance categories among the Naga wrestlers and controlled group

Somatotype categories	Wrestlers		Controlled	
	N	%	N	%
Central	1	1.92	4	7.69
Balanced Endomorph	2	3.85	0	0.00
Mesomorphic Endomorph	5	9.62	0	0.00
Mesomorph-Endomorph	20	38.46	3	5.77
Endomorphic mesomorph	18	34.62	8	15.38
Balanced Mesomorph	6	11.54	13	25.00
Ectomorphic Mesomorph	0	0.00	12	23.08
Mesomorph-Ectomorph	0	0.00	5	9.62
Mesomorphic Ectomorph	0	0.00	4	7.69
Balanced Ectomorph	0	0.00	2	3.85
Endomorphic Ectomorph	0	0.00	1	1.92
Endomorph-Ectomorph	0	0.00	0	0.00
Ectomorphic Endomorph	0	0.00	0	0.00

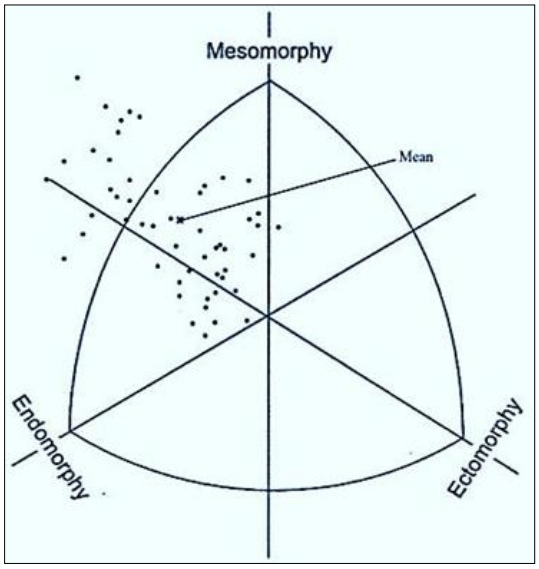

Fig 1: Somatochart of Naga wrestlers

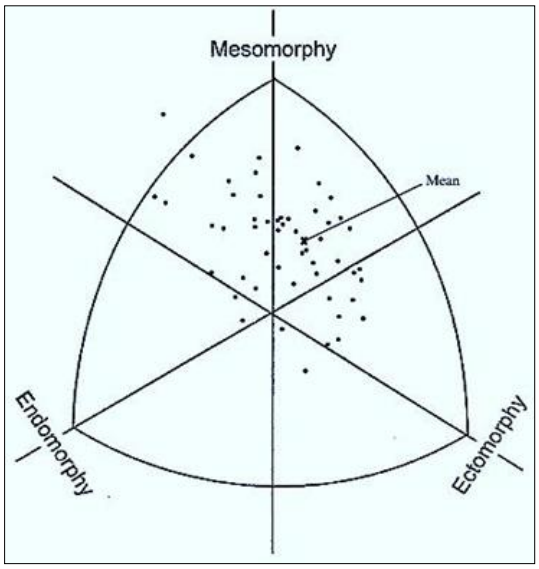

Fig 2: Somatochart of controlled group

The nutritional status, as derived from the computation of body mass index (BMI) shows predominant occurrence of obesity among the wrestlers, while, normal-weight among the non-wrestlers (Table 4). Nutritional status by age groups suggests that BMI elevates with advancing age in both the studied groups. In the present study, no wrestler was found to be underweight as expected among the combat-sport athletes. Only a small margin (7.7%) of wrestlers fall under the normal-weight category, while, a large majority of the wrestlers was overweight (38.5%) and obese (53.8%). The controlled group showed more variation in their nutritional status with an almost equal frequency occurrence of underweight and obese. Normal-weight (48.1%) is the dominant category among the non-wrestlers. The difference in nutritional status between the wrestlers and the controlled group is found to be statistically significant ($p<0.001$).

Table 4: Nutritional status among Naga wrestlers and controlled group

Nutritional status*	Wrestlers				Controlled			
	Age groups (years)				Age groups (years)			
	18-22 N=17	23-28 N= 16	29-34 N=19	All ages N=52	18-22 N=14	23-28 N=23	29-34 N=15	All ages N=52
Under-weight	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (35.71)	3 (13.04)	0 (0.00)	8 (15.38)
Normal- weight	2 (11.76)	2 (12.50)	0 (0.00)	4 (7.69)	8 (57.14)	13 (56.52)	4 (26.67)	25 (48.08)
Over- weight	13 (76.48)	6 (37.50)	1 (5.26)	20 (38.46)	1 (7.15)	5 (21.74)	7 (46.66)	13 (25.00)
Obese	2 (11.76)	8 (50.00)	18 (94.74)	28 (53.85)	0 (0.00)	2 (8.70)	4 (26.67)	6 (11.54)

χ^2 (Wrestler X Controlled) =39.127, d.f=4, $p<0.001$ *percentages are given in parentheses

The relationship between nutritional status and somatotype components are presented in Table 5. Regardless of the studied group, endomorphy and mesomorphy components exhibit an increment with an increase in BMI levels. On the contrary, ectomorphy decreases with an increase in BMI levels. These evidences strongly suggest that nutritional status do influence in shaping the different somatotype components of an individual's body. This association between nutritional status and somatotype components in both the wrestlers and the controlled group found highly significant ($p<0.001$).

Table 5: Somatotype components according to nutritional status among the Naga wrestlers and controlled group

Nutritional status*	Wrestlers		
	Endomorphy Mean ± SD	**Mesomorphy Mean ± SD**	**Ectomorphy Mean ± SD**
Normal range (4)	3.27 ± 0.86	4.66 ± 1.12	2.55 ± 0.30
Overweight (20)	4.19 ± 0.57	5.59 ± 0.91	1.79 ± 0.29
Obese (28)	5.04 ± 1.16	5.34 ± 1.82	0.53 ± 0.44
ANOVA	22.79 (p<0.001)	14.60 (p<0.001)	89.76 (p<0.001)
Nutritional status*	Controlled		
	Endomorphy Mean ± SD	Mesomorphy Mean ± SD	Ectomorphy Mean ± SD
Underweight (8)	1.84 ± 0.41	3.06 ± 1.21	4.16 ± 0.58
Normal range (25)	2.28 ± 0.48	4.91 ± 1.21	2.39 ± 0.42
Overweight (13)	2.45 ± 0.80	4.52 ± 1.03	1.53 ± 0.32
Obese (6)	4.20 ± 1.16	5.53 ± 1.64	0.71 ± 0.40
ANOVA	19.72 (p<0.001)	8.93 (p<0.001)	72.11 (p<0.001)

*numbers of subjects are given in parentheses

Discussion

The morphological characteristics between the wrestlers and the controlled group differ to a great extent. The wrestlers are taller, significantly heavier with a larger body built and broader epiphysis than the controlled group. Previous studies have also reported similar difference in physical built between athletes and non-athlete groups in different sport disciplines [11, 15, 19].

The finding of the present study shows that the Naga wrestlers possess a fat but muscular body physique (4.15 – 5.31 – 1.18). Such dominance of the mesomorphy component is expected among the wrestlers because of the physical built demand of the game accomplished by regular exercise and a protein-rich diet. On comparing the mean somatotype ratings of the Naga wrestlers with the Indian wrestlers (3.18 – 6.0 – 1.22) [11], Naga wrestlers exhibit a much higher relative fatness and lesser musculoskeletal development in their body physique. The Naga wrestlers of the present study have marked relative fatness and a muscular body physique as most wrestlers were grouped in the subcategories of endomorphy and mesomorphy components. The most obvious cause of the increase in body fat is due to the regular consumption of meat and high-calorie food at wrestling camps, as has also been reported among the Indian Olympic wrestlers in training camps [9]. This increase in body fat is in strong association with the dramatically high prevalence of overweight and obesity among wrestlers.

In general, the controlled group exhibits a lean and muscular body physique (2.37 – 4.48 – 2.43), apparent from the higher incidence of occurrence in the sub-categories of mesomorphy and ectomorphy components. One important factor for the dominance of mesomorphy component among the non-wrestlers is because of the physical demand in agriculture-related activities using the traditional method, more importantly concerned with terrace cultivation in hilly regions as practised by the Chakhesang tribe. This mode of cultivation requires a host of manpower to plough the fields and for channelling water into the fields for irrigation purpose. Further, participants in this study were mostly cultivators and daily wagers, and perhaps, the dominance of mesomorphy is justified due to the physical built demand in such laborious occupations. Similar impact of the use of primitive agricultural technology and involvement in daily wage works on higher mesomorphy ratings were reported among the Sabars [20] and the Santhals [21] of West Bengal.

The prevalence of obesity among the wrestlers is outrageously higher than the non-wrestlers. The mean BMI of the Naga wrestlers (27.29 kg/m^2) is found to be higher than the Italian wrestlers (24.5 kg/m^2) [22] and wrestlers of the Australian Institute of Sports (24.2 kg/m^2) [23]. A probable cause of high BMI reading among the Naga wrestlers could be the absence of weight category in Naga-style wrestling, and as such, wrestlers tend to deliberately increase body weight by excess intake of meat and high energy food to gain advantage over lower weight opponents. Such a trend of increasing weight was also observed among the professional Sumo wrestlers attempting to gain weight by excess energy intake in addition to muscle training to get promotion to higher divisions [24]. However, we cannot ignore the fact that BMI is influenced by both fat mass and fat-free mass. Hence, using BMI for trained subjects can overestimate their level of body fat because muscle is denser than fat and it weighs more [25]. In this connection, the results of the present study indicate that obese classified wrestlers show higher endomorphy and lesser mesomorphy when compared to their obese classified non-wrestler counterparts. Even BMI predictors like skinfolds were much higher among wrestlers and showed significant variations with the controlled group. These evidences strongly suggest that higher BMI readings among the Naga wrestlers are more influenced by fat mass rather than the fat-free mass.

Recent studies have shown that obesity-related co-morbidities such as metabolic syndrome and its resultant cardiovascular diseases have become a major health burden even in North-East India [26, 27, 28]. In such a scenario, the prevalence of cardiovascular diseases related to obesity is undeniably conspicuous among the Naga wrestlers due to their practice in deliberate increase of body weight by excessive consumption of red meat and high energy intake at the expense of reduced physical activity. However, more data on the wrestler's physiological conditions and dietary intake are required to come to any conclusion on co-morbidities of obesity and the future health risks of Naga wrestlers.

Conclusion

Naga wrestlers are generally mesomorph-endomorph with a fatty-muscular body physique, whereas, the controlled group are ectomorphic-mesomorph characterized by a lean-muscular body physique. The controlled group showed more variation in their physical built because of the difference in physical activities performed and individual dietary intake. However, for wrestlers the dietary intake as well as the level of physical activities performed, is somewhat similar because of the common physical and nutritional demands of the game. Therefore, the occurrence of various somatotype component dominance categories among the wrestlers is not as scattered as the controlled group. The present study suggests the presence of a common body physique among the wrestlers. Relatively high ratings of endomorphy and its association with the prevalence of overweight and obesity among the wrestlers can be attributed to the absence of weight category

in Naga wrestling.

Acknowledgement
The authors sincerely acknowledge the wrestlers, officials of different wrestling units and the controlled group participants who have actively participated in this study. Our sincere thanks to the Headmen and the people of the respective villages covered for the necessary permissions, their hospitality and their willingness to help. Without them, this study wouldn't be a success.
This study was funded by the Department of Anthropology, Kohima Science College Autonomous, Jotsoma.

Conflicts of interest
The authors declared no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

References
1. Gouda J, Prusty RK. Overweight and obesity among women of economic status in urban India. Journal of Health Population Nutrition 2014;32(1):79-88.
2. Bharati P, Pal M, Bharati S. Overweight and obesity among the adult population in Northeast India. In: Sengupta S, Dutta D ed. Growth and Nutritional Studies: Perspectives from North-East India. New Delhi: Gyan Publishing House 2019, 27-35.
3. Khongsdier R. Body mass index of adult males in 12 populations of Northeast India. Annals of Human Biology 2001;28(4):374-383.
4. Khongsdier R. Body mass index and morbidity in adult males of the War Khasi in northeast India. European Journal of Clinical Nutrition 2002;56(6):484-489.
5. Rengma MB, Bose K, Mondal N. Socio-economic and demographic correlates of stunting among adolescents of Assam, North-east India. Anthropological review 2016;79(4):409-425.
6. Carter JEL. The Heath-Carter anthropometric somatotype: Instruction Manual. Surrey, Canada 2002.
7. Bacciotti S, Baxter-Jones A, Gaya A, Maia J. Body physique and proportionality of Brazilian female artistic gymnasts. Journal of Sports Sciences 2018;36(7):749-756.
8. Carter JE, Phillips WH. Structural changes in exercising middle-aged males during a 2-year period. Journal of Applied Physiology 1969;27(6):787-94.
9. Kapoor YS, Singh IP. A Comparative Study of Physique and Body Composition of Indian and Olympic Wrestlers. Indian Anthropologist 1999;21(1):23-28.
10. Madhavan N. Physical characteristics of adolescent male wrestlers of Kerala. International Journal of Physical Education Fitness and Sports 2013;2(4):39-41.
11. Choudhary S, Singh S, Singh I, Varte LR, Sahani R, Rawat S. Somatotypes of Indian Athletes of Different Sports. Online J Health Allied Scs 2019, 18(2).
12. Dkhar JW. Somatotype of the Football Players of Meghalaya [M.Phil Thesis]. Shillong, India: North-Eastern Hill University 1991.
13. Blah I. An Anthropological study of Basketball players among Khasi women of Shillong [M.Phil Thesis]. Shillong, India: North-Eastern Hill University 1993.
14. Devi HS. Variation in physical structure of the Meitei women weight lifters and the controlled group. Anthropologists 2006;8(4):227-230.
15. Devi HS, Singh KS. Bio-cultural aspects of the Meitei Women Football Players of Manipur. Journal of Human Ecology 2007;21(4):251-256.
16. Weiner JS, Lourie JA. Practical Human Biology. New York: Academic Press 1981.
17. Tanner JM, Hiernaux J, Jarnan S. Human Biology: A Guide to Field Methods. Oxford: Blackwell Scientific Publication 1969.
18. World Health Organization. The Asia-Pacific perspective: Redefining obesity and its treatment. Geneva: World Health Organization 2000.
19. Sodhi HS. Kinanthropometry and Performance of Top Ranking Basketball Players. Brit. J Sports Med 1980;14:139-144.
20. Das K, Mukherjee K, Ganguli S, Pal S, Bagchi SS. The association between somatotype and nutritional status: A cross-sectional study among the adult Sabar males of Purulia, West Bengal, India. International Journal of Anthropology and Ethnology 2021;5(5):1-16. DOI: 10.1186/s41257-021-00046-5
21. Ghosh S, Malik SL. Variations of Body Physique in Santhals: An Indian Tribe. Collegium Antropologicum 2010;34(2):467-472.
22. Zaccagni L. Anthropometric characteristics and body composition of Italian national wrestlers. European Journal of Sport Science 2012;12(2):145-151.
23. Reale R, Burke LM, Cox GR, Slater G. Body composition of elite Olympic combat sport athletes. Euro. J of Sp. Science 2019. DOI: 10.1080/17461391.2019.1616826
24. Hattori K, Kondo M, Abe T, Tanaka S, Fukunata T. Hierarchical differences in body composition of professional Sumo wrestlers. Annals of Human Biology 1999;26(2):179-184.
25. Mazic S, Djelic M, Suzic J, Suzic S, Dekleva M, Radovanovic D *et al*. Overweight in trained subjects– are we looking at wrong numbers? Gen. Physiol. Biophys 2009;28:200-204.
26. Khual GK, Limbu DK. Prevalence of Obesity and Hypertension among the Zou Mothers of Manipur, Northeast India. The Oriental Anthropologist 2019;19(1):112-120.
27. Meshram II, Rao MVV, Rao VS, Laxmaiah A, Polasa K. Regional variation in the prevalence of overweight /obesity, hypertension and diabetes and their correlates among the adult rural population in India. British Journal of Nutrition 2016;115:1265-1272.
28. Shah A, Afzal M. Prevalence of diabetes and hypertension and association with various risk factors among different Muslim populations of Manipur, India. Journal of Diabetes and Metabolic Disorders 2013, 12(1). DOI: 10.1186/2251-6581-12-52.