Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Associations of Body Mass Index and Metabolic Indicators with Depression and Anxiety amongPolice Officers: A Cross-Sectional Study

Hangyuan Liang
Guilin People's Hospital
Dong Gao
The First Affiliated Hospital of Guilin Medical University
Limei Li
Guilin People's Hospital
Xiaxian Tan
Guilin People's Hospital
Shenghua Qin
Guilin People's Hospital
Shengxiang Liang
ShengXiangLiang@tmmu.edu.cn

Health Management Centre, The Second Affiliated Hospital of Guilin Medical University

Research Article

Keywords: Police officers, Depression, Anxiety, Body mass index, Metabolic health

Posted Date: November 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11524359/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Associations of Body Mass Index and Metabolic Indicators with Depression and Anxiety among Police Officers: A Cross-Sectional Study

[1]Guilin People's Hospital, Guilin 541001, Guangxi, China

[2]Department of Medical Psychology, The First Affiliated Hospital of Guilin Medical University, Guilin, 541001, Guangxi, China.

[3]Health Management Centre, The Second Affiliated Hospital of Guilin Medical University, Guilin 541199, Guangxi, China.

[4]Guangxi Key Laboratory of Metabolic Reprogramming and Intelligent Medical Engineering for Chronic Diseases, Guilin 541199, Guangxi, China

[1]Hangyuan Liang, 345412440@qq.com
[2]Dong Gao, 251908600@qq.com
[1]Limei Li, mei11132002@126.com
[1]Xiaxian Tan, 820582654@qq.com
[1*]Shenghua Qin, 1197844669@qq.com
[3,4*]Shengxiang Liang, ShengXiangLiang@tmmu.edu.cn

[*]Correspondence

Shengxiang Liang, E-mail: ShengxiangLiang@tmmu.edu.cn

Shenghua Qin, E-mail: 1197844669@qq.com

Abstract

Background: Police officers experience substantial occupational stress and may face considerable psychological and metabolic health burdens. However, the associations between metabolic characteristics and depression and anxiety in this population, and whether metabolic indicators modify the associations between body mass index (BMI) and psychological symptoms, remain unclear.

Methods: This cross-sectional study included 416 on-duty police officers in Guilin, China, recruited using stratified cluster random sampling from municipal, county, prison, and water police units. Depression and anxiety symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) and Generalised Anxiety Disorder-7 (GAD-7), respectively. Anthropometric measurements, blood pressure, fasting glucose, lipid profiles, and serum uric acid were assessed. Binary logistic regression models were used to examine associations between BMI categories and moderate-to-severe depression and anxiety, adjusting for age, sex, and job position. Interaction terms between continuous BMI and individual metabolic indicators were also examined.

Results: Among the 416 participants, 348 (83.65%) were male, and the mean age was 42.97 ± 10.15 years. In unadjusted analyses, overweight was associated with lower odds of anxiety (OR = 0.56, 95% CI: 0.33–0.97, P = 0.04), while obesity was associated with lower odds of depression (OR = 0.32, 95% CI: 0.11–0.95, P = 0.04) and anxiety (OR = 0.36, 95% CI: 0.15–0.86, P = 0.02). After adjustment for age, sex, and job position, obesity remained inversely associated with depression (OR = 0.29, 95% CI: 0.09–0.89, P = 0.03) and anxiety (OR = 0.34, 95% CI: 0.14–0.83, P = 0.02), whereas overweight was not significantly associated with either outcome. Job position was also significantly associated with both outcomes. A significant positive interaction between continuous BMI and blood pressure was observed for anxiety (OR = 1.37, 95% CI: 1.08–1.74, P = 0.01). No significant interactions were found between BMI and the other examined metabolic indicators for anxiety or between BMI and any examined metabolic indicator for depression.

Conclusions: Among police officers, obesity was inversely associated with moderate-to-severe depression and anxiety after adjustment for demographic and occupational factors, whereas overweight was not significantly associated with either outcome. The significant BMI × blood pressure interaction for anxiety, but not depression, suggests that the joint association of BMI and blood pressure with psychological symptoms may differ by outcome. Prospective multicentre studies are needed to validate these findings and clarify the underlying relationships.

Keywords: Police officers; Depression; Anxiety; Body mass index; Metabolic health

Background

Policing is a prototypical high-stress occupation characterised by substantial exposure to organisational and operational stressors. A global systematic review and meta-analysis of 272,463 police personnel from 24 countries reported pooled prevalences of 14.6% for depression and 9.6% for generalised anxiety disorder [1]. Among Chinese police officers, a cross-temporal meta-analysis of 116 studies involving 88,306 officers found a continuous deterioration in mental health since 2000, particularly among male officers, prison police, and those with longer tenure [2]. A meta-analysis of 67 studies similarly reported poorer mental health among Chinese police officers than community norms [3]. Police personnel also experience a substantial metabolic health burden, with systematic review and meta-analytic evidence indicating that approximately 70%–75% are overweight or obese and that metabolic syndrome affects approximately 26% [4,5]. Consistent with these findings, metabolic syndrome was reported in 23.2% of 10,348 Chinese police officers and 26.7% of participants in the Buffalo Cardio-Metabolic Occupational Police Stress (BCOPS) study [6,7]. The coexistence of psychological and metabolic disorders suggests that these conditions may be interconnected in police populations.

Growing evidence supports an association between adiposity, metabolic status, and mental health. In a prospective cohort of 438,483 UK Biobank participants, overweight and obesity were associated with increased risks of depression, anxiety, and sleep disorders, including among individuals with metabolically healthy obesity [8]. Obesity has also been associated with adverse markers of brain health, such as greater white matter hyperintensity volume [9]. Police-specific studies have similarly linked adiposity with depressive symptoms [10]. A study of 87 elite Brazilian police officers found that overweight officers did not show statistically significantly greater anxiety or depression; however, a trend toward higher levels of negative psychological indicators was observed. Length of service was likely a non-negligible contributing factor [11]. Within the BCOPS cohort, higher depressive symptom scores were associated with increased odds of hypertriglyceridaemia, hypertension, and glucose intolerance [12], while a 4-year longitudinal study of 5,867 Chinese police officers found that psychological distress independently predicted incident dyslipidaemia [13]. These findings suggest that the relationship between mental and metabolic health extends beyond a single metabolic component and may differ according to the specific psychiatric outcome.

Several mechanisms may contribute to this relationship, including chronic inflammation, hypothalamic-pituitary-adrenal axis dysregulation, and metabolic disturbances. Metabolomic evidence has identified distinct lipid-related metabolic profiles in individuals with depression [14], while prolonged stress and glucocorticoid dysregulation may promote inflammatory signalling, impaired neuroplasticity, and activation of the kynurenine pathway [15]. Depression and anxiety may nevertheless have distinct metabolic correlates. Anxiety has been linked bidirectionally with hypertension, with obesity potentially mediating part of this association [16,17]. Moreover, BMI may act as an effect modifier rather than simply an independent risk factor, as it has been reported to moderate the relationship between anxiety and depression [18]. These observations support examining BMI together with individual metabolic indicators and their potential interactions when investigating mental health in police personnel.

Despite increasing evidence linking metabolic health to mental health, important gaps remain. Existing police studies have largely focused on single regions or specific occupational

groups and have examined metabolic and psychological variables primarily as independent factors [19]. Although organisational stressors are well recognised determinants of police mental health [20], metabolic characteristics have rarely been incorporated into this framework, and intervention studies have similarly paid limited attention to metabolic factors [21]. Furthermore, few studies have simultaneously considered multiple metabolic indicators, including BMI, blood pressure, glucose, lipids, and uric acid, or examined whether BMI modifies their associations with depression and anxiety. This issue may be particularly relevant to high-stress groups such as prison police, who have shown marked deterioration in mental health over time (2). Whether depression and anxiety exhibit different metabolic profiles and whether BMI modifies their associations with individual metabolic indicators therefore remains unclear.

To address these gaps, the present study adopted a biopsychosocial framework [22] to investigate on-duty police officers in Guilin, China. We examined the associations of BMI, blood pressure, blood glucose, blood lipids, and uric acid with moderate-to-severe depression and anxiety, with particular emphasis on interactions between BMI and individual metabolic indicators. We hypothesised that (1) BMI would be associated with depression and anxiety; (2) BMI would interact with one or more metabolic indicators in relation to these outcomes; and (3) the metabolic profiles associated with depression and anxiety would differ. This study may provide evidence to inform risk stratification and integrated approaches to the physical and mental health of police personnel.

Methods

Study Population

From December 2024 to February 2025, on-duty, permanently employed police officers from public security agencies in Guilin, Guangxi, China, were recruited using a stratified cluster random sampling method. The sampling frame comprised six municipal district public security sub-bureaus, 11 county-level (including county-level city) public security sub-bureaus, two prisons, and one Lijiang River public security sub-bureau (water police). Independent sub-bureaus, prisons, and the water police unit served as sampling units. The sampling frame was stratified into four strata: municipal bureau, county bureau, prison, and water police. One cluster unit was randomly selected from each stratum, yielding four survey sites. Data were collected during routine physical examination periods. On-site questionnaire administration and physiological measurements were performed for eligible officers. A total of 438 questionnaires were distributed, of which 416 were valid, corresponding to a valid response rate of 94.98% (Fig. 1A).

The inclusion criteria were: (1) age 20–64 years; (2) holding a formal police position; (3) ability to independently complete the questionnaire and physical assessments; and (4) voluntary participation with written informed consent.

The exclusion criteria were: (1) use of antidepressants, anxiolytics, sedative-hypnotics, or other psychotropic medications within the previous 3 months; (2) severe somatic diseases, including heart, brain, liver, or kidney disease, or malignant tumours; (3) a previous diagnosis of schizophrenia, bipolar disorder, or other severe mental illness; or (4) inability to participate in the on-site assessment because of extended leave, external assignment, or transfer.

The study was approved by the Ethics Committee of Guilin People's Hospital (Ethics Approval No. City People's Hospital Ethics Fast Review [2025-312KY]). All participants provided written informed consent.

Sample Size Calculation

This cross-sectional observational study used binary logistic regression as the primary analytical method. The significance level was set at $\alpha = 0.05$, with a two-sided test and 80% statistical power ($1 - \beta = 0.80$). Based on previous studies of physical and mental health in occupational populations, an expected odds ratio of approximately 0.50 for the primary BMI exposure and a prevalence of depression or anxiety of approximately 15%–20% were assumed. Under these assumptions, the estimated minimum sample size was 350 participants. The final sample of 416 participants exceeded this estimated requirement. Because the present study was cross-sectional, no loss-to-follow-up adjustment was applied.

Measurements

Trained professional nurses conducted face-to-face assessments of depression and anxiety and collected blood samples using standardised procedures.

Depressive and anxiety symptoms were assessed using the 9-item Patient Health Questionnaire (PHQ-9) [23] and the 7-item Generalised Anxiety Disorder scale (GAD-7) [24], administered in Chinese. The PHQ-9 total score ranges from 0 to 27, with scores of 0–4 indicating minimal or no depressive symptoms, 5–9 indicating mild symptoms, 10–14 indicating moderate symptoms, 15–19 indicating moderately severe symptoms, and 20–27 indicating severe symptoms. The GAD-7 comprises seven items, with a total score ranging from 0 to 21; scores of 0–4 indicate minimal or no anxiety symptoms, 5–9 indicating mild symptoms, 10–14 indicating moderate symptoms, and 15–21 indicating severe symptoms. Both instruments have shown good internal consistency (Cronbach's $\alpha = 0.89$ for the PHQ-9 and 0.92 for the GAD-7) [23,24].

Demographic characteristics, disease history, and medication history were self-reported. Height and weight were measured using standard procedures, and BMI was calculated as weight (kg) divided by height squared (m^2). After sitting and resting, blood pressure was measured using a sphygmomanometer. Participants with elevated blood pressure underwent repeat measurement after at least 30 minutes of rest. Persistent elevation on repeat measurement was considered indicative of hypertension, and the repeat measurement was used in the statistical analysis.

A 3-mL anticoagulated fasting venous blood sample and a 5-mL fasting venous blood sample collected into a procoagulant tube were obtained from each participant. Serum uric acid (SUA), fasting plasma glucose (FPG), total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) were measured using calibrated automated biochemical analysers.

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarised as frequencies and percentages, whereas continuous variables were summarised using appropriate descriptive statistics according to their distribution. All statistical tests were two-sided, and $P < 0.05$ was considered statistically significant. Binary logistic regression was used to examine associations between BMI, metabolic indicators, and the presence of moderate-to-severe depression or anxiety. Given the cross-sectional design, the analyses were interpreted as associations rather than causal effects.

Moderate-to-severe depression and anxiety were defined as PHQ-9 and GAD-7 scores ≥ 10, respectively; participants with scores <10 were classified as non-depressed and non-anxious. These binary variables (1 = score ≥ 10; 0 = score <10) were used as dependent variables in the logistic regression models. BMI was initially examined as the primary exposure. For the main-effect analysis, two hierarchical logistic regression models were constructed for each outcome. Model 1 was unadjusted, whereas Model 2 was adjusted for prespecified demographic confounders.

To examine potential effect modification, interaction terms between continuous BMI and individual metabolic indicators were subsequently introduced into the adjusted models. The metabolic indicators included FPG, TC, TG, LDL-C, HDL-C, blood pressure, and SUA. Each interaction was evaluated in a separate logistic regression model to avoid simultaneously introducing highly correlated metabolic variables into the same model. Thus, separate models were constructed for depression and anxiety for each BMI × metabolic indicator interaction. The statistical significance of effect modification was assessed using the regression coefficient

(B) and corresponding P value for the interaction term. Because multiple interaction tests were performed across two outcomes, these analyses should be regarded as exploratory unless an appropriate multiplicity strategy was prespecified.

Continuous variables included in interaction analyses were mean-centred before construction of the interaction terms to facilitate model estimation and interpretation. Where a significant interaction was identified, the association between BMI and the corresponding mental health outcome was further examined across levels of the interacting metabolic indicator. ** Odds ratios (ORs) and 95% confidence intervals (CIs) were reported for the regression models. The Hosmer-Lemeshow test was used to assess model goodness-of-fit.

Results

Descriptive Characteristics

A total of 416 police officers were included in the analysis. The mean age was 42.97 ± 10.15 years, and 348 participants were male (83.65%) and 68 were female (16.35%). By job position, 208 officers (50.00%) were from municipal bureaus, 106 (25.48%) from county bureaus, 34 (8.17%) were water police, and 68 (16.35%) were prison police (Table 1).

Hierarchical Logistic Regression Analysis

Main Effects of Overweight and Obesity on Depression and Anxiety

BMI was categorised as normal weight, overweight, or obesity, with the normal-weight group used as the reference category in binary logistic regression analyses. In the unadjusted models, overweight was associated with anxiety (OR = 0.56, 95% CI: 0.33–0.97, P = 0.04), whereas obesity was associated with both depression (OR = 0.32, 95% CI: 0.11–0.95, P = 0.04) and anxiety (OR = 0.36, 95% CI: 0.15–0.86, P = 0.02) (Table 2).

After adjustment for age, sex, and job position, the overall depression and anxiety models remained statistically significant ($\chi^2 = 33.18$, $P < 0.001$, Nagelkerke $R^2 = 0.14$; and $\chi^2 = 37.06$, $P < 0.001$, Nagelkerke $R^2 = 0.14$, respectively). Job position was significantly associated with both depression and anxiety (both $P < 0.001$). After adjustment, obesity was inversely associated with both depression (OR = 0.29, 95% CI: 0.09–0.89, P = 0.03) and anxiety (OR = 0.34, 95% CI: 0.14–0.83, P = 0.02), whereas overweight was not significantly associated with either outcome (depression: OR = 0.86, 95% CI: 0.44–1.65, P = 0.64; anxiety: OR = 0.57, 95% CI: 0.31–1.04, P = 0.07). Age and sex were also not significantly associated with either outcome (all $P > 0.05$) (Table 3).

Interaction Models

Separate logistic regression models were constructed to examine interactions between continuous BMI and individual metabolic indicators after adjustment for age, sex, and job position. For anxiety, a significant positive interaction was observed between BMI and blood pressure (OR = 1.37, 95% CI: 1.08–1.74, P = 0.01). The interpretation of this interaction OR depends on the exact blood pressure variable and its units; these should be specified in the Methods and Table 4. No significant interactions were observed between BMI and blood glucose, blood lipids, or uric acid for anxiety (all $P > 0.05$). Similarly, none of the BMI × metabolic indicator interactions was statistically significant for depression (all $P > 0.05$). Although the overall regression models for depression were statistically significant (all $P < 0.001$), this did not indicate that the individual interaction terms were significant (Table 4). The interaction should be interpreted as statistical effect modification, not as evidence that elevated blood pressure itself increases anxiety.

Discussion

Using a biopsychosocial framework (Fig. 1B). [22], the current study examined the associations of BMI and metabolic indicators with depression and anxiety among on-duty police officers in Guilin, China, with particular emphasis on potential interactions between BMI and individual metabolic indicators. Three findings are noteworthy (Fig. 1C). First, job position was significantly associated with both depression and anxiety after adjustment for age and sex. Second, obesity remained inversely associated with both depression and anxiety after adjustment for demographic and occupational factors, whereas the associations for overweight were not statistically significant. Third, a significant interaction between BMI and blood pressure was observed for anxiety, but not depression, whereas no significant interactions were detected between BMI and blood glucose, blood lipids, or uric acid. Our findings are consistent with previous research linking psychological symptoms to metabolic health among police officers, although the inverse associations between obesity and depression and anxiety observed in the present study differ from the positive association between adiposity and depressive symptoms reported previously [12].

Population-based studies have consistently shown that obesity is associated with an elevated risk of depression and, to a lesser extent, anxiety [8,25], whereas the present study found an inverse association after adjustment for demographic and occupational factors. The direction and strength of these associations may vary according to population characteristics, the psychological outcome measures used, and strategies for controlling confounding [25–27]. Several factors may account for this discrepancy. First, the healthy worker effect may contribute: obese officers who remain on active duty may represent a relatively healthy subset, whereas those with more severe obesity-related comorbidities (including psychological problems) may have left frontline positions. Second, BMI does not distinguish fat from lean mass, and in a physically demanding occupation such as policing, higher BMI may partly reflect greater muscle mass and physical fitness rather than excess adiposity, which could be protective against mental health problems [11]. Another possible explanation is that occupational factors may account for part of the observed association between body weight and mental health in police personnel. In the present study, job position remained significantly associated with both outcomes after adjustment for age and sex, suggesting that differences in occupational responsibilities, workload, stress exposure, and organisational support may be relevant to police mental health. Previous systematic reviews have similarly identified lack of organisational support, high job demands, administrative and organisational stress, heavy workloads, and long working hours as important correlates of psychological distress among police personnel [20]. These findings support the importance of considering occupational context when developing mental health strategies for police officers. However, because of the cross-sectional design, the present findings cannot establish that occupational factors are more important than BMI or other metabolic factors in causing depression or anxiety. Meanwhile, BMI may be simultaneously influenced by occupational selection, the healthy survivor effect, disease-related weight changes, lifestyle, and unmeasured psychosocial factors. Future studies should incorporate data on waist circumference, body fat percentage, muscle mass, diet, and physical activity to determine the specific body composition characteristics represented by BMI and to avoid excessive inference about police metabolic risk based solely on BMI.

The significant BMI × blood pressure interaction observed for anxiety but not depression is of particular interest. This finding suggests that, within the present sample, the association between BMI and anxiety may change with blood pressure level. However, because

the interaction analysis was based on cross-sectional data, it cannot be determined whether higher blood pressure is an antecedent or consequence of anxiety, or whether it jointly reflects some unmeasured occupational or behavioral exposure together with BMI. Previous systematic reviews have proposed that police work-related stress may be associated with increased cardiovascular disease risk [28]. Another comparative study of police officers and civilians found that male law enforcement officers had a higher mean BMI than civilians and assessed cardiovascular risk using indicators such as resting blood pressure, cholesterol, and ambulatory blood pressure [29]. Anxiety and hypertension have been reported to have a bidirectional relationship, and obesity may contribute to this association [16,17]. These findings support simultaneously addressing weight, blood pressure, and psychological symptoms in police occupational health management, but they cannot directly prove the biological mechanism of the BMI × blood pressure interaction observed in this study. In the present study, the interaction term indicated that the association between BMI and anxiety varied according to blood pressure level. However, an interaction OR above 1 should not be interpreted directly as evidence that elevated blood pressure increases anxiety risk or that normal blood pressure protects individuals with higher BMI. Such conclusions require examination of the predicted probabilities or simple slopes of BMI across relevant blood pressure levels. Therefore, the present finding should be regarded as evidence of statistical effect modification rather than proof of a specific biological mechanism.

The absence of significant interactions between BMI and glucose, lipid variables, or uric acid, particularly for depression, further suggests that the relationships between metabolic characteristics and mental health may differ according to psychiatric outcome. Previous studies have identified metabolic alterations associated with depression, including changes in triglycerides and HDL cholesterol, and have implicated inflammatory and neuroendocrine pathways in these associations [14,15]. However, the present cross-sectional data do not allow these mechanisms to be tested. The observed differences between depression and anxiety should therefore be considered hypothesis-generating rather than evidence of distinct metabolic mechanisms. Additionally, the absence of significant interaction effects may also reflect the characteristics of the study population, the relatively modest sample size, or limited variability in metabolic measures. In particular, interaction effects generally require larger samples than main effects to detect reliably. These possibilities should be examined in larger and prospective studies rather than attributed to a specific duration or severity of metabolic abnormalities, which were not directly assessed in the present study.

This study has several practical implications. First, the association between job category and both psychological outcomes suggests that mental health services for police should be tailored to the organisational characteristics and stressors of different positions, rather than relying solely on a one-size-fits-all individual screening approach. Second, the BMI × blood pressure interaction observed for anxiety highlights the potential value of considering psychological symptoms alongside routine metabolic assessments, although this exploratory finding requires replication. Psychological screening is intended to identify individuals who may require further clinical evaluation, rather than to establish a diagnosis; its interpretation depends on the properties of the screening instrument and the prevalence of the condition in the target population. Third, interventions should address both individual and organisational factors. Existing evidence suggests that organisational stressors are important correlates of psychological symptoms among police officers. Potential approaches include reviewing work schedules, strengthening managerial support, fostering psychological safety, providing access to psychological counselling, and reducing non-policing administrative workloads. These strategies are plausible implications of the wider evidence but were not evaluated in the present

study. Positive psychology interventions, including mindfulness-based programmes, have also been reported to improve anxiety, depression, and negative affect among police officers [21]. These approaches could be incorporated into stratified occupational health frameworks (Fig. 2), with effectiveness evaluated in future studies.

Strengths and limitations

This study has several strengths. It examined the associations of BMI and multiple metabolic indicators, including blood pressure, glucose, lipid profiles and serum uric acid, with moderate-to-severe depressive and anxiety symptoms among police officers. It also explored potential interactions between BMI and metabolic indicators, providing a broader assessment of these associations. The inclusion of officers from different occupational settings, including municipal and county police, prison police and water police, broadened the range of occupational contexts represented. However, the study was conducted at a single centre in Guilin, which may limit the generalisability of the findings to police officers in other regions or occupational settings.

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference and does not establish the temporal relationship between BMI, metabolic indicators and psychological symptoms; reverse causation cannot be excluded. Second, depressive and anxiety symptoms were assessed using self-report screening instruments rather than clinical diagnostic interviews, which may have resulted in outcome misclassification. Third, adjustment was limited to age, sex and job position. Potential confounders, including smoking, alcohol consumption, physical activity, diet and sleep, were not fully accounted for. Sleep is particularly relevant given its established relationship with psychological distress [30, 31]. Fourth, BMI does not distinguish fat mass from lean mass or reflect fat distribution, potentially limiting its ability to capture adiposity-related risk. Finally, the interaction analyses involved multiple comparisons, and the observed BMI x blood pressure interaction for anxiety should therefore be considered exploratory. In addition, because the sampling involved one cluster from each of four strata, the potential effects of the sampling design on variance estimation and generalisability should be considered, and the analysis should clarify whether the design was accounted for. Multicentre prospective studies with more comprehensive confounder adjustment and appropriate consideration of the sampling design are needed to validate these findings.

Conclusion

Among on-duty police officers in Guilin, China, job position was significantly associated with both moderate-to-severe depressive and anxiety symptoms. Obesity was inversely associated with both outcomes after adjustment for demographic and occupational factors, whereas overweight was not significantly associated with either outcome. A significant interaction between BMI and blood pressure was observed for anxiety, but not depression, and no significant interactions were identified for the other metabolic indicators examined. These findings suggest that associations between metabolic characteristics and mental health may vary by psychological outcome and occupational context. However, the cross-sectional design and exploratory nature of the interaction analyses preclude causal conclusions and highlight the need for further validation.

Abbreviations

PHQ-9: Patient Health Questionnaire-9

GAD-7: Generalised Anxiety Disorder-7

BMI: Body mass index

BCOPS: Buffalo Cardio-Metabolic Occupational Police Stress

SUA: Serum uric acid

FPG: Fasting plasma glucose

TC: Total cholesterol

TG: Triglycerides

LDL-C: Low-density lipoprotein cholesterol

HDL-C: High-density lipoprotein cholesterol

Acknowledgements

We thank all police officers who participated in this study, as well as the administrative staff of the participating public security bureaus, prisons, and water police units, for their assistance with data collection. We acknowledge the use of artificial intelligence-assisted translation and language-editing tools to improve the clarity of the manuscript. All substantive scientific content was verified and edited by the authors.

Authors' Contributions

SL and SQ conceived and designed the study. HL, DG, LL, and XT collected the data. DG and SQ oversaw the quality control of data collection. HL and LL managed the data. HL and SL performed the statistical analyses and drafted the manuscript. SL supervised the project and critically revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

Funding

This study was funded by the Guilin Science and Technology Planning Project (Grant No. 20222E394473).

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The study was approved by the Ethics Committee of Guilin People's Hospital

(Ethics Approval No. 2025-312KY). Participation was entirely voluntary, and written informed consent was obtained from all eligible participants before enrolment. All participants were informed of the research objectives and study procedures, as well as their right to withdraw from the study at any time without penalty. Questionnaire data and metabolic measurements obtained during physical examinations were processed with strict measures to protect participants' personal identifying information.

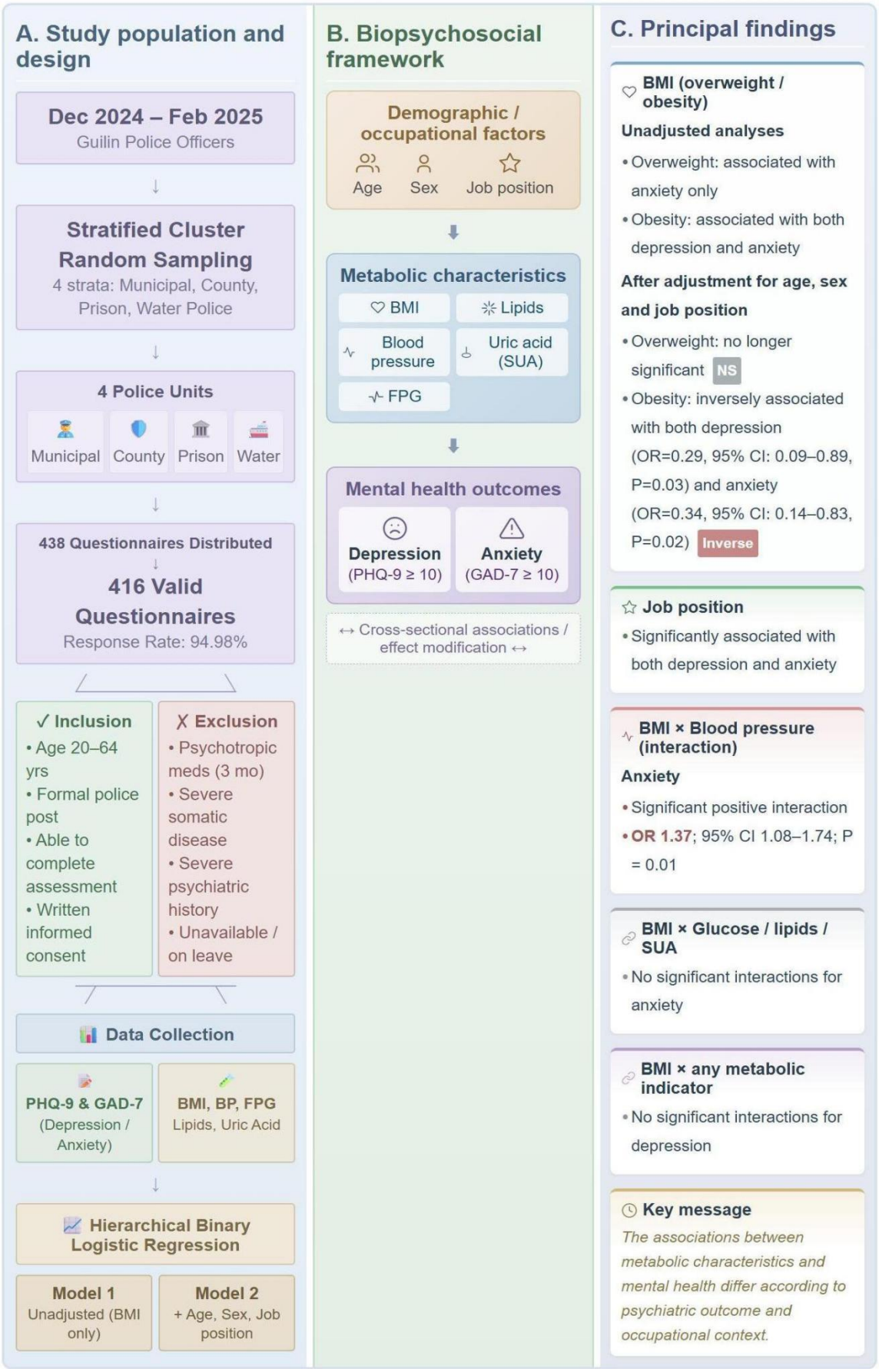
Consent for publication

Not applicable.

Competing interests

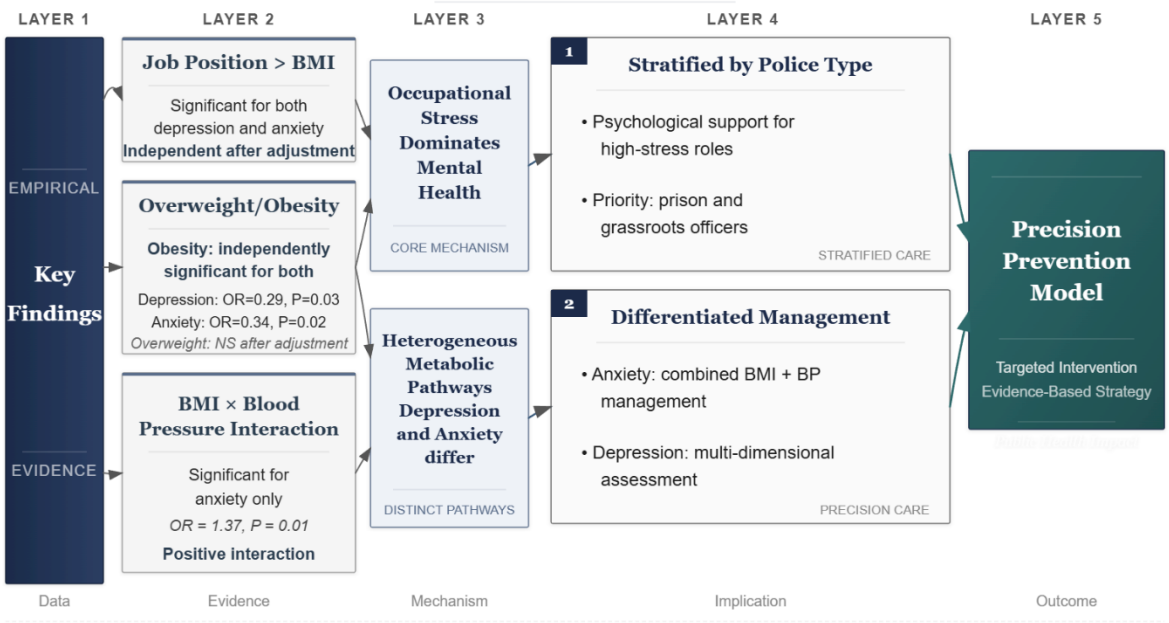
The authors declare no competing interests.

Figure 1. Biopsychosocial framework and principal findings of the study.



The schematic summarises the study population, analytical framework, and principal findings. (A) A total of 438 questionnaires were distributed, of which 416 valid responses from on-duty police officers were included in the analysis. Participants were recruited from municipal, county, prison, and water police units. (B) The study examined the associations of demographic and occupational factors, body mass index (BMI), blood pressure, glucose, lipid profiles, and serum uric acid (SUA) with depression and anxiety. Potential effect modification was assessed by examining interactions between continuous BMI and individual metabolic indicators. (C) In unadjusted analyses, overweight was associated with anxiety (OR = 0.56, 95% CI: 0.33–0.97, P = 0.04), whereas obesity was associated with both depression (OR = 0.32, 95% CI: 0.11–0.95, P = 0.04) and anxiety (OR = 0.36, 95% CI: 0.15–0.86, P = 0.02). After adjustment for age, sex, and job position, overweight was not significantly associated with depression or anxiety, whereas obesity remained inversely associated with depression (OR = 0.29, 95% CI: 0.09–0.89, P = 0.03) and anxiety (OR = 0.34, 95% CI: 0.14–0.83, P = 0.02). Job position remained significantly associated with both depression and anxiety. A significant BMI × blood pressure interaction was identified for anxiety (OR = 1.37, 95% CI: 1.08–1.74, P = 0.01), whereas no significant interactions were observed between BMI and glucose, lipid variables, or SUA for anxiety or between BMI and any examined metabolic indicator for depression. Because the study was cross-sectional, the relationships shown represent statistical associations and effect modification rather than causal pathways.

Figure. 2 Association pattern between BMI and depression/anxiety in police



The framework illustrates hierarchical relationships between occupational factors, metabolic characteristics, and mental health outcomes, informing precision prevention strategies for psychiatric illnesses.

459 Table 1. Descriptive statistics of sample demographic factors.

Characteristic	Total n (%)	Depression (cases/prevalence)	Anxiety (cases/prevalence)
Sex			
Male	348 (83.65)	46 (13.22)	59 (16.95)
Female	68 (16.35)	9 (13.24)	13 (19.12)
Job position			
Municipal bureau	208 (50.00)	16 (7.69)	26 (12.50)
County bureau	106 (25.48)	14 (13.21)	16 (15.09)
Prison police	68(16.35)	23 (33.82)	28 (41.18)
Water police	34 (8.17)	2 (5.88)	2 (5.88)
BMI			
Normal	162 (38.94)	26 (16.05)	38 (23.46)
Overweight	184 (44.23)	25 (13.59)	27 (14.67)
obesity	70 (16.83)	4 (5.71)	7 (10.00)
Blood lipids			
Normal	240 (57.69)	35 (14.58)	49 (20.42)
Abnormal	176 (42.31)	20 (11.36)	23 (13.07)
Blood glucose			
Normal	379 (91.11)	51 (13.46)	67 (17.68)
Abnormal	37 (8.89)	4 (10.81)	5 (13.51)
Uric acid			
Normal	270 (64.90)	35 (12.96)	52 (19.26)
Abnormal	146 (35.10)	20 (13.70)	20 (13.70)
Blood pressure			
Normal	361 (86.78)	46 (12.74)	64 (17.73)
Abnormal	55 (13.22)	9 (16.36)	8 (14.55)

460

461 Table 2. Association between overweight/obesity groups and depression/anxiety.

Variable	B	OR	95% CI	P-value	B	OR	95% CI	P-value
	Depression				Anxiety			
Overweight	-0.2	0.82	0.45–1.49	0.52	-0.58	0.56	0.33–0.97	0.04*
obesity	-1.15	0.32	0.11–0.95	0.04*	-1.02	0.36	0.15–0.86	0.02*

462 Note: BMI groups with "normal group" as reference; *$p < 0.05$

Table 3. Association between overweight/obesity groups and depression/anxiety after controlling for covariates.

Variable	B	OR	95% CI	P-value	B	OR	95% CI	P-value
			Depression				Anxiety	
Age	0.01	1.00	0.97−1.04	0.78	0.01	1.01	0.98−1.04	0.62
Sex	0.08	1.08	0.46−2.53	0.86	0.05	1.05	0.50−2.21	0.89
Job position	–	–	–	< 0.001***	–	–	–	< 0.001***
Overweight	-0.16	0.86	0.44−1.65	0.64	-0.56	0.57	0.31−1.04	0.07
obesity	-1.24	0.29	0.09–0.89	0.03*	-1.09	0.34	0.14–0.83	0.02*
Nagelkerke R^2			0.14				0.14	
LR χ^2 (df)			33.18 (7)				37.06 (7)	

Note: BMI groups with "normal group" as reference; The overall Wald χ^2 for Job position is a joint test of 4 levels (df = 3); coefficients and ORs are not reported separately; *$p < 0.05$, **$p < 0.01$. ***$P < 0.001$.

Table 4. Relationships between blood glucose, blood pressure, blood lipids, uric acid, and BMI in polices with depression and anxiety.

Outcome	Model	Wald χ^2 (P)	Interaction B	OR (95% CI)	P-value
Depression	BMI × Glucose	33.90 (< 0.001)	0.11	1.12 (0.87–1.43)	0.39
Depression	BMI × Lipids	36.11 (< 0.001)	0.18	1.20 (0.98–1.47)	0.08
Depression	BMI × Blood pressure	38.22 (< 0.001)	0.23	1.25 (0.99–1.58)	0.06
Depression	BMI × Uric acid	34.01 (< 0.001)	-0.11	0.90 (0.73–1.11)	0.32
Anxiety	BMI × Glucose	41.53 (< 0.001)	0.08	1.09 (0.85–1.39)	0.50
Anxiety	BMI × Lipids	43.42 (< 0.001)	0.11	1.12 (0.92–1.35)	0.27
Anxiety	BMI × Blood pressure	47.53(< 0.001)	0.32	1.37 (1.08–1.74)	0.01**
Anxiety	BMI × Uric acid	43.40(< 0.001)	-0.14	0.87 (0.70–1.08)	0.21

Note: BMI and metabolic indicators were treated as continuous variables and mean-centred. $^{**}P < 0.01$.

References

1. Syed S, Ashwick R, Schlosser M, Jones R, Rowe S, Billings J. Global prevalence and risk factors for mental health problems in police personnel: a systematic review and meta-analysis. Occup Environ Med. 2020;77(11):737-47. https://doi.org/10.1136/oemed-2020-106498.

2. Zhou J. A cross-temporal meta-analysis of changes of Chinese police officers' mental health status since 2000. J China Crim Police Univ. 2022;(2):117-128.

3. Li Y, Ren Z, Jiang G. Meta-analysis on the mental health of the Chinese policemen of public security organization. Adv Psychol Sci. 2016;24(5):692-706. https://doi.org/10.3724/SP.J.1042.2016.00692.

4. Sergi TE, Bode KB, Hildebrand DA, Dawes JJ, Joyce JM. Relationship between body mass index and health and occupational performance among law enforcement officers, firefighters, and military personnel: a systematic review. Curr Dev Nutr. 2023;7(1):100020. https://doi.org/10.1016/j.cdnut.2022.100020.

5. 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(9-10):e417-e425. https://doi.org/10.1093/milmed/usz144.

6. 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. Medicine (Baltimore). 2019;98(40):e17306. https://doi.org/10.1097/MD.0000000000017306.

7. Hartley TA, Burchfiel CM, Fekedulegn D, Andrew ME, Knox SS, Violanti JM. Associations between police officer stress and the metabolic syndrome. Int J Emerg Ment Health. 2011;13(4):243-56.

8. Wang RZ, He Y, Deng YT, et al. Body weight in neurological and psychiatric disorders: a large prospective cohort study. Nat Ment Health. 2024;2(1):41-51. https://doi.org/10.1038/s44220-023-00158-1.

9. Wang RZ, Deng YT, Zhang W, et al. Associations between adiposity and white matter hyperintensities: cross-sectional and longitudinal analyses of 34,653 participants. Hum Brain Mapp. 2024;45(1):e26560. https://doi.org/10.1002/hbm.26560.

10. Violanti JM, Fekedulegn D, Andrew ME, Charles LE, Hartley TA, Burchfiel CM. Adiposity in policing: mental health consequences. Int J Emerg Ment Health. 2011;13(4):257-66.

11. Vancini RL, de Lira CAB, Anceschi SA, et al. Anxiety, depression symptoms, and physical activity levels of eutrophic and excess-weight Brazilian elite police officers: a preliminary study. Psychol Res Behav Manag. 2018;11:589-95. https://doi.org/10.2147/PRBM.S186128.

12. Hartley TA, Knox SS, Fekedulegn D, et al. Association between depressive symptoms and metabolic syndrome in police officers: results from two cross-sectional studies. J Environ Public Health. 2012;2012:861219. https://doi.org/10.1155/2012/861219.

13. Chen X, Leng L, Yu H, et al. Psychological distress and dyslipidemia in Chinese police officers: a 4-year follow-up study in Tianjin, China. J Occup Environ Med. 2015;57(4):400-5. https://doi.org/10.1097/JOM.0000000000000372.

14. Bot M, Milaneschi Y, Al-Shehri T, et al. Metabolomics profile in depression: a pooled analysis of 230 metabolic markers in 5283 cases with depression and 10,145 controls. Biol Psychiatry. 2020;87(5):409-18. https://doi.org/10.1016/j.biopsych.2019.08.016.

15. Bose MM, Govindula A, Nampoothiri M, Arora D, Mudgal J. The HPA axis and kynurenine pathway: exploring the role of stress and neuroinflammation in treatment-resistant depression. Pharmacol Rep. 2026;78(2):374-390. https://doi.org/10.1007/s43440-025-00806-6.

16. Fan C, Wang J, Guo B, et al. Exploring the causal relationships between anxiety, obesity, and hypertension: a two-sample Mendelian randomization study. Am J Hypertens. 2025;38(10):852-8. https://doi.org/10.1093/ajh/hpaf072.

17. Ivanušić-Pejić J, Degmečić D. Hypertension in association with anxiety and depression – a narrative review. Southeastern Eur Med J. 2022;6(1):31-43. https://doi.org/10.26332/seemedj.v6i1.216.

18. Tian Y, Yang Z, Zhang J, et al. Study on the moderating effect of body mass index in correlation of anxiety and depression disorders. Chin Gen Pract. 2022;25(11):1368-72. https://doi.org/10.12114/j.issn.1007-9572.2021.01.416.

19. Yates JD, Aldous JWF, Bailey DP, et al. 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.

20. Purba A, Demou E. The relationship between organisational stressors and mental wellbeing within police officers: a systematic review. BMC Public Health. 2019;19:1286. https://doi.org/10.1186/s12889-019-7609-0.

21. Kukucska D, Whitehall J, Shorter GW, et al. A systematic review of positive psychology interventions (PPIs) to improve the health behaviours, psychological wellbeing and/or physical health of police staff. J Police Crim Psychol. 2023;38(3):728-42. https://doi.org/10.1007/s11896-023-09579-1.

22. Bohnen JLB, Wigstrom TP, Griggs AM, et al. Ketogenic-mimicking diet as a therapeutic modality for bipolar disorder: biomechanistic rationale and protocol for a pilot clinical trial. Nutrients. 2023;15(13):3068. https://doi.org/10.3390/nu15133068.

23. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: validity of a brief depression severity measure. Journal of General Internal Medicine. 2001;16(9):606–13. doi: 10.1046/j.1525-1497.2001.016009606.x

24. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Archives of Internal Medicine. 2006;166(10):1092–97. doi: 10.1001/archinte.166.10.1092

25. Steptoe A, Frank P. Obesity and psychological distress. Philos Trans R Soc Lond B Biol Sci. 2023;378(1888):20220225. https://doi.org/10.1098/rstb.2022.0225.

26. Eik-Nes TT, Tokatlian A, Raman J, Spirou D, Kvaløy K. Depression, anxiety, and psychosocial stressors across BMI classes: a Norwegian population study- the HUNT Study. Front Endocrinol (Lausanne). 2022;13:886148. https://doi.org/10.3389/fendo.2022.886148.

27. Jibril AT, Ganjeh BJ, Mirrafiei A, et al. Dose-response association of obesity and risk of mental health among tehranian residents: result of a cross-sectional study. BMC Public Health. 2024;24(1):1444. https://doi.org/10.1186/s12889-024-18670-z.

28. Magnavita N, Capitanelli I, Garbarino S, Pira E. Work-related stress as a cardiovascular risk factor in police officers: a systematic review of evidence. Int Arch Occup Environ Health. 2018;91(4):377-89. https://doi.org/10.1007/s00420-018-1290-y.

29. White SC, Ruiz JM, Allison M, et al. Cardiovascular risk, social vigilance, and stress profiles of male law enforcement officers versus civilians. Health Psychol Open. 2024;11:20551029241244723. https://doi.org/10.1177/20551029241244723.

30. Dou Y, Zhang M. A study on the dynamic bidirectional relationship between depression and sleep quality of police officers. J Shanxi Police Coll. 2024;32(4):100-8. https://doi.org/10.3969/j.issn.2095-5154.2024.04.012.

31. Dou Y, Li Y, Zhang M. A 1-year longitudinal study of anxiety and sleep quality in police officers. Chin Ment Health J. 2024;38(6):528-533. doi:10.3969/j.issn.1000-6729.2024.06.011.