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Prevalence of metabolic syndrome and its risk factors among 10,348 police officers in a large city of China
A cross-sectional study

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Abstract

The aim of this study was to assess the prevalence of metabolic syndrome (MS) and its risk factors among the police officers in a large city of China.

A cross-sectional study was conducted in 10,348 police officers in 2017 in Changsha, a provincial capital located in central-south China. All participants underwent a physical examination to measure the compotents of MS and completed a questionnaire to collect data on potential risk factors. According to the current guidelines of China, MS was defined as the presence of any 3 of the following five traits: abdominal obesity, defined as a waist circumference ≥90 cm in men and ≥85 cm in women; fasting serum triglycerides ≥1.70 mmol/L, or drug treatment for elevated triglycerides; fasting serum high-density lipoprotein cholesterol <1.03 mmol/L, or drug treatment for low high-density lipoprotein cholesterol; blood pressure ≥130/85 mmHg, or drug treatment for elevated blood pressure; fasting plasma glucose ≥6.1 mmol/L, or 2-hour plasma glucose ≥7.8 mmol/L after a 75-g oral glucose load, or drug treatment for elevated blood glucose.

The prevalence of MS was 23.2% (95% confidence interval [CI]: 22.2%–24.2%). The main risk factors associated with MS were older age (odds ratio [OR] 1.546, 95% CI 1.431–1.670), being male (OR 11.256, 95%CI 7.147–17.726), alcohol consumption (OR 1.250, 95% CI 1.070–1.461), and tobacco use (OR 1.398, 95% CI 1.232–1.586). Exercise was associated with decreased risk of MS (OR 0.865, 95% CI 0.755–0.991).

The prevalence of MS was low in the study population. Its risk factors were similar to those identified in the general population of China. Lifestyle intervention is warranted in policemen to reduce the risk of MS and prevent diabetes and cardiovascular disease.

Abbreviations: HDL-C = high-density lipoprotein cholesterol, IDF = International Diabetes Federation, MS = metabolic syndrome.

Keywords: cross-sectional study, metabolic syndrome, police, prevalence, risk factors

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1. Introduction

Metabolic syndrome (MS) is a clinical condition characterized by the co-occurrence of metabolic risk factors for both type 2 diabetes mellitus and cardiovascular disease. Although there are several different definitions for MS, all of them require the presence of at least 3 of the following 5 traits, that is, abdominal obesity, elevated triglycerides, low high-density lipoprotein cholesterol (HDL-C), elevated blood pressure, and elevated blood glucose.[1,2] The prevalence of MS in different countries varied from 17% to 37%.[3–7] MS is associated with increased risk of morbidity and mortality of various diseases.[8–10] For example, a meta-analysis including 87 studies and 951,083 subjects demonstrated that MS was associated with a 2-fold increase in the risk for morbidity and mortality of cardiovascular disease, and a 1.5-fold increase in the risk for all-cause mortality.[9] It was estimated that 5.5% of all-cause mortality and 9.4% of cardiovascular mortality were attributable to MS.[11]

Police is a special occupation involving high workload, high risk, high stress, a physically inactive life, irregular diet and limited choice of food while on duty, overtime and shift work, disrupted sleep patterns, and higher rates of tobacco and alcohol consumption than the general population.[7] Previous studies showed that the mortality of policemen was much higher than that of general populations.[12,13] This is understandable because the intensive nature of police work may lead to many adverse

health outcomes, including MS. For example, studies from Brazil,[14] India,[7] and Korea[15] showed that the prevalence of MS among police officers was higher than that in general populations.

Although some studies have been published to investigate the prevalence of MS among police in China, they are generally limited by such issues as small sample size.[16] We therefore conducted a cross-sectional study with a much larger sample size to obtain a more robust estimate of the prevalence and explore the determinants of MS among Chinese police officers.

2. Method

2.1. Participants

The study was conducted in Changsha, the capital of Hunan province located in central-south China. The city covers a total area of 11,819 km^2 and had a registered population of 7,087,900 in 2017.[17] In 2017, there were 15,560 registered police officers in the city. All of them were invited and 10,348 (representing 66.5% of all) agreed to participate in this study. The study was approved by the Ethics Committee of the Central-South University and all participants gave informed consent to participate in this study.

2.2. Data collection

The participants were invited to undergo a physical examination in the selected hospitals in Changsha, which included general assessments such as height, weight, waist circumference, and blood pressure, and laboratory tests such as measurement of blood glucose and blood lipids. Blood pressure was measured on the right arm with participants being seated, after at least 10 minutes of rest, using a standard mercury sphygmomanometer. The mean of the 2 readings was taken as each individual's blood pressure. Waist circumference was measured with participants wearing light clothing at a level midway between the lower rib margin and iliac crest using tapelines. Fasting plasma glucose was determined using the glucose oxidase method. Serum triglycerides were measured enzymatically after hydrolyzation of glycerol. HDL-C was measured after the precipitation of other lipoproteins with heparin manganese chloride mixture. The participants were also asked to complete a face-to-face, anonymous questionnaire that was aimed to collect demographic and lifestyle information, such as age, sex, the category of police (front-line vs. second-line), physical activity, smoking, and alcohol consumption.

2.3. Definition of MS

According the current guidelines in China, MS was defined as the presence of any 3 of the following 5 traits:[8] abdominal obesity, defined as a waist circumference ≥90 cm in men and ≥85 cm in women; fasting serum triglycerides ≥1.70 mmol/L, or drug treatment for elevated triglycerides; fasting serum HDL-C <1.03 mmol/L, or drug treatment for low HDL-C; blood pressure ≥130/85 mmHg, or drug treatment for elevated blood pressure; fasting plasma glucose ≥6.1 mmol/L, or 2-hour plasma glucose ≥7.8 mmol/L after a 75-g oral glucose load, or drug treatment for elevated blood glucose. In sensitivity analysis, the criteria proposed by the International Diabetes Federation (IDF) criteria were used to estimate the prevalence of MS.[1]

2.4. Statistical analysis

The data were double-checked for validity by 2 investigators and then entered into SPSS software, version 22.0 (SPSS Inc, Chicago, IL). The mean and standard deviations were estimated for continuous variables such as age. The composition of each category of independent variables and the prevalence of each component of MS were calculated. The distribution of MS across different groups defined by the independent variables (i.e., the potential risk factors) was compared through χ^2 tests. Multivariate logistic regression analysis was conducted to evaluate the independent effects of the potential risk factors on MS.

3. Results

A total of 10,348 police officers were included in this study, with a mean age of 42.60±12.13 years, 86.0% being male, and 70.5% working at front line, 63% smoking, 16.4% had a habit of drinking alcohol, and 27.9% exercised for more than 150 minutes per week (Table 1). Table 2 presents the prevalence of each different component of MS. The most prevalent component was elevated triglycerides (40.8%), followed by elevated blood pressure (38.2%) and abdominal obesity (25.7%). The number of participants with data on all five components of MS available was 6833. These participants were included for the subsequent analyses of prevalence and risk factors of MS.

Table 3 shows the proportions of participants positive for different numbers of MS components. The proportions of participants positive for 3, 4, and 5 components were 16.0%, 6.2%, and 1.0%, respectively, giving a total prevalence of MS of 23.2% (95% CI 22.2%–24.2%). Sensitivity analysis by using the IDF definition for MS yielded a prevalence of 15.1% (95% CI 14.3%–16.0%). Table 4 shows the distribution of MS in subgroups defined by basic characteristics of participants. The prevalence of MS varied with age, sex, category, smoking, and alcohol consumption, but appeared to be similar between those exercised for ≥150 minutes per week and those did not. Table 5 shows the results of multiple logistic regression analysis. Older age, being male, smoking, and alcohol consumption were

Table 1

Characteristics of the 10348 police officers included in this study.

Characteristics	N (%)
Age (N=10,348)	
<35	3749 (36.2)
35-	3622 (35.0)
≥50	2977 (28.8)
Sex (N=10,348)	
Male	8899 (86.0)
Female	1449 (14.0)
Category (N=10,348)	
Front line	7293 (70.5)
Second line	3055 (29.5)
Smoking (N=10,341)	
Yes	6524 (63.0)
No	3817 (36.9)
Alcohol consumption (N=8878)	
Yes	1456 (16.4)
No	7422 (83.6)
Exercise ≥150 minutes per week (N=8875)	
Yes	2472 (27.9)
No	6403 (72.1)

Table 2

Prevalence of each component of metabolic syndrome.

Components	No. of participants included for analysis	No. of participants positive for the component	Prevalence (95% CI)
Abdominal obesity	7260	1868	25.7 (24.7–26.7)
Elevated triglycerides	10,111	4121	40.8 (39.8–41.7)
Low HDL-C	10,141	1724	17.0 (16.3–17.7)
Elevated blood pressure	10,348	3953	38.2 (37.3–39.1)
Elevated blood glucose	10,092	1556	15.4 (14.7–16.1)

CI = confidence interval, HDL-C = high-desity lipoprotein cholesterol.

Table 3

The proportions of participants positive for different numbers of metabolic syndrome components (N = 6833).

No. of positive components	No. of participants	Proportion (95% CI)
0	1850	27.1 (26.0–28.1)
1	1747	25.6 (24.5–26.6)
2	1651	24.1 (23.1–25.2)
3	1090	16.0 (15.1–16.8)
4	424	6.2 (5.6–6.8)
5	71	1.0 (0.8–1.3)

CI = confidence interval.

associated with increased risk of MS, whereas exercise was associated with decreased risk of MS.

As 3515 participants were excluded from the above analyses of prevalence and risk factors, the basic characteristics of them and those included in the analyses were compared to investigate potential selection bias (Table 6). The results showed that the participants included for analyses were younger and had a higher proportion of male than those excluded.

4. Discussion

Previous studies showed that the prevalence of MS ranged from 16% to 58%.[7,14,18,19] The prevalence of MS in police officers was 23.2% in this study, which is similar to the results from the United States but much lower than those of Brazil and India.[7,14,18,19] The different prevalence rates could be because of various reasons. For example, compared with the present study, the mean age was higher in a study from Brazil that reported a higher prevalence of MS.[14] Different criteria for MS may also lead to the difference in prevalence. For example, in the present study, the prevalence of MS defined by IDF criteria was much lower than that based on the current guidelines of China (15.1% vs 23.2%).

A previous study from India found that the prevalence of MS was significantly higher in police (57.3%) than in the general population (28.2%), and attributed the difference to the more unhealthy lifestyle in policemen such as the much higher proportion of alcohol consumption.[7] In this study, no direct comparison between policemen and general population was made, but the prevalence of MS (23.2%) seems to be close to that in China's general population (24.5%) as estimated by previous studies.[6] This similarity is difficult to explain based on the available information because the prevalence of smoking and the proportion of male, both associated with increased risk of MS, were much higher in this study than in the general population. Thus, the exact mechanism underlying the observation remains to be investigated.

Male sex, older age, smoking, and alcohol consumption were found to be associated with increased risk of MS in this study,

Table 4

Distribution of metabolic syndrome in subgroups defined by basic characteristics of participants.

Characteristics	No. of participants	No. of participants with metabolic syndrome	Prevalence (%) (95% CI)	P value for χ^2 test
Age				
<35	3013	518	17.2 (15.8–18.5)	<.001
35–49	2165	531	24.5 (22.7–26.3)	
≥50	1655	536	32.4 (30.1–34.6)	
Sex				
Male	5976	1552	26.0 (24.9–27.1)	<.001
Female	857	33	3.9 (2.6–5.1)	
Category				
Front line	4925	1175	23.9 (22.7–25.0)	.04
Second line	1908	410	21.5 (19.6–23.3)	
Smoking				
Yes	2441	744	30.5 (28.7–32.3)	<.001
No	4392	817	18.6 (17.5–19.8)	
Alcohol consumption				
Yes	1201	390	32.5 (29.8–35.1)	<.001
No	5632	1183	21.0 (19.9–22.1)	
Exercise				
Yes	2012	437	21.7 (19.9–23.5)	.22
No	4821	1113	23.1 (21.9–24.3)	

CI = confidence interval.

Table 5

Results of multiple logistic regression analyses to evaluate the independent effects of various factors on metabolic syndrome.

Factors	Odds ratio	95% CI	P
Older age	1.546	1.431–1.670	<.001
Male sex	11.256	7.147–17.726	<.001
Smoking	1.398	1.232–1.586	<.001
Alcohol consumption	1.250	1.070–1.461	.01
Exercise	0.865	0.755–0.991	.04

Table 6

Basic characteristics of the participants included and those excluded in the analyses of metabolic syndrome prevalence and risk factors: a comparison.

Characteristics	Included (n = 6833)	Excluded (n = 3515)	P
Age	40.18 ± 11.78	46.59 ± 11.94	<.001
Sex			
Male	5965 (87.3%)	2921 (83.1%)	<.001
Female	868 (12.7%)	594 (16.9%)	

which was consistent with the findings of previous studies.[4,5,7,16,20] The odds ratio for male sex was particularly high (11.256). Although this might be partly explained by the clustering of lifestyle risk factors in male participants, we suspected that the odds ratio was exaggerated by the confounding caused by some uncontrolled factors. In addition, the big difference in the number of male and female might have caused some problems in the regression analysis. However, we believe it is unlikely that such a strong effect is purely a result of confounding. That male sex is associated with increased risk of MS is likely to be true even if all potential bias is removed.

Compared with previous studies conducted in policemen, particularly those from China, this study had a much larger sample size. However, it also has some limitations. First, because of incomplete data, some participants were excluded in the analyses of prevalence and risk factors of MS. A comparison of the basic characteristics between those included and those excluded showed that the included ones had a younger mean age and a higher proportion of male. As shown in Table 5, younger age was associated with a lower risk of MS, whereas male sex was associated with a higher risk. However, the association between male sex and MS was much stronger than that between age and MS. Thus, the prevalence of MS calculated on the basis of the included participants might have been overestimated. Second, the temporal order between lifestyle factors and MS was unclear given the cross-sectional nature of this study, which may undermine the validity of causal inference based on the results of regression analyses. Future prospective studies can help verify our findings.

5. Conclusion

The prevalence of MS was low in the study population. Its risk factors were similar to those identified in the general population of China. Lifestyle intervention is warranted in policemen to reduce the risk of MS and prevent diabetes and cardiovascular disease.

Author contributions

Data curation: Sisi Long, Chuhao Guo, Qian Liu.
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