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A CROSS-SECTIONAL STUDY FOR ESTIMATING THE PREVALENCE OF HYPERTENSION AND VARIOUS CARDIOVASCULAR DISEASE (CVD) RISK FACTORS AMONG APPARENTLY HEALTHY YOUNG ADULTS IN GOVERNMENT SERVICE

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ABSTRACT

Introduction: In general, young adults are healthier and more physically active than the general civil population. However, the risk of hypertension and consequent cardiovascular diseases may increase in the young adult population due to various factors. This prompted the workers to make an earnest attempt to estimate the prevalence of hypertension (HTN) among apparently fit young adultsin government service.

Material And Methods: A community based cross sectional descriptive study was planned. Multistage systematic random sampling was carried out. A written informed consent was obtained from all willing participants for taking part in the study. The study protocol was approved by the institutional ethics committee before commencement of the study.

Height, body weight, BMI, waist and hip circumference; and blood pressure were measured using standard guidelines; and precallibrated instruments. Biochemical profile and resting ECG were also carried out. Normal values of all the above parameters were considered based on current available medical literature. Data was compiled, tabulated and analysed using SPSS version 23 using appropriate statistical tests.

Results: Our study population included 10% class two government employees and 90% class three government employees. Overall prevalence of hypertension among study population was found to be 66.76%. Overall prevalence of BMI>23kg/m2 was 51.54%, while overall prevalence of various CVD risk factors ranged from 14.70% to 75%.

Conclusion: Our study has revealed a high overall prevalence of some cardio-metabolic risk factors in young adults in government service. The baseline data provided by our study may be utilized effectively for monitoring of future trends; and for health promotion planning to reduce CVD risk factors in young adults in government employment.

KEYWORDS : Hypertension, Body mass index, Blood sugar, serum creatinine

INTRODUCTION

In this modern era, non communicable diseases are a cause of majority of deaths. More than fifty percent of these deaths are due to Coronary Artery Disease (CAD), with over one third of these deaths being reported in middle-aged adults[1]. Hypertension is an important risk factor for development of CAD. Recording of blood pressure is a single most useful test recommended for identifying individuals who are at high risk of developing CAD[2]. Since over half a century hypertension has been known to be an "iceberg" disease[3]. Early studies which suggested an association between high blood pressure and subsequent morbidity and mortality led to the introduction of the term "pre-hypertension" nearly eighty years ago.[4] European Society of Hypertension provided new guidelines in 2018 which are currently being followed in India, under which SBP of 130- 139 mmHg and DBP of 85-89 mmHg is now known as high normal BP which is transient range, and individual is at verge of developing the disease if not intervened timely. Individuals with blood pressure >120/80 mmHg, but <140/90 mmHg, had an increased risk of not only hypertension but also cardiovascular disease and early death from cardiovascular causes. These observations have been corroborated by Shikha D et al and Vasan RS et al[4,5].

In the year 2014, Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure proposed this classification of blood pressure[6]. Evaluation and mitigation of hypertension as a risk factor, in order to reduce the overall risk of CAD was one of the major recommendations of this report.

India is facing a dual onslaught of rapidly rising prevalence of both hypertension and cardiovascular disease. Ray et al reported pre-hypertension in Indian population to be in the range of 40 to 60 percent[7].

Yadav S et al reported a prevalence of hypertension and pre-hypertension to be 32.2 percent and 32.3 percent respectively in an affluent north Indian population[8].

In general, military personnel are healthier and more physically active than the general civil population. However, the risk of pre-hypertension, hypertension and consequent cardiovascular disease may increase in the military population on account of psychosocial factors, physical and mental stress and strain of military service, prolonged separation from their families; and ongoing nutritional transition including a gradual shift to a western diet[7]. However, we observed that similar studies wherein prevalence of hypertension was estimated in Armed Forces personnel in India, were conspicuous by their scarcity. This prompted the workers to make an earnest attempt to fill in the gaps; and estimate the prevalence of hypertension (HTN) among apparently fit armed forces serving personnel.

Aims And Objectives:

To estimate the prevalence of hypertension and various cardiovascular disease (CVD) risk factors among apparently

healthy serving army personnel.

MATERIAL AND METHODS

General Settings And Study Design:

A community based cross sectional descriptive study was planned. Based on review of literature, prevalence of hypertension was estimated to be around 50 percent[4,7,9]. With 95% confidence level, 3% of prevalence as absolute error; and using the formula $n = z_{(1-\alpha/2)}^2 \times pq/d^2$, the sample size was calculated to be 1067. However, an even greater sample of 1360 serving personnel was included, thereby greatly increasing the power of the study. The study was carried from out from Apr 2019 to Dec 2021 in an urban population in western India.

Sampling Procedure:

Multistage systematic random sampling was used for the selection of study sample. We estimated the adult military population of the study area, by collecting data from the military establishments. The estimated study population was around 20000. This included around 2000 Junior Commissioned Officers (JCOs) and 18000 Non Commissioned Officers (NCOs) and Other Ranks (ORs), thus giving a JCO to NCO/OR of 1 : 9. There were in all around 40 military establishments in the area with a population of more than 250 each, while the other military establishments had a lesser population. Out of the 40 military establishments 18 military establishments were selected by random sampling. List of all personnel borne on the strength of each unit was obtained. From this list, 80 participants were chosen in the two rank categories of JCOs (higher socio-economic stratum) and NCOs/ORs (lower socio-economic stratum) according to their proportion (JCOs: NCOs/ORs 1:9) in the total population. Thus, 8 JCOs and 72 NCOs/ORs from other ranks were chosen from each of these military establishments. Thus, 1440 study subjects were selected.

Subsequently, personnel who were known cases of ischaemic heart disease, hypertension, obesity, chronic kidney disease, diabetes or any other chronic ailment were excluded from the study. Of the total 1440 persons, 60 study subjects were excluded on account of above morbidities. Nine study subjects were excluded on account of refusal to participate in the study, while eleven study subjects were excluded as due to some exigencies, they could not be made available on the day of the examination. Thus a total 1360 study subjects were finally available for the study. This included 136 JCOs and 1224 NCOs.

Conduct Of The Study:

A written informed consent was obtained from all the participants who were willing to participate in the study. The study protocol was approved by the institutional ethics committee before the commencement of the study.

Few of the major biological risk factors identified by Ray S et al, viz, overweight and raised blood pressure were taken into account for our study. Overweight was defined as BMI>23 kg/m^2[10].

Anthropometry:

A portable stadiometer was used to measure the standing height. The study participant was asked to position his head appropriately; and look directly forward with the Frankfurt plane. Height was recorded to the nearest 0.1 cm. Body weight was measured to the nearest 0.1 kg using an electronic weighing machine (Phoenix true way Electronic weighing machine. CM/L 9648707, max 200 kg, min 1 kg, E 50 gm). BMI was determined as Quetlet's index (kg/m2). BMI (weight in Kg/Height in metre2) was classified as per the WHO recommendation, International Association for the study of obesity and the international obesity task force [10]. BMI was categorized as <23.0 Kg/m2, 23-24.9 Kg/m2, 25-26.9 Kg/m2, 27-29.9 Kg/m2 and ≥ 30 Kg/m2. BMI>23kg/m^2 was taken as the additional cut-off point in the category of normal range given in WHO International classification of BMI, necessitating public health action[11]. Hip measurement was done at the maximum circumference of the hip. Waist circumference was measured at the midpoint between lower most point of the costal margin and highest point of iliac crest with the subject standing, at the end of normal expiration. A waist hip ratio < 0.9 was taken as normal, and >0.9 was taken as abnormal.[12]

An automated blood pressure monitor (Omron automatic blood pressure monitor, Model HEM 8712) was used to measure blood pressure on the right arm after 15 minutes of rest in seated position in a quiet room. Two such readings were taken at an interval of 10 minutes. Mean of both the readings was taken into account. 'Hypertension' was defined as systolic blood pressure (SBP) > 140 Hg and diastolic blood pressure (DBP) > 90 mm Hg. Isolated systolic hypertension was defined as systolic blood pressure (SBP) > 140 Hg and diastolic blood pressure (DBP) < 90 mm Hg[13]. All instruments were calibrated prior to commencement of data collection.

Above methodology of recording height, weight, BMI, blood pressure has already been validated by several workers [4,7,9,14].

Random blood sugar, lipid profile, serum creatinine and resting ECG in respect of all study participants were also carried out. Normal plasma glucose was taken as 91 mg%, total cholesterol < 200 mg%, HDL > 40 mg%, LDL > 130 mg%, triglycerides < 150 mg% and serum creatinine < 1.16 mg%[7,15,16].

Data thus collected was compiled, tabulated and analysed using SPSS version 23. Mean and SD were calculated for continuous variables; and proportions/ percentages were calculated for categorical variables. Student's t test was used to analyse differences in the mean values of the subject characteristics in the two groups. Chi square test was used to assess differences in the distribution of risk factors in the two groups. Risk (Odds Ratio) was estimated to show strength of association. $p<0.05$ was taken as the level of significance.

Relationship of prehypertension with the risk factors was assessed using univariate as well as multivariate logistic regression analyses. Univariate logistic regression analyses were later adjusted for age. Multivariate logistic regression model was adjusted for potential confounders such as age, rank and BMI.

RESULTS

Our study population included 10% JCOs and 90% NCOs/ORs. (Figure 1). The mean, and standard deviation of age, height, weight, body mass index, waist hip ratio, systolic blood pressure and diastolic blood pressure of the study population is tabulated in Table 1. It was observed that all these parameters except BMI were higher among JCOs when compared to NCOs/ORs. Age distribution of the study participants is given in Table 2.

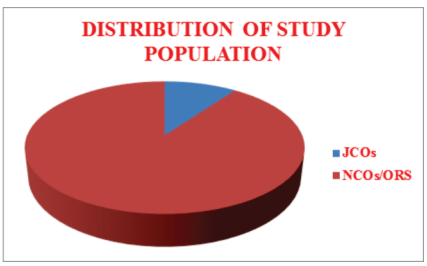

Figure 1: Distribution Of Study Population

Table 1: Characteristics Of The Study Subjects

	JCOs (n=136)		NCOs/ORs (n=1224)		TOTAL (n=1360)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Age (yrs)	34.34	9.72	33.84	9.44	33.89	9.46
Systolic Blood Pressure (mm of Hg)	127.40	12.06	126.99	12.47	127.03	12.43
Diastolic Blood Pressure (mm of Hg)	94.85	9.93	92.79	9.94	92.99	9.94
Body Mass Index (kg/m^2)	23.39	3.67	23.39	3.81	23.38	3.79
Height (cm)	173.76	4.98	173.53	5.17	173.55	5.14
Actual Body Wt (kg)	70.48	10.54	70.22	10.47	70.24	10.47
Waist hip ratio	0.94	0.06	0.97	0.08	0.96	0.08

Table 2: Age Distribution of Study Participants

Age (yrs)	JCOs (%)	NCOs/ORs (%)	Overall (%)
20-29	-	468	468
30-39	55	473	528
40-49	81	283	364
Total	136	1224	1360

Out of 1360 study participants, 908 were found to have hypertension, giving an overall prevalence of 66.76%. Out of 136 JCOs, 95 (69.85%) were found to have hypertension, and out of 1224 NCOs/ORs 813 (66.42%) were found to have hypertension. The prevalence of BMI > 23kg/m^2 among JCOs and NCOs/ORs was found to be 50% and 51.71% respectively. Overall prevalence of BMI>23kg/m^2 was 51.54%.

Overall 669, (49.19%), 823 (60.51%), 838 (61.61%) 1020 (75%), 414 (30.44%) 200 (14.70%) and 822 (60.44%) of the study participants were found to have abnormal waist hip ratio, random blood sugar, total cholesterol, LDL, HDL, Triglycerides and serum creatinine respectively. Age group wise distribution of these cardiovascular risk factors is tabulated in Table 3. It was observed that two hundred and twenty four (16.47%) had some ECG abnormality. Out of these 27 (12.05%) had an old Q wave, while 198 (87.95%) had right bundle branch block or left bundle branch block. There was no significant association between age and hypertension, BMI > 23 kg/m^2 and hypertension, age and waist hip ratio > 0.9, waist hip ratio > 0.9 and hypertension, age and blood sugar, age and total cholesterol, age and HDL, age and LDL, age and triglycerides; BMI < 23 kg/m^2 and random blood sugar < 91 mg%; and age and ECG abnormality. Significant association was observed between age and serum creatinine. (Chi square = 6.376, p < 0.05) These findings are tabulated in Table 4.

Table 3 : Age Group Wise Distribution Of Cardiovascular Risk Factors

Cardiovascular Risk Factor	Age group			Total
	20-29	30-39	40-49	
BMI				
< 23 kg/m^2	234	243	182	659
> 23 kg/m^2	234	285	182	701
Hypertension				
Systolic < 140 and diastolic < 90 mm Hg	145	182	125	452
Systolic > 140 and diastolic > 90 mm Hg or Systolic > 140 and diastolic < 90 mm Hg	323	346	239	908
Waist hip ratio				
< 0.9	255	249	187	691
> 0.9	213	279	177	669
Random blood sugar				
< 91 mg%	193	204	140	537
> 91 mg%	275	324	224	823
Total serum cholesterol				
< 200 mg%	181	200	141	522
> 200 mg%	287	328	223	838
LDL				
< 130 mg%	113	132	095	0340
> 130 mg%	355	396	269	1020
HDL				
< 40 mg%	159	149	106	414
> 40 mg%	309	379	258	946
Serum triglycerides				
< 150 mg%	392	445	323	1160
> 150 mg%	076	083	041	0200

Table 4: Association Between Age And Serum Creatinine

Age (yrs)	Overall (%)	
	Serum creatinine < 1.16 mg%	Serum creatinine > 1.16 mg%
20-29	174	294
30-39	231	297
40-49	133	234
Total	538	822

(Chi square = 6.376, df =2, p < 0.05)

DISCUSSION

Baygi F et al in their systematic review and meta analysis reported a global pooled prevalence of hypertension in military personnel as 26%.[17] Various other researchers have reported a prevalence of hypertension among Armed Forces personnel ranging from 13% to 39.1%.[18-21]

Nangia et al in their study on 5143 apparently healthy armed forces personnel ereported a prevalence of hypertension of 14.07%.[14] Shikha D et al reported a prevalence of hypertension of 19% in North India.[4] Yadav S et al, Ravi RM et al and Prabhakaran D et al reported a prevalence of hypertension of 32.2%, 24.6% and 30% respectively.[8,9,22]

The findings of our study are at variance from all the above studies, wherein a much lower prevalence of hypertension has been reported as compared to our study.

Soughat Ray et al in their study on 767 military personnel reported
an overall prevalence of prehypertension of nearly 80%.[7] The findings of this study are somewhat similar to our findings of 66.76%.

Baygi F et al reported a global pooled prevalence of overweight, generalized obesity and abdominal obesity, in military personnel as 35%, 14% and 29% respectively.[17]

Al-Qahtani DA et al in their study on 2250 Saudi male soldiers reported raised serum triglycerides in 32.2% of the study population; and at least one criterion for metabolic syndrome in 71% of the subjects.[20] In a prospective other study 18.5% of the study subjects were diagnosed with at least one CVD risk factor viz, hypertension, obesity, hyperlipidaemia, abnormal

blood sugar level and diabetes during the ten year surveillance period.[23] Horaib GB et al in their study on 10500 active military personnel, reported a prevalence of overweight, obesity and central obesity of 40.9%, 29% and 42.4% respectively.[24] Napradit P et al in their study on 42766 Royal Thai Army personnel reported a prevalence of overweight and obesity of 27.1% and 4.9% respectively.[25]

The findings of our study differ from the above studies wherein we have observed an overall prevalence of BMI>23kg/m^2 to be 51.54%; and raised serum triglycerides in 14.7% of the population.

Col R Nangia (Retd) et al reported 67.72% pre-obese, 3.425 obese and raised blood sugar levels in 1.71% of their study population.[14] Yadav S et al reported central obesity, elevated LDL and abnormal glucose tolerance in 86.7%, 22.8% and 41.6% of their study population respectively. [8] Prabhakaran D et al reported diabetes, impaired fasting glucose/impaired glucose tolerance, overweight and central obesity in 15%, 37%, 35% and 43% of their study respondents. Forty seven percent of their respondents had at least two CVD risk factors viz, hypertension, diabetes and high cholesterol/HDL ratio.[22]

Saughat Ray et al in their study reported a prevalence of various CVD risk factors such as overweight, elevated total cholesterol, raised LDL, serum HDL cholesterol <40 mg/dl; and raised serum triglyceride as 30, 22, 22, 67, and 14 per cent, respectively.[7]

The findings of our study differ from the above studies wherein we have observed an overall prevalence of BMI>23kg/m^2 to be 51.54%; elevated LDL in 75%; raised total cholesterol in 61.61%, serum HDL cholesterol <40 mg/dl in 30.44% and raised random blood sugar levels in 60.51% of the population. However, the findings of our study are similar to that by Saughat Ray et al[7] as regards prevalence of raised serum triglyceride.

Al-Qahtani DA et al reported an increasing prevalence of CVD risk factors with age.[20] Horaib GB et al and Napradit P et al reported age to be a statistically significant positive predictor of BMI.[24,25] Age and BMI were reported to have an association with increasing odds of having hypertension by Smoley BA et al.[21] Overweight and obesity were also reported to be risk factors for hypertension by Wenzel D et al.[18] The findings of our study differ from all the above studies.

Shikha D et al observed that overweight and obesity were significant determinants of prehypertension even at a BMI > 23kg/m^2. They also reported a progressively increasing prevalence of prehypertension and hypertension with increasing BMI.[4] Yadav S et al reported that age, BMI, waist hip ratio and impaired glucose tolerance/diabetes were significantly associated with both hypertension and prehypertension.[8] Prabhakaran D et al reported an increasing prevalence of several CVD risk factors with increasing age, BMI and waist circumference.[22] Saughat Ray et al observed that prehypertension was associated with BMI >23 kg/m^2, serum HDL cholesterol <40 mg/dl, serum triglyceride >150 mg/dl; and age.[7] These findings differ from the findings of our study.

The researchers would like to emphasize that the present study incorporated relatively younger individuals of age group 19 – 49 years which is akin to the study conducted by Soughat ray et al[7]. Most of our study subjects with hypertension, had at least one or two additional CVD risk factors viz, BMI > 23 kg/m^2, raised total cholesterol, raised LDL, low HDL, raised triglycerides, and raised random blood sugar levels. These findings are in consonance with the study carried out by Soughat Ray et al.[7] A high overall prevalence of 66.76% of hypertension in these young physically active adults coupled with a relatively high overall prevalence of BMI > 23 kg/m^2 is a cause of concern because of the higher risk of cardiovascular disease in this productive age group. This high burden of hypertension and BMI > 23 kg/m^2 is an impending epidemic of CVD risk factors and CVD in this young and apparently healthy population.

CONCLUSION

Our study has revealed a high overall prevalence of some cardio-metabolic risk factors in military personnel. Our study provides strong evidence to the military healthcare providers' and policy makers for devising and implementing feasible and practical interventions so as to control CVD risk factors in this population. High rates of various CVD risk factors including hypertension among young apparently healthy military personnel, predicts an increasing burden of CVD in times to come. This calls for effective health care planning and management to combat and contain this silent epidemic. Prompt and proactive measures need to be instituted by all concerned to control the CVD risk factors; and mitigate their deleterious consequences on the health of serving military personnel. The researchers would also like to recommend review of the anthropometric standards for recruitment, continuation and promotion of military personnel. Further, multi-centric studies can be conducted to frame the guidelines for obtaining these standards. Further studies would also serve to identify various associated risk factors and reveal best predictors of high-risk subpopulation; and to delineate the epidemiological trends of the NCDs, especially hypertension.

The baseline data provided by our study may be utilized effectively for monitoring of future trends; and for health promotion planning to reduce CVD risk factors in serving military personnel.

Limitations Of The Study

Owing to the cross-sectional design of our study, no inference with respect to the causal relationship among variables can be drawn. Possibility of reverse causality may have arisen. Our study sample comprised of a select group of young, apparently healthy military personnel; adults and the findings may not be generalized to the whole population. The study population may not be representative of the entire defence forces. Besides, the data of our study does not provide any information about the female sex.

The authors would also like to acknowledge that, various CVD risk factors such as personal and demographic details including the dietary habits, smoking and alcohol consumption, socioeconomic status, knowledge attitude practice regarding hypertension of the study participants were not incorporated in our study. Another limitation of our study is that, classification of individuals based on even just 2 measurements can lead to a significant overdiagnosis of hypertension. This study has incorporated optimal, normal and high normal values of blood pressure into one single category of normal blood pressure due to various resource constraints. This study has incorporated isolated systolic hypertension, Grade I, Grade II and Grade III hypertension into one single category of hypertension due to various resource constraints.

Extrapolation of the prevalence of hypertension and other CVD risk factors, estimated from this relatively small sample size to the entire military population remains a query. The conclusions of the study, therefore, need to be interpreted with caution.

Conflicts Of Interest

The authors have none to declare.

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