ANNALS OF HUMAN BIOLOGY, 2001, VOL. 28, NO. 4, 374–383

Body mass index of adult males in 12 populations of Northeast India

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Received 6 January 1999; accepted 10 August 2000

Summary. *Background*: Of the anthropometric indices, body mass index (BMI) is considered to be more nutritionally than genetically related. Thus, in a country with diverse ethnic groups like India, it is more appropriate to use BMI as an indicator of the nutritional status of adult population. However, literature on BMI of adult Indians is limited to certain geographical regions or populations, and little is known about the populations in the northeast region of the Indian sub-continent.
Aim: The present report deals with the BMI of adult males in 12 populations of Northeast India with a view to understanding their nutritional status.
Subjects and methods: Anthropometric data collected by the Anthropological Survey of India on 946 adult males aged 18–62 years of 12 populations in Northeast India were used in this analysis. The populations were broadly categorized into three groups, namely, caste, Hinduized and tribal groups. The data were collected mostly from rural areas, taking into consideration the different social ranks such as castes, tribes and religious groups.
Results: The variation in mean BMIs between populations was highly significant, ranging between 18.3 and 20.5 kg m^{-2}. Despite a few exceptions, the mean values of BMI in the tribal populations were significantly higher than the caste groups. The prevalence of chronic energy deficiency (CED) was also lower in the tribal (19%) than in the Hinduized (49%) and caste (52%) populations ($\chi^2 = 89.4$, d.f. = 2, $p < 0.001$). Although it is difficult to explain why the tribals have higher BMI than the higher castes, the Cormic index or CI (SH/H) was significantly lower among the caste groups as compared with some tribal groups. The linear regression coefficient ($b \pm$ standard error) of BMI on CI for all the populations, irrespective of ethnic origin, was 30.4 ± 4.3 ($t = 7.1$, $p < 0.000$), and the correlation coefficient ($r \pm$ standard error) 0.22 ± 0.03. The differences in BMI across groups were, however, significant even after allowing for CI.
Conclusion: A majority of the adult males in these populations were lean. The high proportion of individuals with grade I CED suggests the need of other information on morbidity and health status of these populations.

1. Introduction

One of the major health problems in many developing countries is the widespread prevalence of undernutrition and infectious diseases (WHO 1990). Inadequacies in nutritional intake, or undernutrition, can be considered a major scourge of many adverse effects on growth and health of individuals (Gordon, Ascoli, Mata *et al.* 1968, Chandra and Newberne 1977, Chen, Huq and Huffman 1981, Chandra 1981, 1983, Martorell and Ho 1984, Mitra 1985, Mascie-Taylor 1991, Edmundson, Sukhatme and Edmudson 1992). It is generally reported that the basic causes of undernutrition and infections in developing countries are poverty, poor hygienic conditions and little access to preventive and health care (Mitra 1985, WHO 1990). Hence, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socio-economic status of the population (Osmani 1992).

Annals of Human Biology ISSN 0301–4460 print/ISSN 1464–5033 online © 2001 Taylor & Francis Ltd
http://www.tandf.co.uk/journals
DOI: 10.1080/0301446001000461 0

Of different methods, anthropometry is one that is generally used for measuring the magnitude of undernutrition at both individual and population levels. In the case of adult individuals, Quetelet or body mass index (BMI) is widely accepted as one of the best indicators of the nutritional status of adult individuals and populations (James, Ferro-Luzzi and Waterlow 1988, Ferro-Luzzi, Sette, Franklin *et al.* 1992, Shetty and James 1994). It is also suggested that the BMI may be more nutritionally than genetically related (Rolland-Cachera 1993), despite a wide variation between human populations in weight and height (Eveleth and Tanner 1990, Majumder, Shanker, Basu *et al.* 1990). Thus the use of BMI as an anthropometric indicator of nutritional status may be more appropriate in a country with diverse ethnic groups like India. However, literature on BMI of adult Indians is concerned mostly with populations in south India (Shetty 1984, Ferro-Luzzi *et al.* 1992, Shetty and James 1994, Naidu and Rao 1994, Visweswara Rao, Balakrishna, Thimmayama *et al.* 1990, Visweswara Rao, Balakhrishna and Shatrugna 1995, Reddy 1998), but it is very limited in the northeast region of the country (Bharati 1989, Khongsdier 1997). Therefore, the present report is concerned with the BMI of adult males in 12 populations of Northeast India with a view to understanding their nutritional status.

2. Populations studied

The present study is concerned with the populations in Northeast India, which are by and large dependent on agriculture as the mainstay of their livelihood. Almost all the populations are distributed in the state of Assam, which is characterized by a sub-tropical climatic condition with high rainfall and humidity. The study populations may be broadly divided into three groups, namely, caste, Hinduized and tribal groups.

Caste groups: The caste groups consist of the Brahmins, Kalitas, Jogis and Kaibartas (Das, Das, Das *et al.* 1986, Das, Walter, Gilbert *et al.* 1987). The Brahmins are a group of priestly caste. They occupy the topmost position in the caste hierarchy of the Assamese Hindu caste system. They are mainly distributed all over the Brahmaputra valley of Assam. The present sample consists of the Brahmins from Darang and Goalpara districts of Assam.

The Kalitas occupy the position next to the Brahmins in the caste hierarchy of Assam. They are distributed all over the Brahmaputra valley and their main concentration is in the lower and middle parts of the state of Assam. This study deals with the Kalitas of Darang and Sibsagar districts.

The Jogis are mainly distributed in the districts of Darang, Goalpara, Kamrup and Nowgong in Assam. The present study is based on the anthropometric data collected from the first two districts.

The Kaibartas, one of the scheduled castes of Assam, are also known as the fishing community because of their primary occupation on fishing and plying boats. Thus they are mainly found on the riverbanks of the Bramaputra valley. The present data were collected from Lakhimpur and Nowgong districts.

Hinduized groups: The different ethnic groups like the Ahoms, Kochs and Rajbanshis, who have embraced Hinduism, or become assimilated into Hindu culture (Das 1987, Das *et al.* 1987, Bhowmik, Huq and Basu 1988), were categorized as the Hinduized groups for expediency of the present study. The present data on the

Ahoms were collected from Lakhimpur and Nowgong districts of Assam. In the case of the Kochs, data were collected from Kamrup and Sibsagar districts; while data on the Rajbanshis were collected from Goalpara district.

Tribal groups: The tribal groups consist of the Boro-Kacharis, Mechs, Lalungs, Miris and Pnars. The Boro-Kacharis are one of the sub-groups of the Kachari tribe. They are distributed in the lower and middle parts of Assam. The present sample is composed of the Boro-Kacharis from Darang and Kamrup districts.

The Mechs are distributed in Lakhimpur, Sibsagar and Cachar Hills districts of Assam, and the present study is based on the anthropometric data collected from Goalpara district.

The Lalungs are believed to be one of the members of the great Bodo linguistic group. Their main concentration is in the districts of Nowgong, Kamrup, Mikir and Cachar Hills. The present study is concerned with the Lalungs of Nowgong district.

The Miris are another major tribe of Assam. They belong to the Indo-Mongoloid racial stock and speak the language, which belongs to the Tibeto-Burman linguistic group. They are mainly distributed in the districts of Sibsagar (where the present data were collected), Dibrugarh, Jorhat, and Lakhimpur of Upper Assam.

The Pnars are one of the subgroups of the Khasis who have been following the matrilineal system of society. They are the speakers of the Monkhmer language, which belongs to the Austro-Asiatic group. They are mainly found in the Jaintia Hills district of Meghalaya.

3. Materials and methods

The present study is based on the basic anthropometric data collected by the Anthropological Survey of India (Bhowmik *et al.* 1988). Data on anthropometric measurements of the 12 populations of the present analysis were collected from different locations as mentioned above. No random sampling was applied for the collection of data at both household and population levels. The areas of study were selected conveniently on the basis of prior information from the district headquarters and other available published and unpublished sources regarding the distribution and concentration of different populations in different districts of the states. The data were collected mostly from rural areas and 'the basic criteria of selection of population groups ... was representation of different social ranks' (Bhowmik *et al.* 1988), such as upper caste, middle caste, scheduled caste or backward caste, tribe and religious community.

Anthropometric measurements were taken on adult males aged 18–62 years by the trained physical anthropologists of the Anthropological Survey of India, following standard techniques (Martin and Saller 1956). However, the number of individuals beyond the age of 50 was negligible in the present samples. No questions were asked about the health status of the subjects. However, only adult males who looked apparently active and healthy (but not on the basis of bodily structure or proportion) were included in the sample. Efforts were also made to avoid measurements of the closely related individuals (like brothers, and fathers and sons) and to exclude those with any physical deformities. In this presentation, we have taken into consideration only the body weight (W), height (H), sitting height (SH), Cormic index (SH/H) and BMI (W/H^2). The age variation in BMI was not accounted owing to inadequacy of age data.

4. Results and discussion

Table 1 presents the means and standard deviations of body weight, height, sitting height, CI and BMI. The average height varies from 157.60 ± 5.69 cm for the Pnars to 164.03 ± 5.68 cm for the Jogis, while the average sitting height ranges from 82.19 ± 3.38 cm among the Pnars to 86.44 ± 3.60 cm among the Boro-Kacharis. On the other hand, the mean body weight is highest among the Mechs and lowest among the Kaibartas. The mean BMI (19.14 ± 2.06) for all populations, irrespective of their ethnic origin, is lower than that reported for the well-to-do individuals (Bharati 1989, Vesweswara Rao *et al*. 1990, 1995, Khongsdier 1997, Reddy 1998), but it is not as low as that among the South Indian population (Ferro-Luzzi *et al*. 1992). Nevertheless, it indicates that most of the adult males in these populations are lean, and the mean BMI varies between 18.31 in the Kaibartas and 20.49 in the Mechs.

The one-way analysis of variance (ANOVA) shows that the inter-population differences in respect of these anthropometric measurements and indices are highly significant (table 1). The *post hoc* test of one-way ANOVA for the difference between two populations reveals that the mean BMIs are significantly lower in the caste groups than the tribal groups like the Mechs, Boro-Kacharis and Pnars (table 2). The caste groups are by and large similar in BMI, though the Kalitas are significantly higher than the Kaibartas. Similarly, with the exception of the Mechs, there

Table 1. Means and standard deviations of anthropometric measurements and indices.

Population	Height (cm)	Sitting height (cm)	Weight (kg)	Cormic index	BMI
Caste groups					
Brahmins ($n = 100$)	163.41 ± 6.00	85.12 ± 3.27	50.36 ± 6.16	0.521 ± 0.013	18.86 ± 2.07
Kalitas ($n = 100$)	163.05 ± 5.73	85.12 ± 3.11	50.50 ± 6.75	0.523 ± 0.013	18.97 ± 2.19
Jogis ($n = 100$)	164.03 ± 5.68	85.77 ± 2.90	50.23 ± 5.62	0.523 ± 0.013	18.66 ± 2.01
Kaibartas ($n = 100$)	160.04 ± 6.45	83.21 ± 3.42	47.02 ± 6.66	0.521 ± 0.016	18.31 ± 2.02
Hinduized groups					
Ahoms ($n = 100$)	162.01 ± 5.57	84.57 ± 3.46	49.27 ± 5.53	0.522 ± 0.015	18.74 ± 1.50
Kochs ($n = 100$)	162.56 ± 6.15	84.59 ± 3.43	50.69 ± 7.73	0.521 ± 0.015	19.15 ± 2.52
Rajbanshis ($n = 50$)	161.39 ± 5.93	85.49 ± 2.51	51.16 ± 7.66	0.530 ± 0.013	19.62 ± 2.63
Tribal groups					
Boro-Kacharis ($n = 98$)	162.20 ± 5.33	86.44 ± 3.60	52.13 ± 5.66	0.533 ± 0.016	19.80 ± 1.86
Lalungs ($n = 49$)	160.12 ± 6.42	84.11 ± 3.92	49.29 ± 6.15	0.525 ± 0.015	19.15 ± 1.39
Mechs ($n = 50$)	160.34 ± 4.43	85.42 ± 2.69	52.72 ± 4.25	0.533 ± 0.014	20.49 ± 1.13
Miris ($n = 50$)	159.31 ± 5.79	84.59 ± 3.11	49.64 ± 5.06	0.531 ± 0.014	19.59 ± 1.98
Pnars ($n = 49$)	157.60 ± 5.69	82.19 ± 3.38	49.33 ± 4.56	0.522 ± 0.015	19.85 ± 1.46
F-ratio	11.74*	3.32*	6.10*	9.01*	6.87*

* Significant at 1% level.

Table 2. One-way analysis of variance and *post hoc* multiple range test for BMI.

One-way analysis of variance

Source	Degree of freedom	Sum of squares	Mean squares	F-ratio	Probability
Between populations	11	299.31	27.21	6.87	< 0.001
Within populations	934	3698.52	3.96		
Total	935	3997.83			

Multiple range test (least significant difference)

Population	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Brahmins (1)											
Kalitas (2)	−										
Jogis (3)	−	−									
Kaibartas (4)	−	+	−								
Ahoms (5)	−	−	−	−							
Kochs (6)	−	−	−	+	−						
Rajbanshis (7)	+	−	+	+	+	−					
Boro-Kacharis (8)	+	+	+	+	+	+	−				
Lalungs (9)	−	−	−	+	−	−	−	−			
Mechs (10)	+	+	+	+	+	+	+	+	+		
Miris (11)	+	−	+	+	+	−	−	−	−	+	
Pnars (12)	+	+	+	+	+	+	−	−	−	−	−

$+p < 0.05$, $-p > 0.05$.

are no significant differences in mean BMI between the tribal groups like the Lalungs, Boro-Kacharis, Miris and Pnars. As for the Hinduized groups, the mean BMIs are significantly higher in the Kochs and Rajbanshis than in the Ahoms.

The percentage distribution of BMI according to different grades of chronic energy deficiency (CED) is given in table 3. Considering the cut-off point 18.5 for screening the individuals into normal and CED groups (James *et al.* 1988, Ferro-Luzzi *et al.* 1992), the prevalence of CED is lower in the tribal populations (18.58%) when compared with the Hinduized (49.20%) and caste (52.25%) populations ($\chi^2 = 89.43$, d.f. = 2, $p < 0.001$). However, it is difficult to explain why the nutritional status is better in the tribals than in the caste groups of higher social status like the Brahmins, Kalitas and Jogis. It has been suggested that BMI is correlated with sitting height, or BMI is lower in those populations with higher sitting height (Norgan 1994). Table 1 shows that there are significant differences between populations in respect of CI. However, the variation in CI is not significant among the caste groups ($F = 0.71$, $p > 0.05$) as it does in the case of Hinduized ($F = 7.21$, $p < 0.001$) and tribal groups ($F = 6.60$, $p < 0.001$). Further, the mean value of CI ($\pm$ standard deviation) for all the caste groups (0.522 ± 0.014) is significantly lower than the tribal groups like the Boro-Kacharis ($t = 6.25$, $p < 0.001$), Mechs ($t = 5.23$, $p < 0.001$) and Miris ($t = 4.29$, $p < 0.001$). It may be noted that Strickland and Tuffrey (1997) have also observed the lower values of CI in the non-Mongoloid (caste) populations of Nepal, which are 'consistent with their lower mean BMI'. In view of the small sample sizes, regression analysis was carried out for only three major population groups, namely, caste, Hinduized and tribal groups. Table 4 indicates that the linear regression coefficient ($b \pm$ standard error) of BMI on CI for all these populations, irrespective of their ethnic origin, is highly significant (30.411 ± 4.110, $t = 7.05$, $p < 0.000$). The correlation coefficient ($r \pm$ standard error) is 0.224 ± 0.032. It indicates that the BMI is not independent of CI across the three groups, where the correlation

Table 3. Percentage distribution of BMI (W/H^2).

Population	Percentage distribution of body mass index					
	< 16	16–16.9	17–18.4	18.5–19.9	20–21.9	⩾ 22
Caste groups						
Brahmins	5.00	8.00	30.00	32.00	15.00	10.00
Kalitas	4.00	12.00	39.00	17.00	17.00	11.00
Jogis	8.00	14.00	28.00	26.00	17.00	7.00
Kaibartas	9.00	19.00	33.00	19.00	15.00	5.00
Hinduized groups						
Ahoms	1.00	11.00	40.00	28.00	19.00	1.00
Kochs	5.00	14.00	31.00	18.00	23.00	9.00
Rajbanshis	8.00	2.00	32.00	18.00	30.00	10.00
Tribal groups						
Boro-Kacharis	0.00	4.08	7.14	45.93	34.69	8.16
Lalungs	0.00	4.08	30.61	38.78	22.45	4.08
Mechs	0.00	0.00	6.00	24.00	56.00	14.00
Miris	2.00	4.00	28.00	30.00	24.00	12.00
Pnars	4.08	2.04	8.16	34.69	46.94	4.08

Table 4. Linear regression coefficient of BMI on Cormic index.

Population	Coefficient of correlation		Coefficient of regression		
	r	SE	*b*	SE	*t* value
Caste ($n = 400$)	0.221	0.062	32.46	9.10	3.57**
Hinduized ($n = 250$)	0.184	0.049	27.50	7.35	3.74**
Tribal ($n = 296$)	0.145	0.058	15.80	6.30	2.51*
Total ($n = 946$)	0.224	0.032	30.41	4.31	7.05**

*$p < 0.05$, **$p < 0.000$.

coefficient (r) is positively significant. Thus the present findings seem to corroborate with those reported by Norgan (1994). It may be noted here that the unadjusted means of BMI in the caste, Hinduized and tribal groups are 18.70, 19.08 and 19.78, respectively. These population differences in BMI are found to be highly significant ($F = 25.08$, $p < 0.000$). Allowing for CI, the F-ratio is found to be 13.82, $p < 0.001$, i.e. about 45% less than that for the differences in unadjusted means. Nevertheless, although it is believed that BMI is largely independent of ethnic or genetic variation, its correlation with CI may have certain implications as the latter may be subject to both genetical and environmental influences. In short, it is likely that the differences in BMI between ethnic groups in this study may not only be due to nutrition, but due to other environmental and genetic factors as well.

It may be mentioned that Ferro-Luzzi *et al.* (1992) have proposed that BMI alone is sufficient to define CED in adults, irrespective of energy turnover as they suggested earlier (James *et al.* 1988). However, their findings on the distribution of BMI according to various grades of CED in a South Indian population seem to be corroborated by the present results, i.e. a large proportion of individuals with CED belong to the grade I CED. They have suggested that the majority of the rural population in India are likely to be undernourished if grade I CED is associated with increased risk of morbidity and mortality. Unfortunately, such data were not available on these populations, though the individuals included in the present sample were apparently normal and active. So it is not clear whether a BMI below 18.5 may be considered the cut-off point compatible with both CED and ill health in India.

As a matter of fact, the BMI above 18.5 is compatible with good health among male soldiers and women in the UK and those belonging to the high socio-economic class in the developing countries (Shetty and James 1994). With respect to the BMI below 18.5, Shetty (1984) has reported that the male Indian labourers with BMI below 17.0 are physically fit according to standard tests, though their physical capacity is not known. Of course, BMI seems to be a poor predictor of physical capacity in populations of developing countries (Ferro-Luzzi *et al.* 1992, Strickland and Tuffrey 1997). As regards the relationship between BMI and mortality, Satyanarayana, Rao, Radhiah *et al.* (1991) have shown that the difference in mortality rates between adult males with grade I CED and normal CED is only about 1% per year, but it increases rapidly when the BMI is below 17. The question may, therefore, arise whether the apparently healthy individuals with grade I CED in the present populations are thin but physically active and healthy? It may be noted that Strickland and Tuffrey (1997) have pointed out that the definition of milder forms of CED in terms of BMI may not be appropriate because of the 'wide range of normality'. In fact, James, Mascie-Taylor, Norgan *et al.* (1994) have again suggested the use of both BMI and mid upper arm circumference (MUAC) for screening of nutritional status, especially those persons belonging to grade I CED. The MUAC value of 23 cm in men and 22 cm in women are proposed as the cut-off points for screening the normal and undernourished groups, thus it warrants further studies in these populations of Northeast India. But it is obvious from the above that one is not certain by looking at BMI alone, especially in the populations of Indian subcontinent. The BMI, as a measure of CED, should be supplemented by other observations on morbidity and health status of a population, which are lacking in the present analysis.

From the evolutionary point of view, it may also be realized that 'individuals have the capacity to adjust over a range of states of health, which may all be different, in so far as they represent different balances and trade-offs between physiological and behavioural components of adjustment, but are sustainable in the sense of not carrying severe functional penalties or threat to life' (Payne 1992). It has long been recognized that a lean linear body build with low weight to surface area ratio is one of the general characteristics of the people living in tropical and sub-tropical climates (Roberts 1953, Newman and Munro 1955, Dobzhansky 1962, Schreider 1968). This may have certain implications for the high proportions of individuals with grade I CED in most of these populations in Northeast India.

Acknowledgements

I wish to express my deep sense of gratitude to Dr S. S. Strickland, London School of Hygiene and Tropical Medicine, for supplying valuable materials. I am also grateful to the Department of Anthropology, North-Eastern Hill University, for providing necessary facilities to carry out this work.

References

Bharati, P., 1989, Variation in adult body dimensions in relation to economic condition among the Mahishyas of Howrah district, West Bengal, India. *Annals of Human Biology*, **16,** 529–541.

Bhowmik, D. C., Huq, F., and Basu, A., 1988, *All India Anthropometric Survey: North Zone Basic Anthropometric Data. Vol. 1: Assam* (Calcutta: Anthropological Survey of India).
Chandra, R. K., 1981, Immunodeficiency in undernutrition and overnutrition. *Nutrition Reviews*, **39,** 225–231.
Chandra, R. K., 1983, Nutrition, immunity and infection: present knowledge and future directions. *Lancet*, **1,** 688–691.
Chandra, R. K., and Newberne, P. M., 1977, *Nutrition, Immunity, and Infection: Mechanism of Interaction*, 2nd edn (New York: Plenum).
Chen, L. C., Huq, E., and Huffman, S. L., 1981, A prospective study of the risk of diarrheal diseases according to nutritional status of children. *American Journal of Epidemiology*, **114,** 284–292.
Das, B. M., 1987, *The Peoples of Assam* (Delhi: Gian Publishing House).
Das, B. M., Das, P. B., Das, R., Walter, H., and Danker-Hopfe, H., 1986, Anthropological studies in Assam, India. 5. Observations on four further caste groups (Jogis, Hiras, Kumars, Kaibartas). *Anthropologischer Anzeiger*, **44,** 239–248.
Das, B. M., Walter, H., Gilbert, K., Lindenberg, P., Malhotra, K. C., Mukherjee, B. N., Deka, R., and Chakraborty, R., 1987, Genetic variation of five blood group polymorphisms in ten populations of Assam, India. *International Journal of Anthropology*, **2,** 325–340.
Dobzhansky, T., 1962, *Mankind Evolving: The Evolution of the Human Species* (New Haven and London: Yale University Press).
Edmundson, P. B., Sukhatme, P. V., and Edmudson, S. A. (eds), 1992, *Diet, Disease and Development* (New Delhi: Macmillan India).
Eveleth, P. B., and Tanner, J. M., 1990, *Worldwide Variation in Human Growth*, 2nd edn (Cambridge: Cambridge University Press).
Ferro-Luzzi, A., Sette, S., Franklin, M., and James, W. P. T., 1992, A simplified approach of assessing adult chronic energy deficiency. *European Journal of Clinical Nutrition*, **46,** 173–186.
Gordon, J. E., Ascoli, W., Mata, L. J., Guzman, M. A., and Scrimshaw, N. S., 1968, Nutrition and infection field study in Guatemalan villages, 1959–1964. Acute diarrheal disease and nutrition disorders in general disease incidence. *Archives of Environmental Health*, **16,** 424–437.
James, W. P. T., Ferro-Luzzi, A., and Waterlow, J. C., 1988, Definition of chronic energy deficiency in adults. *European Journal of Clinical Nutrition*, **42,** 969–981.
James, W. P. T., Mascie-Taylor, C. G. N., Norgan, N. G., Bistrian, B. R., Shetty, P. S., and Ferro-Luzzi, A., 1994, The value of arm circumference measurements in assessing chronic energy deficiency in Third World adults. *European Journal of Clinical Nutrition*, **48,** 883–894.
Khongsdier, R., 1997, The War Khasi of Meghalaya: Implications of variation in adult body dimensions. *Journal of Human Ecology (Special Issue)*, **6,** 299–305.
Majumder, P. P., Shanker, B. U., Basu, A., Malhotra, K. C., Gupta, R., Mukhopadhyay, B., Viyayakumar, M., and Roy, S. K., 1990, Anthropometric variation in India: a statistical appraisal. *Current Anthropology*, **31,** 94–103.
Martin, R., and Saller, K., 1956, *Lehrbuch der Anthropologie*, Vol. 3 (Stuttgart: G. Fischer)
Martorell, R., and Ho, T. J., 1984, Malnutrition, morbidity, and mortality. *Population Development Review*, **10** (Suppl.)**,** 49–68.
Mascie-Taylor, C. G. N., 1991, Biosocial influences on stature: a review. *Journal of Biosocial Science*, **23,** 113–128.
Mitra, A., 1985, The nutrition situation in India. In *Nutrition and Development*, edited by M. Biswas and P. Andersen (Oxford: Oxford University Press), pp. 142–162.
Naidu, A. N., and Rao, N. P., 1994, Body mass index: a measure of nutritional situation in Indian populations. *European Journal of Clinical Nutrition*, **48** (Suppl. 3)**,** 131–140.
Newman, R. W., and Munro, S. H., 1955, The relation of climate and body size in US males. *American Journal of Physical Anthropology*, **74,** 385–392.
Norgan, N. G., 1994, Relative sitting height and the interpretation of body mass index. *Annals of Human Biology*, **21,** 79–82.
Osmani, S. R. (eds), 1992, *Nutrition and Poverty* (Oxford: Clarendon Press).
Payne, P., 1992, Assessing undernutrition: the need for a reconceptualization. In *Nutrition and Poverty*, edited by S. R. Osmani (Oxford: Clarendon Press), pp. 121–164.
Reddy, B. R., 1998, Body mass index and its association with socioeconomic and behavioural variables among socioeconomically heterogeneous populations of Andhra Pradesh, India. *Human Biology*, **70,** 901–917.
Roberts, D. F., 1953, Body weight, race and climate. *American Journal of Physical Anthropology*, **11,** 533–558.
Rolland-Cachera, M. F., 1993, Body composition during adolescence: methods, limitations and determinants. *Hormone Research*, **39** (Suppl. 3)**,** 25–40.
Satyanarayana, K., Rao, S. S., Radhiah, G., and Reddy, V., 1991, Body mass index and mortality rates. *Nutrition Reviews*, 12 (Hyderabad, India: National Institute of Nutrition).
Schreider, E., 1968, Ecological rules, body-heat regulation, and human evolution. In *Environments of Man*, edited by J. B. Bresler (Massachusetts: Addison-Wesley), pp. 55–66.

SHETTY, P. S., 1984, Adaptive changes in basal metabolic rate and lean body mass in chronic undernutrition. *Human Nutrition: Clinical Nutrition*, **38**C, 443–451.
SHETTY, P. S., and JAMES, W. P. T., 1994, *Body Mass Index: A Measure of Chronic Energy Deficiency in Adults* (Rome: FAO Food and Nutrition Paper 56).
STRICKLAND, S. S., and TUFFREY, V. R., 1997, *Form and Function: A Study of Nutrition, Adaptation and Social Inequality in Three Gurung Villages of the Nepal Himalayas* (London: Smith-Gordon).
VISWESWARA RAO, K., BALAKRISHNA, N., THIMMAYAMA, B. V. S., and RAO, P., 1990, Indices and critical limits of malnutrition for use among adults. *Man in India*, **70,** 351–367.
VISWESWARA RAO, K., BALAKHRISHNA , N., and SHATRUGNA, V., 1995, Variations in forms of malnutrition in well-to-do adults and the associated factors. *Man in India*, **75,** 241–249.
WHO, 1990, Diet, nutrition, and the prevention of chronic disease. *WHO Technical Report Series No. 797* (Geneva: World Health Organization).

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Zusammenfassung. *Hintergrund:* Von den anthropometrischen Indices wird der Body Mass Index (BMI) als ein Index betrachtet, welcher mehr mit der Ernährung als mit der Genetik in Beziehung steht. Deshalb ist es zweckmäßiger in einem Land mit verschiedenen ethnischen Gruppen, wie es Indien darstellt, den BMI als Indikator für den Ernährungszustand der erwachsenen Bevölkerung zu benutzen. Allerdings beschränkt sich das Schrifttum über den BMI erwachsener Inder auf bestimmte geographische Regionen oder Populationen und über die Populationen in der Nordost-Region des indischen Subkontinents ist wenig bekannt.
Ziel: Der gegenwärtige Report befasst sich mit dem BMI erwachsener Männer aus 12 Populationen Nordostindiens mit Hinblick auf ihren Ernährungsstatus.
Probanden und Methoden: Für die Analyse wurden anthropometrische Daten von 946 erwachsenen Männern zwischen 18 und 62 Jahren von 12 Populationen aus Nordostindien benutzt. Diese Daten wurden im Rahmen der Anthropologischen Untersuchung Indiens erhoben. Die Populationen wurden grob in drei Gruppen eingeteilt: Kasten, Hindus und Stammesgruppen. Die Daten wurden größtenteils in ländlichen Gebieten unter Berücksichtigung der verschiedenen sozialen Schichten wie Kasten, Stämme und religiöse Gruppen erfasst.
Ergebnisse: Die Variabilität der mittleren BMI zwischen den Populationen war hochsignifikant und bewegt sich zwischen 18.3 und 20.5 kg m^{-2}. Trotz einiger Ausnahmen waren die Mittelwerte des BMI der Stammespopulationen signifikant höher als die der Kastengruppen. Die Prävalenz des chronischen Energiedefizits (CED) war ebenfalls in den Stammespopulationen (19%) niedrieger als in den Hindupopulationen (49%) und in den Kastenpopulationen (52%) ($\chi^2 = 89.4$, Freiheitsgrade = 2, $p < 0.001$). Obwohl es schwer zu erklären ist, warum die Stammesgruppen höhere BMI als die höheren Kasten haben, war der Kormische Index oder CI (SH/H) in den Kastengruppen signifikant niedriger gegenüber einigen Stammesgruppen. Der lineare Regressionskoeffizient ($b \pm$ Standardfehler) für die Abhängigkeit des BMI vom CI betrug für alle Populationen unabhängig von ihrem ethnischen Ursprung 30.4 ± 4.3 ($t = 7.1$, $p < 0.000$) und der Korrelationskoeffizient ($r \pm$ Standardfehler) 0.22 ± 0.03. Die Differenzen des BMI zwischen den Gruppen waren jedoch auch nach Berücksichtigung des CI signifikant.
Schlußfolgerungen: Die Mehrheit der erwachsenen Männer in diesen Populationen war schlank. Der hohe Anteil von Individuen mit einer CED Grad I weist auf den Bedarf an weiteren Informationen zur Morbidität und zum Gesundheitsstatus dieser Populationen hin.

Résumé. *Arrière plan*: l'indice de masse corporelle est considéré plus dépendant de facteurs nutritionnels que génétiques parmi les indices anthropométriques, si bien que dans une nationn comprenant divers groupes ethniques comme c'est le cas de l'Inde, il est approprié d'utiliser l'IMC comme indicateur du statut nutritionnel des populations adultes. Il demeure cependant que la littérature concernant l'IMC d'indiens adultes est limitée à certaines populations ou régions géographiques et que font notamment défaut des données sur la partie nord-est du sous-continent indien.
Objectif: ce travail cherche à connaître le statut nutritionnel des hommes adultes de 12 populations du nord-est de l'Inde, à partir de leur IMC.
Sujets et méthodes: des données anthropométriques rassemblées par l'enquête anthropologique de l'Inde sur 946 hommes adultes âgés de 18 à 62 ans et provenant de 12 populations de l'Inde du Nord-Est, ont été utilisées dans cette analyse. Les populations ont été grossièrement réparties en trois groupes: caste, hindouisés, et groupes tribaux. Les données proviennent en majorité de zones rurales et prennent en considération les différents rangs sociaux tels que caste, tribu et groupe religieux.
Résultats: la variation d'IMC moyen entre ces populations, d'une amplitude de 18,3 à 20,5 kg $m^{-2,}$ est très significative. En dépit de quelques exceptions, les valeurs moyennes d'IMC des populations tribales, sont significativement plus élevées que celles des castes. La prévalence de déficience énergétique chronique (DEC) est aussi plus basse dans les populations tribales (19%) qu'hindouisées (49%) et castes (52%) ($\chi^2 = 89.4$, ddl = 2, $p <$ 0,001). Bien qu'il soit difficile d'expliquer pourquoi les tribus ont un IMC plus

grand que celui des castes les plus élevées, l'indice cormique (IC = Stature/taille-assis) est significativement plus bas dans les castes que dans divers groupes tribaux. Le coefficient de régression linéaire ($b \pm$ erreur standard) de l'IMC sur l'IC de toutes les populations, quelques soient leurs origines ethniques, est de 30.4 ± 4.3 ($t = 7{,}1$, $p < 0{,}000$) et le coefficient de corrélation ($r \pm$ erreur standard) est de $0{,}22 \pm 0{,}03$. Les différences en IMC entre groupes demeurent cependant significatives, même après la prise en compte de l'IC.
Conclusion: les hommes adultes de ces populations sont minces en majorité. La forte proportion d'individus avec une DEC de niveau I suggère la nécessité d'obtenir plus d'information sur la morbidité et les conditions de santé de ces populations.