Prevalence of Metabolic Syndrome and Its Associated Factors among Thai Police Officers – A Population-based Study

Mahesh Gurung, M.D.*, Runyawan Chotenimitkhun, M.D., Kasem Ratanasumawong, M.D.**, Bundit Prommete, M.D.**, Wichai Aekplakorn, M.D.*****

**Cardiology Division, Police General Hospital, Thailand, and Jigme Dorji Wangchuck National Referral Hospital, Thimphu, Bhutan, **Cardiology Division, Police General Hospital, Bangkok, Thailand, ***Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand.*

ABSTRACT

Objective: The prevalence of Metabolic Syndrome (MetS) in Thai police officers is unknown. This study aims to accurately determine the prevalence of MetS in this population compared to the Thai general population.

Materials and Methods: We conducted a population-based cross-sectional study of 107,933 Thai police officers during the 2012 annual Police Health Care Center check-up. Metabolic syndrome was defined using the harmonized criteria of six international
expert groups.

Results: The prevalence of MetS among Thai police officers was 39.24%, with a higher prevalence among males compared to female police officers (40.9% male and 14.3% female). The prevalence was higher in male police officers (40.65% versus 23.80%, P<0.001), whereas it was lower in female officers (16.30% versus 31.59%, P<0.001) when compared to the general population. High blood pressure was the most common abnormal metabolic component in both genders (male 67.4 % female 33.3%). Whereas observation of low high-density lipoprotein cholesterol (HDL) in males (11.6%) and high fasting plasma glucose (FG) in females (16.3%). The adjusted odds ratio for MetS increased with age, wide pulse pressure, male gender, lower rank, alcohol drinking, and being in a non-metropolitan city.

Conclusion: The prevalence of MetS is higher among Thai police officers compared to the general Thai population. These findings underscore the need for effective preventive measures and continuous monitoring to reduce the risk and burden of cardiovascular diseases.

Keywords: Metabolic syndrome; prevalence; police officers; Thai (Siriraj Med J 2023; 75: 208-217)

INTRODUCTION

Metabolic Syndrome (MetS) is associated with increased risk of atherosclerotic cardiovascular disease (ASCVD) (2-fold) and all-cause mortality (1.5 fold).[1] MetS is emerging as a dominant public health concern due to its relationship to cardiovascular disease and the dramatic increase in its global prevalence. MetS can be considered a pandemic as it variably ranges from 11.9 % to 49 % in Pacific Asia and 24-34 % in the United States and Europe.[2-5] In Thailand, the Thai National Health Examination Survey (TNHES) 2009 revealed that approximately one-quarter of adults of age more than 19 years had MetS. MetS was observed with higher prevalence in urban versus rural males and the reverse in females.[6,7] Cardiovascular risk factors are higher in Thailand, with an estimated 5.1 million individuals with

Corresponding author: Mahesh Gurung
E-mail: dr.mgurung@gmail.com
Received 8 December 2022 Revised 2 January 2023 Accepted 10 January 2023
ORCID ID:http://orcid.org/0000-0003-4279-0859
https://doi.org/10.33192/smj.v75i3.260869

hypertension, 4.4 million with elevated cholesterol, 8.9 million classified as overweight and obese, 2.4 million with diabetes, and 6.2 million current smokers.[8] Law enforcement is a unique occupation due to the demands of irregular work hours, work-life imbalance, higher rates of tobacco and alcohol use, and disturbances in the sleep cycle leading to continual physical and mental stress. This type of lifestyle is often associated with MetS.[9-14]

Prior global epidemiological studies demonstrated an inconsistent prevalence of MetS in police officers compared to other armed forces or the general population.[15-19] A few studies in Thailand have shown an increasing prevalence of overweight or obesity in Thai army personnel.[20,21] However, no reports on the prevalence of MetS and its components in Thai Police officers are available.

This study aims to update the prevalence of MetS and evaluate factors associated with this condition in Thai police officers. The results will hopefully guide future preventive strategies and may, in turn, help prevent future cardiovascular disease in this unique population.

MATERIALS AND METHODS

Study Population

The Police Health Check Up Program 1 was the first large-scale non-communicable disease screening program conducted in Thailand among police officers throughout the country in 2012. There were approximately 213,664 active-duty Thai police officers working in 76 provinces during the year of study. Of this amount, 123,400 officers (60%) had completed the 2012 Police Health Check Up Program conducted by the Police Health Care Center at Police General Hospital, Bangkok.[22] After excluding those subjects with incomplete data, the remaining 107,933 officers comprised the study population.

Methods

Before the initiation of the study, the Ethical Review Committee, Police General Hospital, Bangkok, approved the study design. Data regarding alcohol consumption, cigarette smoking, prior diagnosis of diabetes, hypertension, use of glucose-lowering medications, anti-hypertensive drug use, and lipid-lowering drugs were obtained through a written questionnaire. Each subject had anthropometric measurements such as waist circumference, height, body weight, along with blood pressure (BP), and pulse measurement obtained by a nurse or medical assistant at the Police Health Care center. We measured waist circumference (WC) from the horizontal plane at a level halfway between the iliac crest and the lower costal margin.[23] Brachial artery blood pressure and pulse rate were measured using an automatic machine after participants rested for at least 5 minutes in a sitting position according to standard procedures.[24] A limited physical examination, including assessment of the head, ear, eye, nose, and throat (HEENT), auscultation of the heart, lungs, and palpation of the abdomen, was performed by the supervising physician. Fasting venous blood samples for glucose (FG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), and triglyceride (TG) were analyzed using an ADVIA 1800 Clinical Chemistry System. The Friedewald formula was used to calculate Low-density lipoprotein cholesterol (LDL-c).[25]

All laboratory techniques were standardized to Center for Disease Control reference methods.[26]

Definitions

We defined metabolic syndrome according to the definition of the joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention, the National Heart, Lung and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association for the Study of Obesity.[27] The diagnosis required three or more of the following five components: 1) FG ≥ 100 mg/dl (≥ 5.6 mmol/L) or having diabetes; 2) TG ≥ 150 mg/dl (≥ 1.69 mmol/L) or taking lipid-lowering medication; 3) HDL-c < 40 mg/al (< 1.04 mmol/L) in men or < 50 mg/dl (< 1.29 mmol/L) in women; 4) BP ≥ 130/85 mm Hg or treated hypertension; 5) WC ≥ 90 cm in men and ≥ 80 cm in women (reflecting the Asian population) or a body mass index ≥ 25 kg/m^2.[28,29] Pre-metabolic syndrome (pre-MetS) was defined as any two of the five MetS components. Alcohol drinking was defined as any self-reported regular consumption of any alcoholic beverage. The definition of pulse pressure (PP) was the difference between systolic and diastolic blood pressures during one cardiac cycle. Participants were categorized into groups based on PP as follows: < 35, 35-45; 46-55 and > 55 mmHg.

Statistical analysis

The prevalence and age-adjusted mean prevalence of MetS were calculated based on the direct method using standard techniques and compared to the 2010 general Thai population.[30] Participants were categorized into age - groups based on the above comparison population as follows: 35-39; 40-44; 45-49; 50-54; and 55-59 years of age. Differences between groups were calculated using the t-test for continuous data and the chi-square for categorical data. The chi-square test was used to calculate differences in the distribution of covariates for police officers in Bangkok (metropolitan) and non-Bangkok (non-metropolitan). Multivariate logistic regression was used to examine the association of demographic variables (age, sex, rank, province, pulse pressure, smoking, and alcohol use) and MetS. Stata software version 11 was used for all calculations.

RESULTS

A total of 107,933 police officers (101,846 males and 6,087 females) constituted the entire study population with mean age (SD) of 43.60 (0.08) years (range, 35 – 59 years). The reported gender baseline characteristics of the study population are in Table 1. Highest age adjusted prevalence of MetS by regions in Thailand was observed in the western region (57%) followed by central region (49%) and lowest was observed in Bangkok (30%) (Fig 1). Lower-rank police officers were predominant (79.5 % Vs. 20.5 %) and were posted in non-metropolitan cities. Compared to female police officers, a higher percentage of male police officers were overweight (39% Vs. 21 %), current smokers (46.7 % Vs. 0.3%), and alcohol drinkers (46.7 % Vs. 6.6 %).

The overall age-adjusted prevalence of metabolic syndrome among active-duty police officers aged 35 to 59 years old was 39.4 % (40.9% male and 14.3 % female) (Table 2) which in comparison to the Thai general population (27.8 %)[6], was significantly high (Fig 2). However, on the gender-based comparison, the prevalence of metabolic syndrome was significantly higher in male police officers compared to males in the general population (40.65% Vs. 23.80%, p<0.001) but significantly lower in female officers compared to females in the general population for all age groups (16.30% Vs. 31.59%, p<0.001) (Fig 2).

Prevalence of MetS increased by age in both genders (male, 32.7%, female, 8.9% in the age group of 35-39 years to male 50.9% and female 23.9% in age group of 55-59 years). The prevalence of MetS in police officers increased with age to a greater degree due to its prevalence among male police officers compared to the general population. The highest common abnormal metabolic component was high BP, whereas the lowest common was low HDL for both genders (Table 2). The prevalence of low HDL and high WC was significantly higher among females compared to male police officers (low HDL 15% Vs. 11.6%; high WC 27.7% Vs. 19.3%, p <0.001), whereas high BP, high TG, and high FG was observed in male police officers (high BP 67.4% Vs. 33.3 %; high TG 54.7% Vs. 17%; high FG 36.6% Vs. 16.3%, p< 0.001).

Table 3 shows a multivariable analysis of crude and adjusted factors associated with the prevalence of MetS in men and women. The factors included were age range, pulse pressure, gender, rank, location (metropolitan or non-metropolitan), and alcohol consumption. After controlling for potential confounding factors in the multivariable analysis, increasing age, pulse pressure above 45, male gender, lower rank, non-metropolitan location, and alcohol drinking were positively associated with MetS. Male police officers had approximately triple more risk of MetS compared to female police officers (OR 2.59, 95% CI 2.30 - 2.92, p < 0.001). Police officers at lower-ranking posts had an additional odds of getting MetS compared to the police officers at higher-ranking posts (OR 1.17, 95% CI 1.12 - 1.22, p < 0.001). The MetS risk doubled when the pulse pressure increased to more than 55 (OR 2.24, 95% CI 2.10 - 2.40, p < 0.001). Compared to Metropolitan police officers, non-metropolitan police officers had a higher risk of MetS (OR 1.25, 95% CI 1.17 -1.34, p < 0.001). Alcohol drinking was significantly associated with MetS (OR 1.29, 95% CI 1.25 - 1.34, p < 0.001).

DISCUSSION

This is the first study conducted in Thailand reporting the findings indicating a high prevalence of MetS in active-duty police officers aged between 35 to 59 years at 39.24%. Erstwhile studies conducted on the prevalence of MetS among police officers vary according to the countries and populations under study. The predominance of MetS in this study was approximately similar to Brazilian police officers (38.54%)[31] but higher than in Iowa, US police officers (27.5%), with a higher cut-off point for abdominal obesity.[32] A study in Japan, using a higher FG cut-off point, reported a prevalence of MetS of 25% in the police officers of the age group of 45-59 years which was lower than our study (45% in the same age group).[33] Studies from India reported varying prevalence of MetS among police officers, 16.8% in Kerala[34] and 57.3% in Chennai[16], India. The difference in MetS prevalence between countries may be due to race-specific diagnostic criteria for MetS.

Compared to the prevalence of MetS in the Thai general population, specifically among those in the age range from 35 to 59[6], the overall age-standardized prevalence of Mets was significantly higher in Thai police officers (39.24% Vs. 27.82%, p<0.001). Nevertheless, MetS was substantially higher in male officers (40.65% Vs. 23.80%) but lower in female officers (16.30% Vs. 31.59%), and the overall prevalence of MetS in police officers increased with age more remarkably than in the general population. This finding was consistent with previous studies in India, Indonesia, and China comparing

TABLE 1. Baseline characteristics of Thai police officers aged ≥ 35 years according to gender.

Parameters	Male, n (%)	Female, n (%)	Total, n (%)	P value
Total	101,846 (94.4)	6,087 (5.6)	107,933 (100)	<0.001
Age, years, mean (SD)	46.3 ± 0.02	46.2 ± 0.02	43.6 ± 0.08	<0.001
Age – group, years				
35-39	15216 (14.9)	2004 (32.9)	17220 (15.9)	<0.001
40-44	32316 (31.7)	1671 (27.5)	33987 (31.5)	<0.001
45-49	19767 (19.4)	1315 (21.6)	21082 (19.5)	<0.001
50-54	20889 (20.9)	758 (12.5)	21647 (20.1)	<0.001
55-59	13658 (13.7)	339 (5.6)	13997 (13.0)	<0.001
Body mass index, kg/m^2, mean (SD)	24.9±0.01	23.3 ± 0.05	24.9 ± 0.01	<0.001
Obese (BMI 25 kg/m^2)	46500 (46)	1598 (26)	40658 (45)	<0.001
Waist circumference, cm, mean (SD)	85.80 ± 0.03	77.40 ± 0.12	85.3 ± 0.03	<0.001
Blood pressure, mmHg, mean (SD)				
Systolic blood pressure	133.72 ± 0.05	120.9 ± 0.20	133.0 ± 0.05	<0.001
Diastolic blood pressure	85.2 ± 0.04	76.96 ± 0.14	84.7 ± 0.04	<0.001
Mean arterial pressure	101.4 ± 0.04	91.60 ± 0.15	100.8 ± 0.04	<0.001
Pulse Pressure	48.5 ± 0.04	43.9 ± 0.13	48.3 ± 0.04	<0.001
Total Cholesterol, mg/dL, mean (SD)	227.5 ± 0.15	215.9 ± 0.53	226.9 ± 0.14	<0.001
Triglycerides, mg/dL, mean (SD)	204.7 ± 0.54	108.1 ± 0.86	199.3 ± 0.51	<0.001
HDL cholesterol, mg/dL, mean (SD)	53.3 ± 0.04	65.5 ± 0.20	54.0 ± 0.04	<0.001
LDL cholesterol, mg/dL, mean (SD)	136.7 ± 0.14	128.4 ± 0.46	136.3 ± 0.13	<0.001
Glucose, mg/dL, mean (SD)	102.9 ± 0.11	91.4 ± 0.26	102.3 ± 0.11	<0.001
Smoking	26590 (26.1)	19 (0.3)	26609 (24.7)	<0.001
Alcohol drinking	47567 (46.7)	404 (6.6)	47971 (44.5)	<0.001
Rank				
High (Commissioned)	19,665 (19.3)	2494 (41.0)	22159 (20.5)	<0.001
Low (Non-Commissioned)	82,181 (80.7)	3593 (59.0)	85774 (79.5)	<0.001
Duty location				
Metropolitan city	11606 (11.4)	2987 (49.0)	14593 (13.5)	<0.001
Non-Metropolitan city	90240 (88.6)	3100 (51.0)	93340 (86.5)	<0.001

Abbreviations: BMI= body mass index; HDL= high density lipoprotein; LDL= low density lipoprotein
**Figures in bracket indicate percentage

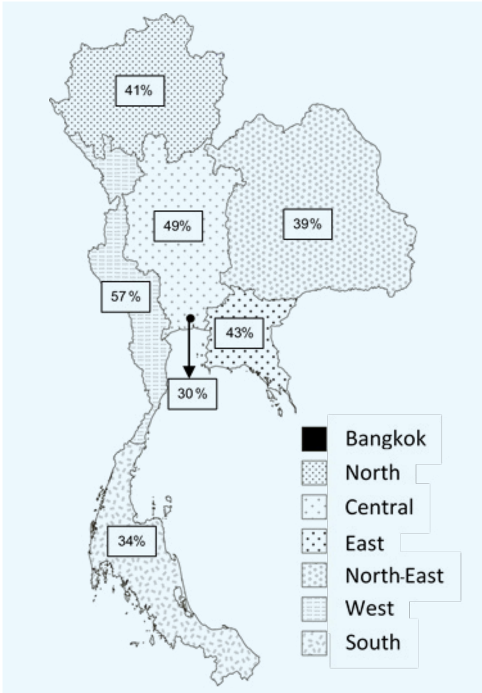

Fig 1. Age-adjusted prevalence of Metabolic Syndrome in percentage (%) by regions in Thailand

TABLE 2. Age-adjusted prevalence of metabolic syndrome and abnormal metabolic components among Thai police officers aged ≥ 35 years.

MetS and its components	Total, n (%)	Age group, n (%) 35-39	40-44	45-49	50-54	55-59	P for trend
Men	101846 (100)	15216 (14.9)	32316 (31.7)	19767 (19.4)	20889 (20.5)	13658 (13.4)	-
MetS	41671 (40.9)	4979 (35.7)	11529 (32.7)	8147 (41.2)	10065 (48.2)	6951 (50.9)	<0.001
WC > 90 cm	19663 (19.3)	2357 (19.7)	5499 (21.3)	3754 (23.7)	4657 (29.6)	3396 (32.5)	<0.001
High BP	68593 (67.4)	8996 (59.1)	20194 (62.5)	13186 (66.7)	15583 (74.6)	10634 (77.9)	<0.001
TG>150 mg/dl	55755 (54.7)	7537 (49.5)	16329 (50.5)	11561 (58.5)	12507 (59.9)	7821 (57.3)	<0.001
HDL<40 mg/dl	11796 (11.6)	1664 (10.9)	3579 (11.1)	2217 (11.2)	2559 (12.3)	1777 (13)	<0.001
FG>100 mg/dl	37281 (36.6)	4175 (27.5)	9954 (30.8)	6889 (34.9)	9417 (45.1)	6846 (50.2)	<0.001
Women	6087 (100)	2004 (32.9)	1671 (27.5)	1315 (21.6)	758 (12.5)	339 (05.6)	-
MetS	873 (14.3)	178 (8.9)	217 (13)	232 (17.6)	165 (21.8)	81 (23.9)	<0.001
WC > 80 cm	1684 (27.7)	464 (26.5)	426 (30.1)	371 (33.2)	273 (40.1)	150 (49.3)	<0.001
High BP	2027 (33.3)	494 (24.7)	519 (31.1)	505 (38.4)	356 (47)	153 (45.1)	<0.001
TG>150 mg/dl	1035 (17.0)	275 (13.7)	228 (13.6)	289 (22)	172 (22.7)	71 (20.9)	<0.001
HDL<50mg/dl	911 (15.0)	274 (13.7)	271 (16.2)	214 (16.3)	103 (13.6)	49 (14.5)	0.61
FG>100 mg/dl	995 (16.3)	226 (11.3)	257 (15.4)	240 (18.3)	176 (23.2)	96 (28.3)	<0.001

Abbreviations: MetS= Metabolic syndrome; WC= waist circumference; BP= blood pressure; TG= triglyceride; HDL= high density lipoprotein; FG= fasting glucose
** Figures in bracket indicate percentage

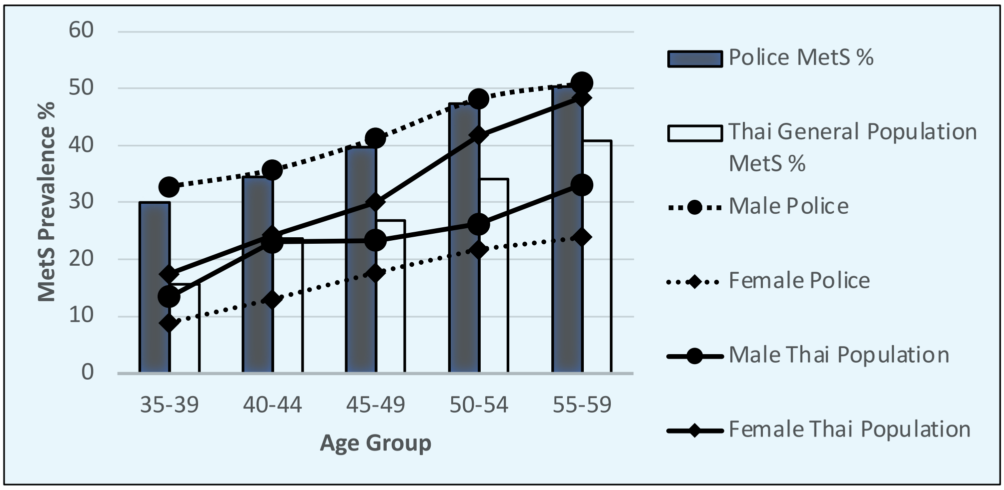

Fig 2. Age-adjusted and gender based prevalence of MetS between Thai police officers and Thai general (NHES 4) population.
Abbreviations: MetS = Metabolic syndrome; NHES= National Health Examination Survey

TABLE 3. The crude and age adjusted odds ratio (OR) with 95% confidence interval (CI) of socio-demographic characteristics and physical activity level on the risk of metabolic syndrome using multivariable logistic regression model.

Variables	Crude OR (95 % CI)	P value	Adjusted OR (95 % CI)	P value
Age (year)				
35-39	1 (-)	-	1 (-)	-
40-44	1.24 (1.19, 1.29)	<0.001	1.18 (1.13, 1.24)	<0.001
45-49	1.54 (1.48, 1.61)	<0.001	1.37 (1.30, 1.44)	<0.001
50-54	2.1 (2.01, 2.19)	<0.001	1.69 (1.60, 1.79)	<0.001
55-59	2.36 (2.25, 2.47)	<0.001	1.84 (1.73, 1.96)	<0.001
Pulse Pressure				
< 35	1 (-)	-	1 (-)	-
35 – 45	1.03 (0.98, 1.08)	0.304	0.99 (0.93, 1.06)	0.764
46 – 55	1.66 (1.59, 1.75)	<0.001	1.53 (1.43, 1.62)	<0.001
> 55	2.79 (2.66, 2.94)	<0.001	2.24 (2.10, 2.40)	<0.001
Gender				
Male	4.14 (3.85, 4.45)	<0.001	2.59 (2.30, 2.92)	<0.001
Female	1 (-)	-	1 (-)	-
Rank				
Low (Non-commissioned)	1.19 (1.15, 1.23)	<0.001	1.17 (1.12, 1.22)	<0.001
High (Commissioned)	1 (-)	-	1 (-)	-
Province				
Metropolitan	1 (-)	-	1 (-)	-
Non-Metropolitan	1.59 (1.53, 1.65)	<0.001	1.25 (1.17,1.34)	<0.001
Smoking				
Yes	1 (-)	0.002	1 (-)	-
No	1.05 (1.02, 1.08)	-	1.13 (1.09, 1.17)	<0.001
Alcohol drinking				
Yes	1.29 (1.25, 1.33)	<0.001	1.29 (1.25, 1.34)	<0.001
No	1 (-)	-	1 (-)	-

MetS prevalence between police officers and the general population reporting a higher prevalence of MetS among police officers.[19,33-36] A case control study conducted in Japan investigated the prevalence of risk factors for ischemic heart disease (IHD) among police officers and examined its association with working conditions and lifestyles. It demonstrated that the frequency of MetS and the risk factors of IHD increased with age and was more rampant in police officers than in office workers. The higher prevalence of MetS in police officers is likely to be attributed to their sporadic working conditions due to shift work, long working time, and unhealthy behaviors including alcohol drinking[11,13,18,33], which in turn predisposes them to develop MetS at an early age. A further study would be required to clarify the mutual effects about the significant relationship between smoking, sleep habits, work stress, and development of MetS.

A lower prevalence of MetS in female officers compared to the general female population, especially office workers, similar to our study, was seen in a study conducted in Germany[37], possibly due to differences in the job characterized by a more sedentary workload and less physical activity. Nonetheless, the exact mechanism for the difference is beyond the scope of this study.

The prevalence was significantly higher among male police officers compared to female police officers by 2.59-fold. This finding was similar to studies conducted in Taiwan and China[19,38] The gender difference in MetS prevalence is observed in many studies attributing to the complex interplay of effects of female and male sex hormones (such as estrogens, androgens, etc), sex- specific gene expression that determines body fat distribution, and attendant cardiometabolic abnormalities regulated by hormones.[39-42] Therefore leading to a higher risk of MetS in males than in premenopausal females, whereas post menopause, the estrogen decline has implications for a higher risk of MetS in females.[39] In this study, despite the similar mean age of males and females, a higher proportion of younger and lower proportion of older female officers compared to male officers could also explain the gender difference in MetS prevalence (Table 1) attributing to lower percentage of menopause in this study group. The higher percentage of male police officers indulging in alcohol drinking and smoking could also lead to higher MetS pervasiveness in this population.

The most frequent component of MetS found in this study was high BP which was more prevalent in males than females. The study by Thayyil and colleagues also showed that the high prevalence of the police officers with MetS had high BP[34], which was in line with similar findings of another study by Yates and colleagues.[43] High perceived and oxidative stress are instrumental in promoting hypertension in police officers.[44] Arterial stiffening and aging being the crucial factors leading to hypertension[41], a relatively higher percentage of older male police officers in this study could have caused the gender based difference. Other than high BP, high TG in male police officers could be attributed to a higher prevalence of alcohol drinking and extrapolating it to other unhealthy habits and lesser physical activity in this population. High impaired FG or dysglycemia are commonly observed in the male population compared to females like in this study. However, the reason for such a pattern is yet to be elucidated. Gender differences in visceral adiposity, lean muscle mass, altered susceptibility to free fatty acid-induced peripheral insulin resistance, the influence of menopausal transition, and other factor may play a role.[41,45] In the same context, high WC and low HDL percentages among female police officers seen in this study were also observed in a study conducted by Hartley and colleagues[12], which can be explained by sexual dysmorphism in body fat distribution and adipocyte size that correlate with a measure of alteration in lipid metabolism and insulin resistance. Premenopausal females have less visceral fat despite having a higher total body fat, BMI, and abdominal subcutaneous adipose tissue, which is gained with age, whereas visceral adipose tissue increase only in post menopause females.[45,46] That explains higher WC, linear correlation between WC, and transitional age increasing towards menopause among female police officers.

Older age, wider pulse pressure, male sex, low rank, non-metropolitan location, alcohol consumption and smoking are associated with increased risk of MetS in this study, which was consistent with the findings of previous studies.[15,19,35,47-50] Male police officers had significantly increased odds of metabolic syndrome.

Low police rank (Non-commissioned) had a higher risk of developing MetS compared to high police rank (Commissioned). A similar finding was also seen in a study by Fontes and colleagues[51] among corporals who were at higher MetS risk. In a NHES 4 study, women with an education level lower than high school had a 60% additional risk of MetS compared to those with a higher educational level.[6] A study conducted in China showed that compared with those with no education, every category of attained academic level lowered the risk of developing MetS.[52] Lower education levels might contribute to inappropriate lifestyle choices, poor eating habits, and physical inactivity.[6,53,54] A lower level of education and socioeconomic status play a decisive role in increasing cardiometabolic risk factors.[41] This could be related to increased MetS risk among low-rank police officers whose required education level is high school, whereas higher rank requires at least a college degree. A higher percentage of smoking and alcohol drinking among lower ranked or non-commissioned police officers may also lead to the difference observed. Another factor influencing higher prevalence in lower ranked police officers could be job descriptions related to shift work disorder leading to sleep deprivation, unhealthy food intake, limited physical activity, drinking, and smoking. The available data suggest that hormonal profiles, coagulatory mediators and autonomic functioning inflammatory are all altered during uncontrolled sleep deprivation, which contributes to the development of atherosclerosis and cardiovascular disease.[10,55,56] However, further investigation regarding the causal relationship is warranted.

The findings of this study reveal that this occupational group of people experiences an increased risk for cardiovascular disease and diabetes, challenging the general notion that police officers constitute a physically fit and healthy population.

There were 19% female and 30.6% male police officers that had "pre-MetS" (2 components of MetS), implicating a significant population at risk of MetS. More than 60% of police officers indulged in drinking alcohol. These findings call for more precise interventions focusing on the detection and treatment of MetS, including health promotion strategies to reduce the incidence of CVD, disability, and death among police officers.

Although the advantage of this study was its large sample size, there were some limitations. Considering the low recruitment percentage of police officers (60%), the study population may not represent the entire Thai police officer population. Data regarding alcohol consumption and smoking was self-reported and may be bias. There were missing or incomplete sociodemographic data, therefore, had to be removed from the study. Other contributors to MetS, including physical inactivity, sleep deprivation, work stress, and low job satisfaction were not assessed. A further in-depth study on associated lifestyle and environmental factors is recommended. This cross-sectional study compared the different burden of MetS using data from the health examination survey of police personnel and the general population during the different year. MetS has become more common among the general Thai community over time therefore this could be one of the limitations of the study findings.

CONCLUSION

The prevalence of MetS is high among Thai police officers compared to the general Population, and the syndrome affects a substantial proportion of male than female police officers in the same age group. Increased risk of MetS among police officers included lower rank, being in a non-metropolitan city, smoking, and drinking alcohol. Therefore, preventive health promotion and treatment programs should be established along with strategic goals to improve the overall health of individual police officers to alleviate adverse cardiovascular outcomes.

ACKNOWLEDGEMENTS

First, I would like to thank the Director General of Police General Hospital for permitting me to conduct this research. Second, my sincere thanks to Dr. Supalerk Pattanaprichakul and Dr. Robert DuBroff for their valuable time and guidance in completing this research paper. Last but not the least, I would like to thank Somchai Wutinarongtrakul MD, Ucharamont Buranasompop , Police Health Care Center, and Pornpen Bunnag MD, Family Medicine Department Police General Hospital Bangkok, Thailand, for their assistance in this research.

REFERENCES

1. Mottillo S, Filion KB, Genest J, Joseph L, Pilote L, Poirier P, et al. The metabolic syndrome and cardiovascular risk: A systematic review and meta-analysis. J Am Coll Cardiol 2010;56:1113-32. https://doi.org/10.1016/j.jacc.2010.05.034.
2. Grundy SM. Metabolic syndrome pandemic. Arterioscler Thromb Vasc Biol 2008;28:629-36. https://doi.org/10.1161/ATVBAHA.107.151092.
3. Moore JX, Chaudhary N, Akinyemiju T. Metabolic syndrome prevalence by race/ ethnicity and sex in the united states, national health and nutrition examination survey, 1988-2012. Prev Chronic Dis 2017;14:E24. https://doi.org/10.5888/pcd14.160287.
4. Ranasinghe P, Mathangasinghe Y, Jayawardena R, Hills AP, Misra A. Prevalence and trends of metabolic syndrome among adults in the asia-pacific region: a systematic review. BMC Public Health 2017;17:101. https://doi.org/10.1186/s12889-017-4041-1.
5. Scuteri A, Laurent S, Cucca F, Cockcroft J, Cunha PG, Mañas LR, et al. Metabolic syndrome across Europe: Different clusters of risk factors. Eur J Prev Cardiol 2015;22:486-91. https://doi.org/10.1177/2047487314525529.
6. Aekplakorn W, Kessomboon P, Sangthong R, Chariyalertsak S, Putwatana P, Inthawong R, et al. Urban and rural variation in clustering of metabolic syndrome components in the Thai population: Results from the fourth National Health Examination Survey 2009. BMC Public Health 2011;11:854. https://doi.org/10.1186/1471-2458-11-854.
7. Aekplakorn W, Chongsuvivatwong V, Tatsanavivat P, Suriyawongpaisal P. Prevalence of metabolic syndrome defined by the International Diabetes Federation and National Cholesterol Education Program criteria among Thai adults. Asia-Pacific J Public Heal 2011;23:792-800. https://doi.org/10.1177/1010539511424482.
8. Suriyawongpaisal P. Cardiovascular risk factor levels in urban and rural Thailand - The International Collaborative

Study of Cardiovascular Disease in Asia (InterASIA). Eur J Cardiovasc Prev Rehabil 2003;10:249-57. https://doi.org/10.1097/00149831-200308000-00006.
9. Garbarino S, Magnavita N. Sleep problems are a strong predictor of stress-related metabolic changes in police officers. A prospective study. PLoS One 2019;14(10):e0224259. https://doi.org/10.1371/journal.pone.0224259.
10. Violanti JM, Burchfiel CM, Hartley TA, Mnatsakanova A, Fekedulegn D, Andrew ME, et al. Atypical work hours and metabolic syndrome among police officers. Arch Environ Occup Heal 2009;64:194-201. https://doi.org/10.1080/19338240903241259.
11. da-Silva CAC, Leite AL, Moreira JA, Abreu DDC, Oliveira PE de A, Nunes DP, et al. Association of dyslipidemia, hypertension and overweight/obesity with work shift and duration of employment among police officers in a small town in Northeastern Brazil. Rev Bras Med Do Trab Publicacao Of Da Assoc Nac Med Do Trab 2019;17:537-44. https://doi.org/10.5327/Z1679443520190401.
12. Hartley TA, Fekedulegn D, Knox SS, Burchfiel CM, Andrew ME, Violanti JM. Associations between police officer stress and the metabolic syndrome. Int J Emerg Ment Health 2011;13:243-56.
13. Chang JH, Huang PT, Lin YK, Lin CE, Lin CM, Shieh YH, et al. Association between sleep duration and sleep quality, and metabolic syndrome in Taiwanese police officers. Int J Occup Med Environ Health 2015;28:1011-23. https://doi.org/10.13075/ijomeh.1896.00359.
14. Violanti JM, Hartley TA, Charles LE, Fekedulegn D, Andrew ME, Mnatsakanova A, et al. Police trauma and cardiovascular disease: Association between PTSD symptoms and metabolic syndrome. Int J Emerg Ment Health 2006;8:227-38.
15. Rostami H, Tavakoli HR, Rahimi MH, Mohammadi M. Metabolic Syndrome Prevalence among Armed Forces Personnel (Military Personnel and Police Officers): A Systematic Review and Meta-Analysis. Mil Med 2019;184:e417-25. https://doi.org/10.1093/milmed/usz144.
16. Chandramohan P, Mohan V. High prevalence of diabetes and metabolic syndrome among policemen. J Assoc Physicians India 2008;56:837-8.
17. Tharkar S, Kumpatla S, Muthukumaran P, Viswanathan V. High prevalence of metabolic syndrome and cardiovascular risk among police personnel compared to general population in India. J Assoc Physicians India 2008;56:845-9.
18. Hong JH, Lee S-W. A Study on the Prevalence and Influencing Factors of Metabolic Syndrome among Police Officers. J Korean Soc Occup Environ Hyg 2014;24:566-77. https://doi.org/10.15269/jksoeh.2014.24.4.566.
19. Zhang J, Liu Q, Long S, Guo C, Tan H. Prevalence of metabolic syndrome and its risk factors among 10,348 police officers in a large city of China: A cross-sectional study. Med (United States) 2019;98(40):e17306. https://doi.org/10.1097/MD.0000000000017306.
20. Nillakupt K, Viravathana N. A survey of metabolic syndrome and its components in Thai medical cadets. J Med Assoc Thai 2010;93 Suppl 6:S179-85.
21. Napradit P, Pantaewan P, Nimit-arnun N, Souvannakitti D, Rangsin R. Prevalence of overweight and obesity in Royal Thai Army personnel. J Med Assoc Thai 2007;90:335-40.
22. National Statistical office, National Statistical Office Thailand, Technology M of I and communication. Key Statistics of Thailand 2012. 2012.
23. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Heal Organ - Tech Rep Ser 2000;894:253.
24. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical Practice Guidelines for the Management of Hypertension in the Community: A Statement by the American Society of Hypertension and the International Society of Hypertension. J Clin Hypertens (Greenwich) 2014;16(1):14-26. https://doi.org/10.1111/jch.12237.
25. Knopfholz J, Disserol CCD, Pierin AJ, Schirr FL, Streisky L, Takito LL, et al. Validation of the friedewald formula in patients with metabolic syndrome. Cholesterol 2014;2014:261878. https://doi.org/10.1155/2014/261878.
26. Certified AS, Cholesterol LDL. Cholesterol Reference Method Laboratory Network List of Analytical Systems Certified for LDL Cholesterol 2010;186:1-9.
27. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome: A joint interim statement of the international diabetes federation task force on epidemiology and prevention; National heart, lung, and blood institute; American heart association; World heart federation; International atherosclerosis society; And international association for the study of obesity. Circulation 2009;120:1640-5. https://doi.org/10.1161/CIRCULATIONAHA.109.192644.
28. Shiwaku K, Nogi A, Kitajima K, Anuurad E, Enkhmaa B, Yamasaki M, et al. Prevalence of the metabolic syndrome using the modified ATP III definitions for workers in Japan, Korea and Mongolia. J Occup Health 2005;47:126-35. https://doi.org/10.1539/joh.47.126.
29. Lohsoonthorn V, Lertmaharit S, Williams MA. Prevalence of metabolic syndrome among professional and office workers in Bangkok, Thailand. J Med Assoc Thai 2007;90:1908-15.
30. National Statistical Office Thailand, Ministry of Information and communication technology. The Population And Housing Census 2010. http://service.nso.go.th/nso/nso_center/project/search_center/23project-en.htm.
31. Filho RTB, D'Oliveira A. The Prevalence of Metabolic Syndrome Among Soldiers of the Military Police of Bahia State, Brazil. Am J Mens Health 2014;8:310–5. https://doi.org/10.1177/1557988313510928.
32. Yoo H. Assessment of contributors to the metabolic syndrome among law enforcement officers. ProQuest Diss Theses 2011:116.
33. Shiozaki M, Miyai N, Morioka I, Utsumi M, Koike H, Arita M, et al. Assessment of the risk of ischemic heart disease and its relevant factors among Japanese police officers. Sangyo Eiseigaku Zasshi 2013;55(4):115-24. https://doi.org/10.1539/sangyoeisei.B12007.
34. Thayyil J, Jayakrishnan TT, Raja M, Cherumanalil JM. Metabolic syndrome and other cardiovascular risk factors among police officers. N Am J Med Sci 2012;4:630-5. https://doi.org/10.4103/1947-2714.104313.
35. Tharkar S, Kumpatla S, Muthukumaran P, Viswanathan V. High prevalence of metabolic syndrome and cardiovascular risk among police personnel compared to general population in India. J Assoc Physicians India 2008;56:845-9.
36. Febyan ., Wetarini K, Rendy ., Thintarso CS, Suastika K. A Clinical Profile of Metabolic Syndrome and Its Determinants among Police Officers in Bali. Eur J Med Heal Sci 2020;2. https://doi.org/10.24018/ejmed.2020.2.6.619.

37. Strauss M, Foshag P, Brzek A, Vollenberg R, Jehn U, Leischik R. Metabolic syndrome in female police officers and female office workers: A cross-sectional study in occupations with different physical activities. Diabetes, Metab Syndr Obes Targets Ther 2020;13:3487-95. https://doi.org/10.2147/DMSO.S267948.
38. Wang WY, Li CH, Wu YS, Chien WC, Wang KY, Tzeng WC. Gender Differences in the Prevalence of Metabolic Syndrome Among Taiwanese Air Force Personnel: A Population-Based Study. J Cardiovasc Nurs 2020;35:502-11. https://doi.org/10.1097/JCN.0000000000000714.
39. Vona R, Gambardella L, Straface E. Gender-Associated Biomarkers in Metabolic Syndrome. Carotid Artery - Gend. Heal. [Working Title], IntechOpen; 2018. https://doi.org/10.5772/intechopen.81103.
40. Ventura-Clapier R, Dworatzek E, Seeland U, Kararigas G, Arnal J-F, Brunelleschi S, et al. Sex in basic research: concepts in the cardiovascular field. Cardiovasc Res 2017;113:711-24. https://doi.org/10.1093/cvr/cvx066.
41. Gerdts E, Regitz-Zagrosek V. Sex differences in cardiometabolic disorders. Nat Med 2019;25:1657-66. https://doi.org/10.1038/s41591-019-0643-8.
42. Shungin D, Winkler TW, Croteau-Chonka DC, Ferreira T, Locke AE, Mägi R, et al. New genetic loci link adipose and insulin biology to body fat distribution. Nature 2015;518:187-96. https://doi.org/10.1038/nature14132.
43. Yates JD, Aldous JWF, Bailey DP, Chater AM, Mitchell ACS, Richards JC. The prevalence and predictors of hypertension and the metabolic syndrome in police personnel. Int J Environ Res Public Health 2021;18(13):6728. https://doi.org/10.3390/ijerph18136728.
44. Janczura M, Rosa R, Dropinski J, Gielicz A, Stanisz A, Kotula-Horowitz K, et al. The associations of perceived and oxidative stress with hypertension in a cohort of police officers. Clin Cosmet Investig Dermatol 2021;14:1783-97. https://doi.org/10.2147/DMSO.S298596.
45. Pradhan AD. Sex Differences in the Metabolic Syndrome: Implications for Cardiovascular Health in Women 2013. https://doi.org/10.1373/clinchem.2013.202549.
46. Lovejoy JC, Champagne CM, De Jonge L, Xie H, Smith SR. Increased visceral fat and decreased energy expenditure during the menopausal transition. Int J Obes 2008;32:949-58. https://doi.org/10.1038/ijo.2008.25.
47. Trivedi T, Liu J, Probst JC, Martin AB. The Metabolic Syndrome: Are Rural Residents at Increased Risk? J Rural Heal 2013;29:188-97. https://doi.org/10.1111/J.1748-0361.2012.00422.X.
48. Atanasova G, Yordanova - Laleva P, Marinov MA. Metabolomics and biomarkers. Clin Chem Lab Med 2017;55:22-5. https://doi.org/10.1515/cclm-2017-7062.
49. Kwon YJ, Chung TH, Shim JY, Lee YJ. The association of pulse pressure with metabolic syndrome in Korean elderly: A nationwide population-based study. Diabetes Res Clin Pract 2017;123:75-81. https://doi.org/10.1016/J.DIABRES.2016.11.027.
50. Xin S, Feng-shi T, Song Y, Xin S, Feng-shi T, Song Y. Prevalence and influencing factors of metabolic syndrome among police. Chinese Journal of Public Health 2010;26:1376-8. https://doi.org/10.11847/zgggws2010-26-11-16.
51. Santos Fontes IS, Sampaio CG, Dos Santos CG, Sá Barros AMM, Fontes DS, Dos Santos IMC, et al. Síndrome metabólica em militares de uma unidade da polícia de Aracaju, Sergipe. Sci Med (Porto Alegre) 2016;26:24160. https://doi.org/10.15448/1980-6108.2016.3.24160.
52. Li Y-Q, Zhao L-Q, Liu X-Y, Wang H-L, Wang X-H, Li B, et al. Prevalence and distribution of metabolic syndrome in a southern Chinese population. Relation to exercise, smoking, and educational level. Saudi Med J 2013;34:929–36.
53. (US) NC for HS. Health, United States, 2011. Heal United States, 2011 With Spec Featur Socioecon Status Heal 2012.
54. Cathal Doyle, Paul Kavanagh, Owen Metcalfe TL. Health Impacts of Employment a review Prepared by. 2005.
55. Mullington JM, Haack M, Toth M, Serrador JM, Meier-Ewert HK. Cardiovascular, Inflammatory, and Metabolic Consequences of Sleep Deprivation. Prog Cardiovasc Dis 2009;51:294-302. https://doi.org/10.1016/j.pcad.2008.10.003.
56. van Leeuwen WMA, Lehto M, Karisola P, Lindholm H, Luukkonen R, Sallinen M, et al. Sleep restriction increases the risk of developing cardiovascular diseases by augmenting proinflammatory responses through IL-17 and CRP. PLoS One 2009;4(2):e4589. https://doi.org/10.1371/journal.pone.0004589.