Indian J Physiol Pharmacol 1998; 42 (4) : 543–547

THE INFLUENCE OF AGE, SEX AND OBESITY ON BLOOD PRESSURE LEVELS IN A TRIBAL POPULATION

B. V. BABU*, Y. S. KUSUMA AND J. M. NAIDU

Department of Anthropology,
Andhra University,
Visakhapatnam – 530 003

(Received on February 3, 1998)

Abstract : The influence of age, sex, body mass index (BMI) and skin fold thickness at triceps and subscapular regions on blood pressure was investigated among Manzai Mali, an agricultural tribe from Andhra Pradesh. Relatively higher levels of blood pressure are observed in this transitional tribe compared to the neighbouring traditional tribes which may be attributed to the acculturization process. Manzai Mali women recorded significantly higher mean levels of SBP and DBP than men. The multiple regression analysis indicates that SBP increases significantly along with age, body mass index and triceps skinfold thickness. Also, DBP raises markedly with age. The regression coefficient for sex infers that the variability in DBP is significant between men and women compared to SBP. The regression coefficients of BMI and TSF are although positive for SBP and DBP, the influence is significant for SBP only.

Key words : epidemiology, blood pressure, hypertension, anthropometric correlates

INTRODUCTION

Arterial blood pressure, an important physiological marker, attained great etiological significance in the epidemiology of heart diseases due to its presumed association with age, height, weight, adiposity, diet, personal habits, etc. of an individual. Further, ethnic variation in blood pressure levels was also suggested long back (1, 2). Hence, population survey of blood pressure levels along with various body dimensions will provide an opportunity to understand the influence and clinical significance of various factors on blood pressure. In the present paper, an attempt is made to probe the influence of age, sex, body mass index, triceps and subscapular skinfolds on arterial blood pressure among men and women belonging to Manzai Mali, an endogamous tribal population from Andhra Pradesh, who are settled agriculturists and horticulturists with subsistence economy. The tribe inhabits the rural villages and hamlets scattered on the Eastern ghats with forest cover at an elevation of about one thousand metres above mean sea level. The environment is free from industrial pollution and the tribes lead relatively tense free life. Alcoholism is a taboo in this unstratified society. Although, the people are non-vegetarians, chicken and eggs as well as pork are totally prohibited. Chewing of a locally available

*Corresponding Author and address : Dr. B. V. Babu, Regional Medical Research Centre, ICMR, C. S. Pur, Bhubaneswar – 751 016

tobacco paste, "Gudaku" is observed frequently but smoking tobacco is minimal and occasional.

METHODS

A sample of 140 men and 138 women of approximately similar age above eighteen years, stratified into five age groups, were selected by random sampling. No individual of known hypertensive history is included in the present study. The systolic (SBP) and diastolic (DBP) blood pressure levels were measured using Sphygmomanometer. The age of each individual is recorded in completed years. The height vertex (H) in centimetres, body weight (wt) in kilograms and skinfold thickness at triceps (TSF) and subscapular (SSF) regions in millimetres were measured following standard techiniques. The body mass index (BMI) or Quetelet index, a ratio of weight to height squared is taken to represent the overall body mass. It represents a more rapid increase in weight per additional increment in height (3) and regional fat deposition (4). Multiple regression analysis by least squares method was performed seprately for men, women and both sexes together to investigate the effect of independent variables namely, age, sex, BMI, TSF and SSF on SSB and DBP. The qualitative variable sex, considered as one of the independent variables, was assigned a numerical value of 0 for men and one for women in multiple regression analysis. The t-values for mean blood pressure levels significance of regression coefficients of variables and correlation coefficients between the variables are computed. The F-values for goodness of fit of multiple regression equation and R^2 values were obtained.

RESULTS

The mean values of SBP and DBP, and other independent variables among Manzai Mali men and women are presented in Table I. The mean SBP and DBP levels are significantly higher in women than men, which indicate clear sex differences in blood pressure levels. Also, women possess more subcutaneous fat with significantly higher mean values of TSF and SSF than men. As usual, the mean values of height and weight are significantly higher in men than women. The mean values of BMI are relatively low,

TABLE I : Mean values ($\bar{x}$) along with standard error (SEM) of blood pressure (SBP and DBP), height, weight, body mass index (BMI), and skinfold thickness measurements at triceps (TSF) and subscapular (SSF).

Variable	*Men* $\bar{x} \pm SEM$	*Women* $\bar{x} \pm SEM$	*'t' test*[a] *(df=α)*
SBP (mmHg)	110.96 ± 1.05	114.99 ± .43	2.271*
DBP (mmHg)	70.07 ± 0.82	73.46 ± 0.93	2.734**
Height (cm)	161.57 ± 0.50	149.80 ± 0.50	16.645***
Weight (Kg)	45.68 ± 0.42	39.24 ± 0.38	11.370***
BMI	17.47±0.13	17.47±0.14	---
TSF (mm)	4.59 ± 0.10	7.33 ± 0.25	10.176***
SSF (mm)	6.67 ± 0.14	8.15 ± 0.25	5.165***

*P<0.05; **P<0.01; ***P<0.001
[a]'t' test for difference between men and women.

both in men and women implying that the relative weight of these tribals is not proportionate up to their height.

The results of multiple regression analysis are given in Table II. The F-values of multiple regression equations for the influence of age, sex, BMI, TSF and SSF on blood pressure are statistically significant suggesting a good fit for the data sets of women and both sexes together. The regression coefficients obtained for combined data set of both sexes are positive and significant for age, BMI and TSF on SBP illustration that SBP elevates markedly along with increasing age, body mass and subcutaneous fat. The DBP also raises along with age, but the influence of BMI and TSF are conspicuous on SBP rather than DBP. The regression coefficient of sex is significant which infers that the variability in DBP is distinct between men and women. The regression coefficients of SSF are negative for both SBP and DBP but not significant. It may be mentioned here that the subscapular skinfold records low mean values denoting very little subcutaneous fat in these tribals. The separate multiple regression equations for the data sets of men and women show that body mass influences both SBP and DBP significantly among men. The influence of age is significant on DBP compared to SBP among men as well as women. The contribuition of TSF for the variability of SBP is significant among women only.

It is worth mentioning here that although the age, BMI, TSF and SSF were considered as independent variables, the correlation matrix suggests that the coefficients between independent variables such as age vs. BMI and weight; BMI vs. TSF and SSF; TSF vs. SSF; SSF vs. weight are highly significant indicating that they are, in fact, not true independent characters. Hence, the results of multiple regression may be viewed along with simple regression analysis for corroboration. Therefore, simple linear regression analysis for dependent variables SBP and DBP vs. Age, height, weight, BMI, TSF and SSF was carried out simultaneously. The linear regression coefficients for H, Wt, BMI, TSF and SSF on SBP and DBP are highly significant but several multiple regression coefficients of independent variables are not significant, probably because of multicollinearity among independent variables considered, which has resulted in

TABLE II : Multiple regression of age, BMI, TSF, SSF and sex on SBP and DBP.

Sex	*Dependent variable*	*Intercept*	*Independent variables*					R^2 *value*	*F value*
			Age	*BMI*	*TSF*	*SSF*	*Sex*		
Men	SBP	61.87	+0.15	+2.73*	+1.67*	1.72*	—	0.14	5.31
	DBP	39.07	+0.21*	+1.38*	+0.73	-0.57	—	0.09	3.75
Wo-	SBP	73.65	+0.62*	+0.40	+1.61*	-0.06	—	0.24	10.91*
Men	DBP	50.16	+0.35*	+0.27	+0.58	+0.13	—	0.17	6.67*
Men +	SBP	69.24	+0.41*	+1.32*	+1.65*	-0.50	+0.03	0.15	9.86*
Women	DBP	44.26	+0.29*	+0.77	+0.65	-0.10	+1.21	0.14	9.10*

*$p<0.05$

TABLE III : Correlation coefficients betwen dependeant (SBP and DBP) and independent variables.

Independent variables	*SSP*			*DBP*		
	Men	*Women*	*Both*	*Men*	*Women*	*Both*
Age	0.095	0.403*	0.275	0.221*	0.351*	0.298*
BMI	0.283*	0.005	0.110	0.185	0.001	0.084
TSF	0.104	0.250*	0.241*	0.065	0.168*	0.196*
SSF	−0.038	0.159	0.139*	0.022	0.130	0.131
Sex	—	—	0.147*	—	—	0.161*

*P<0.05

low R^2 values.

The correlation coefficients between dependent variables (SBP,DBP) and independent variables (age, sex, BMI, TSF and SSF) are presented in Table III. Age, TSF and SSF show positive and significant correlation with SBP and DBP when the data on both sexes are considered together. Though the regression coefficients of SSF on both SBP and DBP are negative, the correlations are positive (except for SBP in males) which are not significant in men and women. Among males, SBP exhibits significant correlation with BMI while DBP has strong association with BMI and age. In women, the SBP and DBP has strong association with BMI and age. In women, the SBP and DBP are significantly correlated with age and TSF.

DISCUSSION

The SBP and DBP levels are significantly higher in Manzai Mali women than men. Similarly, higher levels of blood pressure among women were reported in earlier studies. Pollard et al. (5) supports the suggestion that females have intrinsically greater variability in blood pressure than men and these defferences are plausibly related to the female phenomena of menstruation, pregnancy, parity and menopause. Schall (6) reports, among Manus of Papua New Guinea, that women of 45 years old or older had a tenfold increased risk for hypertension compared to younger women, but for men age was not significantly associated. The present study Manzai Mali tribal population, who are in cultural transition exhibits slightly higher mean values of SBP (113 mmHg) and DBP (76 mmHg) compared to their neighbouring traditional tribes, namely, Konda Dora (108/66 mmHg) and Kotia (110/68 mmHg) (7). The observed higher blood pressure levels in this tribe may be due to the stress of ongoing acculturization process. Pollard et al. (5) reviewed nearly fifty studies from different parts of the world and found that the blood pressure levels are higher among modern populations followed by transitional groups compared to traditional populations. They suggested that the environmental adversity encountered in transitional populations cause a breakdown in the ability to maintain homeostasis equivalent to that found in modern populations.

In this population a clear positive influence of age, BMI and TSF on blood pressure levels is noticed. The consequence

of age on blood pressure is apparent in women. Comparatively greater amounts of variance among women than among men may be attributed to the age associated physiological and hormonal changes that are more specific and prominent in women, since such age associated changes are inevitable for women, but not so for men. Several earlier studies (8-15) have established significant effect of obesity (either expressed as BMI or skinfold thickness) on blood pressure. Mukherjee et al. (13) reported, among rural fishing community of West Bengal, that triceps skinfold thickness and weight are significant predictors of SBP (R^2=3%) and DBP (R^2=5%) respectively. Nirmala et al. (14) reported among Reddy caste from Andhara Pradesh, that various adiposity measures together contribute approximately about 16% and 14% of the variance in either BP respectively among men and women. Mukhopadhyay et al. (15) reported among Himalayan Lepchas, that age contributes 20% to 27% of variance in SBP and DBP of men, while for women, the triceps skinfold thickness along with age enhances the variance to 41% in SBP and to 31% in DBP. It is important to mention that, since several body dimensions show strong correlation, they pose multicollinearity problem in multiple regression analysis and often resulting in low R^2 values. Hence, it is opined that a suitable regression model for analysis of blood pressure and its correlates may be worked out further.

REFERENCES

1. Lovell RRH. Blood Pressure in Pacific Island Population. In: Pamberton J (Ed.), *Epidemiology*. Oxford University Press, London 1963; 115.
2. Boyle E Jr, Griffy WP Jr, Nichamann MZ et al. An Epidemiological Study of Hypertension among Racial Groups of Charleston County, South Carolina. In: Stamler J, Stamler R, Pullmann TN (Eds.), *The Epidemiology of Hypertension*. Grunne and Stratton Inc., New Youk 1967; 193.
3. Garn SM, Leonard WR, Hawthorne. Three limitations of Body mass index. *Am J Clin Nutr* 1986;44: 996-997.
4. Enzi G, Gasparo M, Biondetti P, Fiora D, Semisa M, Zurlo F. Subcutaneous and visceral fat distribution according to sex, age, and over weight: evaluation by by computerized tomography. *Am J Clin Nutr* 1986; 44: 739-746.
5. Pollard TM, Brush G, Harrison GA. Geographic distribution of within- population variability in blood pressure. *Hum Biol* 1991; 63: 643-661.
6. Schall JI. Sex differences in the response of blood pressure to modernisation. *Am J Hum Biol* 1995; 7: 159-172.
7. Yasmin. An Anthropological Profile of Kotia Tribe. Ph. D. thesis (Unpublished), Andhra University, Visakhapatnam 1991.
8. Baker PT. Migration, Genetics and the Degenerative Diseases of South Pacific Islanders. In: Boyce AJ (Ed.), Migration and Mobility. Taylor and Francis Ltd., London 1984; 209-239.
9. Skarfors ET, Lithell HO, Selinus I. Risk factors for the development of hypertension: a 10 year longitudinal study in middle aged men. *J Hyperten* 1991; 9: 217-233.
10. McGarvey ST. Obesity in Samoans and a perspective on its etiology in Polynesians. *Am J Clin Nutr* 1991; 53: 1586s-1594s.
11. Mc Garvey ST. The thrifty gene concept and adiposity studies in biological anthropology. *J Polynes Soc* 1994; 103: 29-42
12. Gershater E, McGarvey ST. Fourteen year changes in adiposity and blood pressure in American Samoan adults. *Am J Hum Biol* 1995; 7: 597–606.
13. Mukherjee BN, Byard PJ, Bhattacharya et al. Blood pressure in a rural West Bengal fishing community: an epidemiological profile. *Hum Biol* 1988; 60: 69–79.
14. Nirmala A, Reddy PC, Reddy KN. Influence of adiposity on blood pressure in an Andhra population. *J Ind Anthrop Soc* 1993; 28: 139–145.
15. Mukhopadhyay B, Mukhopadhyay S, Majumder PP. Blood pressure profile of Lepchas of the Sikkim Himalayas: epidemiological study. *Hum Biol* 1996; 68: 131–145.