Prevalence of Hypertension and Its Risk Factors Among Malaysian Senior Military Officers

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ABSTRACT

Introduction: Hypertension can have serious occupational implications for a military officer, especially for those who have specialised training and has become an essential asset to the organisation. **Objective**:The study aims to investigate the prevalence of hypertension among senior military officers of the Malaysian Armed Forces and determine the associated factors. We reviewed medical records of senior officers who underwent a routine medical examination at the Military Medicine Department, Kuala Lumpur Armed Forces Hospital from January 2018 to December 2018. **Results**: Out of 625 officers, the majority were from the army (61.2%), followed by the navy (19.8%) and air force (19.0%). The mean age of the officers was 47.4 (SD 6.3) years, and 94.1% were male officers. The prevalence of hypertension was 8.8% (55 officers). The results showed that hypertension was significantly associated with high BP (BMI) ($p = 0.018$), increased fasting blood sugar (FBS) ($p < 0.001$), high serum uric acid ($p = 0.005$), and elevated serum creatinine ($p < 0.001$). Moreover, none of the military factors, i.e. type of services, rank, and type of responsibility, were associated with hypertension. The ordinal logistic regression analysis showed that age [Odds ratio (OR) = 1.05], BMI (OR = 1.11), and elevated FBS (OR = 1.36) were significant predictors for the higher BP group. **Conclusion**: The prevalence of hypertension in the senior military officer is lower compared to the general population. However, the senior officers shared similar risk factors with the general population.

Keywords: Senior Military Officer, Hypertension, Prevalence, Risk Factors

INTRODUCTION

Hypertension-related diseases such as ischemic heart disease and stroke are the leading cause of mortality worldwide[1]. Hypertension is one of the most influential risk factors for almost every different cardiovascular disease acquired in life, including coronary artery disease, cardiac arrhythmias, cerebral stroke, and renal failure[2]. A recent study showed that the overall prevalence of hypertension worldwide is approximately 34.9% of the general population, with a steep increase with ageing[3]. The study also showed that 17.3% of individuals who did not receive anti-hypertensive were hypertensive, and 46.3% of individuals who received treatment had uncontrolled blood pressure (BP). The prevalence of hypertension in Malaysians aged 30 years and above was 43.5% in 2015, increasing from 42.6% in 2011 [4]. Hypertension is a silent disease, and the recent morbidity survey showed that there were three with hypertension for every ten adults in Malaysia. Only half of them are aware that they have the disease. Among that, 90% are on medication, only 45% have their blood pressure controlled [5].

A diagnosis of hypertension could cause serious occupational implications for military officers, especially for specialised trained personnel or senior officers who were trained and are essential assets to the organisation. They are not allowed to be deployed or work in a high-risk environment, as it could trigger a cardiovascular event.

Although military officers adopt a healthy lifestyle and maintain their physical fitness, they are not immune to cardiovascular risk factors. Numerous studies proved an increased cardiovascular risk factor among military personnel[6-8]. A recent study done in the United States showed that ideal cardiovascular health was less prevalent in the military than in the civilian population [9]. One of the parameters revealed a high prevalence of prehypertension and hypertension in the military personnel than in the civilian group. Additionally, a study in India revealed that hypertension and being overweight are dominant cardiovascular risk factors in the military population6. The study showed that hypertension among Indian military personnel aged 35 years and above was 14.1%. Another study among military personnel in Iran presented that the prevalence of hypertension in military personnel was 8.8%, and 32.9% were prehypertensive[10]. Apart from that, the military environment is synonymous with work-related stress [11-13]. In stressful situations, the sympathetic nervous system becomes hyperactive, causing BP to rise briefly. In the long run, repetitive and chronic stress could lead to hypertension. Multiple studies have established a significant relationship between stress and hypertension [14, 15].

Although numerous studies have highlighted the prevalence of hypertension and cardiovascular risk factors in Malaysia, no studies have assessed the commonness of hypertension among senior military personnel in Malaysia. Therefore, this study analysed the prevalence of hypertension among the Malaysian Armed Forces (MAF) senior officers and identified the associated factors. Thus, this study presented a guideline to improve the health status of MAF senior officers. This study also examined the relationship between hypertension with the senior officer's rank, type of services, and cardiovascular disease risks.

METHODOLOGY

Subject and Study Design

This study was based on a cross-sectional study using retrospective data extracted from Military Life Health Records (MLHR) database in the Military Medicine Department, Kuala Lumpur Armed Forces Hospital. The data obtained was from January 2018 to December 2018. Following the current prevalence of hypertension in Malaysia, the sample size was calculated using Kish L. (1965), where a minimum of 443 samples was required with a power of 80%, CI 95%.

A senior officer of MAF is a commission officer with a military rank of Lieutenant Colonel (equivalent to Commander for the Royal Malaysian Navy (RMN) and above. In addition, all senior officers are obligated to undergo routine medical examinations every year at the Military Hospital. The senior officers' medical examination is recorded in the MLHR database.

Variables

For this study, only samples with completed data in MLHR were extracted and analysed. The analysed variables were age, gender, race, type of services (Army, Navy or Air Force), rank, position at the unit, current smoking status (smoker or non-smoker), medical history, blood pressure (BP), body mass index (BMI), fasting blood sugar (FBS), cholesterol level, renal profile, and serum uric acid. As defined in the 5th edition Clinical Practice Guideline (CPG) 2018 Management of Hypertension, hypertension is the persistent elevation of systolic BP of 140 mmHg or higher and diastolic BP of 90 mmHg or higher. Meanwhile, the at-risk group of BP is defined as systolic BP 30-139 mmHg and/or diastolic BP 85-89 mmHg.

The BMI values extracted from MLHR were categorized as per the criteria of the Asia-pacific BMI classification [underweight (< 18.5kg/m2), normal (18.5 – 22.9 kg/m2), overweight (> 23 kg/m2) and obese (> 27.5 kg/m2)]. Nevertheless, the World Health Organisation (WHO) 1998 classification (overweight BMI between 25.0–29.9 kg/m2 and obesity as BMI > 30.0 kg/m2) was also used for descriptive comparison with other studies. On top of that, the 5th edition of Malaysian Clinical Practice Guidelines (CPG) 2017 Management of Dyslipidemia defined hypercholesterolemia as total cholesterol (TC) > 5.2 mmol/L.
In this study, the senior officer rank was categorised into three groups. Group one consisted of Lieutenant Colonel or Navy Commander. Group two consisted of Colonel or Navy Captain, while Group 3 comprised the most senior position, Brigadier General and above. The type of duty for the study population was grouped into the Commander and Non-Commander groups based on the position of the officer at his/her unit. The Commander is a senior officer who holds the position of Brigade Commander and above, Director or Commanding Officer (CO). Meanwhile, the others were categorised as Non-Commander.

Data Analysis

All data were analysed using the Statistical Package for Service Solution IBM SPSS (version 21). Descriptive data were expressed as mean, SD for continuous variables, and percentage for categorical variables. Comparative analysis between categorical data was performed using Pearson's chi-square test. Furthermore, the polynomial qualitative data were analysed using analysis of variance (ANOVA), except for serum creatinine and FBS, which were analysed using the Kruskal-Wallis test. Besides, ordinal logistic regression was used for multivariable analysis. Lastly, statistical significance was set at a p-value less than 0.05.

Ethical Consideration

Written permission was obtained from the Health Services Division, MAF before data collection. Further approval was obtained from the Ethics Committee of the National University of Malaysia, with the ethics approval number FF-2020-276.

RESULTS

The senior officers aged between 35 to 59 years had the mean age of 47.4 (SD 6.25) years. The majority were male senior officers (n = 588; 94.1%). Meanwhile, 5.9% (n = 37) were female senior officers. A majority of the senior officers were Army Officers (n = 383; 61.38%), followed by Navy Officers (n = 123; 19.86%) and Air Force Officers (n = 119; 19.04%). Most of the study population were Malay (n = 573; 91.7%) followed by Indian (n = 27; 4.3%), Chinese (n = 18; 2.9%) and (n = 7; 1.1%) officers were Bumiputra Sabah/Sarawak.

The prevalence of hypertension in this study population was 8.8% (55 senior officers), and 29 of them were known cases of hypertension. 26 (4.2%) senior officers were newly diagnosed with hypertension. Among the senior officers with known cases of hypertension, 20 (69.0%) officers had good BP control. Forty-nine (7.8%) senior officers exhibited BP in the range of prehypertension or 'at risk' of hypertension.

The prevalence of diabetes mellitus was 4.8% (38 senior officers), 13 of them were known case of diabetes mellitus, and 25 officers were newly diagnosed. From the recorded diabetic officers, only six officers had controlled diabetes (HbA1C < 6.5%). The prevalence of overweight and obesity (WHO 1998) were 60.0% and 2.4%, respectively. However, using the Asia-pacific BMI classification, the prevalence of overweight and obesity were 58.6% and 27.5%, respectively. Table 1 shows the characteristics of the study population regarding the type of services. Statistical analysis of the cardiovascular risk factors with the type of services shows no significant differences in the mean of the variables.

Bivariate analysis was conducted to prove the relationship between cardiovascular risk factors with hypertension. Table 3 displays the status of BP with other determinants of cardiovascular risk factors and military factors. ANOVA revealed the risk of hypertension significantly increased with older age [F (2,622)

= 8.375, p < 0.001]. Post hoc Bonferroni tests showed that mean age was significantly associated between normotensive (p < 0.001) and hypertensive groups (p < 0.001), but not significantly associated between at-risk BP with normotensive (p = 0.249) and hypertensive groups (p = 0.324). ANOVA also presented that the risk of hypertension significantly increased with elevated serum uric acid [F (2,605) = 7.758, p < 0.001]. Post hoc Bonferroni tests showed that the mean uric acid level was significantly associated between normotensive (p < 0.001) and hypertensive groups (p < 0.001), but not significantly associated between at-risk BP with normotensive (p = 1.000) and hypertensive groups (p = 0.071).

Table 1: Characteristics of the study population

Characteristics	N (%) / Mean + SD				P-value[a]
	Army	Navy	Air Force	Overall	
N(%)	383 (61.2%)	123 (19.8%)	119 (19.0%)	625 (100%)	
Age (years)	47.6 + 6.3	44.9 + 6.5	49.5 + 4.9	47.4 + 6.3	
BMI (kg/m2)	25.8 + 2.7	26.0 + 2.6	25.8 + 2.5	25.8 + 2.6	0.68 [a]
Smoker	102 (26.6%)	39 (31.7%)	37 (31.1%)	178 (28.5%)	
SBP (mmHg)	126.0 + 9.8	124.9 + 9.8	126.9 + 8.8	125.9 + 9.6	0.27 [a]
DBP (mmHg)	79.5 + 7.0	79.3 + 7.4	79.5 + 6.5	79.4 + 7.0	0.42 [a]
FBS (mmol/L)	5.1 + 0.8	5.0 + 0.4	5.3 + 1.9	5.1 + 1.1	0.77 [b]
Se cholesterol (umol/L)	5.6 + 1.1	5.5 + 0.9	5.5 + 1.0	5.6 + 1.0	0.53 [a]
Se uric acid (umol/L)	382.6 + 82.9	399.2 + 92.0	388.6 + 81.9	387.0 +84.7	0.17 [a]

[a] ANOVA [b] Kruskal-Wallis

Using the Kruskal-Wallis test, the results showed a statistically significant difference between the BP group with FBS (H (2) = 27.32, p < 0.001), with median FBS of 4.9 (0.6) mmol/L for normotensive, 5.1 (0.9) mmol/L for at-risk BP and 5.2 (0.9) mmol/L for hypertensive. There was also a statistically significant difference between the BP group with serum creatinine (H (2) = 10.41, p = 0.005), with median creatinine level of 90.0 (18.0) for normotensive, 93.5 (12.0) for at =-risk BP and 97.0 (21.0) for hypertensive.

There were 366 (58.8%) overweight senior officers and 173 (27.7%) were obese. On top of that, only 86 (13.8%) senior officers have healthy BMI. The chi-square test revealed that BMI was significantly associated with BP [$\chi 2$ (4) = 11.59, p = 0.018]. Most senior officers, i.e., 376 (61.7%) have high total cholesterol. On the other hand, a chi-square test revealed no significant relation of high cholesterol with elevated BP and no significant association between smoking status with hypertension.

In terms of military factors, the chi-square test was calculated to compare the frequency of the BP group with the type of services, which showed a significant difference [$\chi 2$ (4) = 11.995, p = 0.017]. However, post hoc analysis using Bonferroni correction revealed that only Air Force officers have a significant number of at-risk BP (p < 0.0056). Therefore, the ranks and type of responsibility were not significantly associated with hypertension.

Table 2: Status of blood pressure (BP) with other determinants of cardiovascular risk factors and military factors

Factors	Blood Pressure			P-value
	Normal	At-Risk	Hypertension	
Age (year) Mean + SD	47.2 + 6.2	48.6 + 5.7	50.7 + 6.1	< 0.001 [a]
BMI (n=625)				
Normal	76 (14.3%)	6 (12.2%)	4 (8.7%)	0.018 [c]
Overweight	321 (60.6%)	23 (46.9%)	22 (47.8%)	
Obese	133 (25.1%)	20 (40.8%)	20 (43.5%)	
Hypercholesterolemia (n=625)				
Normal	200 (37.7%)	15 (30.6%)	18 (39.1%)	0.593 [c]
High	315 (62.3%)	33 (69.4%)	28 (60.9%)	
FBS (mmol/L) Mean + SD	5.0 + 0.7	5.3 + 1.3	6.0 + 2.7	< 0.001[c]
Se Creatinine (umol/L) Mean + SD	90.3 + 15.5	93.0 + 12.7	98.4 + 19.1	0.005 [c]
Se Uric Acid (umol/L) Mean + SD	382.4 + 84.1	393.9 +70.8	433.6 + 93.0	< 0.001 [a]
Smoking (n=625)				
NonSmoker	378 (71.3%)	34 (69.4%)	35 (76.1%)	0.744 [c]
Smoker	152 (28.7%)	15 (30.6%)	11 (23.9%)	
Service (n=625)				
Air Force	98 (18.5%)	17 (34.7%)	4 (8.7%)	0.017 [c]
Army	324 (61.1%)	25 (51.0%)	34 (73.9%)	
Navy	108 (20.4%)	7 (14.3%)	8 (17.4%)	
Rank (n=625)				
Lieutenant Colonel	368 (69.4%)	33 (67.3%)	33 (71.7%)	0.288 [c]
Colonel	98 (18.5%)	11 (22.4%)	4 (8.7%)	
Brig General - General	64 (12.1%)	5 (10.2%)	9 (19.6%)	
Task / Duty (n=625)				
Non-Commander	413 (77.9%)	33 (67.3%)	35 (76.1%)	0.240 [c]
Commander	117 (22.1%)	16 (32.7%)	11 (23.9%)	

[a]ANOVA [b]Pearson's chi-square test [c]Kruskal-Wallis test

Table 3 displays the age distribution of the risk factors of cardiovascular disease. There was a significant association between systolic BP and diastolic BP with age group distribution, with the statistical values of [$\chi2$ (8) = 30.610, p < 0.001] and [$\chi2$ (8) = 20.470, p = 0.009] respectively. Increased age was associated with higher systolic and diastolic pressure. There was also a significant association between the presence of diabetes mellitus with age group distribution [$\chi2$ (4) = 18.151, p = 0.001]. Thus, increased age was associated with an increased risk of diabetes.

Table 3: Age-wise distribution of CVD risk factors

CVD risk factors		Age					p value
		35-39	40-44	45-49	50-54	55-59	
BMI	Normal	14	23	19	17	13	0.536 [a]
	Over-weight	41	83	114	70	58	
	Obese	19	38	46	33	37	
SBP	Normal	58	97	113	68	49	< 0.001[a]
	At Risk	15	39	57	40	43	
	Hyper-tension	1	8	9	12	16	
DBP	Normal	59	124	139	88	68	0.009 [a]
	At Risk	11	12	29	22	27	
	Hyper-tension	4	8	11	10	13	
DM	No	74 (100%)	138 (98.5%)	172 (96.1%)	109 (90.8%)	94 (87.0%)	0.001 [a]
	Yes	0	6 (4.2%)	7 (3.9%)	11 (9.2%)	14 (13.0%)	
Hyper-cholester-olemia	No	34	55	63	43	38	0.596 [a]
	Yes	39	86	112	72	67	
Smoking	No	48	104	124	85	86	0.231 [a]
	Yes	26	40	55	35	22	0.231 [a]

-[a] Pearson's chi-square test

A multivariable analysis was performed using the ordinal logistic regression to predict the BP group. The only significant variables were age, BMI, and FBS, as shown in Table 4. Age was a significant positive predictor of the BP group. For every one-year increase in age, there was a predicted increase of 0.05 in the log odds of an officer being in a higher BP group (hypertensive group). Thus, the older the officer, the more likely he or she is in the higher BP group [odds ratio (OR) = 1.05]. Meanwhile, in every unit of increased BMI, there was a predicted increase of 0.107 in the log odds of an officer being in a higher BP group (OR = 1.11). FBS was also a significant positive predictor of the BP group. The odds of officers with higher FBS being in a higher category of the BP group are 1.36 times than those with normal FBS. In the analysis, the Pearson chi-square test [$\chi2$ (1204) =1141.9, p=0.899] and the deviance test [$\chi2$ (1204) = 594.2, 1.0] were both non-significant. These results suggest a good model fit.

Table 4: Results of the ordinal logistic regression analysis between factors associated with BP group

Variables		B (SE)	OR	95% CI OR		P-Value
				Lower	Upper	
Age		0.052 (0.0200)	1.05	1.013	1.096	0.009
Gender (Female)		-1.035 (1.0649)	0.36	0.044	2.864	0.331
BMI		0.107 (.0479)	1.11	1.013	1.222	0.026
FBS		0.309 (.0948)	1.36	1.131	1.641	0.001
Creatinine		0.009 (0.0091)	1.13	0.991	1.027	0.317
Uric Acid		0.002 (0.0017)	1.00	0.999	1.006	0.161
Cholesterol level	Normal	-0.004 (.2534)	1.00	0.606	1.637	
	High	.	1.00	.	.	

OR = Odds Ratio CI = Confidence Interval

DISCUSSION

In this study, the prevalence of hypertension among senior military officers in Malaysia was 8.8%, which was significantly associated with increasing age, BMI, FBS level, serum uric acid level and serum creatinine level. This result indicates that the prevalence of hypertension is considerably lower than the studies on Malaysia's general population and including Southeast Asia [4, 5, 16, 17].

In other published studies for risk factors of non-communicable disorders in Malaysia, the prevalence of diabetes and obesity (Asia-pacific BMI classification) was reported to be 20% and 35.9%, respectively [5, 18]. However, the data in this paper showed a lower frequency. The discrepancy could be explained in terms of specific occupation-related lifestyle, which is constant physical activity. In addition, military leaders are accountable to ensure the fitness and health of their servicemen. The enforcement and implementation of health-related activities such as regular health screening and physical test are essential for combat readiness[19]. However, the prevalence of smoking in this study was high (28.5%) compared to the national survey (21.0%)[5]. One of the major reasons is to relieve stress of military life 20. A comparative study of cardiovascular risk factor between military and non-military personnel showed that hypertension and diabetes were more common in non-military occupation, while smoking was more common in military personnel[21].

The prevalence of hypertension in this study was more the less the same with other Asian military organisations. In Indonesia, the prevalence of hypertension among active military personnel was 10.7%, with 8.3% in the prehypertensive state[22]. A study among Indonesian Air Force pilots showed that 8.9% of them were diagnosed with hypertension[23]. Meanwhile, in Thailand, the prevalence of hypertension in military personnel was 18.6%, with 41.4% was pre-hypertensive[24]. In this study, military factors showed no significant association with hypertension. However, lifestyle factors such as BMI, high blood sugar level and high uric acid are significantly associated with hypertension. Being older, overweight and obese was associated with the risk of hypertension[24-26].

Several studies presented those overweight and obese individuals have a considerably higher prevalence of hypertension than lean individuals[27, 28]. On top of that, obesity increases the CVS risk factors that accompany hypertension, which worsens the prognosis[27]. The significant association between hyperuricemia and hypertension in this study mirrors other published studies [29-31]. Some studies identified hyperuricemia as an independent risk factor for hypertension [32-33]. Smoking is a significant risk factor for cardiovascular diseases, where a recent study showed that tobacco smoking induces cardiovascular mitochondrial oxidative stress, promotes endothelial dysfunction, and thus increased BP [34]. Nonetheless, this research showed no significant association due to constant physical activity among samples that have a protective effect on BP. The same explanation could also be addressed for no significant association between cholesterol with hypertension.

For the military factors, the rank was not associated with hypertension such as those with diseases, namely uncontrolled hypertension, diabetes and obesity were not promoted, or early retirement from the service. Type of responsibility or role and type of services was also not significantly associated with hypertension. Many senior officers could have been Commander before doing the administrative work, and a majority of them received the same level of military training, despite working at different services. All of these factors could explain the insignificant difference between military factors with hypertension.

Considering that the senior officer of armed forces is expected to be one of the healthiest populations, the low prevalence of hypertension among them should not be overlooked. Therefore, a routine medical examination must continue with more emphasis on biological and psychological monitoring. Based on this study, emphasis must be made on lifestyle modification such as weight reduction, a low purine diet, and diabetes prevention to reduce the incidence of hypertension. Moreover, military commanders need to ensure that the total military force is medically ready to deploy. Thus, enforcement of a healthy lifestyle, including regular physical exercise, healthy diet and ideal body weight need to be implemented. The activities should be constantly monitored to assess their effectiveness.

The limitation of this study was no data regarding the senior officers' reported history of smoking, physical activity, and stress level. With the aims to improve the MLHR database, the International Physical Activity Questionnaire (IPAQ) and the Occupational Stress Index could be integrated into the system for precise estimation of the risk factors. Additionally, this study presented the frequency of the risk factors on a limited number of senior officers. Hence, no generalisation could be summarised from the results about the increasing or decreasing trend in foregoing risk factors among the senior military officer population.

CONCLUSION

The prevalence of hypertension in the senior military officers was found to be low compared to the general population. Despite that, they shared similar risk factors. The results underlined the need for tackling the risk of hypertension and CVD in senior military officers, particularly those with overweight, obesity and smoking problems. This paper strongly recommends future prospective and multicentre investigations to produce precise estimates for future interventions.

Conflict of interests

The authors declare that they have no competing interests.

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