

Biology of the Tribal Groups of Rajasthan, India: 1. Body Mass Index as an Indicator of Nutritional Status

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ABSTRACT In the present study an attempt has been made to study the nutritional status of the Schedules Tribes of Rajasthan on the basis of body mass index. Cross-sectional data on 2928 samples belonging to both adolescent (8+ to 18+) and adult age groups (19 & above) were collected during the year 1999-2001. The data were collected following the Internationally accepted standards. All the populations show an increase in the mean values of BMI in both males and females with advancing age. High prevalence of undernutrition was observed in both adolescent boys and girls of the present study on the basis of BMI. The results of chronic energy deficiency grades also clearly indicated a high prevalence of thinness. Bhils show the lowest BMI than their counterparts in the other tribes. Mina males and females exhibit highest mean values of BMI at higher age groups.

INTRODUCTION

Body mass index was recommended as the basis for anthropometric indicators of thinness and overweight during adolescence (Rolland-Cachera, 1993). The term 'underweight' in adult assessment has been applied to individuals of low body weight relative to height, generally expressed in terms of Body Mass Index. Several scholars have emphasized the importance of Body Mass Index (BMI) as an index of nutritional assessment (Gupta et al., 1979; Cherian et al., 1988; Qamara et al., 1990; Rao, 1996). BMI was found useful for the assessment of the current or short duration malnutrition among adults (Reddy and Rao, 2000). It was observed with retarded growth status and onset of clinical signs of protein energy malnutrition, Vitamin A deficiency and severe forms of anemia (Rao and Rao, 1975; Rao, 1989).

BMI categories of underweight are related to increased mortality (Charney et al., 1976; Morbidity Mortality Weekly Report, 1994; Katzmarzyk et al., 1999). It is used as a measure of underweight and Chronic Energy Deficiency (James et al., 1988; Ferro Luzzi et al., 1992). Very low BMI reflects low fat and fat free mass, which is typical of CED. The condition of low BMI in adults (also termed as 'thinness'), which results in Chronic Energy Deficiency (CED), can be graded on the basis of BMI into mild thinness (BMI<18.49>17.0), moderate thinness (BMI <16.99>16.0) and severe thinness (BMI<16.0). BMI in the range of 18.5-24.99 is considered as normal and individuals above a BMI of 25 are categorized as overweight.

Body Mass Index was also found positively correlated with levels of socio-economic status. Shah et al. (1989) studied the relationship between socio-demographic and behavior variables, and BMI. They identified that the most important correlates of BMI in men are family income, occupation, leisure time, exercise frequency, number of meals eaten out, alcohol intake, smoking, caffeinated drink intake and meal planner. In low socio-economic indicators of living standard, BMI shows a positive correlation with indicators of development (Nube et al., 1998). Delpeuch et al. (1994) reported a large prevalence of low BMI in rural areas. In this context the study was conducted to assess the nutritional status on the basis of the weight/height² (Body Mass Index) and to assess the percentage prevalence of thinness in adults among the tribal groups of Rajasthan and to give a comparative picture among them. The results have also been compared with the standard national and international reference values of BMI and accordingly their status has been determined in relation to them.

AREA AND PEOPLE

Rajasthan is situated in the north-western part of India. Literally, Rajasthan means 'land of the Rajas' and is one of the largest states of India, which came into existence only after independence by making a nominal deal with independent Rajput states. Geographically, the state of Rajasthan is situated in the north-western part of India between 23°30' and 30°11' North Latitude and 69°29' and 78°17' East Longitude. The state

is bound by Pakistan in the west, and the Indian states of Punjab and Haryana in the north and the northeast, Uttar Pradesh and Madhya Pradesh in the east and southeast, and Gujarat in the south (Director of Census Operations, Rajasthan, 1981). The shape of Rajasthan is like an irregular rhomboid, covering a distance of 869 km from west to east.

Rajasthan is the second largest state in terms of area and covers a total area of 3,42,239 sq. km, which is 10.4 percent of the country's total area, inhabited by 44,005,990 persons (Census of India, 1991). Administratively, the state has been divided into 5 divisions and 32 districts (Fig. 1). The state has been divided in 27 districts and 213 tehsils with 222 towns and 39,810 villages (Census, 1991). According to Census (2001) 5 districts have been added, thus increasing their number to 32. Number of tehsils has gone upto 241 with total of 41,353 villages. It may be noted that after 1991, there have been certain changes in administrative boundaries and five more districts namely Baran, Rajsamanad, Dausa, Hanumangarh, and Karauli were formed making the number of districts as 32.

One of the largest states of India, Rajasthan has almost seventy seven percent of its population in the process of urbanization amongst states/UTs of the country as only 23.38 percent of its population lives in urban areas of the state and 76.62 percent in rural areas (Census, 2001). It ranks at 22nd place in urbanization. Rajasthan shows a highly masculine sex ratio of 910 as against 927 for India (Census, 1991). This has been attributed to gender inequality manifested in such symptoms as, the continued practice of female seclusion, very low female force labor participation, large gender gap in literacy, strong boy preference in fertility decisions, widespread neglect of female children and drastic separation of a married woman from her natal family. Low literacy level further precipitates the grave economic and social condition of the state. Rajasthan is one of the most educationally backward states in the country. According to Census (2001) the figure stands at 38.55 percent as against 61.03 for India. There exists a wide gender gap in literacy in Rajasthan, with only 20.44 percent of females as against 54.99 percent of males being literate. In fact, the state occupied the last position according to the ranking of major states of India with respect to female literacy (Census of Rajasthan, 1991).

Rajasthan experiences extremes of temperature, sandstorms and a paucity of rainfall. It is

not only scorched by sun in the endless summer but is also bitterly cold during winter. Health conditions in Rajasthan are poor and morbidity and mortality rates remain high.

The present study was carried out on the Scheduled Tribes, namely Mina, Bhil, Sahariya, Garasia, Damor and Kathodi residing in the districts Sawai Madhopur, Udaipur, Baran, Sirohi, Dungarpur, respectively of Rajasthan (Fig. 2). Majority of the tribal populations fall below poverty line, except in case of Minas, who mostly own large agricultural land and income, thereby having better economic standing. None of the houses of Scheduled Tribes studied have separate lavatory facility. Most of them do not have a separate kitchen, except few as seen in Minas. Most people lived in ill-ventilated houses and the general sanitary condition was quite unsatisfactory. They dispose off their refuse at immediate or nearby surroundings, thereby polluting the atmosphere. Hand-pumps, wells/tanks are seen to be the major sources of water supply. Most houses are without power supply and only a minor proportion is enjoying the same, which again is mostly on account of Minas of Sawai Madhopur.

Major food category for all Scheduled Tribes studied is cereal-based diet. Intake of legumes and pulses, which is a rich source of energy and proteins, is inadequate with a low consumption of milk and milk products, green vegetables and fruits. All the Scheduled Tribes studied followed two meals pattern per day. Cereals (especially maize) constituted a major portion of their diet and the consumption of pulses, roots and tubers, other vegetables was inadequate while the intake of green leafy vegetables, fruits, nuts and oil seeds is completely lacking. People were not aware of the benefits of the essential constituents of foods, and also adverse climatic conditions experienced by the populations residing in the area studied enhanced the poor nutritional status of the tribal groups. Unhealthy surroundings along with difficult ecology make it all the more unsuitable for a proper living.

According to the Scheduled Castes and Scheduled Tribes Act 1976, twelve tribal groups were included in the state of Rajasthan. Of these twelve Scheduled Tribes, the Mina and the Bhil along with Damor, Garasia and Sahariya, constitute the major tribal groups of the state. The Bhils and Minas account of roughly 50 and 40 percent of the total tribal population of

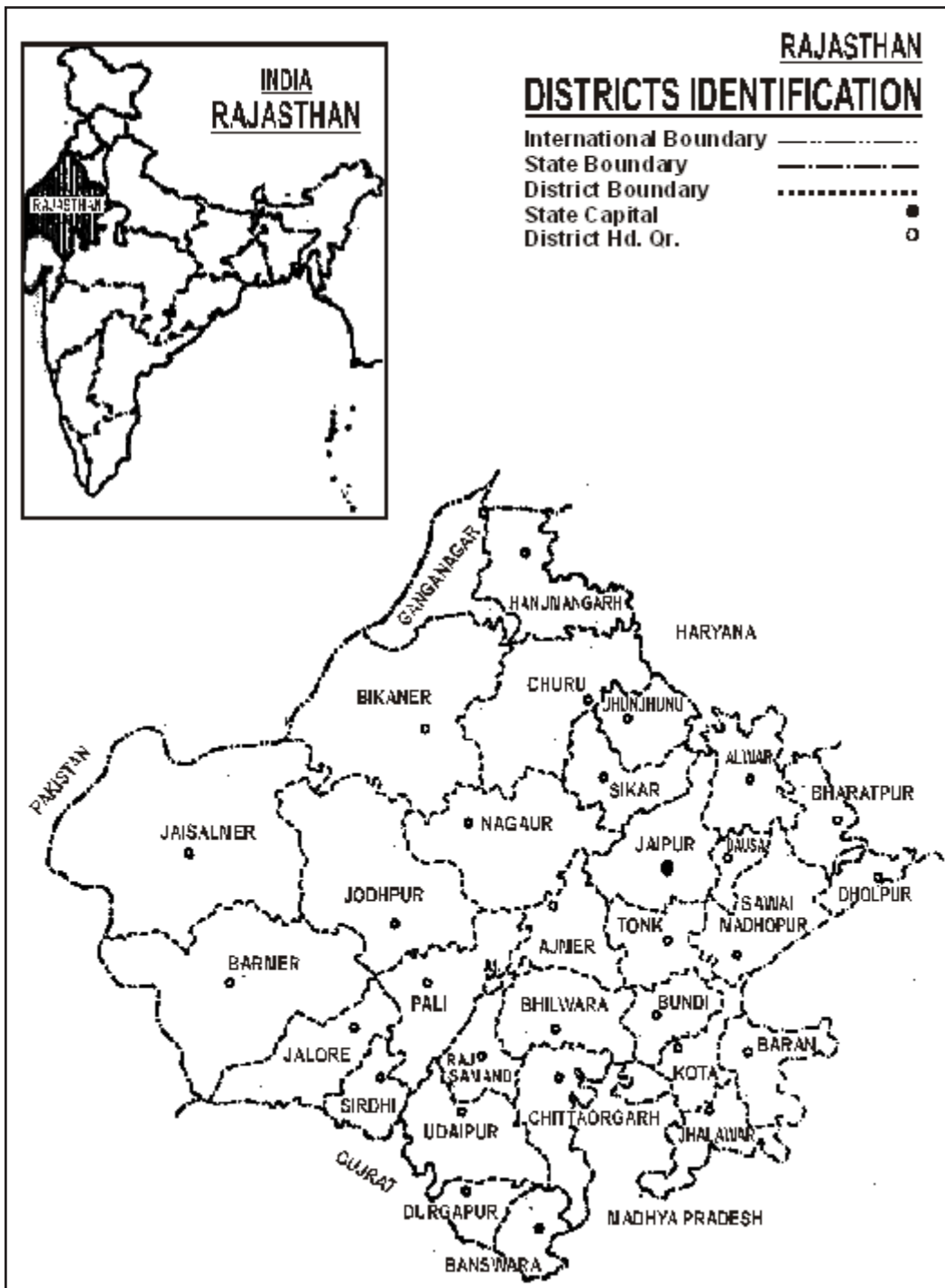


Fig. 1. Rajasthan – Administrative Divisions

Rajasthan. Of the rest, Garasias and Sahariyas constitute roughly 3 and 1 percent, respectively. The southern district of Rajasthan-Banswara, Dungarpur, Udaipur and Chittorgarh-have concentration of tribal groups of Bhils and Damors, while Minas inhabit Jaipur, Sikar and Alwar, whereas Tonk, Bundi, Kota and Jhalawar have both Bhils and Minas. Sahariyas inhabit the tehsils of Kishanganj and Shahbad of Baran district.

Mina who, on the basis of the recorded history as well as the current socio-economic status, constitute a sizable population among the tribes, do not qualify to be 'scheduled' as a community for compensatory discrimination. The Minas are descendants of tribe, which ruled over most of the later princely state of Jaipur before the Kachachwahas. They are spread over the whole state, but are mainly concentrated in Jaipur, Sawai Madhopur and Udaipur where over 51 percent of the population reside. Their main occupation is cultivation and both men and women participate in agricultural activities. Minas constitute the largest part (49.47%) of the total Scheduled Tribe population of the state. They are also spread in the neighbouring states of Uttar Pradesh, Haryana and Punjab. Rajasthan is the home state and here they are designated as Scheduled Tribe, whereas, in other states their number is small and they are not recognized as tribals.

Bhil, the largest Scheduled Tribe, lives in the hilly forests of south-western Rajasthan. Bhils, in contrast to Minas, despite their high socio-political status on account of the military support they gave to the Sisodia rulers of Mewar in general and Maharana Pratap in particular, lead a miserable existence, devoid of the amenities of education, communication, transport and other benefits of economic modernization (Bhasin, 1999). They are spread all over the state but are mainly concentrated in the districts of Udaipur, Banswara and Dungarpur. The Bhils who have been declared Scheduled Tribes are also considered as *adivasis* or original settlers by the local caste groups. Bhils constitute the third largest tribal group of India, next to Gonds and Santhals. They are also one of the largest Scheduled Tribe of Rajasthan and constitute 44.50% of the total tribal population of Rajasthan. They live at the borders of Rajasthan, Gujarat, Maharashtra and Madhya Pradesh in the forests of Vindhya and Satpura hills.

Sahariya is the most backward of all Scheduled Tribes of Rajasthan and is therefore, referred as the primitive tribe. Their customs and manners bear great resemblance with caste Hindus with whom they live in their present habitat and who consider them to be untouchables. Sahariyas, residing in Rajasthan, form 0.91 percent of the total Scheduled Tribe population. They reside in districts of Kota, Jhalawar, Udaipur, Dungarpur, Jaipur, Sawai Madhopur and Churu. Few studies carried among Sahariyas after Independence describe them as the poorest of the poor who are at the power end of the development scale (Mann and Mann, 1989; Doshi and Vyas, 1992; Ghatak, 1998). Sahariyas inhabit marginally productive areas of Baran district and have little access to services and resources. Sahariyas are particularly vulnerable to the pressures of dwindling resources and a burgeoning population since their lifestyles are intrinsically linked to the surrounding ecosystem. Agriculture is their secondary occupation and are mostly employed as daily wage agriculture/casual labourers and raise livestock.

Garasia derive their name from the Sanskrit work 'Gras' which means a morsel or subsistence. Over six hundred years ago, the Chauhan Rajputs of Jalor, when defeated, fled to the hills where subsequently they settled on the grant subsistence. They overpowered the Bhils, inhabitants of the region, and to pacify them also parted with some subsistence in their favour. These Bhil grant-holders came to be known as Garasias. Their general way of life is to a large extent similar to those of Bhils. Rajasthan has 121,939 Garasias who constitute 2.91 percent of the total Scheduled Tribe population. Agriculture and allied occupations are their means of subsistence. They are concentrated mostly in Sirohi, Udaipur and Pali.

Damor (Damararia) are believed to have migrated from Gujarat with which they still continue to have social contacts. The Damors is a small community of 30,603 people constituting 0.71 percent of the total Scheduled Tribe population of Rajasthan. They are divided into two sub-divisions, one claiming a higher descent and on that account a higher social status than the other. They reside exclusively in rural areas where they cultivate land. Their womenfolk also participate in cultivation but do not work as agricultural labourers. The tiny community of Damors is popular for their musical skills.

Kathodis are a small, primitive and isolated

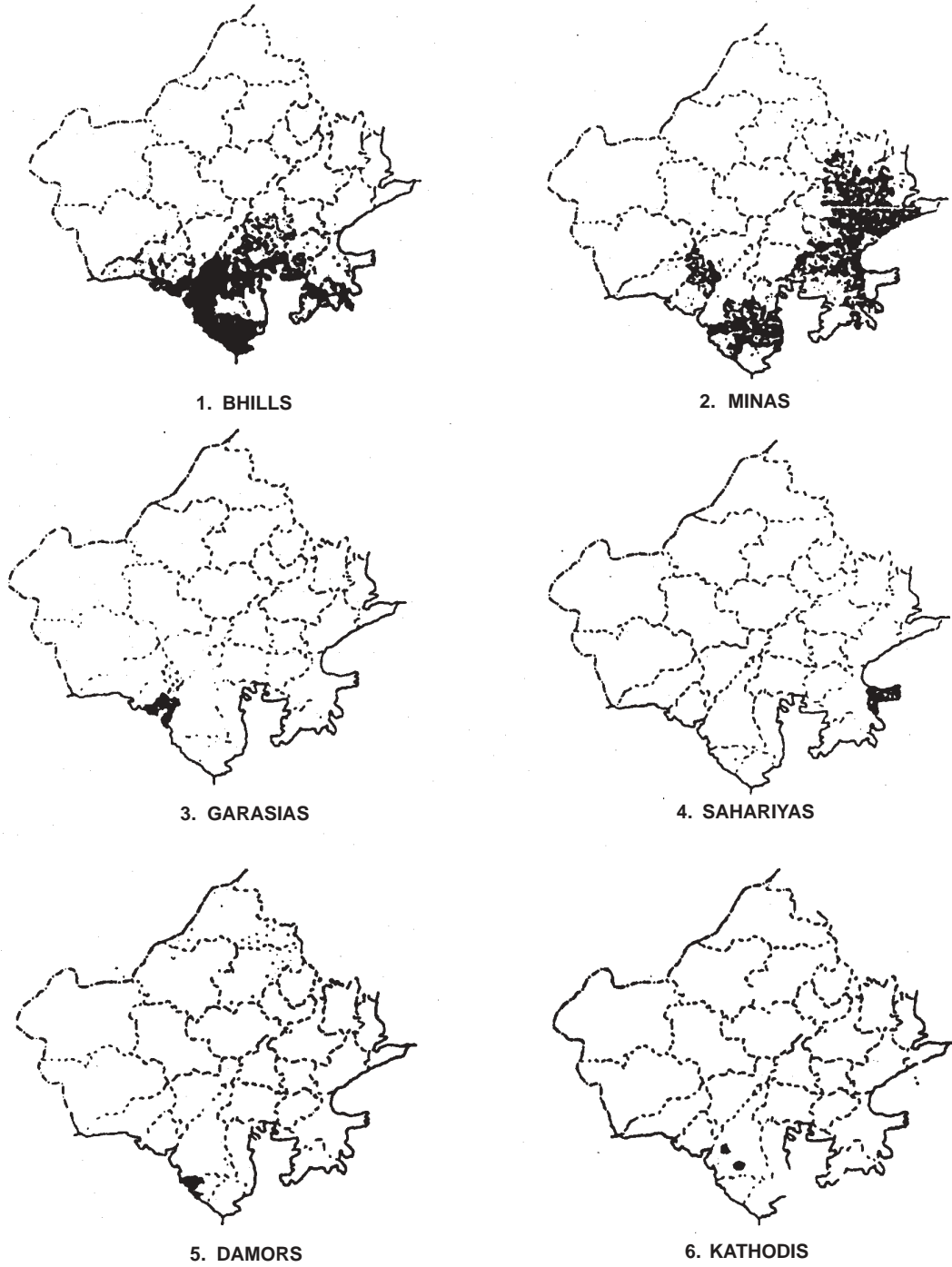


Fig. 2. Distribution of Scheduled Tribes covered in present study

community of 2,553 people (Census, 1981) inhabiting Jhadol and Kotra tehsils in Udaipur district and Abu Road tehsil in Sirohi district of Rajasthan. They are the people of hills and live in the forests and originally did not belong to Rajasthan. Some 80 years ago, Bohras, a noted business community, persuaded about 250 families to part with their parent stock of Bhils in West Khandesh of Bombay state in search of new fortunes in the forests of Rajasthan. They were employed in remote interior forests abounding in *Khair* trees, the raw material for manufacturing *Katha* and thus they came to be known as 'Kathodis' or 'Kathodias'. Presently they are mostly engaged as labourers, as they own no or little land, and often migrate to different parts of the state and even in neigh-bouring Gujarat.

MATERIALS AND METHODS

The present study is based on a cross-sectional investigation on 2928 samples consisting of 1503 males and 1425 females belonging to both adolescent (8+ to 18+) and adult age groups (19 & above) (Table 1). The study was carried out on the Scheduled Tribes, namely Mina, Bhil, Sahariya, Garasia, Damor and Kathodi residing in the districts Sawai Madhopur, Udaipur, Baran, Sirohi, Dungarpur, respectively of Rajasthan. Samples are collected from the place of residence and schools. For the purpose of analysis, the subjects were classified into yearly intervals. Those subjects who had completed 8 years of age but were less than 9 years even by one day were grouped under 8+ age group. Similar pattern was followed for other age groups as well.

The data were collected following the Internationally accepted standards of Martin and Saller (1957), Tanner et al. (1969), Weiner and Lourie (1969), Singh and Bhasin (1989).

RESULTS AND DISCUSSION

Tables 2 shows the age and sex wise distribution of BMI in Minas, Bhils, Sahariyas, Garasias, Damors and Kathodis. It has been observed that there is an increase in the mean values of BMI with age. Among boys the mean value increases from 11.65 at 9 years in Bhils and at 8 years in Damors to 18.12 at 19 and above age group in Minas. Among females, Damors tend to have the minimum value of 11.04 at 8 years followed by Bhils. Minas exhibit the maximum value of 19.11 at 19 and above age group. All the populations at most age groups show an increase in the mean values of BMI in both the sexes with advancing age (Rossenbaum et al., 1985; Bhasin and Singh, 1991; Singh, 1992; Kaur and Singh, 2000).

Among males, Damors and Bhils show the lowest BMI than their counterparts in the other tribes. Sahariya males have higher mean values in the preadolescent and adolescent age groups, whereas in the higher age groups from 17 to 19 and above Minas overtake the Sahariyas and achieve the highest values of BMI. Among females, Bhils show the lowest mean BMI values at preadolescent ages, whereas among adults Kathodi females tend to have least BMI. In the pre-adolescent age group from 8 to 10, Minas have the highest values of BMI, after which the values increase among Sahariya girls such that during adolescent age groups they achieve the

Table 1: Distribution of sample size in various age groups in six tribes of Rajasthan

Age (Yrs)	Mina			Bhils			Garasia			Sahariya			Damor			Kathodi		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
8+	21	26	47	24	20	44	13	13	26	21	24	45	12	12	24	12	12	24
9+	21	20	41	22	20	42	12	12	24	23	22	45	12	12	24	13	12	25
10+	21	20	41	21	23	44	14	13	27	22	25	47	12	11	23	12	12	24
11+	24	20	44	22	23	45	14	11	25	21	21	42	12	12	26	12	12	24
12+	25	20	45	23	23	46	14	12	26	21	21	42	12	12	24	13	11	24
13+	25	21	46	20	21	41	12	12	25	21	21	42	12	12	24	12	12	24
14+	21	20	42	22	21	43	12	11	23	24	22	46	12	12	24	11	11	22
15+	21	20	41	21	20	41	13	11	24	21	21	42	12	12	24	13	12	25
16+	21	19	40	22	20	42	13	11	24	20	23	43	12	11	23	12	12	24
17+	24	21	45	21	20	41	12	13	25	22	20	42	13	13	26	12	12	24
18+	22	21	43	22	20	42	12	12	24	22	17	39	12	12	24	11	11	22
>19	89	76	165	66	66	132	50	39	89	81	76	157	41	37	78	43	43	86
Total	335	304	639	306	297	603	192	170	362	319	313	632	175	169	344	176	172	348

Table 2: Mean and standard deviation of body mass index of six tribal groups of Rajasthan

Age (Yrs)	Mina		Bhils		Garasia		Sahariya		Damor		Kathodi	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Males</i>												
8+	12.29	1.37	12.26	1.69	12.60	1.40	13.26	1.79	11.65	1.41	12.81	1.32
9+	12.35	1.57	11.65	1.03	13.14	0.93	13.31	1.18	12.53	0.63	12.76	1.26
10+	13.72	0.95	12.50	1.89	13.73	0.97	13.60	1.48	12.04	1.32	13.44	1.67
11+	13.81	1.53	13.04	1.13	13.65	0.98	14.41	1.23	12.77	1.13	12.96	2.12
12+	13.94	1.11	13.68	1.39	14.05	0.98	15.07	1.69	13.72	1.58	15.36	1.72
13+	14.34	1.41	15.37	1.19	14.53	1.33	15.34	1.02	15.01	1.48	15.21	1.26
14+	15.33	1.13	15.05	1.23	16.62	0.66	15.31	1.52	14.61	1.25	15.37	1.30
15+	15.73	1.52	15.01	1.45	16.66	0.85	15.88	1.84	15.69	0.94	16.05	1.87
16+	16.11	1.52	15.58	1.85	16.66	0.95	16.89	1.61	15.79	1.71	16.12	1.41
17+	17.25	1.16	16.22	1.04	15.73	0.90	16.95	1.50	15.98	0.98	17.25	1.16
18+	17.50	1.69	16.33	0.83	15.61	0.96	17.72	1.77	16.39	0.87	17.38	1.31
19 & Above	18.12	1.73	16.59	1.16	15.86	1.07	17.55	2.19	16.12	1.43	16.22	1.67
<i>Females</i>												
8+	12.51	1.21	11.66	1.24	12.31	0.91	12.97	1.61	11.04	1.16	11.68	1.10
9+	13.36	1.02	11.95	1.58	13.31	2.52	12.98	2.19	12.35	1.88	11.97	1.05
10+	13.80	1.23	12.18	1.49	13.11	1.29	13.52	1.52	13.27	1.38	12.48	1.03
11+	13.64	1.82	12.83	1.28	13.95	1.59	15.14	1.65	14.05	1.49	13.39	1.54
12+	14.11	1.43	14.18	1.64	14.72	0.96	14.91	1.53	14.47	0.79	13.40	1.38
13+	14.91	1.95	14.64	1.35	15.29	1.25	16.92	2.37	14.81	2.27	15.51	1.53
14+	15.52	1.55	15.38	1.47	14.99	1.29	17.51	1.51	17.06	1.66	15.78	1.36
15+	16.89	1.89	16.56	1.53	15.66	1.35	18.07	2.02	16.77	1.36	16.19	1.89
16+	17.61	1.84	16.04	1.48	16.70	1.50	17.62	1.74	17.40	1.38	15.51	1.01
17+	17.46	1.48	15.76	1.25	15.86	1.41	17.88	1.67	17.05	1.44	15.51	1.01
18+	18.32	1.59	16.69	1.43	17.04	0.94	18.11	2.12	16.98	1.00	16.05	1.87
19 & Above	19.11	1.39	16.49	2.05	16.24	1.33	17.80	2.47	17.33	1.69	15.93	1.47

highest values than their counterparts in other populations. Finally, the Minas overtake them again and thus exhibit the highest BMI mean values in the adult age groups of 18 and 19 and above.

Table 3 indicates the distribution of BMI values according to the malnutrition grades in adult men and women among Minas, Bhils, Sahariyas, Garasias, Damors and Kathodis. The results indicate that the prevalence of Grade I thinness (mild thinness) is highest among Mina men (48.3%) and among women it is in Sahariyas (35.5%). Both Mina men and women have the highest percentage that fall under the normal range of BMI values than the other two populations. Garasia men have the highest percentage i.e. 62.0%, of Grade III thinness (severe thinness), whereas among women it is in Kathodi (58.1%). Grade II thinness (moderate thinness) is seen maximum among Bhil men (36.4%) and Damor women (30.6%).

Minas and Sahariyas (man and women) have the highest percentage prevalence of 'Mild Thinness', whereas Garasias, Damors and Kathodis show higher prevalence of 'Severe Thinness'. Thus, on the basis of BMI, it can be concluded that women are more in thinness

grades as compared to men. It is suggested that 40% of population, which falls below the BMI of 18.5, show very high prevalence of critical situation of malnourishment. The present sample shows that among males, all the populations (except Minas), have high prevalence of malnourishment and among females, except Minas and Sahariyas, other four populations are in critical situations of malnourishment. Figures 3 and 4 give a graphical representation of the thinness grades in males and females on the basis of BMI values among the tribal groups of Rajasthan.

High prevalence of undernutrition was observed in both adolescent boys and girls of the present study on the basis of BMI as is reported elsewhere also (Kapoor and Aneja, 1992; Sawaya et al., 1995; Abahussain et al., 1999). The tribal groups of Rajasthan studied reside in hamlets, which are generally out of reach of the health care and welfare services. Majority of the population is not capable of managing poverty. Several parameters related to health, economy, food and nutrition are still far from the averages in other parts of Rajasthan and the nation (Health Information of Indian Economy, 1993). Rajasthan returned a relatively high Infant Mortality Rate of 90 per 1000 live births (Sample Registration

Table 3: Chronic energy deficiency grades among six tribal groups of Rajasthan by body mass index

Thinness grades BMI values	Mina		Bhils		Garasia		Sahariya		Damor		Kathodi	
	M (N=89)	F (N=76)	M (N=66)	F (N=66)	M (N=50)	F (N=39)	M (N=81)	F (N=76)	M (N=41)	F (N=36)	M (N=43)	F (N=43)
Above 18.5 (Normal)	No. 30 % (33.7)	47 (61.8)	3 (4.5)	12 (18.2)	1 (2.0)	2 (5.1)	2 (2.5)	22 (28.9)	5 (12.2)	11 (30.6)	3 (7.0)	3 (7.0)
17.0-18.49 (Mild)	No. 43 % (48.3)	25 (32.9)	17 (25.8)	11 (16.7)	6 (12.0)	11 (28.2)	3 (3.7)	27 (35.5)	3 (7.3)	7 (19.4)	8 (18.6)	8 (18.6)
16.0-16.99 (Moderate)	No. 10 % (11.2)	4 (5.4)	24 (36.4)	13 (19.7)	12 (24.0)	9 (23.1)	26 (32.1)	13 (17.2)	11 (26.8)	11 (30.6)	12 (27.9)	7 (16.3)
<16.0 (Severe)	No. 6 % (6.7)	-	22 (33.0)	30 (45.5)	31 (62.0)	17 (43.6)	50 (61.7)	14 (18.4)	22 (53.7)	7 (19.4)	20 (46.5)	25 (58.1)

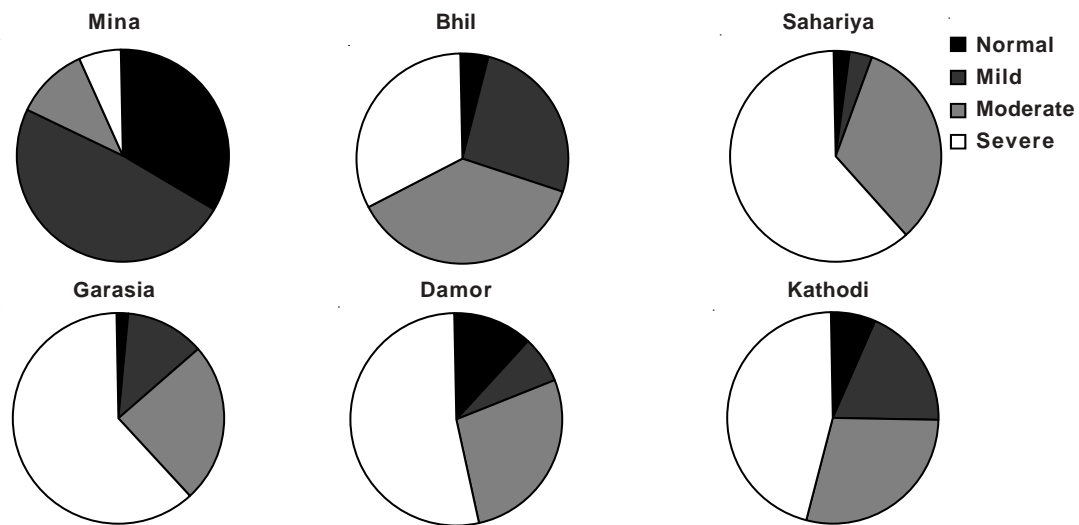


Fig. 3. Thinness Grades among males on the basis of BMI values

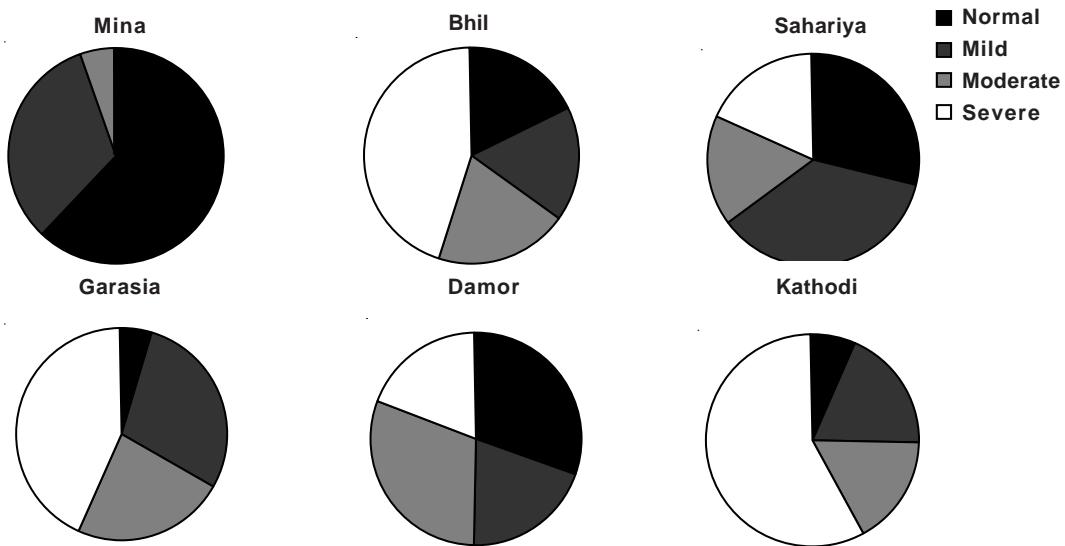


Fig. 4. Thinness Grades among females on the basis of BMI values

System, 1992) and majority of population is recorded to be below poverty line. Low literacy level, lack of medical services, unfavorable living conditions contributes to a very high level of poverty. Thus the current nutritional status of vulnerable population groups provides the best possible objective measure to assess the extent and seriousness of community level nutritional status.

The results of CED clearly indicated a high prevalence of thinness and may result in illness and may also have a profound impact on morbidity and mortality (Lew and Garnfinkel, 1979; Marton et al., 1981; Harris, 1988; Pryer, 1993; de Vasconcellos, 1994). More than half of the study subjects suffered from CED, which reflects a high degree of nutritional insult in adolescents. This indicates a great risk and a high prevalence of underweight in the adolescents and the adults of the present population. This may be due to the undernutrition, which is highly rampant in the lower strata of the society. Manisha et al. (2000) reported that deviations on both sides of BMI (thinness and obesity) lead to a greater load of morbidity resulting in reduced health expectancy which are taxing to the families, society and the whole nation in terms of money, care, manpower and resources. Shah et al. (1989) identified various socio-demographic variables as correlates of BMI. The present study tribal groups belong to low income group and show low literacy level. Consumption of nicotine and alcohol make them all the more vulnerable to adverse situations and the condition aggravates due to lack of adequate nutrition as also reported in other studies (Shah et al., 1989; Naidu and Rao, 1994; Guo and Chumlea, 1999).

On comparison of the mean values of BMI in the tribal groups of the present study with those calculated from the standards of NCHS (WHO, 1983) and ICMR (1984), it can be seen that the mean values of the present study tribal group populations falls much below these International and National standards (Fig. 5 and Fig. 6). Both Bhil males and females show quite low values as compared to the reference values. Delpuech et al. (1994) reported a large prevalence of low BMI in rural areas. Naidu and Rao (1994) concluded that mean BMI values were lower in landless agricultural labourers than the other income groups. The majority of present study tribal groups also work as agricultural and/or casual laborers and most of them are below poverty line

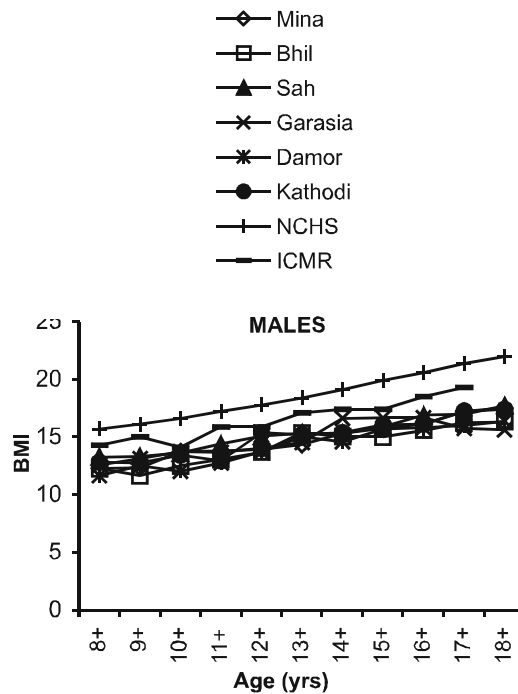


Fig. 5. Distribution of BMI among males

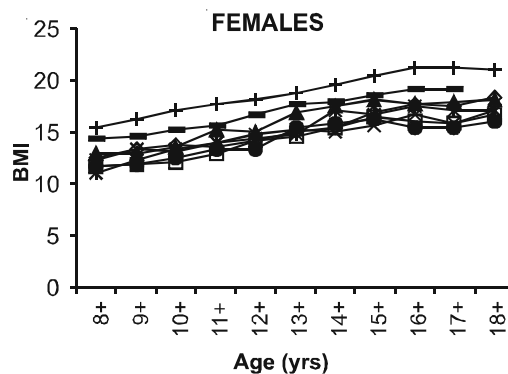


Fig. 6. Distribution of BMI among females

and exhibit low BMI values than the International and National standards.

REFERENCES

Abahussain, N.A., Musaiger, A., Nicholls, P.J. and Stevens, R.: Nutritional status of adolescent girls in the eastern province of Saudi Arabia. *Nutr. Health*, **13** (3): 171-177 (1999).
 Bhasin, M.K. and Singh, L.P.: Body composition of five population groups of Jammu and Kashmir, India. *J. Hum. Ecol.*, **2** (2): 181-186 (1991 b).

- Bhasin, V.: The profile of Rajasthan. *J. Hum. Ecol.*, Special Issue No. 7: 3-20 (1999).
- Census of India 1981: *Rajasthan*. Directorate of Census Operation, Rajasthan, Jaipur (1981).
- Census of India 1991: Series 21 *Rajasthan*. Directorate of Census Operations, Rajasthan (1994).
- Census of India: *Series I*, Rajasthan, Provisional population Totals, Jaipur (2001).
- Charney, E., Goodman, H.C., McBerde, M., Lyon, B. and Pratt, R.: Childhood antecedents of adult obesity: do chubby infants become obese adults? *N. Engl. J. Med.*, **295**: 6-9 (1976).
- Cherian, R., Rajasree, S. and Soman, C.R.: Anthropometric assessment of malnutrition: Comparison of two age independent criteria. *Ind. J. Nutr. Dietet.*, **25**: 82-86 (1988).
- de Vasconcellos, M. T. L.: Body mass index: Its relationship with food consumption and socio-economic variables in Brazil. *Eur. J. Clin. Nutr.*, **48 (Suppl.)**: S115-S123 (1994).
- Delpuech, F., Cornu, A. and Massamba, J.P.: Is body mass index sensitively related to socioeconomic status and economic adjustment? A case from the Congo. *Eur. J. Clin. Nutr.*, **48 (Suppl. 3)**: 141-147 (1994).
- Doshi, S.L. and Vyas, N.N.: *The Sahariya in Tribal Rajasthan: Sunshine on the Aravalli*. Himanshu Publications, Udaipur (1992).
- Ferro-Luzzi, A., Sette, S., Franklin, M. and James W.P.T.: A simplified approach of assessing adult chronic energy deficiency. *Eur. J. Clin. Nutr.*, **46**: 173-186 (1992).
- Ghatak, N.K.: Sahariya. In: *People of India: Rajasthan*. K. S. Singh (Ed.). Popular Prakashan Pvt. Ltd., Mumbai (1998).
- Guo, S.S. and Chumlea, W.C.: Tracking of BMI in children in relation to overweight in childhood. *Am. J. Clin. Nutr.* **70 (Suppl.)**: 145S-148S (1999).
- Gupta, S.D., Sharma, R., Chaturvedi, S.K. and Gupta, R.: Weight for height² ratio in assessment of protein calorie malnutrition. *Ind. J. Pediatr.*, **46**: 187-190 (1979).
- Harris, T.: Body mass index and mortality among non-smoking elder persons: The Framingham Heart-Study. *J. Am. Med. Assoc.*, **259**: 1520-1524 (1988).
- Health Information of Indian Economy: Director General of Health Services. Government of India, New Delhi. Pp. 6-12 (1993).
- Indian Council of Medical Research: Growth and Physical Development of Indian Infants and Children. *Technical Report, Series No. 18*, ICMR, New Delhi (1984).
- James, W.P.T., Ferroluzzi, A. and Waterlow, J.C.: Definition of chronic energy deficiency in adults. Reports of a working party of the International Dietary Energy Consultative Group. *Eur. J. Clin. Nutr.*, **42**: 969-981 (1988).
- Kapoor, G. and Aneja, S.: Nutritional disorders in adolescent girls. *Ind. Pediatr.*, **29 (8)**: 969-973 (1992).
- Katzmarzyk, P.T., Mahaney, M.C., Blangero, J., Quek, J.J. and Malina, R.M.: Potential effects of ethnicity in genetic and environmental sources of variability in the stature, mass and body mass index of children. *Hum. Biol.*, **71(6)**: 977-987 (1999).
- Kaur, R. and Singh, S.P.: Body mass index in young and old Punjabi females. *J. Hum. Ecol.*, **11 (5)**: 347-350 (2000).
- Lew, E.A. and Garfinkel, L.: Variation in mortality by weight among 750,000 men and women. *Journal of Chronic Disease*, **32**: 563-576 (1979).
- Manisha, D., Singh, S.P. and Mehta, P.: height, weight and BMI among Punjabi males. *Anthropologist*, **2 (4)**: 233-235 (2000).
- Mann, R.S. and Mann, K.: *The Life and Culture of Sahariya in Tribal Culture and Change*, pp. 48-72. Mittal Publications, Delhi (1989).
- Martin, R. and Saller, K.: *Lehrbuch der Anthropologie*. Gustav Fischer Verlag, Stuttgart (1957).
- Marton, K.L., Sox, H.C. and Krupp, J.R.: Involuntary weight loss: Diagnostic and prognostic significance. *Ann. Int. Med.*, **324**: 1839-1844 (1981).
- Mortality Morbidity Weekly Report: Prevalence of overweight among adolescents- United States, 1998-1991. *M.M.W.R.*, **43**: 818-821 (1994).
- Naidu, A.N. and Rao, N.P.: Body mass index: a measure of the nutritional situation in Indian populations. *Eur. J. Clin. Nutr.*, **48 (Suppl.3)**: S131-140 (1994).
- Nube, M., Aseno-Okyere, W.K. and Boom van den, G.J.M.: Body mass index as indicator of standard of living in developing countries. *Eur. J. Clin. Nutr.*, **52**: 136-144 (1998).
- Pryer, J.: Body mass index and work disabling morbidity: Results from a Bangladeshi case study. *Eur. J. Clin. Nutr.*, **48**: 653-657 (1993).
- Qamara, S. R., Mehta, S. and Deodhar, S.D.: Physical growth in school girls, relationship to socio-demographic status and dietary intake, II. *Ind. Pediatr.*, **27**: 1051-1063 (1990).
- Rao, D. H.: Nutrition profile of Indian tribes. *Nutr. News*, **17 (2)**: 1-6 (1996).
- Rao, K.V.: Efficiency of anthropometric indices for the diagnosis of malnutrition. *Courier*, **30**: 113-121 (1989).
- Rao, K.V. and Rao, N.P.: Association of growth status and the incidence of nutritional deficiency signs. *Amer. J. Clin. Nutr.*, **28**: 209-215 (1975).
- Reddy, P.Y.B. and Rao, A.P.: Body mass index among the Sugalis, a tribal population of Cuddapah district, Andhra Pradesh. *J. Hum. Ecol.*, **11 (5)**: 409-410 (2000).
- Rolland-Cachera, M.F.: Body composition during adolescence: methods, limitations and determinants. *Hormone Research*, **39 (Suppl.)**: 25-40 (1993).
- Rosenbaum, S., Skinner, R.K., Knight, I.B. and Garrow, J.S.: A survey of heights and weights of adults in Great Britain. *Ann Hum. Biol.*, **12**: 115-127 (1985).
- Sawaya, A.L., Dallal, G., Solymon, G., Desousa, M.H., Ventura, M.L., Roberts, S.B. and Singulem, D.M.: Obesity and malnutrition in a shantytown population in the city of Sao Paulo, Brazil. *Obes. Res.*, **3**: 107S-115S (1995).
- Shah, M., Jeffrey, R.W. and Hannan, P.J. and Honstad, L.: Relationship between sociodemographic and behavior variables and body mass index in a population with high normal blood pressure: Hypertension prevention trial. *Eur. J. Clin. Nutr.*, **43**: 583-596 (1989).
- Singh, I.P. and Bhasin, M.K.: *Anthropometry*. Reprinted, Kamla-Raj Enterprises, Delhi (1989).
- Singh, R.: Nutritional anthropometric measurements and indices of adults in Delhi: selected centiles and age changes. *J. Hum. Ecol.*, **3 (1)**: 9-20 (1992).
- Tanner, J.M., Hiernaux, J. and Jarnan, S.: growth and physique studies, pp. 315-340. In: *Human Biology*

A Guide to Field Methods. IBP Handbook No. 9, J.S. Weiner and J.A. Lourie (Eds.), Blackwell Scientific Publication, Oxford (1969).
Weiner, J.S. and Lourie, J.A.: *Human Biology: A Guide*

to Field Methods. IBP Handbook No.9, Blackwell Scientific Publications, Oxford (1969).
WHO: *Measuring Change in Nutritional Status*. WHO, Geneva (1983).