



SANAT K. BHATTACHARYA, CHUMKI PIPLAI, PARTHA P. MAJUMDER, RANJAN GUPTA

A STUDY ON TESTING BLOOD PRESSURES AMONG TWO MIGRANT GROUPS LIVING IN SIMILAR ECOLOGICAL CONDITIONS IN JALPAIGURI DISTRICT, WEST BENGAL, INDIA

ABSTRACT — *A large number of studies on resting blood pressure has been conducted on people with diverse life styles and living in diverse ecological conditions.*

Recently some studies have shown that environment plays a major role in determining blood pressures and that blood pressure is directly influenced by migration.

Many studies have shown that blood pressure does not rise with age, hypertension is absent in many traditional societies and that age-related increase of blood pressure is not necessarily a part of physiological ageing process.

In view of this, the present study was conducted on two genetically (ethnically) diverse populations, the Oraons and the Tamangs, both migrant groups living under similar ecological conditions and working as tea garden labourers in the Jalpaiguri district, West Bengal, India, to examine the nature of age-related changes in systolic and diastolic pressures and variation in blood pressure, if any, in relation to sex, migrational status and packed cell volume (PCV). The results show that both male and female Oraons have higher values of both systolic and diastolic pressures compared with Tamangs.

The data on migrational status groups show that both Oraon and Tamang males of migrational status group M_1 have higher systolic and diastolic pressures compared with the M_2 status group. In Tamang females, M_2 status group have higher values of both systolic and diastolic pressures compared with M_1 group but in Oraon females, the M_1 status group have higher values of both systolic and diastolic pressures.

The data on both Oraon and Tamang show that in both males and females, systolic and diastolic pressures increase with age and that correlation coefficients as well as linear regression coefficients are significantly different from zero at the 5 percent level. The slope of the regression line (blood pressure on age) is the steepest among Oraon females.

The multiple regression coefficient involving age and packed cell volume as the independent variables is non-significant at the 5 percent level.

KEY WORDS: *Resting blood pressures — Systolic pressure — Diastolic pressure — packed cell volume — Age changes — Migration — tea garden labourers — Oraon — Tamang.*

INTRODUCTION

A large number of studies on resting blood pressure has been conducted on diverse ecological conditions and on people with diverse ways of life (Scotch, 1960; Boyden, 1969; Huizinga, 1972; Cruz Coke et al. 1973; Cassel, 1975; Clegg et al. 1976; Beaglehole et al. 1977; Boyce et al. 1978; Hanna and Baker, 1979; Basu et al. 1984).

It is generally believed that the resting blood pressures vary with respect to age, sex, body build, physical environmental conditions (e.g., altitude), socioeconomic conditions (e.g., occupation, education, migration, etc.), chronic diseases, haematological values, and certain biochemical parameters.

Recently many studies have shown that blood pressure does not rise with age, and hypertension is absent in many traditional societies (Lowenstein,

1961; Maddocks, 1961; Sinnet and Whyte, 1973). Also it is not necessarily a part of the physiological ageing process. Age-related change in blood pressure is rather a characteristic of modern, urban way of life, presumably related to psychological stress associated with Westernization/modernization.

Environment plays a major role in determining the blood pressure level. Cruz Coke et al. (1964) show that the rate of rise of diastolic blood pressure with age increased significantly among the inhabitants of Easter Island when they migrated to the South American continent and that the increase of variance of blood pressure was directly influenced by migration. Prior et al. (1968) found that Polynesians who were living in islands and relatively more involved in cash economy had higher blood pressure as well as steeper age-related change in systolic pressure compared with those living in remote islands. Scotch (1963) showed that South African Zulus living in a large city had higher blood pressure and a greater tendency for systolic pressure to rise with age compared with those inhabiting rural areas. Rural to urban migrants show increases in blood pressure with age (Stamler et al. 1967; Huizinga, 1972) and non-migrants when exposed to the modernization process tend toward elevated blood pressures (Bassett et al. 1966; Labarth et al. 1973; Prior, 1974). Maddocks (1967) found that Melanesians residing in traditional villages had lower blood pressure than those living in more European dominated towns and the latter showed a tendency for the systolic pressure to rise with age. In contrast to these findings, Norman-Taylor and Rees (1963) showed that there was virtually no difference in blood pressure levels of three subgroups of the Melanesians living in the New Hebrides.

Basu et al. (1984) studied two subpopulations of the Sherpas living in two contrasting ecosystems (i.e., high and low altitudes) in the eastern Himalaya and found that the blood pressure of the latter subpopulation (i.e., low altitude) tended to rise with increasing age. They concluded that the age-related change in the low altitude Sherpas was a characteristic of their relatively modern/Western urban conditions rather than an altitude effect. Thus the rise of blood pressure with age increases significantly when a traditional population emigrates to a more Westernized/urbanized area.

The length of exposure to and residence in Westernized/urbanized culture has an important effect on blood pressure.

Examination of the changes in elements of the life styles of different populations which have taken place due to migration may provide important insights. But hardly any study has been undertaken to examine this possibility.

It is also believed that the haematological parameters like packed cell volume (PCV) and total red cell count may affect blood pressure. McDonough et al. (1965) have shown significant partial correlations between haematocrit (PCV) and diastolic pressure in American Whites and Blacks of both sexes and between haematocrit and systolic pressure in White and Black females. Penaloza (1971) has

demonstrated hypoxia induced polycythaemia with the resulting elevated blood viscosity and peripheral resistance being counteracted or overcounteracted by the vasodilatory effects of hypoxia, thereby leading to low blood pressure, particularly systolic in high altitude populations.

In view of the above, the purpose of the present paper is to examine whether

- (I) migration has any effect on blood pressure,
- (II) length of exposure to residence in a new environment has any effect on blood pressure,
- (III) the nature of age changes is different between the males and females in different ethnic groups,
- (IV) the nature of age changes is different between systolic and diastolic blood pressures in different ethnic groups,
- (V) the haematological parameter packed cell volume (PCV) makes any contribution in determining blood pressure.

MATERIALS AND METHODS

With the advent of tea industry in the Duars in Jalpaiguri district, West Bengal, a large number of labourers was brought in mainly from Chotanagpur. The tea labourers of the Duars area comprise mostly of immigrant populations brought in over the last 100 years or so from Chotanagpur, Santal Paraganas, Darjeeling hill areas as well as from Sikkim and Nepal (Grunings, 1911; Choudhury, 1978).

Oraons

Oraons are the third largest group in Jalpaiguri district, West Bengal (Grunings, 1911). Linguistically they belong to the "Khurukh" or "Dravidian group" (Risley, 1891). They are generally believed to have migrated from Southern India and settled in the Sahabad district of Bihar several centuries ago and thence to have moved to Chotanagpur (Hunter, 1877; Roy, 1915).

Oraons started immigrating to the Duars area around 1881 as tea labourers. Many of them have eventually settled down as cultivators. The staple food of the Oraons comprise rice, though wheat and millet are also used. Potato, green vegetables, fish, pork and milk products are also consumed. The alcoholic beverages are "handia" (rice beer) and sometimes "chhang" the latter generally prepared by various Nepali groups.

Tamangs

In Tibetan language "Ta" means pony and "Mang" means many. According to some scholars the Tamangs originated as a trading class in Tibet who used pony as a pack animal, and others believed that the word Tamang is derived from the Sanskrit word Tamra (copper) as they worked in copper mines in the past. They are essentially a middle altitude (i.e., 1000—1200 m) population in Nepal.

Tamangs started immigrating to the Duars area around 1874—75 with the advent of tea industry in this area. They are mainly concentrated near the hills in somewhat elevated areas. Their staple food is rice. Wheat, green vegetable, beef, pork etc. are also consumed. Their common alcoholic beverage is "chhang" (rice beer) (Haimendorf, 1965; Census of India 1961).

Both the migrant groups studied here are tea labourers and entitled to similar facilities like subsidised food items, free water supply, fuel, health, education in addition to standard wages.

The two migrant groups were classified with respect to migrational status: M_{2+} — those born of parents who themselves (or their parents/grand parents, etc.) were born in the Duars, and M_1 — those born in the Duars.

The data on systolic and diastolic pressure, age and packed cell volume are utilized in the present paper.

Blood pressures were measured on 119 Oraon and 111 Tamang adults of both sexes. Blood pressures were taken after about a 15 minutes' rest period, in a sitting position on the left arm by the auscultatory method using an inflatable blood pressure cuff, mercury sphygmomanometer and stethoscope and measured by the same observer on all subjects.

Packed cell volume (PCV) was measured by collecting blood specimens in standard heparinized microcapillaries and spinning them down shortly after collection in a haematocrit centrifuge.

In the absence of systematic written records in most house holds ages were estimated by reference to local important events, cross checked with the ages of some individuals for whom written records existed, and also verified from other sources wherever possible.

RESULTS

Table 1 shows that both male and female Oraons have higher values of both systolic and diastolic blood pressures compared with the Tamangs, and that significant differences are found in systolic blood pressure in both male and female.

Figures 1 and 2 show that the pattern of age-related increase is similar in both Oraons and Tamangs of both sexes and that the slope of the regression line (blood pressure on age) is steepest among the Oraon female (Figure 2).

Table 2 shows that all the correlation coefficients i.e.,

male $r_{\text{syst., age}}$, female $r_{\text{syst., age}}$, male $r_{\text{dias., age}}$, female $r_{\text{dias., age}}$

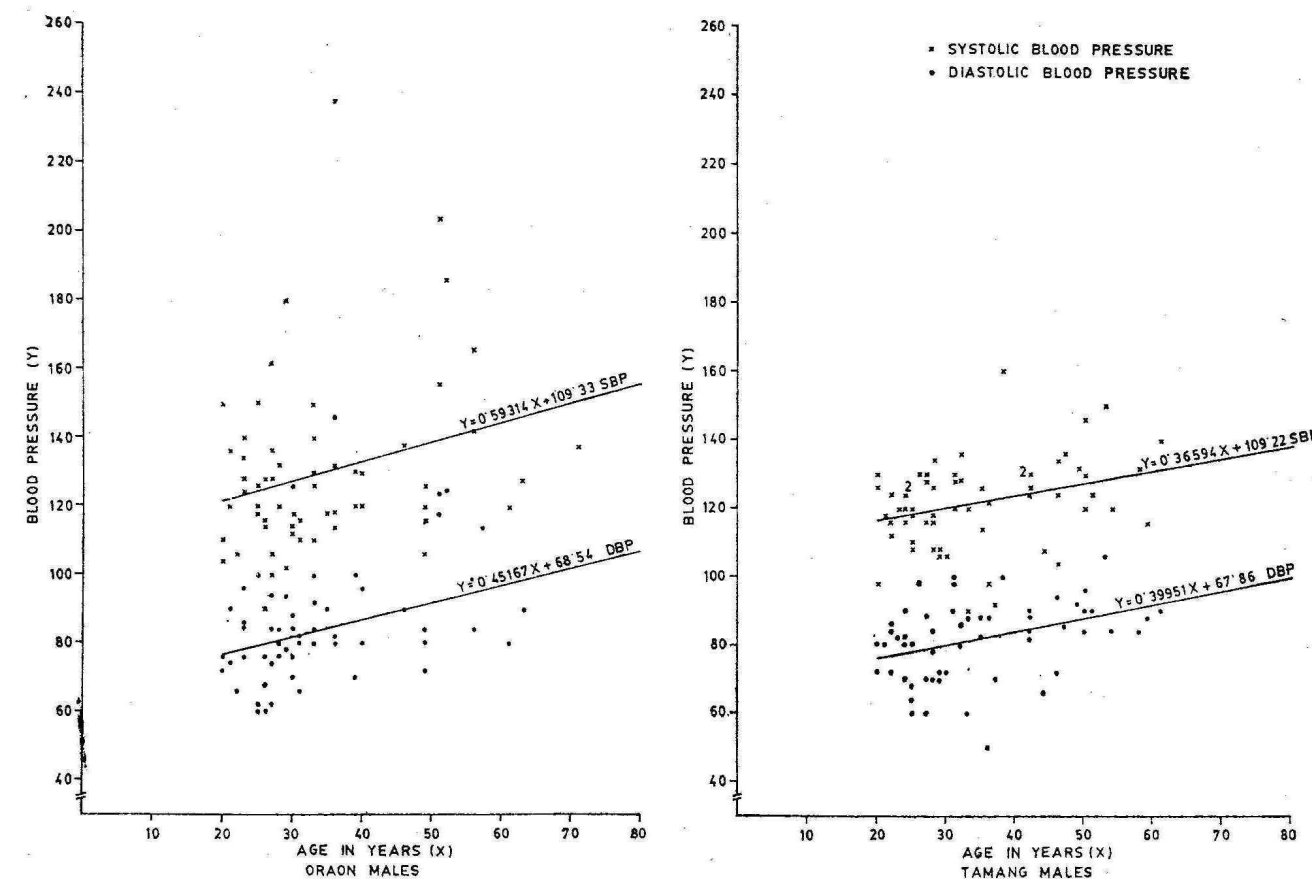


FIGURE 1. Regression of systolic and diastolic pressures on age for Oraon and Tamang males.

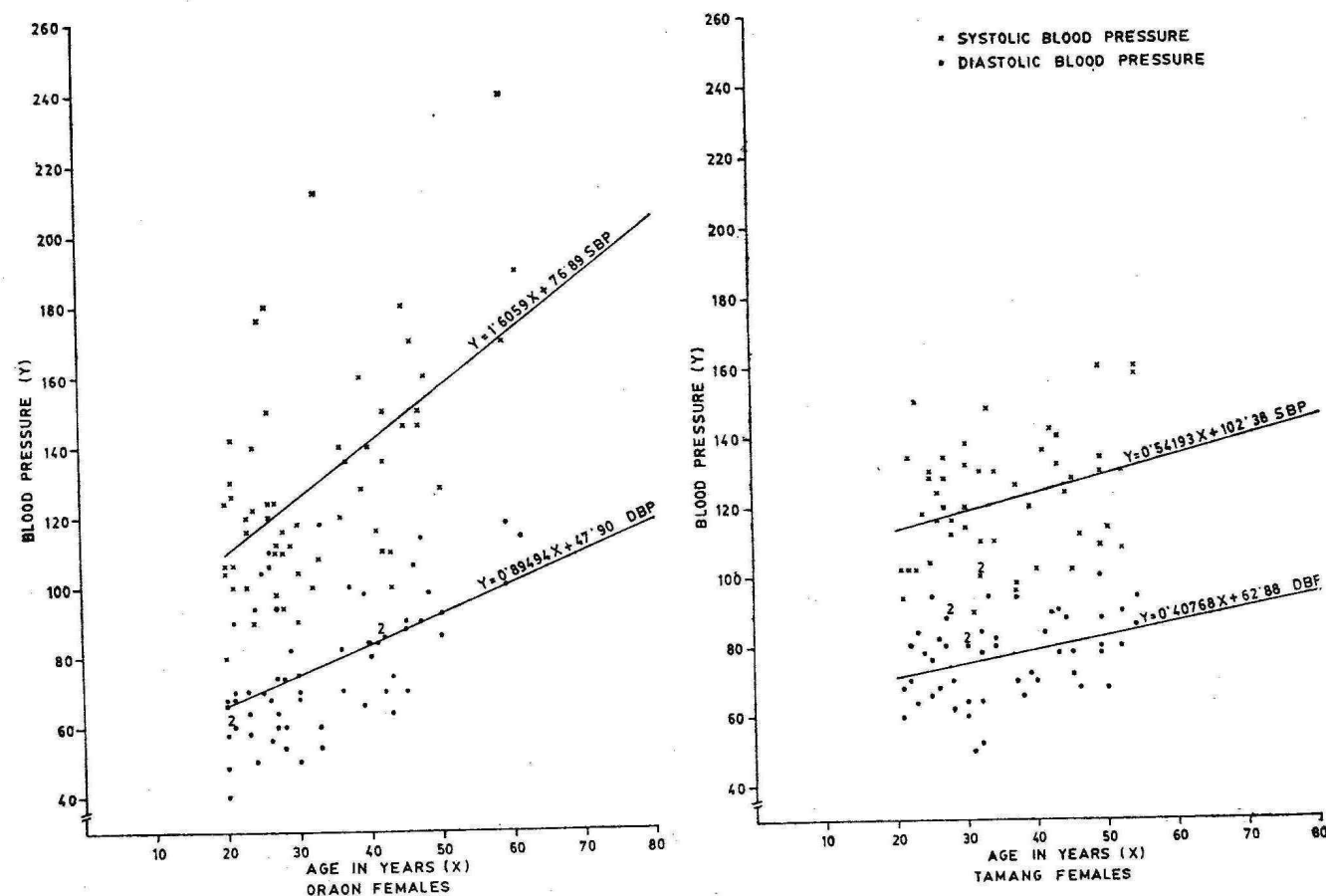


FIGURE 2. Regression of systolic and diastolic pressures with age for Oraon and Tamang Females.

are significantly different from zero at 5 percent level and the difference between males and females in both the groups is non-significant at 5 percent level. Further, the difference between systolic and diastolic pressures is also non-significant at 5 percent level in both males and females in both the groups.

Since haematocrit is generally believed to affect both systolic and diastolic pressures of the high and medium altitude populations, multiple regression coefficients were computed using age and packed cell volume (PCV) as predictor variables.

TABLE 1. Means and standard deviations of systolic and diastolic blood pressures by sex and ethnic group

Population	Systolic (mm Hg)			Diastolic (mm Hg)		
	N	Mean	SD	N	Mean	SD
*Oraon Males	64	129.47	24.86	64	83.87	16.10
Females	56	130.00	31.44	56	77.50	20.37
*Tamang Males	60	121.83	12.84	60	81.63	11.55
Females	51	121.49	17.52	51	77.25	11.61
Males: $t = 2.91^*$, $df = 122$ 1.66 $df = 122$						
Females: $t = 2.49^*$, $df = 105$ 0.11 $df = 105$						

*Significant at 5 percent level.

TABLE 2. Correlation coefficients between age and systolic and diastolic pressures by sex and ethnic blood group

Population	Systolic	Diastolic
Oraon Males	0.28*	0.33*
Females	0.56*	0.48*
Tamang Males	0.32*	0.39*
Females	0.31*	0.35*

*Significant at 5 percent level.

It appears that the packed cell volume has no detectable effect since the regression coefficient is not significantly different from zero.

The data on migrational status groups (Table 3) show that both Oraon and Tamang males of migrational status group M_1 have higher systolic and diastolic blood pressures compared with the M_{2+} status group. In Tamang females, the M_{2+} status group has higher values of both systolic and diastolic pressures compared with the M_1 status group but in Oraon females the M_1 status group has higher values of both systolic and diastolic blood pressures.

TABLE 3. Blood pressure with respect to group migrational status

Population	Sex	Systolic (mm Hg)			Diastolic (mm Hg)		
		N	Mean	SD	N	Mean	SD
Tamang	Males	27	122.96	14.97	27	83.93	11.13
		21	119.24	17.76	21	76.38	10.86
	Females	33	120.91	10.79	33	79.76	11.36
		30	123.07	17.19	30	77.87	11.88
Oraon	Males	31	131.10	22.30	31	84.90	15.52
		25	140.08	33.30	25	84.64	19.40
	Females	33	127.51	26.36	33	83.71	16.31
		31	121.87	27.33	31	72.72	18.02

Significant differences are found to occur between M_1 and M_{2+} status groups in systolic and diastolic pressures in all the groups barring Tamang females.

DISCUSSION

It is generally believed that both systolic and diastolic blood pressures are higher and that the nature of age-related increase is more pronounced in the migrants than in the sedentes. We are unable to test this hypothesis directly since we do not have data on sedente counterparts of both the groups. However, we can suggest from the present results that migration may have some roles in determining blood pressure since there is a trend of age-related change in blood pressure in both the groups, which is generally considered to be indicative of the effect of modern urban way of living along with other modernization/urbanization effects; for example, the rate of rise of diastolic blood pressure with age increase significantly in the inhabitants of Easter Island when they migrated to South American Continent and that variance of blood pressure is directly influenced by migration (Cruz-Coke et al. 1964). Scotch (1963) found that the recently migrant Zulus to large urban centres had higher blood pressure levels than those living in their rural setting and also higher than those who spent 10 years of their lives in the city. Stamler et al. (1967) found a lower rate of hypertension among the Blacks who migrated to Chicago less than 10 years ago compared with both the Chicago-born Blacks and those who migrated to Chicago more than 10 years ago.

Comparative data are not available for sedente counterparts, and in the absence of such data, we are at present unable to test directly whether there has been any rise in blood pressure due to acculturation or Westernization, or any sharper age-related increase due to increased psychological stress associated with modern urban life style, as suggested by Scotch (1960), Maddocks (1961), Boyden (1969), Beaglehole et al. (1977) and Baker (1986).

However, our results on blood pressure differences among the migrational status groups within each ethnic group suggest that these possibilities might indeed be true.

The apparent similarity in the nature of age-related increase of blood pressure between males and females among both the groups is in conformity with the findings of Basu et al. (1984) but not so with many others (Huizinga, 1972; Clegg et al. 1976; Boyce et al. 1978) for which no explanation can be offered.

A similar lack of any effect of haematological parameters on blood pressure is also apparent for the high altitude Ethiopian population which may be due to the increased peripheral vasodilation (Clegg et al. 1976), but in low altitude group the association may hold (Clegg et al. 1976). So Marticorena et al. (1969) have reported that systolic and diastolic pressures, particularly the former, decrease with long term residence at altitude in non-natives and that with passage of time the blood pressure of the non-natives approached those of Peruvian natives living in the same altitude.

From the results it is possible to surmise that the lower blood pressures among the Tamangs may reflect their history of residence in medium altitude areas in Nepal (Bista, 1976), or alternatively, may be due to their different ethnic history.

ACKNOWLEDGEMENTS

We are indebted to the Oraons and Tamangs of the study area for their unstinted help and cooperation. Thanks are due to the management of the Birpara, Lankapara and Tulsipara Tea Gardens for their kind cooperation throughout the work. We are thankful to Dr. N. Sarkar, Mr. B. Dutta, Mr. J. Roy and Ms. Ursula Toppu of Birpara Tea Garden and to Mr. A. Goswami of Tulsipara Tea Garden for their kind help and cooperation, to Mr. P. C. Kumar for preparing diagrammes, to Mr. A. Chakrabarti for typing the manuscript, to Mr. R. M. Sarkar for secretarial assistance and to Professor A. Basu for initiating and guiding this project.

REFERENCES

- BAKER P. T., 1986: Modernization, migration and health: A methodological puzzle with examples from the Samoans. *J. Indian Anthropol. Soc.* 21: 1-22.
- BASSETT D., ROSENBLATT G., MOELLER R., HARTWELL A., 1963: Cardiovascular disease, diabetes mellitus and anthropometric evaluation of Polynesian males on the island of Niihau. *Circulation* 28: 1088-1097.
- BASU A., GUPTA R., MITRA P., DEWANJI A., SINHA A., 1984: Variation in resting blood pressures among Sherpas of the eastern Himalaya. In: *Proceedings of the Indian Statistical Institute. Golden Jubilee International Conference on Human Genetics and Adaptation*, Vol. 2. Human Adaptation, A. BASU and K. C. MALHOTRA (eds), pp. 60-69. Indian Statistical Institute, Calcutta.
- BEAGLEHOLE R., SALMOND C. E., HOOPER A., HUNT-

- SMAN J., STANHOPE J. M., CASSEL, J. C. PRIOR, L. A., 1977: Blood pressure and social interaction in Tokelauan migrants in New Zealand. *J. Chron. Dis.* 30: 803—812.
- BISTA D. B., 1976: *People of Nepal*. Ratna Pustak Bhandar, Kathmandu, Nepal.
- BOYCE A. J., ATTENBOROUGH R. D., HARRISSON G. A., HORNABROOK R. W., SINNET P., 1978: Variation in blood pressure in a New Guinea Population. *Ann. Hum. Biol.* 5: 313—319.
- BOYDEN S. A., 1969: The impact of civilization on human biology. *Aust. J. Exp. Biol. Med. Sci.* 47: 287—298.
- CASSEL J., 1975: Studies of hypertension in migrants. In: *Epidemiology and Control of Hypertension*, O. Paul (ed), pp. 41—61, Stratton, New York.
- CENSUS OF INDIA, 1961: *Village Survey Monograph on Upper Pedong*, Volume XIV, Part VI(10), West Bengal and Sikkim, Government of India, Delhi.
- CHOUDHURY M. R., 1978: *The Tea Industry in India: A Diagnostic Analysis of its Geoeconomic Studies*. Oxford Book and Stationary Company, Calcutta.
- CLEGG J., JEFFRIS D. J., HARRISON G. A., 1976: Determinants of blood pressure at high and low altitudes in Ethiopia. *Proc. Roy. Soc. Lond. B* 194: 63—82.
- CRUZ-COKE R., ETCHEVERRY R., NAGEL R., 1964: Influence of migration on blood pressure of Easter Islanders. *Lancet* 1: 697—699.
- CRUZ-COKE R., DONOSO, H., BARRERA R., 1973: Genetic ecology of hypertension. *Clin. Sci. Mol. Med.* 45: 55—65.
- GRUNINGS J. F., 1911: *Eastern Bengal and Assam District Gazette*. Allahabad Press, Allahabad.
- HAIMENDORF C. V. F., 1956: Ethnographic Notes on the Tamangs of Nepal. *Eastern Anthropol.* 9: 34.
- HANNA J. M., BAKER P. T., 1979: Biocultural correlates to the blood pressure of Samoan migrants in Hawaii. *Hum. Biol.* 51: 481—497.
- HUIZINGA J., 1972: Casual blood pressure in populations. In: *The Human Biology of Environmental change*, D. VOSTER (ed), pp. 164—172, Unwin, London.
- HUNTER W. W., 1877: *A statistical Account of Bihar*. Vol. 17 — Concept, Delhi.
- LA BARTHE D., REED D., BRODY J., STALLONES R., 1973: Health effects of modernization in Palau. *Am. J. Epidemiol.* 98: 161—194.
- LOWENSTEIN F. W., 1961: Blood pressure in relation to age and sex in the Tropics and subtropics: A review of the literature and an investigation in two tribes of Brazil Indians. *Lancet*, 1: 389—392.
- MADDOCKS I., 1961: Possible absence of hypertension in two complete Pacific Island populations. *Lancet*, 2: 396—397.
- MADDOCKS I., 1967: Blood pressures in Melanesians. *Med. J. Aust.* 1: 1123—1126.
- MARTICORENA E., RUIZ L., SEVERINO J., GALVES J., PENALOZA D., 1969: Systolic blood pressure in White men born at sea level: Changes after long residence at high altitude. *Am. J. Cardiol* 23: 364—368.
- MCDONOUGH J., HAMES C. G., GARRISON G. E., STULB S. C., LICHTMAN M. A., HEFELFINGER D. C., 1965: The relationship of hematocrit to cardiovascular states of health in the Negro and White populations of Evans County, Georgia. *J. Chron. Dis.* 18: 243—257.
- NORMAN—TAYLOR W., REES W. H., 1963: Blood pressure in three New Hebrides communities. *Brit. J. Prev. Soc. Med.* 17: 141.
- PENALOZA D., 1971: In: *High Altitude Physiology*, R. PORTER AND J. KNIGHT (ed), pp. 169—170, Churchill Livingstone, London.
- PRIOR I. A. M., 1974: Cardiovascular epidemiology in New Zealand and the Pacific. *N. Z. Med. J.* 80: 245—252.
- PRIOR I. A. M., GRIMLEY-EVANS J., HARVEY H. P. B., DAVIDSON F., LINDWEY M., 1968: Sodium intake and blood pressure in two Polynesian populations. *New Engl. J. Med.* 279: 515—520.
- RISLEY H. H., 1891: *Tribes and Castes of Bengal: Ethnographic Glossary*. Vol. 1. — Bengal Secretariat Book Depot, Calcutta.
- ROY S. C., 1951: *The Oraons of Chotanagpur: History, Economic Life and Social Organization*. Man in India Press, Ranchi.
- SCOTCH N. A., 1960: A preliminary report on the relation of sociocultural factors to hypertension among the Zulu. *Ann. N. Y. Acad. Sci.* 84: 1000—1009.
- SCOTCH N. A., 1963: Sociocultural factors in the epidemiology of Zulu hypertension. *Am. J. Publ. Hlth.* 53: 1205.
- SINNET P. F., WHYTE H. M., 1973: Epidemiological studies in a total highland population, Tukisenta, New Guinea. *J. Chron. Dis.* 26: 265—290.
- STAMLER J., BERKSON D. M., LINDBERG H. A., MILLER, W. A., STAMLER, R., COLLETTE P., 1967: Socioeconomic factors in the epidemiology of hypertensive disease. In: *The Epidemiology of Hypertension*, J. STAMLER AND P. PULLMAN (ed) pp. 289—320, Grune and Stratton, New York.

S. K. Bhattacharya
P. P. Majumder
Dr. Ranjan Gupta
Anthropometry and Human
Genetics Unit
Indian Statistical Institute
203, Barrackpore Trunk Road
700 035 Calcutta
India.

Chumki Piplai
Anthropological Survey of India
27, Jawaharlal Nehru Road
700 016 Calcutta
India