Prevalence of obesity and its association with hypertension: A cross sectional study of military personnel in the Royal Brunei Armed Forces

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ABSTRACT

Introduction: Obesity is a growing health issue in both the civilian and military populations. Obesity is known to be an independent risk factor for hypertension. Studies have demonstrated that pre-hypertension and hypertension are both associated with increasing risk for cardiovascular events. In this study, we assessed the prevalence of overweight and obesity amongst senior military personnel and examined the association between obesity and blood pressure. **Materials and Methods:** This cross-sectional study utilised the medical information obtained from the RBAF 40 year old Health Screening Programme carried out in 2011-2013. There were 271 participants included in the study. This health screening consisted of a series of anthropometric measurements, blood tests and medical assessment. Age, ranks, military units, smoking status, height, weight and blood pressure measurements were also extracted from the existing data of the programme. The differences in the means of the measures were analysed by using one-way ANOVA test and the chi square test was used to analyse the differences in the blood pressure of normal BMI, overweight and obese groups. **Results:** The prevalence of overweight and obesity were 60.1% and 12.1% respectively. There was a significant positive correlation between obesity and hypertension (p=0.008). It was also noted that the mean systolic (p<0.001) and diastolic (p=0.040) blood pressure significantly increased with BMI. **Conclusions**: Both military and civilian population are equally affected with obesity. This study showed that overweight and obesity are strongly related to elevated blood pressure. Ranks, military units and smoking do not have any association with obesity.

Keywords: Obesity, military, blood pressure, body mass index, prevalence

INTRODUCTION

Obesity is one of the growing health problems in both developed and the developing countries. In 2008, the World Health Organisation (WHO) estimated that more than 1.4 billion adults were overweight and about 10% of the adult population was obese. [1] In Brunei Darussalam, the 1st National Health and Nutri-

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tional Status Survey (NHNSS) in 1997 estimated that 44.5% of the participants were overweight or obese. In 2009, a health-screening programme (Integrated Health Screening programme) for the civil servants reported that 64.4% were overweight or obese, and the majority of these were from the middle-aged group. [2] These figures have demonstrated that obesity is increasing and affecting the younger population as well; therefore, it is important to address and overcome this growing health problem.

Obesity has been associated with chronic diseases such as hypertension, diabetes mellitus and coronary heart disease [3], which eventually lead to tremendous spending on medical expenses. [4] This demonstrates the impact of obesity to the society, hence, it is necessary to introduce and implement preventative measures and strategies to address this worrying health issue.

The most extensive study investigating the relationship between body mass index (BMI) and hypertension were derived from the Framingham Heart Study. This study re-examined the cohort of 5,209 participants who were followed up for a period of 26 years and concluded that obesity is an independent risk factor of developing cardiovascular disease. [5] A similar conclusion was deduced from the Framingham Offspring Study [6] and other studies. [7-8] However, these studies were based primarily on Caucasian population.

There are a number of Asian studies that described a positive relationship between BMI and hypertension. [9, 10] These studies also demonstrated that there are differences in the 'BMI cut-off' amongst the Asian population, [9-11] and this figure is used to identify the moderate to high risk of cardiovascular disease. For instance, Vietnamese adults have much lower BMI cut-off of 20.5-21 kg/m^2 compared to the Chinese with a cut-off of 23-24 kg/m^2. Similarly, Vietnamese adults have a lower prevalence of hypertension compared to the Chinese. [9] Therefore, ethnicities, culture and lifestyle influence among other things, BMI and hypertension and cardiovascular diseases.

Hypertension is also a well-known risk factor contributing to cerebrovascular events. [12] In addition, there are now more studies that show the association of pre-hypertension and stroke. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) introduced the concept of pre-hypertension which is defined as systolic blood pressure of 120-139 mmHg and diastolic of 80-89 mmHg. [13] An individual with pre-hypertension is at high risk of developing hypertension and even a slight increase in blood pressure can increase the likelihood of cardiovascular events. [14] Furthermore, there have been a number of studies in the military population which concluded that overweight is associated with developing pre-hypertension. [15, 16] Therefore, it is equally important to address pre-hypertension and hypertension as well as obesity in order to prevent the risks of developing cardiovascular events.

Obesity is also a growing health threat to the military population. It can indirectly affect the capabilities of any military organisation by having personnel exempted from military duties due to medical conditions

related to obesity such as hypertension. To counteract this, the Royal Brunei Armed Forces (RBAF) has implemented strict regulations in which each personal must maintain certain BMI standards in order to continue the service or otherwise face the possibility of termination of service or Service No Longer Required (SNLR). The other strategy implemented by RBAF is a detailed medical review of military personnel prior to attending courses and military deployments. Apart from these, RBAF has also introduced the 40-year-old Health Screening Programme in order to identify, treat and manage those individuals with chronic diseases (Non-Communicable Diseases [NCDs]) such as hypertension, diabetes mellitus and hypercholesterolemia. This health screening is necessary, as most of the senior military personnel will retire at around this age and this will ensure their health status prior to leaving the service.

This study looked at the association of obesity and hypertension amongst military personnel at the age of 40 or above in the RBAF. To date there has been no clinical study conducted in the RBAF that looked into the association of obesity and the risk of developing hypertension in the population that are considered to be physically fit and healthy. This study assessed the prevalence of overweight and obesity amongst senior military personnel and the prevalence of pre-hypertension and hypertension in the same population. We also determined the association between obesity and hypertension. This study is important in designing evidence-based strategies for the control and prevention of cardiovascular diseases including hypertension.

MATERIALS AND METHODS

Study Design and Participants Population: This cross-sectional study consisted of senior RBAF personnel aged 40 or over between the year of 2011 until 2013. The population size was approximately 270 personnel and no sampling was done as we included the samples that fulfilled our inclusion criteria. The study population also included all senior military personnel in RBAF including Royal Brunei Land Forces (RBLF), Royal Brunei Navy (RBN), Royal Brunei Air Force (RBAirF), Training Institute of Royal Brunei Armed Forces (TI RBAF) and also the Ministry of Defence (MINDEF).

Data Collection: This study utilised the data obtained from the 40-year old Health Screening Programme undertaken in 2011-2013. This screening programme required each personnel to undergo a series of examinations including the anthropometric and blood pressure measurements, blood investigations and also final assessment by the medical officer.

For this study, we included the age of the personnel at the time of enrolment for the programme, the rank, the unit of the personnel and their smoking status. We took into account the readings for blood pressure, height and weight when they first presented to the clinic for the programme.

The inclusion criteria in our study were male personnel who attended the programme on 1st January 2011 to 31st December 2013. The personnel must not have hypertension, stroke, diabetes and hypercholesterolemia prior to the enrolment to the programme. The personnel must be eligible to enrol for the health programme (i.e. age 40

and above) and it must be done in the MRS (Medical Reception Service). The personnel must also complete all components of the programme within three months.

For our study, we took the weight of the participants to the nearest 0.1 kg. The height was taken to the nearest 0.1 cm. The BMI was calculated using the formula [weight (Kg) / height squared (m^2)] and recorded to nearest one decimal place. The blood pressure readings were recorded to the nearest two mmHg.

We obtained written consents from all participants for the release of their medical information as stated in the 40-year old Health Screening Form. The study protocol was reviewed and approved by the Chain of Command in the RBAF and also the Ethics Committee in the PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam.

Definitions: The classification of hypertension is derived from the JNC-7 [12]; normal blood pressure (or normotension) is when systolic blood pressure <120 mmHg and diastolic pressure <80 mmHg. Pre-hypertension is defined as systolic blood pressure of between 120-139 mmHg and/or diastolic blood pressure between 80-89 mmHg. Hypertension is defined as systolic blood pressure ≥140 mmHg or diastolic pressure ≥90 mmHg. The World Health Organisation (WHO) classification for weight disorder was used for this study (Table 1). [16]

Table 1: Body mass index based on WHO classification. [16]

Classification	BMI (Kg/m^2)
Underweight	<18.5
Normal	18.5 – 24.9
Overweight	25 – 29.9
Obese	≥ 30

RESULTS

We initially identified 410 participants for the study, however; only 271 participants fulfilled our inclusion criteria. From Table 2, the mean age of the study population was 41.7 years ranging from 40 to 49 years of age. The population consisted of mostly non-commissioned officers or other ranks. Most of the personnel in the study were serving with RBLF with a total number of 92 personnel. The number of smokers in the study was about 121 (44.6%) in which most of them smoked less than 10

Table 2: Characteristics of the study population.

Variables	n (%)	Mean (SD)
Age (Years)		41.7 (1.99)
Rank		
Officers	40 (14.8)	
Other ranks	231 (85.2)	
Units		
RBLF	92 (33.9)	
RBN	51 (18.8)	
RBAirF	39 (14.4)	
TIRBAF	33 (12.2)	
MINDEF	56 (20.7)	
Smoking Status		
Smoker	121 (44.6)	
Non-smoker	150 (55.4)	
Number of cigarettes smoke/day		
1-5 sticks	50 (41.3)	
6-10 sticks	51 (42.2)	
≥11 sticks	20 (16.5)	
Weight (Kg)		72.4 (9.37)
Height (cm)		165.1(5.49)
BMI (kg/m^2)		26.6 (3.11)
18.5-24.99	74 (27.3)	
25-29.99	163 (60.1)	
≥30	33 (12.2)	
Blood Pressure (mmHg)		
Systolic		119.6(15.66)
Diastolic		74.7 (10.93)

Legends: RBLF: Royal Brunei Land Forces, RBN: Royal Brunei Navy, RBAirF: Royal Brunei Air Force, TIRBAF: Training Institute Royal Brunei Armed Forces, MINDEF: Ministry of Defence.

Table 3: Factors associated with BMI.

	Variable	n	Normal Freq (%)	Overweight Freq (%)	Obese Freq (%)	X^2 Statistics[a] (df)	*P-value*
Ranks							
	Officers	40	10 (25.0)	25 (62.5)	5 (12.5)	0.13 (2)	0.939
	Other ranks	231	64 (27.7)	139 (60.2)	28 (12.1)		
Units							
	RBLF	92	23 (25.0)	59 (64.1)	10 (10.9)	3.87 (8)	0.868
	RBN	51	18 (35.3)	28 (54.9)	5 (9.8)		For trend
	RBAirF	39	10 (25.6)	23 (59.0)	6 (15.4)		
	TIRBAF	33	8 (24.2)	22 (66.7)	3 (9.1)		
	MINDEF	56	15 (26.8)	32 (57.1)	9 (16.1)		
Smoking Status							
	Smoker	121	33 (27.3)	77 (63.6)	11 (9.1)	2.06 (2)	0.357
	Non-smoker	150	41 (27.3)	87 (58.0)	22 (14.7)		
Blood Pressure							
	Normal	123	44 (35.8)	72 (58.5)	7 (5.7)	13.84 (4)	0.008
	Pre-hypertension	119	24 (20.2)	74 (62.2)	21 (17.6)		For trend
	Hypertension	29	6 (20.7)	18 (62.1)	5(17.2)		

Legends: RBLF: Royal Brunei Land Forces, RBN: Royal Brunei Navy, RBAirF: Royal Brunei Air Force, TIRBAF: Training Institute Royal Brunei Armed Forces, MINDEF: Ministry of Defence.

sticks of cigarettes a day.

The mean weight of the population was 72.4 kg and the mean height of 165.1 cm with the mean body mass index of 26.6 kg/ m^2.

The prevalence of overweight and obesity amongst the officers were 62.5% and 12.5% respectively. The proportions of overweight and obesity amongst the non-commissioned officers were 60.2% and 12.1% respectively. From Table 3, there were no significant differences of BMI distribution between different ranks (p=0.939), the military units (p=0.860) and the smoking status (p=0.357).

The mean systolic blood pressure was 119.6 mmHg and the mean diastolic blood pressure was 74.7 mmHg (Table 2). The prevalence of pre-hypertension and hypertension were 43.9% and 10.7% correspondingly.

Table 4 showed a significant association between the BMI groups and the blood pressure (p=0.008). Both mean systolic (p<0.001) and diastolic blood pressure (p=0.040) were noted to be significantly higher with increasing BMI (Table 4). The Scheffe's test revealed that the mean systolic blood pressures were significantly different (p=0.011, p=0.010 and p<0.05 respectively) for all the BMI groups. For the mean diastolic blood pressure, the Scheffe's test demonstrat-

Table 4: Systolic and diastolic blood pressure and BMI.

Variable	Normal BMI (n=74) Mean (SD)	Overweight (n=163) Mean (SD)	Obese (n=33) Mean (SD)	Fstatistics[a] (df)	*P*-value
Blood Pressure (mmHg)					
Systolic	113.7 (11.91)	120.0 (10.99)	130.5 (30.45)	14.62 (2, 268)	<0.001[b]
Diastolic	72.8 (11.12)	74.7 (10.85)	78.6 (10.29)	3.26 (2, 268)	0.040[c]

ed that only the normal BMI and the obese group was significantly different (p=0.040) compared to the normal BMI and overweight group and the overweight and obese group (p=0.433 and p=0.184 respectively). The required assumptions for the respective statistical analyses were checked.

DISCUSSION

This study demonstrated that 60.1% of RBAF senior military personnel were overweight and 12.1% were considered to be obese. These figures are similar to the findings of the nutritional and health survey conducted in the civil setting. [2] This warrants for an immediate action, as military population are perceived to be physically fit and healthy individuals. We postulate that this similarity is probably due to the sedentary behaviour, becoming less physically active as they become more senior in their positions or ranks. In addition, they also become less physically active due to older age. This study did not show any significant correlation between the excess BMI and the ranks, units and also smoking status. However, we found that the prevalence of smokers was high (44.6%) and this alarming figure called for smoking cessation programme in RBAF. Currently, there are smoking cessation service provided by the Ministry of Health and hence, the introduction of such service into the military health sector may be warranted.

In our study, the prevalence of pre-hypertension and hypertension were about 43.9% and 10.7% respectively. To date there are no published studies on the prevalence of pre-hypertension and hypertension in the civilian setting. Sansanayudh *et al.,* reported the prevalence of pre-hypertension and hypertension amongst Thai soldiers to be 41% and 18% respectively. These figures are much higher when compared to their civilian population. [19] These differences could possibly arise from the nature of work in which soldiers are exposed to high degree of stress. The other reason could be due to the variations in the blood pressure measurements and methodology of the studies.

We have demonstrated in this study that blood pressure rises as the BMI increases. Hence, it is strongly associated with pre-hypertension and also increases the risk of developing hypertension. This association is also seen in Napradet *et al.*, whereby overweight and obesity were correlated with higher blood pressure amongst Thai soldiers. [20] It is also known that both pre-hypertension and hypertension can lead to stroke. [12, 14] Therefore, it is paramount to address both risk factors in order to minimise or reduce the mortality and morbidity associated with cardiovascular disorders.

There were a number of limitations in this study. Firstly, this study looked at senior military personnel only (i.e. aged 40 and above); therefore, the findings would be different if younger populations were also included in the study. We excluded a significant number of participants (139 participants excluded) and this could also affect the outcomes of the paper. We were limited only to the information available in the existing data of the programme and any incomplete information resulted in the exclusion of the participants from the study. The other weakness of the study was that the initial blood pressure readings when they first presented to the clinic and these might not represent the true in-

terpretations of their blood pressure.

In conclusion, our study showed that overweight and obesity were prevalent among senior military officers. Obesity is a factor associated with the risk of developing hypertension. Both military and civilian population are equally affected by obesity. Ranks, military units and smoking do not have any association with obesity. Therefore, it is important to address this growing health issue that can indirectly impact on the capabilities of the military organisation.

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