



Risk factors of hypertension and physical activity level among the adult Wanchos of Arunachal Pradesh

John Basumatary¹ and Gulrukh Begum²

¹ICMR-SRF, Department of Anthropology, Gauhati University Email ID: johnnivatarun@rediffmail.com; ²Associate Professor, Department of Anthropology, Gauhati University, Email ID: gulrukhbegum@gauhati.ac.in

KEYWORDS

risk factors, blood pressure, physical activity, Wanchos.

ABSTRACT

The objective of this paper is to determine different risk factors of hypertension, and especially the effect of physical activity level on blood pressure among the adult Wanchos. Physical activity is found to be positively associated with blood pressure among the adult Wanchos at a very lesser level ($r = 0.003$), but significantly associated with BMI and the cardio-metabolic risk factors. Even though physical activity is not very strongly related with hypertension, surely it has some bearings in developing hypertension as all the other risk factors of hypertension are significantly associated with both blood pressure and the physical activity level.

Introduction

Blood pressure is created by the force of blood pushing against the walls of blood vessels (arteries) as it is pumped by the heart. The higher the pressure the harder the heart has to pump. Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure (WHO 2013).

Hypertension is one of the major causes of mortality globally for the last two decades or so. Hypertension is responsible for at least 45% of deaths due to heart disease, and 51% of deaths due to stroke (WHO 2008). The threat of hypertension is much more pragmatic in low and middle-income countries than high-income countries. Not only is hypertension more prevalent in low and middle-income countries, there are also more people affected because more people live in those countries than in high-income countries. Further, because of weak health systems, the numbers of people with hypertension who are undiagnosed, untreated and uncontrolled are also higher in low and middle-income countries compared to high-income countries (WHO 2013).

The increasing prevalence of hypertension is attributed to population growth, ageing and behavioural risk factors, such as unhealthy diet, harmful use of alcohol, lack of physical activity, excess weight and exposure to persistent stress. Lack of physical activity being one of the important behavioral risk factors of hypertension, is also a major cardio-metabolic risk factor in general. The World Health Organization (2003) has emphasized on different dimensions of physical activity and stretches on the fact that regular moderate physical activity such as walking, cycling or participating in sports has significant benefits for health. For instance it can reduce the risk of cardiovascular diseases, diabetes, colon and breast cancer, and depression. Moreover, an adequate level of physical

activity will decrease the risk of hip or vertebral fracture and help control weight.

Cross-sectional epidemiologic studies and controlled experimental investigation have demonstrated that physically active adults as contrasted with their sedentary counterparts tend to develop and maintain higher levels of physical fitness. Epidemiologic research has demonstrated protective effects of varying strength between physical activity and risk for several chronic diseases including coronary heart disease, hypertension, non-insulin-dependent diabetes mellitus, osteoporosis, colon cancer and anxiety and depression (Blair et al. 1995).

This study focuses on the Wancho tribe, one of the indigenous tribes of Arunachal Pradesh, who are also currently found in some bordering areas of Assam. There are no studies among the Wanchos. The 2011 Census of India estimates the population of Wanchos as 56,866. They are very hard working and physically active tribe. Being a hill dwelling tribe, their day to day activities are vastly different in terms of the intensity of bodily movements than those among people living in the plain. This leads to the question of their health status depending on the fact that they are highly active and live in a difficult and elevated terrain. An ample number of studies prove the fact that the lack of physical activity is one of the risk factors of hypertension and other cardio-metabolic diseases of people living mostly in the plain areas, especially urban dwellers (Dhall 2012, Kim et al. 2010, Hu et al. 2007, 2001), but no study looks into the lives of the hill dwelling, highly active people (irrespective of their being rural or urban inhabitants). It was hypothesized that, since Wanchos are very hard working people, as walking itself can be considered a vigorous activity for them, which involves constant upward and downward movements of the whole body muscles, this essentially should have some bearings on their body composition and the prevalence of the cardio-metabolic risk factors. The objective of this paper is to determine different risk factors of hypertension, and especially the effect of physical activity level on blood pressure among adult Wanchos.

Materials and methods

The present study was conducted among the Wanchos of Arunachal Pradesh. The data collection was done in the two surrounding localities of Longding town; Niaunu and Zedua, RUSA village of the Kanubari block, the Nitong village of the Tirap district, and the greater Kanubari block of the Longding district.

The data collection was done with the help of purposive sampling. The sample size was calculated with the help of OpenEpi open-source software version 3.01, 2006. The sample size of the present study is a proportional representative of the total Wancho population of 56,886 (according to 2011 Census of India). 318 Wancho adults, belonging to the age range from 20 to 60 years, of the present study fall under 90% confidence interval of the total population with anticipated frequency of 50% and design effect of 1.0.

A total of 318 adult Wanchos (177 males and 141 females) ranging from 20 to 60 years of age were measured for height, weight, BMR, skinfold measurements and blood pressure. The data collection on physical activity was done with the help of WHO Step-wise instrument version 3.2, 2004. The questionnaire was custom devised as a survey schedule with appropriate activity related modifications. The sample was divided into 3 physical activity levels depending on their daily activity routine, i.e., vigorously active, moderately active and sedentary. This division was made with the help of the directions given by GPAQ (Global Physical Activity Questionnaire) which was specially designed by

WHO for developing countries to measure physical activity. Every subject was classified by their daily physical activities associated with work, travel, leisure time. Depending on the time invested in each of these categories, MET (Metabolic Equivalent) was calculated independently. The sum of the total MET value of the three categories was used to classify an individual in a physical activity level. Those with a MET score less than 600 in a week, were considered as sedentary or physically inactive. Those who are both vigorously and moderately active throughout a week were further assessed on the basis of their independent MET for vigorous intensity and moderate intensity physical activity and put in the physical activity level according to whichever had a higher MET score. The daily household activities involving, cleaning, washing, cooking were considered as moderate intensity activity, whereas fetching water from stream, collecting firewood and daily foraging were reckoned as vigorous intensity activity.

Waist-Height ratio was used for assessing cardio-metabolic risk factors. WHO (2008) suggests that, waist circumference and central adiposity indices are much more convincing and stronger in getting a clear picture of risk factor of cardiovascular diseases (CVD) and mortality caused by obesity, than BMI, as these avoid the need for age, sex and ethnic differences. The universally accepted critical value which signifies increased risk is 0.5 (Browning et al. 2010).

40 >	0.5 critical value
40 – 50	between 0.5 and 0.6
50 <	0.6 onwards

Blood pressure levels were categorised using JMC 7 report blood pressure classification (U.S. Department of Health and Human Services 2003). The sample was divided into four categories, normotensive, prehypertensive, hypertensive stage 1 and hypertensive stage 2. Those with <120mmHg systolic BP and <80mmHg diastolic BP were put in the normotensive category, those with 120-139mmHg systolic BP and 80-89mmHg diastolic BP were put in prehypertensive category, those with 140-159mmHg systolic BP and 90-99mmHg diastolic BP were put in hypertensive stage 1, and finally those with ≥160mmHg systolic BP and ≥100mmHg diastolic BP were put in the hypertensive stage 2 category. People with prehypertension are at increased risk for progression to hypertension.

All the data analysis was done with the help of MS Excel 2007 and SPSS 16.0 software. Descriptive statistics were used to calculate the frequency of basic measurements among the participants. Multiple linear regressions were calculated to establish predictability of variability in blood pressure status, by physical activity level and other variables. Pearson's correlation coefficient test was applied to see the relationship among physical activity level, blood pressure, Basal Metabolic Rate, Body Fat Percent, and Body Mass Index. Chi square test was used to test the significance of variance between male and female among the blood pressure categories (normotensive, prehypertensive, and hypertensive). In all the statistical analysis p-value at 0.05 level was considered to be statistically significant.

Results

The anthropometric, physiological and behavioural data of 318 adult Wanchos, ranging from 20 to 60 years are shown in Table 1. The mean stature of the sample shows that the adult Wancho male (161.05) falls in the below medium stature category and adult females (150.01) in the short stature category according to Martin's scale (Das, 1991). The sexwise differences of mean values of stature, weight, Basal Metabolic Rate, body fat per cent and systolic blood pressure among the adult Wanchos are statistically significant. The mean BMI of the adult females (22.04) is higher than the adult males (21.98). The adult (74.01%) Wancho males are found to be more vigorously active than

the adult Wancho females (35.46%). However, the females (63.12%) are more moderately active than the males (19.21%). Similarly, inactive males (6.78%) are higher than the females (1.42%). 61.58% males are smokers/tobacco chewers, whereas only 4.26% females are found in the same category. Among the male 53.67% are alcohol consumers, in contrast to this 99.29% females are non-consumers. Maximum number of adult male (44.07%) and female (41.84%) Wanchos are found to be resting less than or equal to 3 hours in most number of days in a week.

Waist-Height ratio shows the highest percentage of at risk of cardio-metabolic risk factor is found to be among the adult females, i.e. 31.91%, of which the highest proportion of adult females, i.e. 68.89% were found to be involved in moderate intensity activity most number of days in a week (Table 4). However, 16.95% of adult males were found to be at risk, of which the majority, i.e. 53.33%, were mostly found to be involved in vigorous intensity activity in most days in a week. Contrary to this, adult males are at a higher risk of having hypertension than adult females with 41.24% and 31.91% respectively, in the prehypertensive stage (Table 2). Similarly, 19.77% males and 14.18% females are found to be in the hypertensive category. More males (16.38%) are found to be in the hypertensive stage 1 than females (10.64%), whereas, in stage 2 females (3.55%) are slightly higher than males (3.39%). The variance among the three blood pressure categories (i.e. normotensive, prehypertensive and hypertensive) between adult male and female Wanchos was found to be statistically significant ($\chi^2=7.0883$ and p value 0.028893) at 0.05 level.

Table 1: Descriptive statistics for anthropometric, physiological and behavioural data

Variables	Male (N= 177)	Female (N= 141)	Total (N= 318)
Stature	161.05 ± 5.61	150.01 ± 5.15**	156.15 ± 7.71
Weight	56.17 ± 7.56	49.58 ± 8.44**	53.69 ± 8.76
Body Mass Index	21.98 ± 2.79	22.04 ± 3.42	22.01 ± 3.08
Basal Metabolic Rate	1325.77 ± 140.49	1120.98 ± 150.79**	1234.97 ± 177.15
Body Fat Percent	18.97 ± 4.51	27.15 ± 3.99**	23.06 ± 4.25
Sum of Skinfold	17.02 ± 4.29	17.78 ± 6.54	17.36 ± 4.68
Systolic Blood Pressure	123.75 ± 14.11	120.38 ± 15.54*	122.25 ± 14.83
Diastolic Blood Pressure	78.5 ± 10.18	77.58 ± 10.74	78.09 ± 10.42
Physical activity level*			
Vigorous	132(74.58%)	50(35.46%)	182(57.23%)
Moderate	34 (19.21%)	89(63.12%)	123(38.68%)
Sedentary	11(6.21%)	2(1.42%)	13(4.09%)
Smoking/Tobacco chewing*			
Yes	109(61.58%)	6(4.26%)	115 (36.16%)
No	68(38.42%)	135(95.74%)	203 (63.84%)
Alcohol consumer*			
non-consumer	95(53.67%)	1(0.71%)	96 (30.19%)
Resting time			
≤ 1 hours	82(46.33%)	140(99.29%)	222 (69.81%)
≤ 3 hours	22(12.43%)	23(16.31%)	45 (14.15%)
> 3 hours	78(44.07%)	59(41.84%)	137 (43.08%)
> 6 hours	53(29.94%)	48(39.04%)	101 (31.76%)
	24(13.56%)	11(7.8%)	35 (11.01%)

Note. Here, * $p < 0.05$, ** $p < 0.001$ when compared to the mean values of male and female. P values were obtained by independent samples t test for anthropometric and physiological variables and chi square test for behavioural data.

Of the total 19.77% males who were found to be hypertensive, 68.57% are vigorously active, which is higher than the females, where 35% of the total 14.18% hypertensive females are vigorously active in most days in a week (Table 3). As adult Wanchos females were mostly involved in moderate intensity activity in a week (63.12% vs 19.21% males; Table 1), the higher proportion of females (65%) in the moderate intensity physical level are found to be hypertensive than males (22.86%). Similarly, 72.6% males who are at risk of hypertension are vigorously active in most days, whereas, the highest proportion of females, i.e. 55.56% who are at risk of hypertension, are moderately active in most days in a week.

Table 2: Distribution of adult Wanchos according to blood pressure categories

Sex	Normotensive	Prehypertensive	Hypertensive		Total
			Stage I	Stage II	
Male (N 177)	69 (38.98%)	73 (41.24%)	29 (16.38%)	6 (3.39%)	35 (19.77%)
Female (N 141)	76 (53.9%)	45 (31.91%)	15 (10.64%)	5 (3.55%)	20 (14.18%)
Total (N 318)	145 (45.6%)	118 (37.11%)	44 (13.84%)	11 (3.46%)	55 (17.3%)

Note. Blood pressure levels are significant at the level of 5% between the sexes.

Table 3: Distribution of Physical Activity as per Blood pressure of the adult Wanchos

Sex	Blood pressure categories	Vigorous	Moderate	Sedentary	Total	
Male (N 177)	Normotensive	55(79.71%)	12(17.39%)	2(2.9%)	69(38.98%)	
	Prehypertensive	53(72.6%)	14(19.18%)	6(8.22%)	73(41.24%)	
	Hypertensive	Stage1	20(68.97%)	7(24.14%)	2(6.9%)	29(16.38%)
		Stage2	4(66.67%)	1(16.67%)	1(16.67%)	6(3.39%)
Female (N 141)	Normotensive	24(31.58%)	51(67.11%)	1(1.32%)	76(53.9%)	
	Prehypertensive	19(42.22%)	25(55.56%)	1(2.22%)	45(31.9%)	
	Hypertensive	Stage1	5(33.33%)	10(66.67%)	0	15(10.64%)
		Stage2	2(40%)	3(60%)	0	5(3.55%)

Table 4: Distribution of Physical Activity level as per Waist-Height Ratio of the adult Wanchos

WHtR status	Sex	N	Vigorous		Moderate		Sedentary		Total	
			N	%	N	%	N	%	N	%
Normal	Male	177	115	78.23	25	17.01	7	4.76	147	83.05
	Female	141	37	38.54	58	60.42	1	1.04	96	68.09
	Total	318	152	47.80	83	34.16	8	3.29	243	76.42
At Risk	Male	177	16	53.33	9	30	5	16.67	30	16.95
	Female	141	13	28.89	31	68.89	1	2.22	45	31.91
	Total	318	29	38.67	40	53.33	6	8	75	23.58

To see the association of different physiological and behavioural variables with the blood pressure levels among the adult Wanchos, Pearson's correlation coefficient test was applied (Table 5). Blood pressure is found to be positively and significantly associated with BMI, smoking/ chewing tobacco and alcohol consumption, of which is smoking/ chewing tobacco is found to be having the strongest

association with blood pressure levels. Apart from this, Physical activity level is found to be negatively associated with BMI and the cardio-metabolic risk factors defined by WHtR, which clearly suggests that those who are more active are less likely to have cardio-metabolic risk factors. Similarly, smoking/chewing tobacco and alcohol consumption also have a negative correlation with the cardio-metabolic risk factors defined by WHtR. Basal Metabolic Rate is found to be significantly associated with BMI, daily total energy expenditure, cardio-metabolic risk factors defined by WHtR, body fat per cent, sum of skinfold, sedentary/resting time, smoking/chewing tobacco and alcohol consumption.

Taking blood pressure levels as dependent variable, the linear regression test was applied to see the predictability of physiological and behavioural variables (Table 6). The cumulative effect of all the covariates can not be reckoned as strong predictor of the variability in blood pressure levels among the adult Wanchos (overall 7.7% chances of association with blood pressure). However, among all the covariates only body fat per cent and smoking/chewing tobacco can be taken as statistically significant predictors of blood pressure levels.

Table 5: Pearson's correlation coefficient between the different variables

	BMR	BMI	TEE	BP	WHtRs	PHY	BFP	SS	ST	SMK/T	ALCH
BMR	1	0.624**	-0.246**	0.107	0.250**	0.030	-0.185**	0.274**	0.192**	0.352**	0.401**
BMI		1	-0.044	0.143*	0.686**	-0.138*	0.577**	0.416**	0.069	-0.031	0.015
TEE			1	-0.008	-0.082	0.557**	0.196**	-0.235**	-0.398**	-0.057	-0.110*
BP				1	0.098	0.003	0.088	0.001	-0.014	0.164**	0.139*
WHtRs					1	-0.227**	0.571**	0.342**	0.081	-0.176**	-0.140*
PHY						1	-0.234**	-0.254**	-0.255**	0.221**	0.143*
BFP							1	0.281**	-0.118*	-0.452**	-0.453**
SS								1	-0.014	-0.110	-0.125*
ST									1	0.163**	0.197**
SMK/T										1	0.681**
ALCH											1

Note. **. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level, BMR= Basal Metabolic Rate, BMI= Body Mass Index, TEE= total energy expenditure, BP= blood pressure level, WHtRs= Waist-Height Ratio status, PHY=physical activity levels, BFP= Body Fat Per cent, SS= sum of skinfold, ST= sedentary/resting time, SMK/T= smoking/chewing tobacco and ALCH= alcohol consumption.

Table 6: Adjusted linear regression between BP and other variables

	Standardized Coefficients	Sig.	R ²
WHtR	0.033	0.683	.077
PHY	0.009	0.894	
SS	-0.072	0.265	
ST	-0.075	0.227	
SMK/T	0.192	0.014	
ALCH	0.101	0.208	
BMR	0.130	0.350	
BMI	-0.104	0.556	
TEE	-0.069	0.383	
BFP	0.313	0.027	
Dependent Variable: BP			

Note. Here, BMR= Basal Metabolic Rate, BMI= Body Mass Index, TEE= total energy expenditure, BP= blood pressure level, WHtRs= Waist-Height Ratio status, PHY=physical activity levels, BFP= Body Fat Per cent, SS= sum of skinfold, ST= sedentary/resting time, SMK/T= smoking/chewing tobacco and ALCH= alcohol consumption.

Discussion

Hypertension is one of the major health issues in the developing countries according to the WHO (2008). India, being a developing country, is not a divergent case in this regard. The problem of hypertension is not limited to only urban areas but studies have shown a significant amount of prevalence in rural areas as well (Simon et al. 2017, Khanam et al. 2015, Chanak and Bose 2019). In the present study, the sample not only belongs to a rural remote area but also is sparsely distributed in a large hilly terrain, which effortlessly makes their each and every bodily movement much harder and labour intensive than those living in the plains. Considering all this, the Wanchos of the present study showed an overall 17.3% hypertension prevalence, which can not be just considered a benign trend. A study conducted among female Filipino workers (Lu 2008), whose work profile includes heavy lifting, prolonged standing, highly repetitive work, also showed a positive relationship between physical activity and hypertension. This study showed that excessive work was associated with poorer health, dissatisfaction with life, poor recuperation from fatigue, and hypertension. Although in the present study there is no strong association between blood pressure and physical activity, it can not be denied that 57.23% adults were mostly vigorously active and of them 38.67% were at risk of cardio-metabolic diseases as detected by Wasit-Height Ratio and of the total 37.11% (total prehypertensive proportion), who were specifically at risk of hypertension, 72.6% males and 42.22% females are vigorously active in most days in a week.

A study among the rural Bengalee adults (Chanak and Bose 2019) central obesity parameters showed a higher female proportion at risk than male (WHtR showed 73.7% vs 44.2%). Similarly, prevalence of hypertension was also found to be higher among the females than males (52.5% vs 27.3%). However, in the present study although the central obesity parameter has shown a higher prevalence of cardio-metabolic risk among the females (31.91% vs 16.95%), prevalence of hypertension found to be higher among the males (19.77%) than the females (14.18%). Like the prevalence of hypertension, the risk of hypertension is also higher among the Wancho males than females (41.24% vs 31.91% in the prehypertensive category). Similar to the Filipino study of moderate to vigorous occupational physical activity (Lu 2008), where vigorous physical activity was positively correlated with hypertension, it could be reckoned that the Wancho adult males are more at the risk of hypertension since they are comparatively more vigorously active than the females (74.58% vs 35.46%). Similarly, among the males highest number of hypertensive (68.97% at stage 1 and 66.67% at stage 2) and prehypertensive (72.6%) adults are found to be vigorously active in most days in a week. Ali et al. (2018) also found a higher prevalence of hypertension among males (12.1%) than females (3.4%) among Bangladeshi adults. They suggested that this sexual variation between male-female groups may depend on age, food habits, physical exercise, dietary salt intake and smoking status. They also found systolic and diastolic blood pressure positively associated with smoking. In the present study as well, smoking/chewing tobacco and alcohol consumption were found to be positively and significantly associated with blood pressure. Since a very low percentage of females were found to be either in the smoking/chewing tobacco and alcohol consumption category, an overall less percentage of females were found in the hypertensive category, as well as in the prehypertensive category. This proves that smoking/chewing tobacco and alcohol consumption are significant risk factors of hypertension among the Wanchos.

BMI is also a very important factor associated with hypertension. Studies have talked about the association between blood pressure and BMI which is positive in the general population and in tens of thousands of subgroups, suggesting that the trend of increasing BMI will be associated with the prevalence of hypertension across nearly all segments of the population (Linderman et al. 2018). Hu et al. (2004) addressed both independent and joint association of physical activity and BMI for risk of hypertension. Studies in this field of association of physical activity and hypertension are very

scant and inconsistent. It's very difficult to ascribe differences in blood pressure between the most and least fit or active, which rarely exceeds after controlling for confounding factors such as age and body size. Therefore, longitudinal intervention studies are more appropriate to assess the effect of physical exercise on blood pressure (Fagard 1999). In the present study as well, BMI was found to be significantly correlated with blood pressure, proving BMI as one of the risk factors of hypertension among the Wanchos. Gogoi and Begum (2018) in their study among the Ahoms of Assam also found a significant relation between BMI and blood pressure.

Considering physical activity as a risk factor of hypertension, studies have been made specifically to look into the different dimensions of physical activity. Studies have proved that only leisure time vigorous to moderate physical activity (or intentional exercise) can act as a preventive measure for hypertension. Huai et al. (2013) suggested an inverse relationship between levels of recreational physical activity and risk of hypertension. However, no evidence of association was found in between high or moderate level occupational physical activity and developing hypertension. Contrary to this, Ali et al. (2018) and Luke et al. (2004) found a positive and significant association between BMR and systolic and diastolic blood pressure, which is completely opposite to the well documented inverse relationship between physical activity and blood pressure. In the present study BMR was not found to be significantly associated with blood pressure. However, BMR is positively and significantly correlated with the overall cardio-metabolic risk factors among the Wanchos. The interesting fact here is that, as the daily total energy expenditure increases among the adult Wanchos, their BMR or resting time energy expenditure decreases. This perhaps suggests an indirect relationship between blood pressure and BMR, i.e. those who are least active (less daily total energy expenditure) have significantly higher Basal Metabolic Rate and this in turn is again positively associated with BMI and finally this leads to developing hypertension.

Conclusion

A number of risk factors are found to be having significant association with blood pressure among the adult Wanchos. BMI, smoking/chewing tobacco and alcohol consumption are important risk factors of hypertension. However, physical activity levels perhaps work as an indirect factor in developing hypertension, with BMR and the daily total energy expenditure. Males are not only more prevalent in the hypertensive category, but also are at higher risk of hypertension than females. However, the central obesity parameter among the adult Wanchos has shown more females at overall cardio-metabolic risk. Wanchos being a very hard working population with more than half of them involved in vigorous intensity physical activity in most days in a week, have shown sexual differences in terms of those who are at cardio-metabolic risk. Most females, who are at risk, are mostly moderately active in a week, while most vigorously active males suffer a lower risk of cardio-metabolic diseases. However, these vigorously active males are more at risk of hypertension, which again brings about different sets of questions and assumptions about the association between physical activity levels and the overall health of adult Wanchos.

Acknowledgement

This study is a part of the doctoral research of the researcher which is funded by Indian Council of Medical Research under the scheme of ICMR-JRF 2017.

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