

Prevalence and determinants of Systemic Hypertension in Inhabitants of high altitude of Nepal



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ABSTRACT

Background: Several studies have shown increase in prevalence of cardiovascular risk factors in the individuals residing in high altitude in various parts of the world. **Aims and Objective:** This study was conducted with an aim to estimate the prevalence and determinants of hypertension among the high-altitude population of Jomsom district of Nepal. **Materials and Methods:** We carried out a prospective camp based survey in Jomsom area on 4th and 5th June of 2017 where we measured the blood pressure, recorded anthropometric measurements like weight, height, BMI, Waist, Hip, Waist/hip ratio and maintained the thorough recorded after verbal consent of the participants. **Results:** A total of 617 local residents of Jomsom were screened. The mean age was 44.4 ± 17.6 years with predominant female subjects (53.5% female vs. 46.5% male). Hypertension was present in 142(23.0%) which was significantly lower than in the general population of Nepal as compared to other large scale studies. In addition, alcohol consumption in 29.3%, cigarette smoking in 15.9% and tobacco consumption in 8.3% was present. Higher BMI and waist/hip ratio was significantly associated with male sex and hypertension. **Conclusion:** The overall prevalence of hypertension is lower among the individuals residing in higher altitude compared to the general population although the other determinants are comparable.

Key words: Hypertension; Cardiovascular risk factors; high altitude population

INTRODUCTION

A significant proportion of population of Nepal resides at high altitude. There are very few studies done on the prevalence and determinants of systemic hypertension in the people who reside in high altitude of Nepal. Globally about 2% of the population resides at an altitude of 2500 meters or more.¹ However, a total of 6.7% of population of Nepal reside in mountains.² Hypertension is one of the major non communicable diseases with increasing incidence in both developed as well as developing countries and is a common cause of premature mortality and morbidity.

The effect of chronic hypoxia on the systemic blood pressure in the people living in high altitude is uncertain and various studies have shown contradictory results. There is an enhanced vascularization secondary to chronic hypoxia which results in reduction of the total peripheral resistance ultimately maintaining the blood pressure in normal ranges in the people living in mountains.³

The objective of this study is to estimate the prevalence and determinants of systemic hypertension in people living in high altitude of Nepal.

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MATERIALS AND METHODS

A descriptive cross sectional study was carried out in 4th and 5th June of 2017 at Jomsom of Mustang district of Nepal which is situated at an altitude of 2743 meters from sea level. A routine cardiac screening camp of Shahid Gangalal National Heart Center was conducted and a total of 617 adults of more than 18 years of age were screened.

Adults of either sex, who were the permanent resident at the given place, were enrolled in the study. They were explained about the purpose of study and the methods used. Informed verbal consent was taken assuring full confidentiality. The details of the patients which include sex, age, height, weight, BMI, waist and hip circumference were measured and recorded in a predesigned data collection form.

Statistical analysis was performed with statistical software (SPSS-22.0 for windows). Results were analyzed using appropriate statistical methods. P-value was calculated under the predetermined level of significance (0.05) and Confidence interval (CI) of 95% was constructed. Results were expressed in percentage, mean and standard deviation. Ethical clearance was taken from IRC of Shahid Gangalal National Heart Center, Nepal.

Blood pressure was measured by standard BP cuffs in both arms by auscultatory/manual method and higher of the two readings were taken for analysis. A blood pressure of more than or equal to 140/90 mmHg was considered as hypertension as per JNC-7 guidelines.

RESULTS

There were total 617 people who were screened in the camp, which included 287(46.5%) male and 330(53.5%)

female. The mean age of the study population was 44.473 ± 17.6497 years. Among them, the mean age of male participants was 44.7 ± 17.8 years and the mean age of female was 44.3 ± 17.5 years.

Hypertension was present in 142(23.0%) subjects with the mean age of hypertensive patients being 56.8 ± 14 years whereas mean age of non-hypertensive subjects was 40.8 ± 17 years. There were 80 male with HTN with mean age being 55.7 ± 15.1 years and 62 female were diagnosed with HTN with mean age being 58.1 ± 12.5 years. Compared to female, male has 1.67 times more likely to have HTN (CI: 1.14 to 2.44) which is significant at 95% CI (p value: 0.007) as shown in Table 1.

Out of 142 subjects with HTN, 121(85.2%) were aware of their HTN status but only 81(66.9%) were using antihypertensive drugs. Among the subjects using antihypertensive drugs, 31(38.2%) subjects didn't have their Blood Pressure controlled whereas the rest were normotensive. Among the subjects (40, 33.1%) who were not using antihypertensive drugs, only 4(10%) had their Blood pressure controlled. Various anthropometric measurements including height, weight, body mass index (BMI), waist, hip and waist/hip ratio were taken and analyzed as shown in Table 2.

BMI recording revealed that the prevalence of overweight was seen in males, However prevalence obesity was present more in females and was statistically significant (p value: 0.015). Also, prevalence of hypertension was directly proportional to increased BMI at 95%CI (p value <0.001) as shown in Table 3.

Waist/Hip ratio was significantly higher in male at 95%CI (p value: 0.007) and also significantly higher in hypertensive subjects at 95%CI (p value <0.001) as shown in Table 4.

Table 1: Incidence of hypertension in males and females

	HTN Present	HTN Not Present	Total	OR (95%CI)	p-value
Sex					
Male	80	207	287	1.67(1.14-2.44)	0.007
Female	62	268	330		
Total	142	475	617		

Table 2: Anthropometric measurements

	Minimum	Maximum	Mean	Standard Deviation
Height (cm)	108	180	156.399	8.9083
Weight (Kg)	32	110	62.251	11.4394
BMI (kg/m ²)	14.22222222	50.5829904	25.45258113	4.275798309
Waist (cm)	48	130	86.733	10.578
Hip (cm)	49	166	92.716	9.4654
Waist/hip ratio	0.470588235	1.632653061	0.935888875	0.071499084

Table 3: Anthropometric variables in the study subjects

	BMI (kg/m ²)				Total	p-value
	Underweight (< 18.5)	Normal (18.5-24.9)	Overweight (25-29.9)	Obese (>30)		
Sex						
Male	8	70	135	74	287	0.015
Female	9	90	115	116	330	
HTN						
Not Present	13	135	203	124	475	<0.001
Present	4	25	47	66	142	

Table 4: Waist/hip ratio measurement

	Sex	Number	Mean	Std. Deviation	p-value
Waist/hip ratio	Male	287	0.944271948	0.061566308	0.007
	Female	330	0.928598142	0.078498402	
	HTN	Number	Mean	Std. Deviation	p-value
Waist/hip ratio	Not Present	475	0.930332427	0.076461734	<0.001

DISCUSSION

Analysis of the results revealed the overall prevalence of hypertension in inhabitants of high altitude of Nepal to be 23%. Our result is in accordance to the study done in Himanchal Pradesh of India by Bhardwaj et al in the year 2010 which revealed the prevalence of 22.5%.⁴ In contrast to this, results obtained from the study done by Shrestha et al in the year 2012 showed the overall prevalence of hypertension in the population residing in high altitude of Nepal to be 3.7%.⁵ Study performed by Sharma et al in the large scale population of Eastern Nepal in the year 2011 showed the overall prevalence of hypertension in Nepal to be 33.9%.⁶ This clearly demonstrates the lower prevalence of hypertension in the people living in high altitude than in low altitude. It is probably due to the protective effects of hypobaric hypoxia or chronic hypoxia in the blood pressure which is hypothesized due to the reduction of total peripheral resistance via increased microvasculature.

In our study, a significantly higher prevalence of hypertension was found in males than in females in people of high altitude which accounted for 27.8% and 18.7% respectively. Similarly, Male preponderance was seen in another study performed by Raina et al with the prevalence being 12.9% in males and 6% in female.⁷ Likewise, the prevalence of hypertension was higher among males living in high altitude as shown in various studies done by Sherpa et al,⁸ Negi et al⁹ and Zheng et al.¹⁰ In contrast to our and above studies a study done in a high altitude region in rural region of Uttarkhand, India revealed higher prevalence of hypertension in females (34.2%) than in males (20.3%).¹¹

Obesity is an important indicator of the cardiovascular disease with the emerging trend in our part of the world

and has linkage with hypertension and Dyslipidemia. According to our study 30.8% of the study population had obesity as per the BMI (>25kg/m²) with the prevalence of obesity being 25.8% in males and 35.1% in females. It was comparable to the study done by Sharma et al where the overall prevalence of obesity in Nepalese population was reported to be 32.5%. Sharma et al also reported the overall prevalence of overweight (BMI=22-24.9) in Nepalese population to be 28.2%.⁶ However, the overall prevalence of overweight people in our study was 40.5 %, with 47.03% males and 35.15 females being overweight. This clearly signifies burden of overweight and obesity in the people residing in high altitude region of Nepal. The result is in contrary to the study done by Gutierrez et al.¹² The possible explanation of the increased prevalence of overweight in people residing in high altitude of Nepal could be due to the sedentary life style due to cold weather and increased intake of carbohydrate and dairy products like potatoes, barley, yak milk, ghee, maize, etc. In addition, high intake of homemade alcohol in high altitude region of Nepal can also be an important factor.

Our study showed the overall prevalence of hypertension in obese and overweight population residing in high altitude to be 34.7% and 18.8% respectively. This was contrary to the results obtained from the study done by Akintunde et al¹³ which showed 31.9 % of hypertensive patients were overweight and 25.5% were obese. This signifies the lower prevalence of hypertension in obese and overweight patient residing in high altitude of Nepal despite the significant proportion of people being overweight or obese.

Abdominal obesity is also of emerging concern in Nepal even in people residing in high altitude. There

are many previous studies reflecting the high waist hip ratio contributing to hypertension.¹⁴ Our study showed a significantly higher waist hip ratio in males than in females. In addition, the mean waist hip ratio was higher in hypertensive people than in normotensive individuals with the mean waist hip ratio in hypertensive and normotensive individuals being 0.954 and 0.93 respectively.

The reduced prevalence of hypertension in individuals of high altitude despite the similar prevalence of the risk factors like obesity compared to general population has been shown in many earlier studies. The protective effect of chronic hypoxia,

reduction of blood pressure under hypoxic hypobaric conditions due to the relaxation of smooth muscles, increased microvasculature and collateral circulation and vascularization is one of the hypothesis which still needs to be proved in other large scale studies.¹⁵ In addition, lower blood pressure in high altitude individuals is also suggested due to increased peripheral capillary density and circulatory nitric oxide levels.¹⁶

Single centered, small sample with limited time frame and cross sectional study were the major limitations of our study. More prevalence studies especially population based and large scale, multicentered studies are needed to estimate the comprehensive burden of hypertension and its determinants in the high altitude region of Nepal.

CONCLUSION

The study presented the lower prevalence of hypertension in people residing in the higher altitude of Nepal compared to the general population. This can be correlated with the protective effects of chronic hypoxia and other multiple mechanisms including nitric oxide mediated systemic vasodilatation and reduced total peripheral resistance. The overall burden of hypertension with the prevalence of 23% is still significant and noteworthy and has to be addressed. However, other determinants of hypertension like overweight, obesity as per the BMI and waist Hip ratio as well as male predominance are almost comparable to the general population.

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DP- Concept and design of the study, manuscript preparation, statistically analyzed and interpreted, Critical revision of the manuscript; **PP**- Concept and design of the study, critical revision of manuscript and review of the study; **AH**- Reviewed the literature, helped in preparing first draft of manuscript, collected data; **KS**-Collected data, statistically analyzed and interpreted, helped in preparing first draft of manuscript; **BS**- Reviewed the literature, helped in preparing first draft of manuscript; **DK**- Collected data and maintained Performa; **MY,SD,AD,RS, BT,US**- Data Collection; **KPA**- Collected data, statistically analyzed and interpreted, helped in preparing first draft of manuscript.

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