Prevalence of Prehypertensive State and Other Cardiovascular Risk Factors in the First Infantry Regiment, The King's Own Bodyguard

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Objective: *The objective of the present study was to identify the prevalence of pre-hypertension in the Army officers in a combat unit and to characterize the factors that are associated with increased prevalence of pre-hypertension.*
Material and Method: *This was a cross sectional study performed in all officers of the 1st Infantry Regiment, the King's own bodyguard, in June 2007. Baseline demographic data were obtained and physical examination was performed in all participants. Apart from serum hemoglobin and urinalysis, which were studied in all participants, other laboratory examination were studied in officers whose age was 35 years old or more. All participants were classified into three groups according to their blood pressure using the Joint National Committee (JNC) 7 criteria; Group 1: Normal (BP < 120/80 mmHg), Group 2: Pre-hypertension (BP 120-139/ 80-89 mmHg), and Group 3: Hypertension (BP ≥ 140/90 mmHg). The prevalence of pre-hypertension was calculated and the factors that correlated with increasing prevalence of prehypertension were identified using logistic regression analysis.*
Results: *There were 1,472 officers who participated in the present study, all of them were male. The mean age of the studied population was 36.25 ± 8.98 years. The mean weight, height, body mass index (BMI) and waist circumference were 68.66 ± 9.61 kilograms, 169.60 ± 4.85 centimeters, 23.87 ± 3.21 and 32.40 ± 3.39 inches, respectively. The prevalence of normotension, pre-hypertension and hypertension were 40.01%, 41.44% and 18.55% respectively. The factors that were correlated with increasing prevalence of pre-hypertension (p < 0.05) were older age; overweight and obesity (compared with normal BMI); high serum uric acid, hemoglobin, aspatate aminotransferase (AST); and proteinuria and metabolic syndrome.*
Conclusion: *The prevalence of pre-hypertension in this population was relatively high. Pre-hypertension was found more often in older persons, with the increase in BMI, serum AST, hemoglobin and uric acid, proteinuria and metabolic syndrome.*

Keywords: *Prevalence, Pre-hypertension, Risk factors, Army Officers, Thailand*

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Hypertension is a very common disease in clinical practice. It is associated with an increased risk of morbidity and mortality from cardiovascular disease (CVD) and represents the single greatest preventable cause of death in humans[1]. The standard definition of hypertension as blood pressure (BP) ≥ 140/90 mm Hg is based on the observation that the risk of CVD increases sharply above this level. However, recent data have shown that an increased risk of CVD is present in persons with BP levels as low as 115/70 mm

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Hg and that the risk of cardiovascular disease doubles with each increment of 20/10mmHg[2]. On May 14, 2003, The National High Blood Pressure Education Program Coordinating Committee of the National Heart, Lung, and Blood Institute released the Seventh Report of the Joint National Committee (JNC) on prevention, detection, evaluation, and treatment of high blood pressure[3]. According to the new report, normal BP is defined as systolic BP (SBP) less than 120 mm Hg and diastolic BP (DBP) less than 80 mmHg; a SBP of 120 to 139 mmHg or a DBP of 80 to 89 mmHg is defined as pre-hypertension. Lifestyle modifications for all patients with pre-hypertension and the addition of drug therapy for prehypertensive patients who have other compelling indications, including multiple diseases is recommended. Clearly, these new guidelines have broadened the target population for high BP (HBP) control. However, little is known about the scope of the current high blood pressure problem. Since the publication of the 7th JNC report, several studies have assessed the prevalence and significance of pre-hypertension. However, the importance of this entity in regard to global CVD risk and the preferred approach to its treatment are still a matter of debate, and the term prehypertension has yet to be widely adopted.

Evidence supporting a pre-hypertensive state has been demonstrated in several studies[4-8]. Important data came from the longitudinal Framingham Heart Study, which showed that BP in the pre-hypertensive range preceded the diagnosis of hypertension in 90% of subjects aged $\geq$ 55 years[9]. Similarly, the longitudinal study performed by Winegarden[10] showed that the risk of hypertension was substantially higher among subjects with "high normal" BP (130 to 139/85 to 89 mm Hg) compared with those with normal BP. However, several reports have documented an increased risk of CVD among pre-hypertensive subjects[5,6,9]. Other studies suggested that pre-hypertension increased the risk of CVD only modestly or only when pre-hypertension is associated with additional risk factors[4,7]. Because little is known about the risk factors for pre-hypertension and their association with other CVD risk factors in young adults. At present, it is unclear whether the increased risk of CVD among pre-hypertensive subjects is wholly related to increased BP or whether it can be attributed to a deleterious CVD risk factor profile. The purpose of the present study was to determine the prevalence of pre-hypertension among Thai Army personnel in combat unit and to characterize the CVD risk profiles and CVD risk scores of pre-hypertensive subjects within this population.

Material and Method

Study population

All military personnel in the first Infantry regiment, the King's Own bodyguard were invited to participate in the present study. The age at the beginning of military service in this unit is 20 years and all personnel are compulsory retired at the age of 60 years. All personnel were male combatants. The unit is the elite combat unit of the Army. The regular duty of the personnel in this unit included providing security for the royal family, standing guard at the palace, being deployed to three southernmost provinces for peace keeping mission. All personnel are involved in regular drill and constantly prepared to be deployed to any combat mission, rescue mission or other assignment from the Army. This study population represents a group of physically fit males who have a high level of regular exercise.

Data collection

The authors integrated the present study to the annual medical check up for military personnel of the First Infantry Regiment, King's Own Bodyguard, which took place in June 2007. The protocol was revised and approved by the ethic committee. Informed consent was signed after all military personnel were explained about the present study. Each subject completed a detailed medical questionnaire, which included items on previous medical problems, current medications, smoking habits and physical activity. Questions regarding physical activity included the following: the type of activity performed, the duration of activity, and the weekly frequency of the activity. Physical examination was performed by physicians, except for body weight, height, waist circumference, and 12-lead EKG which were recorded by trained paramedical staff. Blood pressure was measured by well-trained paramedical staff using standard protocol. Automatic blood pressure measurement machines (Omron IA2, Omron, Japan) were used in order to reduce operator bias and error from loud background noise. All machines were calibrated with standard sphygmomanometer before use. All subjects rested at least 5 minutes in a sitting position before measurement. Both arms were used in each subject and the one with higher value was used for analysis and subsequent follow up measurement. Blood pressure was measured at least 2-3 times using a cuff suitable to the subject's arm circumference and the mean value was recorded. Complete blood count (CBC) was done in all subjects and only personnel who were 35 years old or

older received additional blood tests for fasting plasma glucose, total cholesterol, fasting triglycerides, high-density lipoprotein (HDL) cholesterol, serum uric acid, aspatate aminotransferase (AST), alanine aminotransferase (ALT), blood urea nitrogen (BUN), and creatinine. Urinary examination was also performed in all subjects. LDL cholesterol was calculated using the Freidewald formula.

Data analysis

The result of physical examination, blood pressure and blood tests were used in the analysis. Body mass index (BMI) was classified into 4 categories according to World Health Organization (WHO) criteria for Asian population. BMI between 18.5-22.9 was normal, whereas BMI < 18.5, BMI 23-24.9 and BMI $\geq$ 25 were classified as underweight, overweight and obesity respectively[11-13]. Normotension was defined as SBP < 120 mm Hg and DBP < 80 mm Hg. Pre-hypertension was defined as SBP 120 to 139 mm Hg and/or DBP 80 to89 mm Hg. Hypertension was defined as SBP $\geq$ 140 mm Hg and/or DBP $\geq$ 90 mm Hg or by the use of anti-hypertensive medications. Subjects were considered diabetic if their fasting blood glucose level was $\geq$ 126 mg/dL or if they used hypoglycemic medications. Normoglycemia was defined as fasting blood glucose less than 100mg/dL and fasting blood glucose between 100-125.9 mg/dL was classified as impaired fasting glucose[14]. Abnormal lipid profile was defined as total cholesterol > 200mg/dL or triglyceride > 150mg/dL or HDL < 40 mg/dL or by the use of lipid lowering medication. Recommended LDL cholesterol level was calculated according to subject's risk factors and co-morbid disease using National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines[15]. LDL cholesterol was considered high if it was more than the recommended level for each individual.

Metabolic syndrome was defined using both NCEP ATP III[15] and International Diabetes Federation (IDF) criteria[16]. However, waist circumference more than 36 inches instead of 40 inches was used as a cut-off for diagnosing metabolic syndrome as recommended for Asian populations[17,18].

Statistical analysis

The characteristics between normotension, pre-hypertension, and hypertension were presented as percentage for categorical variables and mean $\pm$ standard deviation (SD) for continuous variables. Comparisons between characteristics in each BP group were carried out using One-Way Analysis of Variance (ANOVA) or Wilcoxon sign rank test for continuous variables and Chi-square tests or Fisher's exact tests for categorical variables. Univariate analysis between normotension group and pre-hypertension as well as hypertension groups. Comparison of pre-hypertension and hypertension groups were performed using Student t-test or Mann-Whitney U test for continuous data and Chi-square test or Fisher's exact test for categorical data. Logistic regression analyses were used to test significant determinants of pre-hypertension and hypertension status, with pre-hypertension and hypertension serving as the dichotomous outcome variable (pre-hypertension versus normotension and hypertension versus normotension). Age, presence of metabolic syndrome, lifestyle parameters, family history, BMI, and laboratory parameters are the independent predictor variables. Stepwise backward selection was used as the method for variable selection, and variables with $p > 0.05$ were eliminated from the model. Data were analyzed using SPSS software (version 13.0; SPSS Inc., Chicago, USA).

Results

Altogether 1,472 participants were enrolled in the present study. All were male, aged between 20 and 59 years with a mean age of 36.25 $\pm$ 8.98 years (Table 1). The mean weight and height in the study population were 68.66 $\pm$ 9.61 kg and 169.60 $\pm$ 4.85 cm. The mean BMI was 23.87 $\pm$ 3.21 kg/m^2. Using modified criteria for diagnosis of overweight and obesity mentioned above, most subjects had BMI in the normal range (42.6%) but 25.1% and 31.6% were classified as overweight (BMI 23.5-24.9) and obese (BMI > 25), respectively. The mean waist circumference was 32.40 $\pm$ 3.39 inches. The prevalence of metabolic syndrome in the study population was 13.6% and 18.8% using IDF and NCEP criteria, respectively (Table 2).

The prevalence of pre-hypertension was 610/1,472 (41.44%). Normal blood pressure and hypertension were observed in 589/1,472 (40.01%) and 273/1,472 (18.55%). Among 273 subjects who had hypertension, 115 subjects (42.1%) were previously diagnosed as having hypertension, while the other 158 subjects (57.9%) were newly detected.

There were significant differences between normotension, pre-hypertension and hypertension subjects in mean age, weight, BMI, pulse rate, waist circumference, history of hypertension, diabetes, dyslipidaemia and coronary artery disease (Table 1). All subjects were tested for complete blood count

Table 1. Baseline demographic data of the study population, normotensive, prehypertenive and hypertensive subjects

Charecteristics	Total (n = 1,472)	Normotensive (n = 589)	Prehypertensive (n = 610)	Hypertensive (n = 273)	p-value
Age (yrs)	36.25 ± 8.98	33.69 ± 8.33	36.24 ± 8.64	41.78 ± 8.63	<0.001
Weight (kg)	68.66 ± 9.61	65.82 ± 8.49	69.63 ± 9.41	72.64 ± 10.50	<0.001
Height (cm)	169.60 ± 4.85	169.83 ± 4.82	169.69 ± 4.93	168.91 ± 4.72	0.068**
Pulse (beats/min)	76.37 ± 11.94	73.67 ± 11.25	76.60 ± 11.25	81.65 ± 13.04	<0.001
BMI (kg/m^2)	23.87 ± 3.21	22.82 ± 2.79	24.17 ± 3.06	25.47 ± 3.57	<0.001
Waist circumference	32.40 ± 3.39	31.38 ± 3.00	32.59 ± 3.21	34.17 ± 3.75	<0.001
Previous HT	115 (7.8)	0 (0.0)	0 (0.0)	115 (42.1)	0.001
Proteinuria	24 (1.6)	3 (0.5)	12 (2.0)	9 (3.3)	0.008
Underlying[#]					
DM	29 (2.0)	5 (0.8)	9 (1.5)	15 (5.5)	<0.001
DLP	109 (7.4)	18 (3.1)	43 (7.0)	48 (17.6)	<0.001
CVA	4 (0.3)	1 (0.2)	2 (0.3)	1 (0.4)	0.835*
CAD	11 (0.7)	4 (0.7)	1 (0.2)	6 (2.2)	0.009*
PAD	4 (0.3)	1 (0.2)	2 (0.3)	1 (0.4)	0.835*
CKD	2 (0.1)	1 (0.2)	0 (0.0)	1 (0.4)	0.183*
Hb (g/dL)	14.34 ± 1.12	14.18 ± 1.15	14.52 ± 1.07	14.34 ± 1.12	<0.001

* Fisher's exact test, ** Kruskal-Wallis test

[#] DM-Diabetes mellitus, DLP-Dyslipidaemia, CVA-Cerebrovascular accident, CAD- Coronary artery disease, PAD-Peripheral artery disease and CKD-Chronic kidney disease

Table 2. Laboratory results of study population, normotensive, prehypertensive and hypertensive subjects (n = 811)

Test	Total	Normotensive	Prehypertensive	Hypertensive	p-value
Glucose (mg/dL)	96.51 ± 24.47	95.28 ± 33.18	94.43 ± 16.28	101.44 ± 22.46	0.003
BUN (mg/dL)	12.77 ± 3.05	12.71 ± 2.96	12.63 ± 2.80	13.06 ± 3.50	0.261
Cr (mg/dL)	1.09 ± 0.16	1.09 ± 0.14	1.10 ± 0.15	1.09 ± 0.18	0.970
Uric (mg/dL)	6.42 ± 1.44	6.12 ± 1.30	6.54 ± 1.41	6.61 ± 1.58	<0.001
AST (U/L)	33.53 ± 23.99	29.61 ± 12.70	34.57 ± 24.67	36.63 ± 31.69	0.004
ALT (U/L)	33.54 ± 24.63	28.71 ± 17.77	35.10 ± 27.72	36.88 ± 25.66	<0.001
Alk (U/L)	70.39 ± 20.74	68.56 ± 20.56	69.65 ± 17.45	73.83 ± 25.16	0.016
Chol (mg/dL)	206.85 ± 39.99	205.41 ± 37.18	206.47 ± 38.28	209.24 ± 45.72	0.574
TG (mg/dL)	171.27 ± 131.34	147.60 ± 102.68	166.18 ± 111.42	208.57 ± 177.31	<0.001*
HDL (mg/dL)	51.86 ± 13.33	52.21 ± 11.58	51.85 ± 13.65	51.45 ± 14.77	0.828
LDL (mg/dL) (n = 802)	122.15 ± 36.11	124.05 ± 33.34	122.45 ± 35.40	119.30 ± 40.35	0.366
MET-IDF - No. (%)	108 (13.6)	14 (5.4)	37 (11.3)	57 (27.3)	<0.001
MET-NCEP - No. (%)	149 (18.8)	16 (6.2)	55 (16.9)	78 (37.3)	<0.001

* Kruskal-Wallis test

MET-IDF: Metabolic syndrome defined by IDF criteria

MET-NCEP: Metabolic syndrome defined by NCEP criteria

(CBC) and urinalysis. The mean serum hemoglobin and prevalence of proteinuria were significantly difference between three groups.

Among 811 participants whose ages were more than 35, complete blood tests including lipid profile and fasting blood sugar were performed. The mean fasting blood sugar, serum uric acid, ALT, AST and triglyceride were significantly different among participants in normotension, pre-hypertension and hypertension group (Table 2). The prevalence of metabolic syndrome using both IDF and NCEP criteria were also difference among three groups.

When pre-hypertensive subjects were compared with normotensive subjects by using univariate analysis, it was found that the mean age, BMI, serum hemoglobin, uric acid, AST and triglyceride of the pre-hypertensive groups were significantly higher than normotensive groups ($p < 0.05$). Moreover, the prevalence of proteinuria and metabolic syndrome, using the IDF and NCEP criteria, were higher in the pre-hypertensive subjects ($p < 0.001$) (Table 3).

When hypertensive subjects were compared with normotensive subjects by using univariate analysis, it was found that the mean age, BMI, serum hemoglobin, fasting blood sugar, uric acid, AST, ALT and triglyceride of the pre-hypertensive groups were significantly higher than normotensive groups ($p < 0.05$). Moreover, the prevalence of proteinuria and metabolic syndrome, using the IDF and NCEP criteria, were higher in the hypertensive subjects ($p < 0.005$) (Table 4).

From multivaritate analysis, factors that were independently associated with increased prevalence of pre-hypertension from multivariate analysis included first, increasing age; second, high BMI; third, serum hemoglobin; fourth, proteinuria; fifth, serum AST; sixth, serum uric acid; and finally, metabolic syndrome ($p < 0.05$) (Table 5).

Table 3. Univariate analysis comparison between normotensive and prehypertensive subjects

Variables	Normotensive (n = 589)	Prehypertensive (n = 610)	OR	95% CI		p-value
				Lower	Upper	
Age (yrs)†	33.69 ± 8.33	36.24 ± 8.64	1.036	1.022	1.050	<0.001
20-30	242 (41.1)	189 (31.0)	1.000			
31-40	213 (36.2)	225 (36.9)	1.353	1.036	1.767	0.027
41-50	125 (21.2)	168 (27.5)	1.721	1.275	2.322	<0.001
> 50	9 (1.5)	28 (4.6)	3.984	1.836	8.644	<0.001
BMI (kg/m^2)	22.82 ± 2.79	24.17 ± 3.06	1.173	1.125	1.222	<0.001
Normal	340 (57.7)	226 (37.0)	1.000			
Overweight	135 (22.9)	167 (27.4)	1.861	1.403	2.468	<0.001
Obesity	114 (19.4)	217 (35.6)	2.864	2.159	3.798	<0.001
Family history*						
Male dead < 55 yrs	14 (2.4)	14 (2.3)	0.965	0.456	2.042	0.925
Female dead < 65 yrs	7 (1.2)	13 (2.1)	1.810	0.717	4.570	0.209
Right arm (BP)	288 (48.9)	351 (57.5)	1.416	1.128	1.779	0.003
Smoking	364 (61.8)	355 (58.2)	0.861	0.683	1.085	0.203
Drinking alcohol	72 (12.3)	87 (14.3)	1.190	0.851	1.664	0.309
No exercise	270 (46.0)	259 (42.7)	0.874	0.695	1.098	0.247
Proteinuria	3 (0.5)	12 (2.0)	3.920	1.100	13.961	0.035
MET-IDF	14 (5.4)	37 (11.3)	2.222	1.174	4.207	<0.001
MET-NCEP	16 (6.2)	55 (16.9)	3.057	1.706	5.477	<0.001
Glucose (mg/dL)†	95.28 ± 33.18	94.43 ± 16.28	0.999	0.992	1.005	0.682
BUN (mg/dL)†	12.71 ± 2.96	12.63 ± 2.80	0.991	0.936	1.048	0.743
Cr (mg/dL)†	1.09 ± 0.14	1.10 ± 0.15	1.150	0.374	3.534	0.807
Uric (mg/dL)†	6.12 ± 1.30	6.54 ± 1.41	1.262	1.113	1.431	<0.001
AST (U/L)†	29.61 ± 12.70	34.57 ± 24.67	1.017	1.005	1.029	0.005
ALT (U/L)†	28.71 ± 17.77	35.10 ± 27.72	1.014	1.005	1.023	0.002
Alk (U/L)†	68.56 ± 20.56	69.65 ± 17.45	1.003	0.994	1.012	0.485
Chol (mg/dL)†	205.41 ± 37.18	206.47 ± 38.28	1.001	0.996	1.005	0.733
TG (mg/dL)†	147.60 ± 102.68	166.18 ± 111.42	1.002	1.000	1.003	0.041
HDL (mg/dL)†	52.21 ± 11.58	51.85 ± 13.65	0.998	0.985	1.010	0.733
LDL (mg/dL)†	124.05 ± 33.34	122.45 ± 35.40	0.999	0.994	1.003	0.574
Hb (g/dL)†	14.18 ± 1.15	14.42 ± 1.11	1.208	1.091	1.338	<0.001

† The OR was continuous and calculated for 1 unit

* Family history dead from heart disease

Discussion

Pre-hypertension is a new category of blood pressure classification. People whose blood pressure was in this range had a tendency to become hypertensive with a conversion rate around 20% over 4 years[18]. Pre-hypertension per se was also found, from previous studies, to be associated with increased cardiovascular event[19]. The 7th JNC report introduced this new term in order to emphasize on its importance and to raise the public attention and awareness of this entity. The present study is the most recent and precise data of pre-hypertension in Thai males with good exercise capacity and fitness. The authors found a very high prevalence (41.44%) of pre-hypertension in the study population.

Army officers are the most valuable resource of the Army and the country. Their physical and mental well-beings are important to the performance of the Army. Unfortunately, they are the subgroup that is usually left out in the national health survey and other public health promotion campaigns. Little data is available regarding the prevalence of cardiovascular risk factors in this subgroup and no previous study regarding the prevalence of pre-hypertension has been reported.

The study population is a group of relatively young males who are elite combatants with excellent

Table 4. Univariate analysis comparison between normotensive and hypertensive subjects

Variables	Normotensive (n = 589)	Hypertension (n = 273)	OR	95% CI		p-value
				Lower	Upper	
Age (yrs)†	33.69 ± 8.33	41.78 ± 8.63	1.114	1.093	1.135	<0.001
20-30	242 (41.1)	31 (11.4)	1.000			
31-40	213 (36.2)	77 (28.2)	2.822	1.789	4.451	<0.001
41-50	125 (21.2)	122 (44.7)	7.619	4.861	11.943	<0.001
> 50	9 (1.5)	43 (15.8)	37.297	16.594	83.834	<0.001
BMI (kg/m^2)	22.82 ± 2.79	25.47 ± 3.57	1.302	1.237	1.370	<0.001
Normal	340 (57.7)	72 (26.4)	1.000			
Overweight	135 (22.9)	67 (24.5)	2.344	1.590	3.454	<0.001
Obesity	114 (19.4)	134 (49.1)	5.554	3.887	7.927	<0.001
Family history*						
Male dead < 55 yrs	14 (2.4)	7 (2.6)	1.081	0.431	2.709	0.868
Female dead < 65 yrs	7 (1.2)	5 (1.8)	1.551	0.488	4.932	0.457
Right arm (BP)	288 (48.9)	149 (54.6)	1.256	0.942	1.675	0.121
Smoking	364 (61.8)	154 (56.4)	0.800	0.598	1.070	0.133
Drinking alcohol	72 (12.3)	62 (23.1)	2.153	1.478	3.136	<0.001
No exercise	270 (46.0)	126 (47.0)	1.042	0.780	1.392	0.782
Proteinuria	3 (0.5)	9 (3.3)	6.659	1.788	24.796	0.005
MET-IDF	14 (5.4)	57 (27.3)	6.509	3.506	12.085	<0.001
MET-NCEP	16 (6.2)	78 (37.3)	8.969	5.029	15.993	<0.001
Glucose (mg/dL)†	95.28 ± 33.18	101.44 ± 22.46	1.009	1.001	1.017	0.033
BUN (mg/dL)†	12.71 ± 2.96	13.06 ± 3.50	1.034	0.977	1.095	0.244
Cr (mg/dL)†	1.09 ± 0.14	1.09 ± 0.18	1.016	0.323	3.195	0.978
Uric (mg/dL)†	6.12 ± 1.30	6.61 ± 1.58	1.272	1.115	1.451	<0.001
AST (U/L)†	29.61 ± 12.70	36.63 ± 31.69	1.022	1.008	1.036	0.002
ALT (U/L)†	28.71 ± 17.77	36.88 ± 25.66	1.019	1.009	1.029	<0.001
Alk (U/L)†	68.56 ± 20.56	73.83 ± 25.16	1.011	1.002	1.021	0.018
Chol (mg/dL)†	205.41 ± 37.18	209.24 ± 45.72	1.002	0.998	1.007	0.319
TG (mg/dL)†	147.60 ± 102.68	208.57 ± 177.31	1.004	1.002	1.006	<0.001
HDL (mg/dL)†	52.21 ± 11.58	51.45 ± 14.77	0.996	0.982	1.010	0.532
LDL (mg/dL)†	124.05 ± 33.34	119.30 ± 40.35	0.996	0.991	1.001	0.167
Hb (g/dL)†	14.18 ± 1.15	14.52 ±1.07	1.322	1.154	1.514	<0.001

† The OR was continuous and calculated for 1 unit

* Family history dead from heart disease

Table 5. Multivariate logistic analysis between normotensive amd prehypertensive subjects

Variable	OR crude	OR adj.	95% CI of OR adj.		p-value
			Lower	Upper	
Age (yrs)					
20-30	1.000				
31-40	1.353	1.170	0.887	1.545	0.267
41-50	1.721	1.443	1.056	1.972	0.021
> 50	3.984	3.289	1.489	7.265	0.003
BMI (kg/m^2)					
Normal	1.000				
Overweight	1.861	1.748	1.308	2.335	<0.001
Obesity	2.864	2.541	1.899	3.400	<0.001
Hb (g/dL)	1.208	1.162	1.046	1.292	0.005
Proteinuria	3.920	4.268	1.158	15.727	0.029
AST (U/L)	1.017	1.017	1.005	1.029	0.006
Uric acic (mg/dL)	1.262	1.182	1.031	1.354	0.017
MET-NCEP	3.057	2.085	1.071	4.058	0.031

Table 6. Multivariate logistic analysis between normotensive and hypertensive subjects

Variable	OR crude	OR adj.	95% CI of OR adj.		p-value
			Lower	Upper	
Age (yrs)					
20-30	1.000				
31-40	2.822	2.062	1.283	3.317	0.003
41-50	7.619	4.886	3.048	7.833	<0.001
> 50	37.297	23.940	10.365	55.293	<0.001
BMI (kg/m^2)					
Normal	1.000				
Overweight	2.344	2.014	1.320	3.073	0.001
Obesity	5.554	3.887	2.622	5.764	<0.001
Drinking alcohol	2.153	1.917	1.256	2.927	0.003
AST (U/L)	1.022	1.016	1.003	1.028	0.017
MET-NCEP	8.969	6.539	3.235	13.218	<0.001

level of exercise capacity and are constantly engaged in regular drills and missions. The BMI (23.87 $\pm$ 3.21 kg/m^2) and the prevalence of metabolic syndrome (18.8% and 13.6% by NCEP and IDF criteria) in the present study were much less than those observed in other army units. For example, in a survey of 682 male army personnel working in Phramongkutklao Hospital, the mean BMI was 24.7 $\pm$ 2.4 and the prevalence of metabolic syndrome were 21.5% and 19.2% respectively[20]. Therefore, the authors expected a lower prevalence of pre-hypertension in the presented study population compared to other army units or compared to the prevalence from the national survey.

Surprisingly, the present study found a very high prevalence of pre-hypertension (41.44%). This is higher than the prevalence from the 2004 Third National Health Examination Survey (NHESIII) in Thailand[21], which had of pre-hypertension of 36.7% in male, and much more than the prevalence from the InterASIA study in Thailand in the year 2000, which showed a 21% overall prevalence of prehypertension[22]. The prevalence of pre-hypertension in males from other previous studies varied from 36% in Taiwan to as high as 51.2% in Laoning province in China[23-27]. Although there are diversities in the study population among those studies, making comparison between studies very difficult, the present study revealed equal or higher prevalence of pre-hypertension in the population studied despite more favorable risk factors compared to other studies from Thailand.

The reason of higher prevalence of pre-hypertension in the present study may be from many causes. First, the present study used both arms for BP measurement. The higher value between both arms was used for analysis and for follow up in each individual. That makes the estimation of the prevalence of pre-hypertension more accurate than studies that use only BP measurement from either arm, which may underestimate the true prevalence of pre-hypertension. Second, the presented participants had a very high level of stress. Their job included, but was not limited to, many night shifts on duty, providing security of the royal family, engaging in combat mission, being deployed to three most-southern provinces for peacekeeping. The long-standing high level of stress may have effects on their blood pressure. Also, the changing pattern of sleep from the night shifts can have some impact on the level of hormones in the participants leading to high blood pressure. Third, the authors classified participants into three blood pressure categories using only one ambulatory measurement. The JNC 7 recommended making the diagnosis of hypertension and prehypertension from at least two or three office measurements. Some of the presented pre-hypertension subjects may have normal blood pressure if measured repeatedly. Fourth, the present study was conducted three years after the national survey in 2004. It is also possible that the prevalence of pre-hypertension has increased in the last few years The prevalence of pre-hypertension has been found to increase in many countries[25,28]. In

Thailand, the prevalence of pre-hypertension increased from 21% in 2000 to 36.7% (male) in 2004. Look at the rate of increase during that four-year period; it is possible that the prevalence of pre-hypertension may have increased at the same rate during 2004 to 2007 and explains the high prevalence detected in the present study.

However, no matter what the cause of high prevalence of pre-hypertension is, the result of the present study should gain immediate attention not only from the doctors who take care of the military personnel, but also the policy makers in the Army, and in the Ministry of Public Health.

In the present study, univariate analysis revealed that higher age, BMI, uric acid, AST, ALT, triglyceride, hemoglobin and metabolic syndrome were associated with pre-hypertension. Similar factors also were found to be associated with hypertension in the present study population as well. The present findings are consistent with many previous studies[21,23,24,26,27]. Multivariate analysis revealed higher age, BMI, uric acid, AST, hemoglobin, proteinuria and metabolic syndrome were independently associated with increased prevalence of pre-hypertension. The relationship between these factors and pre-hypertension justifies further large scale studies to confirm the present findings and also to find the possible mechanism to explain such relationship. Of special interest is the high serum uric acid which has been found in many previous studies to be associated with hypertension[29]. Recent studies showed that serum uric acid increased risk of blood pressure progression and risk of developing hypertension[30-33]. Some studies even found the correlation between serum uric acid and end organ damage, high incidence of adverse cardiovascular events or even increased mortality in patients with high blood pressure[34-36]. In the present study, the relationship between high serum uric acid and pre-hypertension as well as hypertension were found. Whether the high serum uric acid level has the same effect on pre-hypertension as it does with hypertension still needs to be studied.

Study Limitation

The participants in the present study were young male combatants with a high level of physical fitness and regular exercise. Although, this may limit the generalizability of the results to other subgroups, the present findings are consistent with findings from other studies involving different subgroup of people. In addition, the authors used only one measure of BP and cannot exclude the effect of white coat phenomenon, which may result in a higher prevalence of pre-hypertension. However, most of other epidemiological studies used the same method of measurement making the present method justifiable for comparison.

Conclusion

The present study demonstrates that the prevalence of pre-hypertension is very high in army officers in combat units. The results underline the need for routine blood pressure measurement and early detection of pre-hypertension and hypertension in young adults. Further studies should be encouraged to assess the role of pre-hypertension as an independent risk factor and to assess the effect of lifestyle modification and medication on the progression to hypertension, as well as on cardiovascular morbidity and mortality.

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ความชุกของภาวะความดันโลหิตสูงระยะเริ่มต้น (prehypertension) และความชุกของปัจจัยเสี่ยงของโรคหัวใจและหลอดเลือดในกำลังพลกรมทหารราบที่ 1 มหาดเล็กรักษาพระองค์

นครินทร์ ศันสนยุทธ, วีระ ลุวีระ, ณัฐศักดิ์ วรเจริญศรี, ดวงพร พูลสุขสมบัติ, ราตรี ศรีเพ็ญ

วัตถุประสงค์: *เพื่อหาความชุกของภาวะความดันโลหิตสูงระยะเริ่มต้น (prehypertension) และความชุกของปัจจัยเสี่ยงอื่น ๆ ของโรคหัวใจและหลอดเลือดในกำลังพลของหน่วยรบของกองทัพบก และหาปัจจัยพื้นฐานที่มีความสัมพันธ์กับการพบภาวะความดันโลหิตสูงระยะเริ่มต้น*

วัสดุและวิธีการ: *เป็นการศึกษาแบบภาคตัดขวาง ศึกษากำลังพลทั้งหมดของกรมทหารราบที่ 1 มหาดเล็กรักษาพระองค์ ในช่วงเดือนมิถุนายน พ.ศ. 2550 ทำการเก็บข้อมูลพื้นฐานด้านสุขภาพและตรวจร่างกาย รวมถึงวัดความดันโลหิตทำตามวิธีมาตรฐาน บันทึกค่าเฉลี่ยของการวัดความดันอย่างน้อยสองครั้ง แบ่งกลุ่มกำลังพลตามความดันโลหิตเป็น 3 กลุ่ม กลุ่มที่ 1: ความดันปกติ (ความดัน น้อยกว่า120/80 มิลลิเมตรปรอท) กลุ่มที่ 2: ความดันโลหิตสูงระยะเริ่มต้น (ความดัน 120-139/80-89 มิลลิเมตรปรอท) และกลุ่มที่ 3: ความดันโลหิตสูง (ความดัน ≥ 140/90 มิลลิเมตรปรอท) กำลังพลทุกรายได้รับการเจาะเลือดตรวจ complete blood count (CBC) และตรวจ urinalysis ในกำลังพลที่อายุมากกว่า 35 ปี จะได้รับการตรวจเลือดเพิ่มเติม เพื่อหาระดับน้ำตาล ไขมันในเลือด กรดยูริก การทำงานของตับและไต นำผลที่ได้มาคำนวณหาความชุกของภาวะ ความดัน โลหิตสูงระยะเริ่มต้นและความชุกของปัจจัยเสี่ยงของโรคหัวใจและหลอดเลือดต่างๆ ในประชากรที่ศึกษา และหาปัจจัยที่สัมพันธ์กับการพบความดันโลหิตสูงระยะเริ่มต้นโดยใช้ multiple logistic regression analysis*

ผลการศึกษา: *มีกำลังพลเข้าร่วมในการศึกษาทั้งสิ้น 1,472 ราย ทั้งหมดเป็นชายอายุเฉลี่ย 36.25 ± 8.98 ปี ดรรชนีมวลกายเฉลี่ย 23.87 ± 3.21 พบความชุกของภาวะความดันโลหิตสูงระยะเริ่มต้น ความดันโลหิตสูง และความดันปกติ เท่ากับ 40.01%, 41.44% และ 18.55% ตามลำดับ จาก multiple logistic regression analysis พบว่า ปัจจัยที่สัมพันธ์กับการพบภาวะความดันโลหิตสูงระยะเริ่มต้นอย่างมีความสำคัญทางสถิติได้แก่ อายุที่มาก น้ำหนักตัวเกิน มาตรฐาน และภาวะอ้วน การมีระดับฮีโมโกลบินสูง ระดับกรดยูริกในเลือดสูง ระดับ aspatate aminotransferase (AST) สูง การพบโปรตีนในปัสสาวะ และโรคอ้วนลงพุง (metabolic syndrome)*

สรุป: *การศึกษานี้พบความชุกของภาวะความดันโลหิตสูงระยะเริ่มต้น (prehypertension) สูงมากในกำลังพลหน่วยรบของกองทัพบก ปัจจัยที่สัมพันธ์กับการพบภาวะความดันโลหิตสูงระยะเริ่มต้นได้แก่ อายุ ดรรชนีมวลกาย ระดับฮีโมโกลบิน ระดับกรดยูริกในเลือด ระดับASTในเลือด การพบโปรตีนในปัสสาวะ และโรคอ้วนลงพุง*