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BODY COMPOSITION, BLOOD PRESSURE TRENDS AND DIETARY INTAKE OF ADULT MALES AND FEMALES OF BHIL TRIBE, UDAIPUR, RAJASTHAN (INDIA)

ABSTRACT: Background and Objectives: The present cross-sectional study is an attempt to evaluate body composition, blood pressure trends and dietary intake of adult males and females of Bhil tribe of district Udaipur (Rajasthan) India to assess their overall health status. Methods and Study Design: The present cross-sectional study enrolled 171 subjects (males 89, females 82), ranging in age from 21 to 55 years selected by purposive sampling method. Body composition, blood pressure and dietary intake were gauged following the standard methods. Results: An age related increasing trend was observed for various body composition parameters among both Bhil males and females from 21 to 55 years. Adult Bhil females showed significantly higher percentage body fat, fat mass index and lower fat free mass index than their age matched male counterparts. Overall prevalence of hypertension was found to be 14.6% in males and 12.19% in females. Dietary intake of energy, iron, calcium, fat, and protein was significantly higher in males than their female counterparts but their dietary intake was grossly deficient than recommended dietary allowances for Indians. Conclusion: Bhil tribal adult males and females had an alarming health status indicating a poorer dietary intake and trend towards increased prevalence of hypertension.

KEY WORDS: Bhil - Dietary intake - Fat mass index - Tribe

INTRODUCTION

Composition of all living beings is the outcome of net lifetime accumulation of nutrients and other substrates gained from the environment and retained by the body. Components ranging from elements to tissue and organs are not only the building blocks but also provide shape, mass, and function to all the organisms and empower them with life (Shen *et al.* 2003). A study conducted by Siri (1961) illustrated genetics,

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environment, dietary habits, age, gender, and disease all influence the gross composition of the body, which consequently may be expected to undergo changes during the entire life span and to vary widely among different individuals. Malina (2005) highlighted negligible gender differences in body composition during infancy and childhood, but with the advent of adolescent spurt and sexual maturation these differences are magnified and persist through adulthood.

While analyzing regional variations in nutritional status Varadarajan and Prasad (2009) observed dietary intake of any population is influenced by various factors including beliefs, customs, and type of food stuff available in the area. Globally, unhealthy eating habits and sedentary lifestyle are responsible for at least 300,000 deaths every year. Approximately 39% of all deaths in year 1998 were due to diseases related with diet (WHO 1998). Body composition serves as an important determinant of blood pressure trends in the adult population. Rao *et al.* (2012) observed that risk estimation for hypertension with fat mass index (FMI) was 3-times greater in men and 5-times greater risk in women. Despite much advancement in the field of medicine, the prevalence of hypertension continues to grow (Chobanian 2009) and remains a medical burden of global proportions (Kearney *et al.* 2005).

A cross-sectional study carried out by Gupta (1997) estimated that in India the incidence of hypertension has increased by 30 times among the urban population over a period of 55 years and about 10 times among the rural population over a span of 36 years. A large number of studies have been conducted on body composition, blood pressure trends and dietary intake of general population (Kearney *et al.* 2005, Gupta 1997, Kaur, Talwar 2011, Kaur *et al.* 2012, Gupta, 2016), but unfortunately very little work on this domain has been done on Indian tribal population. According to Annual report (2010–11) of Ministry of Tribal Affairs, Government of India, Scheduled tribes constitute 8.2% of the total population and live in about 15% of the country's areas, in various ecological, climatic and geographical conditions with different levels of social, economic and educational development. A study conducted by Kshatriya (2014) concluded that widespread poverty, illiteracy, malnutrition, problems of potable water, sanitary and living conditions, poor maternal and child health services and practices, ineffective coverage of national health and nutritional services, communication facilities, incidence of genetic-environmental disorders are the major causes of poor health status of tribal population. Unfortunately to date till date not many tribes are studied comprehensively for assessing their health status. Therefore the present study is an attempt (i) to assess and compare age changes in body composition among adult Bhil males and females (ii) to gauge trends of blood pressure and prevalence of hypertension among adult Bhil males and females and (iii) to evaluate dietary intake among adult Bhil males and females.

Land and People

Data for the present study were collected from three small villages (Wadagaon, Mehrokagura and Bhiloka-vedla) Bargaon town of Girwa (tehsil) of Udaipur, Rajasthan, north-western India. Out of the total population of the area under study, approximately 70% were from Bhil tribe belonging to different clans like Gameti, Kooriya, Kher, whereas rest of the population was comprised of other caste (Rajput, OBC, Brahmins, Jains and Scheduled caste). Most of the male participants of the area under study were working in the nearby marble factories as labourers. Very few subjects were doing farming at family level. Some of them also go for the grazing of goats. Bhil population of Udaipur district usually marries at early age i.e. age of marriage mostly varies between 14 years to16 years. A very few females were engaged in farming or grazing animals. Their major staple food was wheat, maize, pulses and vegetables. Chilli was very commonly used. Vegetables mainly included potatoes, onion, cauliflower and brinjal. Their favorite food was dal-bhati. No intake of fruits or milk was reported from the subjects. People of Bhil tribe of tehsil Girwa mainly believed in Hindu religion. They worshiped Hindu Gods and Goddesses and were also believers of survival after death as well as numerous types of spirits. Bhopa was their traditional religious chief performing various religious functions. General characteristics of the subjects (*Table 1*) present that out of the total participants, most of the males (51.7%) and females (79.2%) were illiterate, 37.07% males and 15.8% females studied up to the 5thstandard. Only 10.1% males and 4.9% females studied up to matric and only one male was graduates. Most of the males (94.4%) and very few females (30.5%) were working. About 79.8% males and 53.7% females were non vegetarian, whereas remaining male (20.2%) and female (46.3%) participants were vegetarian.

MATERIAL AND METHODS

The present cross-sectional study was based on a sample of 171 participants (males 89, females 82)

TABLE 1: General characteristics of adult Bhil males and females.

Parameters	Males N (%)	Females N (%)	Total N (%)
Education			
Illiterate	46 (51.7%)	65 (79.2%)	111 (64.9%)
Up to 5th	33 (37.07%)	13 (15.8%)	46 (26.9%)
Matric	9 (10.1%)	4 (4.9%)	13 (7.6%)
Graduate	1(1.1%)	-	1 (0.5%)
Occupation			
Working	84 (94.4%)	25 (30.5%)	109 (63.7%)
Not working	5 (5.6%)	57 (69.5%)	62 (36.2%)
Diet			
Vegetarian	18 (20.2%)	38 (46.3%)	56 (32.7%)
Non- vegetarian	71 (79.8%)	44 (53.7%)	115 (67.3%)

ranging in age from 21 to 55 years from Bhil tribe of Rajasthan. The sample was selected by purposive sampling method. The data were collected from 16th September to 26th September, 2015 from three small villages i.e. Wadagaon, Mehrokagura and Bhilokavedla of tehsil Girwa of district Udaipur, Rajasthan, North-western India. Only normal and healthy participants who were not suffering from any long term disease or physical deformity were included in the study. Age in years has been obtained from the date of birth and then converted to decimal age by using the decimal age calendar of Tanner *et al.*, (1966). All the subjects were categorized in three age groups with an interval of ten years, but the last age group consisted of subjects from 41 years to 55 years as shown in *Table 2*. All the participants were randomly selected and contacted individually at their residence. An interview schedule was used to get the general information about the subjects regarding their age, caste, income, education and occupation.

All the anthropometric measurements were taken by following the standard procedure given by Weiner and Lourie (1981). Height (cm) was gauged to the nearest 0.1 cm with an anthropometer and weight was measured in the upright position to the nearest 0.1 kg with a weighing machine. Waist girth and hip girth of all the participants were measured with a Freeman's steel tape. Body fat analyzer (Omron HBF 302-Japanese model) based on the bioelectrical impedance method was used to measure percentage (%) body fat. Among various bioelectrical methods, bioelectrical impedence (BIA) is increasingly used for anthropological studies as it is non invasive as well as applicable for field studies. Fat mass (kg) (body fat/100) × weight) and fat free mass (body weight-fat mass) of all the participants was gauged. Fat mass index (FMI) (fat mass/ height^2 (m^2)) and Fat free mass index (FFMI) (fat free mass (kg) / height^2 (m^2)) of all the Bhil males and females were also calculated (Van Itallie *et al.* 1990, Wells 2001).

Systolic and diastolic blood pressure (mm of Hg) of each participant was gauged using manual mercury Sphygmomanometer, after the subject had rested at least for 15–20 minutes. Incidence of hypertension was determined as per JNC VII criteria (Chobanion *et al.* 2003). The Seventh Report of the Joint National

TABLE 2: Descriptive statistics for various anthropometric, body composition and physiological variables in adult Bhil males and females.

PARAMETERS		AGE GROUP (IN YEARS)				
		21-30 Mean ± SD	31-40 Mean ± SD	41-55 Mean ± SD	TOTAL Mean ± SD	ANOVA Mean ± SD
Height	M	164.83±5.10**	163.88±4.00**	163.17±4.55**	163.85**±4.54	0.96
	F	152.45±3.66	150.76±3.48	150.65±4.27	151.36±3.86	2.02*
Weight	M	51.27±4.97**	51.80±6.89	53.24±6.73	52.24±6.35**	0.79
	F	44.41±5.30	48.41±7.70	50.83±10.85	47.66±8.47	4.56**
WC	M	70.07±5.86**	72.71±9.02	73.95±10.16	72.50±8.82	1.40
	F	63.33±6.62	68.74±6.76	73.52±14.42	68.21±11.55	6.34**
HC	M	84.21±4.47**	86.16±4.82	86.59±6.52	85.81±5.48	1.45
	F	80.83±6.15	85.39±6.11	88.65±13.01	84.70±10.17	4.68**
% Body fat	M	19.90±4.57**	20.87±3.02**	22.46±2.99**	21.25±3.61**	4.10**
	F	24.94±3.31	28.99±4.40	31.00±3.52	28.09±4.52	19.57**
FMI	M	3.77±1.00**	4.08±1.11**	4.51±0.99**	4.17±1.06**	3.84**
	F	4.77±0.94	6.30±1.98	6.92±1.49	5.92±1.75	15.54**
FFMI	M	15.15±1.93	15.24±1.90	15.52±1.75	15.33±1.97	0.29
	F	14.31±1.51	15.10±2.48	15.40±2.90	14.90±2.34	1.68
SBP	M	126.54±10.52**	126.62±9.93	127.08±14.88	126.79±12.18	0.01
	F	119.19±11.28	122.60±10.10	129.92±13.91	123.63±12.56	5.92**
DBP	M	77.83±8.71	81.31±8.01	81.33±8.12	80.38±8.30	1.56
	F	76.45±7.75	79.92±7.47	83.50±8.02	79.74±8.20	5.84**
MAP	M	94.07±8.06	96.41±7.81	96.58±9.77	95.85±8.69	0.68
	F	90.70±8.49	94.15±7.42	98.97±9.35	94.37±9.05	6.75**

Level of significance *p < 0.05, ** p < 0.01, p < 0.001. SBP, Systolic blood pressure; DBP, diastolic blood pressure; MAP, Mean arterial pressure; WC, waist circumference; FMI, Fat mass index; FFMI, Fat free mass index.

Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure define that any subject with increased blood pressure (BP) values of systolic blood pressure at / above 140 mm of Hg and diastolic blood pressure at / above 90 mm of Hg or the current use of antihypertensive medication was classified as hypertensive. Calculation of mean arterial pressure (MAP) was based on the following formula: [DBP + 1/3(SBP-DBP)].

The type as well as the approximate amount of dietary intake of all the male and female subjects was gauged on the basis of 24 hr. dietary recall method. Additional information on frequency (ate twice / day or thrice / day) and type (vegetarian or non-vegetarian; Intake of fruits) of food consumption was also recorded. Nutritive value tables for Indian foods are used to gauge nutrient intake (Gopalan *et al.* 1990).

Statistical analysis

Data thus collected was subjected to SPSS (Statistical Package for Social Sciences) version 20.0 computer software for statistical analysis. Descriptive statistics were calculated for all anthropometric, body composition, physiological variables as well as dietary

intake. One way analysis of variance (ANOVA) was employed to study age trends for each dimension for both the male and female groups. Gender differences were highlighted using student's t-test, with significance of the differences was set at the level of $p < 0.05$. Karl Pearson's correlation coefficient (r) was employed to detect the association between variables.

RESULTS

Table 2 presents descriptive statistics for various anthropometric, body composition and physiological variables in adult Bhil males and females. A trend of increase in the mean values of height, weight and girth measurements (waist and hip girth) with advancing age was observed among both Bhil males and females during the entire age range under consideration. Males were taller (163.85 cm vs 151.36 cm), heavier (52.24 kg vs 47.66 kg) and had larger girths (waist: 72.50 cm vs 68.21 cm, hip: 85.81 cm vs 84.70 cm) than their age-matched female counterparts. Results of one way analysis of variance (ANOVA) displayed significant age difference for height, weight, waist girth and hip girth as is evident from their F-ratio. However non significant age difference was noted for height of males as their F- ratio was not significant. Bhil males and females demonstrated an age associated increment in percentage body fat, fat mass index and fat free mass index (*Table 2*). Adult Bhil females showed significantly higher mean values for percentage body fat (28.09 kg vs 21.25 kg, $p < 0.00$), fat mass index (5.92 kg/m^2 vs 4.17 kg/m^2, $p > 0.00$) and significantly lower values for fat free mass index (14.90 kg/m^2 vs 15.33 kg/m^2, $p > 0.00$) than their age- matched male counterparts.

Both systolic and diastolic blood pressure demonstrated an age associated increase in blood pressure in Bhil adult males and females. Mean values of systolic blood pressure were higher in males than their female counterpart except the last age group 41–55 years, where females present higher mean values for this variable. Statistically significant gender differences for this variable were observed only in the first age group i.e. 21–30 years. Only females displayed significant age differences for systolic blood pressure as is reflected by F-ratio (5.92**). Bhil males demonstrated a higher mean value for diastolic blood pressure than their female counterparts except for the last age group, where females displayed slightly higher value. T-values present statistically non-significant gender differences at all age levels. Results of one way analysis of variance (ANOVA) displayed significant age difference for Bhil females only as is reported from their F- ratio. *Table 3* illustrates the correlation of age, waist circumference, fat mass index and fat free mass index with systolic blood pressure and diastolic blood pressure among Bhil males and females. In males systolic blood pressure showed positive and significant correlation with waist circumference (r = 0.239*) only, whereas diastolic blood pressure had positive and significant correlation with waist circumference (r = 0.341*), fat mass index (FMI) (r = 0.249*) and fat free mass index (FFMI) (r = 0.260*). Bhil females displayed positive and significant association of age (SBP r = 0.382**, DBP r = 0.367**), waist circumference (SBP r = 0.336**, DBP r = 0.310**) and fat mass index (FMI) (SBP r = 0.407**, DBP r = 0.354**) with both systolic and diastolic blood pressure. Mean arterial pressure (MAP) was significantly though weakly associated with fat mass index (r = 0.249*) and fat free mass index (r = 0.250*) in males. A significant association of mean arterial pressure has been found with waist circumference in both Bhil males (r = 0.329**) and females (r = 0.342**). Mean arterial pressure was insignificantly correlated with age (0.197) in males and fat free mass index (0.156) in females.

Dietary intake of energy, protein, fat, calcium and Iron demonstrated an age associated decrement in their mean values in both male and female Bhil participants (*Table 4*). The result of one way analysis of variance (ANOVA) presented significant age difference for all the variables in males and females except for energy intake in males as is reflected from their F-ratio. In comparative terms significant gender differences were observed in regard of dietary intake of energy (males: 1694 Kcal Vs females: 1554.96 Kcal), iron (males: 10.29 mg/d Vs females: 8.56 mg/d), calcium (males: 273.50mg/d Vs females: 257.48 mg/d), fat (males: 16.01 g/d Vs females: 14.98 g/d), and protein (males: 52.34 g/d Vs females: 42.88 g/d).

DISCUSSION

In the present study height and weight of both Bhil males and females displayed an increment in their mean values from 21 years to 55 years. Males were significantly taller (163.85 cm vs 151.36 cm) and heavier (52.24 kg vs 47.66 kg) than their age-matched female counterparts. A longitudinal study conducted by Guo *et al.* (1999) found that body weight continues

TABLE 3: Correlation coefficient (r) of SBP, DBP and MAP with age, waist circumference, FMI and FFMI in adult Bhil males and females.

	Age	WC	FMI	FFMI
MALES				
SBP	0.155	0.239*	0.194	0.179
DBP	0.196	0.341**	0.249*	0.260*
MAP	0.197	0.329**	0.249*	0.250*
FEMALES				
SBP	0.382**	0.336**	0.407**	0.198
DBP	0.367**	0.310**	0.354**	0.106
MAP	0.399**	0.342**	0.402**	0.156

Level of significance * $p < 0.05$, ** $p < 0.01$, $p < 0.001$.

to increase at a rate of 0.30 kg and 0.55 kg per year in white males and females, respectively ranging in age from 40 to 66 years. Our findings are in concordance with the studies (Guo *et al.* 1999, Hughes *et al.* 2004, Raguso *et al.* 2006) conducted on white men and women indicating that body weight may remain stable or even continue to increase until the age of 70. A trend of increasing girth measurements (waist and hip girth) among both Bhil males and females were observed during the entire age range under consideration. Bhil males demonstrated larger girth (waist: 72.50 cm vs 68.21 cm, hip: 85.81 cm vs 84.70 cm) than their age-matched female counterparts. Similar trend was explained by a range of previous studies (Bartali *et al.* 2002, Perissinotto *et al.* 2002, Kaur 2003, Kaur, Talwar 2011).

In the present study both adult Bhil males and females displayed an age associated increment in percentage body fat, fat mass index and fat free mass index. Adult Bhil females displayed significantly higher mean values for percentage body fat (28.09 kg vs 21.25 kg, $p < 0.00$), fat mass index (5.92 kg/m^2 vs 4.17 kg/m^2, $p < 0.00$) and lower mean values for fat free mass index (14.90 kg/m^2 vs 15.33 kg/m^2, $p > 0.00$) than their age-matched male counterparts. This is in consensus with the findings of previous studies (Siervogel *et al.* 1998, Mott *et al.* 1999, Hughes *et al.* 2004) indicating an increase in total body fat with age during adulthood in differential rate with respect to gender as well as race. In a longitudinal study conducted by Guo *et al.* (1999) estimated the rate of increase in total body fat (TBF) to be approximately

TABLE 4: Descriptive statistics for dietary intake according to age in adult Bhil males and females.

Dietary Intake		AGE GROUP (IN YEARS) 21-30 Mean ± SD	31-40 Mean ± SD	41-55 Mean ± SD	Total Mean ± SD	ANOVA Mean ±SD
Energy (Kcal)	M	1743.67±290.3	1621.93±339.6	1609.75*±291.4	1694.83*±309.5	1.54
	F	1613.23±220.7	1557.92±157.8	1482.65 ±176.6	1554.96 ±195.0	3.35**
Protein (g/d)	M	54.39*±3.43	52.90* ±3.42	50.53*±4.14	52.34*± 4.03	8.18**
	F	44.88 ±8.57	42.17 ±4.64	41.17 ±5.10	42.88 ±6.65	2.49*
Fat (g/d)	M	17.17*±2.51	15.83 ±2.11	15.38*±1.87	16.01*±2.24	5.19**
	F	15.61 ±2.20	15.00 ±1.78	14.19 ±1.52	14.98 ±1.95	4.03**
Calcium(mg/d)	M	283.13±36.95	277.34*±35.58	263.50±38.59	273.50*±37.72	2.25*
	F	268.10±38.64	248.24 ±28.80	253.69±14.39	257.48 ±30.61	3.39*
Iron (mg/d)	M	11.46*±2.00	9.97* ±1.27	9.78*±2.07	10.29*±1.94	6.77**
	F	8.90 ±1.45	8.52 ±1.23	8.19 ±1.20	8.56 ±1.33	2.10*

Level of significance * $p < 0.05$, ** $p < 0.01$, $p < 0.001$.

0.37 kg in each year in men and 0.41 kg in each year in women. Mott *et al.* (1999) reported nonlinear trends for fat mass by age in both sexes and populations living in different geographical areas (i.e Asian, Black, Puerto Rican, and white ethnic groups). Maximum mean value for fat mass was between 50 and 60 years, during which there were little or no changes on average. Fat mass decreased after age 60 years, thereafter a trend of decrement sets in among all groups, with the exception of Puerto Rican women. There is accumulating evidence (Gallagher *et al.* 1997, Guo *et al.* 1997, Guo *et al.* 1999) that fat free mass increase during growth is relatively stable throughout maturation and declines during senescence. Rao *et al.* (2012) also noticed significant age and gender differences in FFMI and FMI and reported higher FMI in women (9.1 kg/m^2) than in men (6.6 kg/m^2), while FFMI was relatively lower in women (16.3 kg/m^2) than in men (18.1 kg/m^2). Malina *et al.* (2005) summarized that gender differences in body composition are apparent early in life, are magnified during adolescent growth spurt and sexual maturation, and persist through adulthood. The gender differences increases with age so that young adult males have about 0.36 kg of FFM per centimeter of stature as compared to 0.26 kg of FFM per centimeter of stature in their female counterparts (Malina *et al.* 2004). Findings of Rao *et al.* (2012) also reported risk for hypertension with FMI was 3-times higher in men and 5-times higher of women. Our study also demonstrated a positive and significant correlation of diastolic blood pressure with fat mass index ($r = 0.249^*$) and fat free mass index ($r = 0.260^*$) in males. Bhil females also demonstrated positive and significant association of fat mass index (FMI) with both systolic ($r = 0.407^{**}$) and diastolic ($r = 0.354^{**}$) blood pressure. Mean arterial pressure revealed positive significant association with waist circumference and fat mass index in both the sexes. In accordance with our findings correlation studies of Bhadra *et al.* (2002) also exhibited strong association of waist circumference with systolic blood pressure, diastolic blood pressure and mean arterial pressure in both sexes of young Bengalee adults of Kolkata.

In the present study both systolic and diastolic blood pressure indicated an age associated increase in blood pressure in both the Bhil males and females. Bhil females displayed positive and significant association of age with both systolic ($r = 0.382^{**}$) and diastolic ($r = 0.367^{**}$) blood pressure. A variety of previous research (Koyama *et al.* 1988, Chaturvedi *et al.* 2007, Kaur, Talwar 2011) also observed an increment in blood pressure with advancing age. The primary underlying cause of age-related increases in systolic blood pressure was arterial stiffening (Park, Lakatta, 2012). Overall mean value of systolic blood pressure (126.79 mm of Hg Vs 123.63 mm of Hg) and diastolic blood pressure (80.38 mm of Hg Vs 79.74 mm of Hg) of Bhil males were found to be higher than their female counterparts. Studies of Reckelhoff (2001) also illustrated that men were at greater risk for cardiovascular disease than age-matched premenopausal women. In addition, Burl *et al.* (1995) in third National Health and Nutrition Evaluation Survey (NHANESIII) analysed higher blood pressure among men as compared to women through middle age. Our study identified that overall prevalence of hypertension was14.6% in males and 12.19% in females. This is in accordance with observations of Anastos *et al.* (1991) showing greater incidence of uncontrolled hypertension in men than in women. Similar results were noticed by Sandberg and Ji (2012) while studying sex differences in primary hypertension. Stini (1985) stated that variation due to environmental stresses is reflected more among males as compared to females. In blood pressure studies, tribal populations provide an interesting domain of research because a large number of researches (Sandberg, Ji 2012, Dressler 1999, Schall 1995, Kusuma *et al.* 2004) across the globe evaluated that prevalence of hypertension and blood pressure (BP) does not rise with increasing age among tribals. Likewise a study conducted by Gupta (2004) also presented a small increase in hypertension incidence among less acculturated Indian tribal and rural populations, whereas in the last 50 years prevalence of hypertension has grown by more than five times among the urban populations which were exposed to unhealthy lifestyles and the stress of acculturation. But recent studies conducted on tribal populations (Laxmaiah *et al.* 2015, Manimunda *et al.* 2011) witnessed a trend of age associated increment as well as growing prevalence of hypertension among them. National Nutrition Monitoring Bureau (2005) reported that the prevalence of hypertension among adult tribal population, as per JNC VII Criteria was 25% among men and 23% among women, which was comparable to that reported for rural adults. Similarly, Sachdev (2011) studied the prevalence of hypertension among nomad tribal groups and observed the prevalence of hypertension to be 27.1% in Banjaras, 16.3% in Natt, 22.7% in Sapara, 27.3% in Bawaria, 19.4% in Sansui, 30.9% in Bhopa and 21.7% in Gujjars. Although lower prevalence of hypertension has been

TABLE 5: Nutrient intakes of Bhil males and females with reference to Recommended Dietary Allowances (RDA).

Nutrients	RDA	Bhil Males	RDA	Bhil Females
Energy(Kcal)	3200	1694.83	2450	1554.96
Protein(g/d)	60	52.34	50	42.88
Fat(g/d)	15	16.01	15	14.98
Calcium(mg/d)	400	273.50	400	257.48
Iron(mg/d)	28	10.29	30	8.56

found among tribal populations, but with changes in their lifestyle a trend towards increased prevalence of hypertension has been noticed. This may be attributed to the changing lifestyle of the tribals who are exposed to modernization and its associated stresses.

In current cross-sectional study dietary intake of energy, protein, fat, calcium and iron demonstrated an age related decline in their mean values in both male and female Bhil participants. Dietary intake of energy (males: 1694 Kcal Vs females: 1554.96 Kcal), iron (males: 10.29 mg/d Vs females: 8.56 mg/d), calcium (males: 273.50mg/d Vs females: 257.48 mg/d), fat (males: 16.01 g/d Vs females: 14.98 g/d), and protein (males: 52.34 g/d Vs females: 42.88 g/d) was significantly higher in males than their female counterparts. Nutrient intake of Bhil males and females have been compared with the recommended dietary allowances (RDA) suggested by the ICMR Expert Committee (*Table 5*). Their comparison demonstrates much lower nutrient intake of adult Bhil males and females than recommended dietary allowances for Indians (RDA) except for fat intake among Bhil males. Most of the subjects (87%) ate twice a day, only few participants (13%) had food thrice a day. They did not eat fruits or drink milk. Their food included a significant amount of chili. A poor dietary intake of the adult males and females may be due to poverty, ignorance due to illiteracy and their local customs. Kapil *et al.* (1998) assessed dietary intake of trace elements and minerals among adults in underprivileged communities of rural Rajasthan and reported intake of calcium was found to be low in females and intake of iron as well as energy was also low in both sexes as compared to RDA values. Observations of Kshatriya (2014) also documented the alarming dietary status of Indian tribal population and observed that tribal diets are generally grossly deficient in calcium, Vitamin A, Vitamin C, riboflavin and animal proteins.

Limitation of the study

Bipolar approach used in the present study to predict body fat can be considered as the methodological limitation as Dittmar (2004) recommended the use of tetrapolar impedance techniques for this purpose. Although bipolar techniques measure fat from some part of the body but give estimates of the whole body fat. So definitely bipolar approach might be more prone to accuracy issues (Deurenberg, Deurenberg 2002), but these techniques are being used world over for estimation of body fat and thus allow comparisons among different studies.

CONCLUSION

In conclusion, the findings of present study highlighted poor health status of Bhil tribal adult males and females having deficient dietary intake and indicating a trend towards increased prevalence of hypertension. Nayak and Babu (2003) recognised that tribes in addition to the conventional diseases also face enormous newer emerging health issues. Hence there is an urgent need for effective implementation of governmental policies and formulate new policies keeping in view of newer health issues being faced by the tribal.

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REFERENCES

ANASTOS K., CHARNEY P., COHEN E., JONES C. Y., MARTE C., SWIDERSKI D. M., WHEAT M. E., WILLIAMS S., 1991: Hypertension in women: what is really known? The Women's Caucus, Working Group on

Women's Health of the Society of General Internal Medicine. *Ann Intern Med* 115: 287–293.

BARTALI B. E., BENVENUTI A. M., CORSI S., BANDINELLI C. R., RUSSO A., DIIORIO F., LAURETANI I. FERRUCCI, 2002: Changes in anthropometric measures in men and women across the life span findings from the In CHIANTI study. *Soz. Präventivmed* 47: 336–348.

BHADRA M., MUKHOPADHYAY A., BOSE K., 2002: Adiposity, central body fat distribution and blood pressure among young Bengalee adults of Kolkata, India: sexual dimorphism. *J Physiol Anthropol Appl Human Sci.* 21, 6: 273–276.

BURL V. L., WHELTON P., ROCCELLA E. J., BROWN C., CUTLER J. A., HIGGINS M., HORAN M. J., LABARTHE D., 1995: Prevalence of hypertension in the US adult population: results from the Third National Health and Nutrition Examination Survey, 1988–1991. *Hypertension* 25: 30555.

CHATURVEDI S., PANT M., YADAV G., 2007: Hypertension in Delhi: prevalence, awareness, treatment and control. *Trop Doct* 37: 142–145

CHOBANIAN A. V., 2009: Shattuck Lecture. The hypertension paradox–more uncontrolled disease despite improved therapy. *N Engl J Med* 361: 878–887.

CHOBANION A. V., BAKRIS G. L., BLACK H.R., 2003: The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure-The JNC 7 report. *JAMA* 289: 2560–2572.

DITTMAR M., 2004: Comparison of Bipolar and Tetrapolar Impedance Techniques for Assessing Fat Mass. *American Journal of Human Biology* 16: 593–597. doi: 10.1002/ajhb.20066

DRESSLER W., 1999: Modernization, stress, and blood pressure: new directions in research. *Hum Biol.* 71: 583–605.

DEURENBERG P., DEURENBERG-YAP M., 2002: Validation of skinfold thickness and hand-held impedance measurements for estimation of body fat percentage among Singaporean Chinese, Malay and Indian subjects. *Asia Pac J Clin Nutr.* 11: 1–7.

GALLAGHER D., VISSER M., MEERSMAN R. E., SEPÚLVEDA D., BAUMGARTNER R. N., PIERSON R. N., HARRIS T., HEYMSFIELD S. B., 1997: Appendicular skeletal muscle mass: effects of age, gender, and ethnicity. *Journal of applied physiology* 83: 229–239.

GOPALAN C., RAMASASTRY B. V., BALASUBRAMANYAM S. C., NARASINGA RAO B. S., DEOSTHALE Y. G., PANT K. C., 1990: *Nutritive Value of Indian Foods.* Hyderabad: National Institute of Nutrition.

GUO S. S., CHUMLEA W. C., ROCHE A. F., SIERVOGEL R. M., 1997: Age and maturity related changes in body composition during adolescence into adulthood: The Fels longitudinal study. *International Journal of Obesity* 21: 1167–1175.

GUO S. S., ZELLER C., CHUMLEA W. C., SIERVOGEL R. M., 1999: Aging, body composition and life style: The Fels longitudinal study. *American journal of clinical nutrition* 70: 405–411.

GUPTA R., 1997: Meta analysis of prevalence of hypertension in India. *Indian Heart Journal* 49: 43–48.

GUPTA R., 2004: Trends in hypertension epidemiology in India. *Journal of Human Hypertension* 18, 2: 73–78.

GUPTA R., 2016: Convergence in urban–rural prevalence of hypertension in India. *Journal of human hypertension* 30: 79–82. doi: 10.1038/jhh.2015.48

HUGHES V. A., ROUBENOFF R., WOOD M., FRONTERA W. R., EVANS W. J., FIATARONE SINGH M. A., 2004: Anthropometric assessment of 10-y changes in body composition in the elderly. *Am J Clin Nutr* 80, 2: 475–482.

KAPIL U., VERMA D., GOEL M., SAXENA N., GNANASEKARAN N., GOINDI G., NAYAR D., 1998: Dietary intake of trace elements and minerals among adults in underprivileged communities of rural Rajasthan, India. *Asia Pac J Clin Nutr* 7, 1: 29–32.

KAUR M., 2003: *A Study of Morpho-Physiological Variations among Punjabi Rural - Urban Brahmin Females of District Roop Nagar- with Special Reference to Senescence.* Unpublished Ph.D. Thesis, Panjab University, Chandigarh.

KAUR M., TALWAR I., 2011: Body composition and fat distribution among older Jat females: A rural-urban comparison. *Journal of Comparative Human Biology HOMO* 62, 5: 374–385. doi: 10.1016/j.jchb.2010.05.004

KAUR G., BAINS K., KAUR H., 2012: Body composition, dietary intake and physical activity of sedentary adult Indian women. *Food and Nutrition Sciences* 3: 1577–1585.

KEARNEY P. M., WHELTON M., REYNOLDS K., MUNTNER P., WHELTON P. K., HE J., 2005: Global burden of hypertension: analysis of worldwide data. *Lancet* 365, 9455: 217–223.

KSHATRIYA G. K., 2014: Changing Perspectives of Tribal Health in the Context of Increasing Lifestyle Diseases in India. *J Environ Soc Sci* 1, 1: 101.

KOYAMA H., MOJI K., SUZUKI S., 1988: Blood pressure, urinary sodium/potassium ratio and body mass index in rural and urban populations in West Jawa. *Hum. Biol.* 60: 263–272.

KUSUMA Y. S., BABU B. V., NAIDU J. M., 2004: Prevalence of hypertension in some cross-cultural populations of Visakhapatnam district, south India. *Ethn Dis.* 14: 250–259.

LAXMAIAH A, MESHRAM I. I., ARLAPPA N., BALAKRISHNA N., RAO K. M., REDDY CH. G., RAVINDRANATH M., KUMAR S., KUMAR H., BRAHMAM G. N., 2015: Socio-Economic & Demographic Determinants of Hypertension and Knowledge, Practices & Risk Behaviour of Tribals in India. *Indian J Med Res.* 141, 5: 697–708.

MALINA R. M., 2005: Variations in body composition associated with sex and ethnicity. In: S. B. Heymsfield, T. G. Lohman, Z. M. Wang, S. Going (Eds.): *Human Body Composition.* (2nd edition). Pp. 271–298. Human Kinetics, Champaign, IL.

MALINA R. M., BOUCHARD C., BAR-OR O., 2004: *Growth, maturation, and physical activity.* (2nd edition). Champaign, IL: Human Kinetics.

MOTT J. W., WANG J. C., THORNTON D. B., ALLISON D. B., HEYMSFIELD S. B., PIERSON R. N., 1999: Relation between body fat and age in four ethnic groups. *American journal of clinical nutrition* 69: 1007–1013.

MANIMUNDA S. P., SUGUNAN A. P., BENEGAL V., BALAKRISHNA N., RAO M. V., PESALA K. S., 2011: Association of hypertension with risk factors & hypertension related behaviour among the aboriginal Nicobarese tribe living in Car Nicobar Island, India. *Indian J Med Res.* 133: 287–293.

NAYAK A., BABU B., 2003: Tribal health problems: an anthropological appraisal. *Man in India* 88: 301–13.

NATIONAL NUTRITION MONITORING BUREAU. Diet and Nutritional status of rural population (2005–2006), National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.

PARK S., LAKATTA E. G., 2012: Role of inflammation in the pathogenesis of arterial stiffness. *Yonsei Med J.* 53: 258–261.

PERISSINOTTO E., PISENT C., SERGI G., GRIGOLETTO F., ENZI G., 2002: Anthropometric measurements in the elderly: age and gender differences. *Br. J. Nutr.* 87: 177–186.

RAGUSO C. A., KYLE U., KOSSOVSKY M. P., ROYNETTE C., PAOLONI-GIACOBINO A., HANS D., GENTON L., PICHARD C., 2006: A 3-year longitudinal study on body composition changes in the elderly: role of physical exercise. *Clin. Nutr.* 25, 4: 573–580.

RAO K. M., ARLAPPA N., RADHIKA M. S., BALAKRISHNA N., LAXMAIAH A., BRAHMAM G. N. V., 2012: Correlation of Fat Mass Index and Fat-Free Mass Index with percentage body fat and their association with hypertension among urban South Indian adult men and women. *Annals of Human Biology* 39, 1: 54–58.

RECKELHOFF J. F., 2001: Gender Differences in the Regulation of Blood Pressure. *Hypertension* 37: 1199–1208.

SACHDEV B., 2011: Prevalence of hypertension and associated risk factors among Nomad Tribe groups. *Online Journal of Anthropology* 7: 181–189

SANDBERG K., JI H., 2012: Sex differences in primary hypertension. *Biol Sex Differ.* 3: 7.

SCHALL J., 1995: Sex differences in the response of blood pressure to modernization. *Am J Hum Biol* 7: 159–172.

STINI W. A., 1985: Growth rates and sexual dimorphism in evolutionary perspective. In: R. I. Gilbert, J. H. Mielke (Eds.): *The Analysis of Prehistoric Diets*. Pp. 191–226. New York: Academic Press.

SHEN W., WANG Z. M., PUNYANITA M., LEI J., SINAV A., KRAL J. G., LMIELINSKA C., ROSE R., HEYMSFIELD S. B., 2003: Adipose tissue quantification by imaging methods: A proposed classification. *Obes Res.* 11: 5–16.

SIERVOGEL R. M., WISEMANDLE W., MAYNARD S., GUO S., ROCHE A. A., CHUMLEA W. C., TOWNE X., 1998: Serial changes in body composition throughout adulthood and their relationship to changes in lipid and lipoprotein levels: the Fels Longitudinal study. *Arteriosclerosis Thrombosis Vascular biology* 18: 1759–1764.

SIRI W. E., 1961: Body composition from fluid spaces and density analysis of methods. In: J. Brozek, A. Henshcel (Eds.): *Techniques for measuring body composition*. Washington, DC: National Academy Press.

TANNER J. M., WHITEHOUSE R. H., TAKAISHI M., 1966: Standards from birth to maturity for height, weight, height velocity and weight velocity in British children. *Archive Dis. Child.* 41: 454–613.

VAN ITALLIE T. B., YANG M. U., HEYSMSFIELD S. B., FUNK R. C., BOILEAU R. A., 1990: Height-normalized indices of the body's fat free mass and fat mass: potentially useful indicators of nutritional status. *Am J. Clin. Nutr.* 52: 953–959.

VARADARAJAN A., PRASAD S., 2009: Regional Variations in Nutritional Status among Tribals of Andhra Pradesh. *Stud Tribes Tribals* 7, 2: 137–141.

WEINER J. S., LOURIE J. A., 1981: Practical Human Biology. Academic Press, London.

Wells J. C. K., 2001: A critique of the expression of pediatric body composition data. *Arch dis child.* 85: 67–72.

WHO 1998: The World Health Report Life in the 21st Century: A vision for all 2 Measuring Health. Pp. 39–60. World Health Organization, Geneva.

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