Nutritional Status and Hypertension Among Tibetan Adults in India

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INTRODUCTION

Tibetans are believed to have lived at high altitudes for longer than other high-altitude populations of the world (Moore, 1998). Dalai Lama of Tibet was given asylum in India after the political up-heals in 1959. Following Dalai Lama some 80,000 Tibetans fled to India. Tibetan refugees have been living in different parts of India for more than four decades. The different parts of India offer them different climatic and cultural environment; compared with those in which they lived in Tibet. Nutritional status of a population is a very good indicator of overall health status of a population. In the present paper the Nutritional status of the refugee population has been studied with respect to the altitude of residence.

Nutritional status has been found to be associated with many different morbidity conditions and in effect mortality as well (James et al., 1988; Ferro-Luzzi et al., 1992; Naidu and Rao, 1994; Park, 2003). Relationship of mortality and Body Mass Index (BMI) an indicator of Nutritional status is U- or J- shaped (Lee et al., 1993; Shetty and James, 1994; Allison et al., 2002) that is both the ends show higher mortality, and the least mortality is in between. The disease conditions like cardiovascular and renal diseases, which are generally found to be associated with the higher values of BMI (overweight), were all found to be positively related to high blood pressure. Risk of heart attack, heart failure, stroke and kidney disease, have been found to be increased with the increasing blood pressures (JNC7, 2003).

Hypertension affects approximately one billion individuals worldwide (JNC7, 2003). Rates of hypertension have been shown to increase in traditional populations undergoing modernization and also among migrant populations from rural to urban habitats. Many different studies have shown that a number of factors are found to be responsible for higher incidence of hypertension (JNC7, 2003). The traditional rural population not following sedentary way of life don't generally show higher incidence of hypertension.

Altitude also affects blood pressure. Ascent to high altitude results in increase in blood pressure; but after some years of residence blood pressure tend to gradually decline, even falling below those observed at sea level. Both Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) are found to be lower in the high altitude native populations than in the low altitude native populations at high altitude (Clegg et. al., 1976; Hanna, 1999). Prevalence of hypertension is also lower in the higher altitude samples as also the incidence of chronic heart disease compared to the low altitude populations. (Hanna, 1999). There was a gradual reduction in SBP in lowlanders who remain for years at high altitude.

The degree of decline in systemic BP is found to be a function of time at residence at altitude. The Andean evidence is strong in suggesting the above relationship. This observation is also observed in some other populations like Sherpas (Basu et. al., 1984), natives of Tien Shan and the Pamir (Mirrakhimov, 1978) and the Ambars region in Ethiopia (Beall, 1997). One study on Tibetans (Sun, 1986) points to a reverse relationship. Tibetans in Lhasa (high altitude) showed higher incidence of hypertension than the low altitude native Han migrants.

In view of the above the incidence of hypertension and its association with altitude and nutritional status among adult Tibetans have been investigated in this study.

MATERIALS AND METHODS

Tibetans are a predominantly Mongoloid population inhabiting the central Tibetan Plateau. The central Tibetan Plateau is land locked and bounded on all sides by huge mountains ranges. Tibetan Plateau represents the world's largest and highest landmass, with an average elevation of more than 4500m and supporting human populations up to 5000m. As a country, Tibet has been quite isolated from the rest of the world because of climate/geographical, cultural and political reasons resulting in very few anthropological studies on the populations of Tibet. Tibetans are believed to have lived at high altitudes for longer than other high-altitude populations of the

world. Controversy exists as to when the high altitude areas were first inhabited by humans in evolutionary history (Aldenderfer, 2003). The present Dalai Lama with many of his followers fled Tibet in 1959 and entered India. The Government of India gave them asylum and they were settled in different parts of the country. They number around 85,147 according to Tibetan Demographic survey (1998) and more than 110,000 according to the estimates of USCRI (2004). The different parts of India offer them different climatic and cultural environments, which they had earlier been alien to (web page of department of Home, The Government of Tibet in Exile, 1996). The environment of settlements in Leh/Ladakh is more or less similar to the climatic environment in Tibet. In contrast the settlements/colonies in Himachal Pradesh, Arunachal Pradesh, Karnataka, Orissa, Delhi, and elsewhere offer them a range of climatic settings which range from those of moderate high altitude to low altitudes which are quite in contrast to the climate of Tibet (cold, low humidity and hypoxic). They have been living in India for the last 40 years and a generation is born and brought up in different and contrasting environments at different settlements.

Three Tibetan settlements in India with different ecological settings were selected for the study. Settlements at Bylakuppe (800m) (Mysore, Karnataka) and Chandragiri (970m) (Gajapati, Orissa) were selected at low altitude. The settlement at Choglamsar (3521m), Leh was selected as high altitude sample. Details about the physical features of the three settlement has been described elsewhere (Tripathy and Gupta, 2005). Three of the settlements are agriculture based. Agriculture is a source of stable income for most of the household. One crop per year is cultivated generally. At Bylakuppe some household cultivate even two crop per year. Apart from farming most households are engaged in informal business involving retailing to consumer and traditional products like winter wear, shoes, carpets etc. The income generated from informal business is generally much higher than farming. A few are engaged in small-scale industry like carpet weaving, handicraft etc and few are in service sector.

Individuals aged 18 years and above have been considered as adult in the present study. The assessment of Nutritional status has been done with help of BMI. Height was measured with the help of Harpenden anthropometer rod and weight with a weighing scale. Height was recorded to the nearest millimeter and weight to nearest 0.5 kg. The two measurements: Upper arm circumference and Skinfold thickness at triceps on the left hand were taken to get an estimate of muscle and fat mass. Frisancho's (1981) formula was used to estimate upper arm muscle area and fat area. Mercury sphygmomanometer was used to measure blood pressure. All the measurements were taken by one investigator (VT).

CDC/NCHS (2005) recommended BMI cut off were used for classifying the population for nutritional status. Those having BMI value less than 18.5 were grouped under "Under weight", BMI ≥ 18.5 and < 25 were classified as "Normal", BMI ≥ 25 and < 30 were grouped under 'Over weight", BMI ≥ 30 were grouped under Obese. For classification of Hypertension recommendation of the JNC7 (2003) was used. The classification scheme is shown in Table 1.

Table 1: Hypertension classification based on JNC7

Category	*SBP**	*DBP**
Normal	<120	And <80
Pre -hypertension	120-139	Or 80-89
Stage 1 Hypertension	140-159	Or 90-99
Stage 2 Hypertension	≥160	Or≥100

SBP* Systolic blood pressure, DBP* Diastolic blood pressure

RESULTS

Table 2 presents the classification of nutritional status for adult Tibetans according to sex and altitude. The data of Bylakuppe and Chandragiri has been combined as low altitude and the data from Choglamsar is termed as high altitude. For the total sample just 4.8 percent of the population is underweight and more than 50 percent (55.6%) of the total sample falls in the category normal. Out of total sample 27.9 percent are overweight and 11.7 percent obese. The differences in variation of the frequency of Nutritional status for sex ($\chi^2 = 4.291$, $p = 0.232$) and altitude ($\chi^2 = 3.016$, $p = 0.389$) are not significant. ANCOVA was performed taking BMI as the dependent variable, age as covariate and sex and place of residence as fixed factors. Both sex ($p = 0.000$) and age ($p = 0.037$) were found to be related to BMI. High altitude shows lower BMI values compared to low altitude. Females show higher BMI values than males.

Table 3 presents the classification of hypertension according to Sex and Place of residence. The percentage of normal blood pressure at high altitude (39.1%) is more than that at low altitude (28%). Stage I and Stage II hypertension are in almost equal frequency at both the altitudes. Percentage of

Table 2: Nutritional status among Tibetan adults

	Underweight		*Normal*		*Overweight*		*Obese*		*Total*
	N	%	*N*	%	*N*	%	*N*	%	
High Altitude									
Male	1	2.0	33	64.7	14	27.5	3	5.9	51
Female	7	6.7	60	57.7	27	26	10	9.6	104
Total	8	5.2	93	60.0	41	26.5	13	8.4	155
Low Altitude									
Male	10	6.1	96	58.5	42	25.6	16	9.8	164
Female	7	3.4	102	50	63	30.9	32	15.7	204
Total	17	4.6	198	53.8	105	28.5	48	13.0	368
Grand Total	25	4.8	291	55.6	146	27.9	61	11.7	523

Table 3: Hypertension among Tibetan adults

	Normal		*Prehypertension*		*Stage I Hypertension*		*Stage 2 Hypertension*		*Total*
	N	%	*N*	%	*N*	%	*N*	%	
High Altitude									
Male	16	30.8	15	28.8	14	26.9	7	13.5	52
Female	45	43.3	21	20.2	21	20.2	17	16.3	104
Total	61	39.1	36	23.1	35	22.4	24	15.4	156
Low Altitude									
Male	46	27.2	60	35.5	41	24.3	22	13	169
Female	58	28.6	67	33.0	43	21.2	35	17.2	203
Total	104	28.0	127	34.1	84	22.6	57	15.3	372
Grand Total	165	31.3	163	30.9	119	22.5	81	15.3	528

people classified as pre-hypertension is more at low altitude (23.1 %). The difference in variation of the frequencies of different categories of hypertension between the two places is significant ($\chi^2 = 8.728$, $p = 0.033$). For category sex the variation is non-significant ($\chi^2 = 4.549$, $p = 0.208$).

To test the effect of the above variables on hypertension, Logistic regression was performed after combining three categories Pre-hypertension Stage-I and Stage-II hypertension. Nutritional status, muscles area and fat area show no relationship with the occurrence of hypertension. Both age ($p = 0.000$) and place ($p = 0.037$) has significant effect on hypertension.

Since hypertension is defined as higher pressure values of either systolic or diastolic blood pressure we did the analysis taking the SBP and DBP values separately. Analysis of covariance was performed for studying the effect of nutritional status, height, weight, body composition (muscle and fat area) place of residence and sex on blood pressure. Log transformed values of Blood pressure were used for the analysis. None of the variable had a significant effect on blood pressure except for age.

DISCUSSION

BMI distribution for the Tibetan adult population show very small percentage of people (4.8%) in the underweight category of less than 18.5. The proportion of population in the category overweight and obese increases with age (Fig. 1). This pattern is similar to what is found in the developed countries of Europe (France 4.9%, Hungary 5.1%), North and Latin America (USA 3.5%, Brazil 5.6%, Cuba 7.3%, Peru 3%) (Shetty and James, 1994) (Table 4). In comparison the host country India has a very high percentage of population in the category underweight (48.6%). The mongoloid populations of North East India also show higher percentage of population in the underweight category though the values are less in comparison to the caste groups of India (Khongsdier, 2001). When this result is compared with the China a country comprising largely of mongoloid population we find that Tibetans have lesser people under underweight than China's 12.3%. This pleasant picture for the Tibetan population of very less percentage of people in the category in underweight is offset by percentage of people who

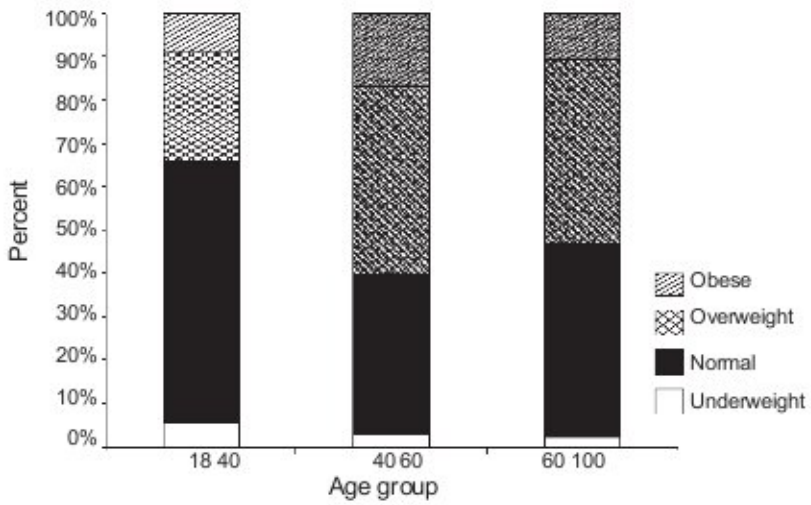

Fig. 1. Nutritional status of Tibetan adults

are above the normal range of BMI (≥25). A total of 39.6% of population is either in the category overweight or obese. The pattern is similar to what is observed for the Latin American countries and a few other developed countries of Europe. The situation is slightly better than USA and other developed countries of Europe like Hungary and United Kingdom. The mean BMI of the Tibetan population 24.36±4.6(SD) is on a higher side when compared with other developed and developing countries. The mean BMI for different countries is given in Table 4. Our sample of Tibetan adults show mean BMI values similar to what is observed for the developed countries of Europe and North America, and for the developing countries of Latin America and Africa like Brazil, Cuba, Peru, Togo and Tunisia which have higher proportion of individuals in the overweight category.

Residence at high altitude is known to have a reducing effect on systemic blood pressures. The longest resident populations show the greatest decline in BP. Tibetans were found to show a reverse relationship (Sun, 1986). In the present study altitude is significantly related to blood pressure, high altitude showing lower values than the low altitude. Migration of Tibetans to lower altitude has resulted in an increase in their blood pressures. But the prevalence of hypertension is similar at the two altitudes. The difference between altitudes is observed only for the percentage of normal and prehypertension. Sun (1986) described the prevalence of Hypertension among Tibetans living at altitudes from 2500 to 5000m in Xizang Autonomous region. Those with SBP ≥ 141 mmHg and/or DBP ≥ 91 mmHg were classified as Hypertensive in that study. Only essential hypertensive, that is reading elevated on two measurement days, were included under the category Hypertensive. The cut off corresponds roughly to the Stage I hypertension of the JNC 7 classification. The prevalence of Hypertensive in the Tibetan population at Tibet was found to be 11.02% for the total sample. An increase with age is evident. For comparison with the present study prevalence rate of hypertension for the two studies is presented in Table 5. The present

Table 4: Comparison of mean BMI for different countries

Place	*Year*	*No. of adults*	*BMI mean*
AFRICA			
Congo (Women)	1986/87	2295	23.1
Ghana	1987/88	6323	(18.5-24.99) 62%
Mali	1991	4868	21.1
Morocco	1984/85	41921	22.97
Tunisia	1990	10023	24.25
EUROPE& N. AMERICA			
France	1980	14233	24
Hungary	1985/88	14012	25.03
USA	1976/80	13760	25.3
LATIN AMERICA			
Brazil	1989	32381	22.8,23.2
Cuba	1982	30363	(18.5-24.99) 56.3%
Peru	1975/76	3145	(18.5-24.99) 63.2%
ASIA			
China	1982	13387	20.98
India (Males)	1988/90	9447	18.9
India (Females)	1988/90	11914	19.0
Tibetan (Males)*	2003-2005	215	23.74
Tibetan (Females)*	2003-2005	308	24.79

*Present study, rest data from Shetty and James 1994.

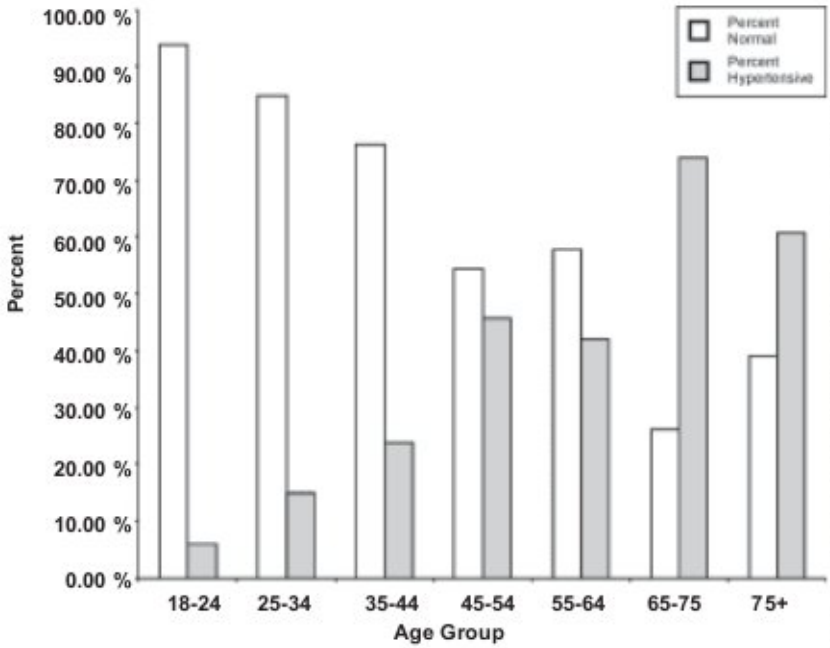

Fig. 2. Percent of normal and hypertensive in the Tibetan adult population

Table 5: Prevalence Rate of Hypertension among Tibetan adults

	Present study		*Sun 1986*	
Age group	*Person surveyed*	*Prevalence of Hypertension (Stage1 + Stage2 Hypertension)*	*Person surveyed*	*Hypertensive*
15-24	84	6.0	4832	1.05
25-34	80	15.0	3187	2.77
35-44	84	23.8	2562	8.13
45-54	68	45.6	2381	19.10
55-64	57	42.1	1620	28.10
65-74	104	74.0	783	38.69
75+	51	60.8	180	37.28
Total	528	37.9	15545	11.02

study shows a much higher prevalence of hypertension among the Tibetans in India compared to what was observed by Sun for Tibetans in Tibet. Increase in prevalence of hypertension with age is also evident in our sample (Fig. 2). The only explanation, which can be given for the higher prevalence of hypertension among Tibetans, is higher intake of salt. Higher salt intake among Tibetan have been observed among the Tibetans mostly in the form of salt tea. Migration of Tibetans to India has resulted in an increase in prevalence of hypertension which may be due to increase in sedentary and modernized way of life.

We could not find any previous study of Nutritional status of Tibetan adults in literature. Nutritional status and body composition may be a possible explanation for the high values of blood pressure. Surprisingly we did not find any relationship between nutritional status and body composition with blood pressures. Only age has a significant effect on blood pressure. How does this higher prevalence of hypertension translate in terms of mortality and morbidity in this population? Morbidity and mortality statistics were obtained from Bhatia et al (2002) which was based on demographic survey of Tibetan refugees in India. A total of just 15.1% of deaths among Tibetan refugees in the settlement population were reported for the period 1994-1996 which were caused by cardiovascular disorder, cerebral hemorrhage and renal diseases. The top four causes of death were cancer, tuberculosis, old age and accident are not related to hypertension and they account for 46.6% of the death. In terms of visits to clinics run by Tibetan government in exile only 3.97% of the total visits were for cardiovascular problems. High prevalence of hypertension among Tibetan may not be in reality an indication of morbidity among Tibetans. The classification of Tibetans in hypertension categories based on studies on European populations may not be free of error as normal blood pressure values may be higher among Tibetans compared to other populations. What causes higher blood pressure among Tibetans and how this may help in adaptation to high altitude is a question to be investigated!

Nutritional status and hypertension level of this Tibetan population show a trend towards overweight and a higher prevalence of hypertension respectively. Tibetans in India resemble populations from developed countries who are described as urban having a sedentary way of life.

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KEYWORDS Nutritional Status. Hypertension. Tibetans, India. Altitude

ABSTRACT Nutritional status and prevalence of hypertension and the relationship between them in adult Tibetan refugee population in India at three different places have been investigated in this study. Some 40% of the adult population is in the category overweight and obese. The trend towards hypertension is also very high. No relationship between nutritional status and body composition with blood pressures was found. Only age has a significant effect on blood pressure. High prevalence of hypertension among Tibetan may not be in reality an indication of morbidity among Tibetans as mortality and morbidity rates related to cardiovascular disease is low. In terms of Nutritional status and hypertension Tibetans in India resemble populations from developed countries who are described as urban having a sedentary way of life.

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