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**Original Article**

# Correlation between Obesity and Risk Factors of Cardiovascular Diseases in Military Personnel

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**Abstract**

**Background:** It is critical to precisely assess the presence of cardiovascular (CV) risk in military personnel, in order to avoid potentially CV-events. In Iran limited number of studies have been performed on military personnel and their CV-risk. We aimed to investigate correlation between obesity and cardiovascular disease (CVD) risk factors in military personnel.

**Methods:** The present cross-sectional analytical study, analyzed the data of 559 military personnel in Tehran, Iran in 2023. The dataset sourced from the registry system. The biochemical analysis of blood samples was performed by a biomedical analysis company. The univariate regression analyses were conducted through separate univariate linear regression within the obesity group.

**Results:** The mean age of personnel was 36.58 years. Among obese personel, there was an inverse relationship between age and cholesterol β=-0.11. Moreover, hemoglobin β=-0.68 and MCH β=-0.33 were significantly related to high cholesterol, MCH is associated with risk of metabolic syndrome (β=-0.57). Moreover among obese personnel, lower uric acid levels and higher ALT levels are correlated with an increased risk of Diabetes.

**Conclusion:** The prevalence of obesity in military personnel was the same as in the general population. Diabetes, hyperlipidemia, high blood pressure, obesity, and metabolic syndrome were all linked to CVD risk factors among military personnel. Although the prevalence of metabolic syndrome in military personnel was lower than their peers in other countries, other risk factors of CVD were prevalent among military personnel.

**Keywords:** Cardiovascular diseases; Military personnel; Metabolic syndrome

## Introduction

As the leading cause of death in worldwide, cardiovascular diseases (CVD) are on the rise and impose a significant financial burden (1). Overall, 18,5 million deaths have occurred due to CVD in

2019, which is around one-third of all deaths in the world. More than three-quarters of CVD-deaths occur in developing countries (2). The prevalence of CVD is also relatively high in Iran (3). Furthermore, CVD has a significant economic impact on the countries. The current costs of cardiovascular events vary in an unknown way. For instance, the average cost of myocardial infarction in a year is between $11,970 and $61,864 (4). In Iran, based on data, direct and indirect costs imposed by CVD are high (5).

Although CVD is multifactorial, it is significantly associated with comorbidities such as obesity, metabolic syndrome, diabetes and hypertension (6). Obesity prevalence has risen significantly over the last decades (7, 8), reaching to pandemic proportions. WHO estimates that roughly 1,9 billion people worldwide (nearly 39% of the world's population) are overweight (9). Furthermore, nearly 30% of the population in the Middle East are overweight (10). Obesity is well-known to be an independent risk factor for metabolic syndrome and CVD. The CVD, on the other hand, is the main cause of disability and death in obese people. Despite treatment advances, CVD is responsible for 70% of deaths among obese adults (11).

Military personnel are often perceived as athletic and generally healthy. Therefore, they are believed to be without the cardiovascular (CV) risk. While metabolic syndrome and obesity, both of which are risk factors for CVD, have become important health issues in the military (12). Moreover, studies show that they have cardiovascular risk factors, as seen in the general population (13). Military personnel work in a place that is unique in terms of high risk environments and high levels of occupational stress. According to reports, military personnel with heavy responsibilities are more likely to be exposed to a higher risk of developing cardiovascular risk factors (14). CVD has the potential to impair military personnel's capecity to perform important missions (15). Therfore, it is critical to precisely assess the presence of CV-risk in military personnel, in order to avoid potentially CV-events.

In Iran limited number of studies have been performed on military personnel and little information is available regarding their cardiovascular risk. In addition, previous studies had small sample sizes, focused on a narrow range of risk factors, or were conducted many years ago (16, 17). Therefore, the primary objective of this study was to explore the relationship between obesity and risk factors for cardiovascular disease among military personnel, while avoiding the constraints observed in previous studies.

## Methods

The present cross-sectional analytical study, analyzed the data of 559 military personnel stationed in Tehran, Iran in 2023. The dataset, sourced from the registry system. After a 12-h overnight fast, venous blood samples were taken and collected into EDTA vacuum tubes. The biochemical analysis of blood samples was performed by a biomedical analysis company. All inter- and intra-assay coefficients of variation were lower than 5.0%. Among all the personnel, only the personnel whose information was collected correctly and completely were included in the study. Personnels with missing data were excluded from the study. In general, the missing data was less than 5%.

Variables: The study's primary outcome variable was cardiovascular risk factors, encompassing High Blood Pressure (exceeding 120/80 mmHg), Pre-diabetes (ranging from 100 to 125 mg/dL), Diabetes (above 126 mg/dL), elevated Cholesterol (exceeding 240 mg/dL), heightened Triglycerides (above 200 mg/dL), LDL (mg/dL), HDL (mg/dL), VLDL (mg/dL), AST (units per liter), ALT (units per liter), and Metabolic Syndrome. Regarding the obesity variable, a Body Mass Index (BMI) below 24 $kg/m^2$ was classified as normal, BMI between 25 and 29 $kg/m^2$ indicated overweight, and BMI exceeding 30 $kg/m^2$ categorized individuals as obese. None of the participants had a BMI below 18.5 $kg/m^2$.

Demographic variables included Age (in years), Work Experience (in years), Marital Status (single

or married), Medical History, Allergies, Hospitalization Record, History of heart problems, Family History of Illness, History of Medication Use, Smoking Habits, and Musculoskeletal Conditions. Clinical factors comprised Heart Rate (in beats per minute), White Blood Cell Count (in cells/microliter), Red Blood Cell Count (mcL), Hemoglobin (g/dL), Hematocrit (%), MCV (fl), MCH (pg), MCHC (g/dL), Platelet Count ($mm^3$), and Uric Acid levels (mg/dl).

### *Data analysis*

To examine differences in quantitative variables across different obesity groups, we employed the Analysis of Variance (ANOVA) test. Additionally, the chi-squared ($\chi 2$) test was utilized to evaluate the frequency differences among qualitative variables concerning obesity groups. Subsequent to these analyses, univariate regression analyses were conducted to investigate the relationship between individual variables and cardiovascular risk factors through separate univariate linear regression within the obesity group. All statistical analyses were carried out using R version 4.3.2 software, with a significance level of 95% adopted for all tests.

## Results

The mean age of personnel is 36.58 yr, with an mean work experience of 3.70 years. Table 1 showes an overview of demographic variables by obesity status. Notably, the average age of obese personnel is lower than that of non-obese personnel ($P$<0.001), while overweight personnel exhibit a higher average work history compared to non-overweight personnel ($P$=0.018). Marital status is associated with obesity, with a lower percentage of unmarried personnel being obese compared to married ones ($P$<0.001). Additionally, a higher percentage of overweight personnel have a history of hospitalization ($P$=0.016).

**Table 1:** Descriptions demographic variables by obesity status

| Variables | | Obese(191) | Overweight(214) | Normal(154) | Total(559) | *P*-value |
|---|---|---|---|---|---|---|
| | Min-Max | Mean±Sd | | | | |
| Age | 23-56 | 33.03±8.48 | 39.14±7.09 | 37.42±8.10 | 36.58±8.288 | <0.001* |
| Work Experience | 1-35 | 3.20±3.44 | 4.31±4.79 | 3.19±3.49 | 3.70±4.147 | 0.018* |
| | | Frequancy(%) | | | | P-value |
| Marital Status | Married | 181(37.7) | 185(38.5) | 114(23.8) | 480(85.9) | <0.001* |
| | Single | 10(12.7) | 29(36.7) | 40(50.6) | 79(14.1) | |
| Disease Background | Yes | 24(35.8) | 26(38.8) | 17(25.4) | 67(12.0) | 0.906 |
| | No | 167(33.9) | 188(38.2) | 137(27.8) | 492(88.0) | |
| Allergy | Yes | 3(18.8) | 7(36.8) | 9(47.4) | 19(3.4) | 0.093 |
| | No | 188(34.8) | 207(38.3) | 145(26.9) | 540(96.6) | |
| History of heart problems | Yes | 5(2.6) | 4(1.9) | 3(1.9) | 12(2.1) | 0.856 |
| | No | 186(97.4) | 210(98.1) | 151(98.1) | 547(97.9) | |
| Hospitalization History | Yes | 25(23.6) | 52(49.1) | 29(27.4) | 106(19.0) | 0.016* |
| | No | 166(36.6) | 162(35.8) | 125(27.6) | 453(81.0) | |
| Family History of Illness | Yes | 52(28.6) | 80(44.0) | 50(27.5) | 182(32.6) | 0.093 |
| | No | 139(36.9) | 134(35.5) | 104(27.6) | 377(67.4) | |
| Taking Medication | Yes | 13(28.3) | 21(45.7) | 12(26.1) | 46(8.2) | 0.532 |
| | No | 178(34.7) | 193(37.6) | 142(27.7) | 513(91.8) | |
| Smoking | Yes | 18(40.9) | 17(38.6) | 9(20.5) | 46(8.2) | 0.470 |
| | No | 173(33.6) | 197(38.3) | 145(28.2) | 513(91.8) | |
| Musculoskeletal Condition | No | 185(35.0) | 200(37.9) | 143(27.1) | 528(94.5) | 0.196 |
| | Yes | 6(19.4) | 14(45.2) | 11(35.5) | 31(5.5) | |

According Table 2, in obese personnel, the mean of HDL, LDL, HCT, MCV, MCH, uric acid, and Hb were lower than those of non-obese personnel ($P$<0.001), whereas the averages of VLDL, Log (WBC), MCHC, PLT, AST, and ALT were higher in obese individuals ($P$<0.001). Additionally, there is a significant association between obesity status and elevated systolic blood pressure, diastolic blood pressure, cholesterol, triglycerides, diabetes, and metabolic syndrome ($P$<0.05).

**Table 2:** Examination of the relation among cardiovascular risk factors and other clinical factors with obesity status

| Variables | | Obese | Overweight | Normal | Total | *P*-value |
|---|---|---|---|---|---|---|
| | Min-Max | Mean±Sd | | | | |
| HDL (mg/dL) | 0.2-63.0 | 27.13±19.95 | 43.93±8.88 | 46.43±5.68 | 38.88±15.72 | <0.001* |
| VLDL (mg/dL) | 6.3-171.5 | 82.67±49.17 | 40.67±28.68 | 27.07±13.37 | 51.27±41.57 | <0.001* |
| LDL (mg/dL) | 16.0-254.4 | 89.47±34.42 | 103.33±32.82 | 96.29±30.44 | 96.66±33.22 | <0.001* |
| Log(WBC)(mcL) | 7.4-11.1 | 9.32±0.51557 | 8.82±0.37476 | 8.72±0.25130 | 8.96±0.47839 | <0.001* |
| RBC (mcL) | 3.7-7.5 | 5.33±0.41 | 5.37±0.43 | 5.34±0.52 | 5.35±0.45 | 0.580 |
| HCT(%) | 16.4-57.9 | 32.80±12.67 | 43.98±4.43 | 44.26±3.10 | 40.24±9.67 | <0.001* |
| MCV (fl) | 51.7-105.3 | 71.54±12.90 | 82.46±5.73 | 83.29±5.64 | 78.96±10.33 | <0.001* |
| MCH (pg) | 17.8-36.2 | 26.35±2.42 | 27.92±1.95 | 27.93±2.45 | 27.39±2.37 | <0.001* |
| MCHC (g/dL) | 28.6-38.3 | 34.21±1.33 | 33.76±1.17 | 33.51±1.25 | 33.84±1.28 | <0.001* |
| PLT($mm^3$) | 70.0-566.4 | 327.17±126.15 | 213.62±60.09 | 197.05±42.12 | 247.85±102.95 | <0.001* |
| Uric A (mg/dl) | 2.4-8.9 | 5.25±1.03 | 5.41±0.93 | 4.97±0.87 | 5.23±0.96 | <0.001* |
| AST (U/L) | 2.0-139.0 | 68.65±43.75 | 29.08±18.81 | 23.89±8.82 | 41.17±34.71 | <0.001* |
| ALT (U/L) | 3.0-664.0 | 319.33±287.19 | 50.14±91.50 | 26.35±17.51 | 135.56±221.39 | <0.001* |
| Hb (g/dL) | 8.1-19.6 | 12.64±2.61 | 14.91±1.28 | 14.84±1.25 | 14.12±2.12 | <0.001* |
| | | Frequency (%) | | | | *P*-value |
| SBP | Normal | 143(32.9) | 160(36.8) | 132(30.3) | 435(77.8) | 0.022* |
| | Hight | 48(38.7) | 54(43.5) | 22(17.7) | 124(22.2) | |
| DBP | Normal | 146(31.9) | 173(37.9) | 138(30.2) | 457(81.8) | 0.006* |
| | Hight | 45(44.1) | 41(40.2) | 16(15.7) | 102(18.2) | |
| diabete | Normal | 83(19.7) | 193(45.8) | 145(34.4) | 421(75.3) | <0.001* |
| | Prediabetes | 7(33.3) | 11(52.4) | 3(14.3) | 21(3.8) | |
| | diabetes | 101(86.3) | 10(8.5) | 6(5.1) | 117(20.9) | |
| Chol | Normal | 181(34.3) | 196(37.1) | 151(28.6) | 528(94.5) | 0.027* |
| | Hight | 10(32.3) | 18(58.1) | 3(9.7) | 31(5.5) | |
| TG | Normal | 60(18.8) | 127(39.8) | 132(41.4) | 319(57.1) | <0.001* |
| | Hight | 131(54.6) | 87(36.3) | 22(9.2) | 240(42.9) | |
| Sandrome Metabolism | No | 176(32.5) | 212(39.1) | 154(28.4) | 542(97.0) | <0.001* |
| | Yes | 15(88.2) | 2(11.8) | 0 | 17(3.0) | |

Table 3 presents the association between demographic variables and other clinical factors with cardiovascular risk factors, stratified by obesity status.

High Blood Pressure: Overall, a higher incidence of high SBP is linked to a history of hospitalization β=0.64. Among obese individuals, higher diastolic blood pressure correlates with higher mean age β=0.05. For non-obese or overweight personnel, marital status is associated with high DBP β=-1.17. while among overweight individuals, there's a significant connection between high DBP and certain blood-related indicators (Hb, HCT, MCHC). The relationship between uric acid and high DBP is significant β=0.22. However, in obese

individuals specifically, there is a notable negative association between high DBP and certain liver enzymes (AST and ALT).

Diabetes: Diabetes is significantly associated with increasing age β=0.08. except for normal-weight personnel. Among overweight personnel, there's a notable link between diabetes and increased work experience β=0.08. In general, the risk of diabetes is higher in single personnel β=2.12. Overweight personnel with an elevated white blood cell count have an increased probability of developing diabetes β=1.21. For normal-weight personnel, MCHC β=0.81. and lower platelet count β=-0.02. are associated with an elevated risk of diabetes. Among obese personnel, lower uric acid levels and higher ALT levels are correlated with an increased chanse of diabetes.

High cholesterol: Among obese individuals, a decrease in age β=-0.11. hemoglobin β=-0.68. and MCH β=-0.33. is significantly related to high cholesterol. Across all personnel, a reduction in hematocrit is generally associated with an increased risc of high cholesterol β=-0.14. In overweight individuals, a decrease in uric acid levels is linked to an increased risk of having high cholesterol β=-0.50. For normal-weight personnel, a decrease in AST and ALT is associated with an increased risk of high cholesterol.

High TG : Being single β=-1.19. having a low white blood cell count β=-0.93. low hemoglobin β=-0.39, mean MCH β=0.15 low uric acid β=-0.68. and low AST β=-0.03. in overweight personnel are associated with an increased risk of high TG. In obese personnel, a decrease in platelet count increases the risk of high TG. For normal-weight personnel, a decrease in uric acid is linked to an increased likelihood of high TG. Across all personnel, a decrease in serum ALT is associated with an increased risk of high TG.

LDL: There is a direct relationship between a history of hospitalization and a reduction in LDL levels β=-11.08. Only among obese personnel, an increase in hemoglobin is directly related to an increase in LDL levels β=8.63. For personnel with normal weight, increased platelet count, serum AST and serum ALT are directly related to increased LDL levels.

HDL: Among obese personnel, there is a direct relationship between the decrease in MCHC and an increase in HDL levels β=-1.44. Except for obese personnel, the reduction of uric acid is significantly related to an increase in HDL levels . In overweight personnel, there is a significant relationship between the decrease in serum AST and an increase in HDL levels.

VLDL: Being single β=11.34, a decrease in MCV β=-0.99. and an increase in serum AST β=0.26. have a significant relationship with the increase in VLDL levels. Across all personnel, having a history of hospitalization, an increase in the number of white blood cells, an increase in hematocrit (HCT), and an increase in AST are significantly related to an increase in VLDL levels. The increase of hemoglobin β=3.28. and uric acid β=8.48. is also significantly related to an increase in VLDL levels. In obese personnel, an increase in MCHC has a significant relationship with the increase in VLDL levels.

Metabolic syndrome: An increase in hemoglobin is associated with an increased risk of metabolic syndrome β=0.91. Among overweight personnel, an increase in hematocrit β=0.89 and MCHC β=1.44 are linked to an increased risk of developing metabolic syndrome. In obese personnel, the MCH is associated with metabolic syndrome(β=-0.57).

**Table 3:** Association between demographic variables and other clinical factors with cardiovascular risk factors, stratified by obesity status

| Variables | Obese statuse | SBP (High) | DBP (High) | Diabetes | Chol (High) | TG (High) | LDL (mg/dL) | HDL (mg/dL) | VLDL (mg/dL) | Metabolic syndrome |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | Normal | 0.01 | -0.03 | 0.06 | -0.01 | 0.02 | 0.16 | 0.05 | -0.15 | - |
| | Overweight | 0.02 | 0.01 | 0.07* | -0.01 | -0.03 | -0.01 | 0.01 | 0.34 | 0.45 |
| | Obese | 0.03 | 0.05* | 0.09* | -0.11* | -0.01 | 0.10 | -0.01 | -0.35 | -0.03 |
| | Total | 0.02 | 0.02 | 0.08* | 0.01 | -0.02 | 0.15 | 0.01 | 0.10 | 0.12 |
| Work Experience | Normal | 0.03 | -0.06 | 0.06 | 17.27 | 0.05 | -0.11 | 0.14 | -0.04 | - |
| | Overweight | 0.01 | 0.01 | 0.08* | -0.03 | -0.02 | -0.14 | -0.04 | 0.52 | 0.09 |
| | Obese | 0.08 | 0.06 | 0.03 | 1.06 | -0.08 | -0.35 | -0.04 | -0.21 | 0.20 |
| | Total | 0.03 | 0.01 | 0.06* | 0.01 | -0.03 | -0.09 | -0.02 | 0.39 | 0.12 |
| Marital Status (Single) | Normal | -0.38 | -1.17* | 0.96 | 0.33 | -0.56 | 0.17 | -0.69 | -0.01 | - |
| | Overweight | -0.28 | -0.75 | 20.28 | -0.08 | -1.19* | -7.44 | -0.09 | 11.41* | 17.40 |
| | Obese | 0.01 | 0.19 | 20.37 | 0.85 | -0.61 | -8.81 | -3.83 | -1.55 | 18.11 |
| | Total | -0.01 | -0.46 | 2.12* | -0.06 | -1.09* | -1.57 | -1.06 | 6.66* | 17.34 |
| Hospitalization History (Yes) | Normal | 0.75 | 0.13 | 2.38* | 20.15 | -0.26 | -19.3* | 2.16 | 5.35 | - |
| | Overweight | 0.13 | -0.60 | 1.95* | -0.91 | -0.48 | -3.65 | -0.36 | 7.53 | -17.40 |
| | Obese | 0.89 | 1.22* | 0.44 | 20.35 | -0.85 | -20.3* | -0.59 | -0.27 | 19.62 |
| | Total | 0.64* | 0.43 | 1.60* | -0.16 | -0.31 | -11.8* | 0.27 | 5.33* | 1.82 |
| Log (WBC) (mcL) | Normal | -0.82 | -0.29 | -0.87 | -3.91 | -1.44 | -3.22 | -0.47 | 5.35 | - |
| | Overweight | -0.25 | -0.46 | 1.21* | -0.27 | -0.93* | -1.75 | -0.15 | 6.62 | 0.74 |
| | Obese | 0.20 | -0.34 | 1.71 | -0.38 | -0.76 | -5.36 | -0.28 | 5.81 | 3.98 |
| | Total | 0.06 | -0.11 | 1.23* | -0.71 | -1.23* | -0.02 | -0.45 | 8.66* | 1.49 |
| Hb (g/dL) | Normal | -0.26 | -0.04 | 0.16 | -0.29 | -0.26 | -1.71 | -0.26 | 1.73* | - |
| | Overweight | 0.15 | 0.39* | 0.26 | -0.34 | -0.01 | -1.84 | -0.17 | 3.88* | 239.9 |
| | Obese | 0.11 | -0.09 | -0.08 | -0.68* | -0.39* | 8.63* | 0.19 | 3.95* | -1.77 |
| | Total | 0.04 | 0.16 | 0.14 | -0.41* | -0.16* | 0.04 | -0.19 | 3.28* | 0.91* |
| HCT (%) | Normal | -0.12 | -0.04 | -0.04 | -0.09 | -0.09 | -0.63 | -0.11 | 0.68* | - |
| | Overweight | 0.07 | 0.12* | 0.09 | -0.14 | -0.01 | -0.33 | -0.05 | 1.52* | 0.89* |
| | Obese | 0.03 | -0.04 | -0.07 | -0.22 | -0.07 | 2.55 | 0.45 | 0.88 | 0.04 |
| | Total | 0.02 | 0.04 | 0.02 | -0.14* | -0.05 | 0.17 | 0.01 | 1.16* | 0.36* |
| MCV (fl) | Normal | -0.01 | -0.01 | 0.06 | -0.07 | -0.05 | -0.71 | -0.03 | 0.13 | - |
| | Overweight | -0.06 | -0.05 | 0.01 | 0.04 | 0.08 | -0.01 | 0.16 | -0.99* | -0.04 |
| | Obese | -0.04 | -0.04 | -0.06 | -0.11 | 0.03 | 0.79 | -0.07 | 0.36 | -0.22* |
| | Total | -0.04 | -0.03 | -0.01 | -0.02 | 0.03 | -0.10 | 0.03 | -0.23 | -0.13 |
| MCH (pg) | Normal | 0.01 | 0.03 | 0.35 | -0.20 | -0.14 | -1.64 | -0.08 | 0.38 | - |
| | Overweight | 0.02 | -0.01 | 0.05 | 0.04 | 0.15* | -0.69 | 0.26 | -1.47 | 0.89 |
| | Obese | 0.02 | -0.09 | -0.12 | -0.33* | 0.01 | -0.48 | -0.41 | 1.42 | -0.57* |
| | Total | 0.01 | -0.03 | 0.03 | -0.10 | 0.03 | -0.99 | -0.04 | 0.01 | -0.24 |
| MCHC (g/dL) | Normal | 0.01 | 0.14 | 0.81* | -0.20 | -0.13 | -1.37 | -0.06 | 0.63 | - |
| | Overweight | -0.01 | 0.33* | 0.06 | -0.12 | 0.02 | -2.16 | -0.24 | 1.43 | 1.44* |
| | Obese | 0.01 | -0.11 | 0.08 | -0.45 | -0.29 | 2.53 | -1.44* | 3.44* | -2.24 |
| | Total | 0.01 | 0.15 | 0.18 | -0.22 | -0.09 | -0.99 | -0.42 | 1.69* | 0.03 |
| PLT ($mm^3$) | Normal | 0.01 | -0.01 | -0.02* | -0.01 | 0.01 | 0.16* | 0.01 | 0.01 | - |
| | Overweight | -0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.06 | -0.01 | 0.01 | -0.03 |
| | Obese | -0.01 | 0.01 | 0.01 | -0.01 | -0.01* | -0.04 | -0.03 | 0.09* | 0.01 |
| | Total | -0.01 | 0.01 | 0.01 | -0.01 | -0.01 | 0.08* | -0.01 | 0.04 | -0.01 |
| Uric Acid (mg/dl) | Normal | -0.01 | 0.04 | -0.01 | -0.89 | -0.80* | 4.49 | -1.07* | 5.63* | - |
| | Overweight | -0.01 | 0.15 | -0.21 | -0.50* | -0.68* | -2.86 | -1.55* | 11.05* | 0.37 |
| | Obese | 0.02 | 0.16 | -0.58* | -0.65 | -0.39 | 4.80 | -1.16 | 3.69* | 0.18 |
| | Total | -0.02 | 0.22* | -0.20 | -0.67* | -0.71* | 2.20 | -1.37* | 8.48* | 0.45 |
| AST (U/L) | Normal | -0.01 | -0.01 | 0.01 | -0.12* | -0.02 | 0.65* | -0.01 | 0.26* | - |
| | Overweight | 0.01 | 0.01 | -0.01 | -0.01 | -0.03* | -0.17 | -0.07* | 0.47* | 0.01 |
| | Obese | 0.01 | -0.05* | 0.02 | -0.01 | 0.01 | -0.14 | -0.03 | 0.13 | -0.04 |
| | Total | -0.01 | -0.01 | 0.01 | -0.02 | -0.02* | 0.05 | -0.05 | 0.41* | -0.01 |
| ALT (U/L) | Normal | -0.01 | 0.01 | 0.01 | -0.05* | -0.02* | 0.41* | -0.01 | 0.20* | - |
| | Overweight | -0.01 | 0.01 | -0.01 | 0.01 | -0.01 | -0.14 | -0.02 | 0.16* | -0.01 |
| | Obese | 0.01 | -0.04* | 0.02* | -0.01 | -0.01 | 0.01 | 0.01 | 0.09 | -0.01 |
| | Total | -0.01 | 0.01 | 0.01* | -0.01 | -0.01* | 0.05 | -0.01 | 0.20* | -0.01 |

## Discussion

The study linked obesity to cardiovascular risk factors like high blood pressure, cholesterol, triglycerides, diabetes, and metabolic syndrome. Among military personnel, common risk factors were hypertension, obesity, overweight, and diabetes, while metabolic syndrome prevalence was low.

Our study, consistent with Lee et al., found a significant link between uric acid levels and high DBP (18). Understanding the relationship between each disease and serum uric acid is crucial for potential new treatment approaches. Hypertension was prevalent among military personnel (19), with a prevalence similar to the general population (20). The prevalence of obesity among military personnel can explain the similarity in hypertension prevalence between the military and the general population. Our study revealed that obese military individuals of older age had elevated blood pressure, aligning with Lee et al.'s findings of higher blood pressure in military obese individuals (21).

Our findings, similar to Gostynski et al, suggest a significant link between lower age and high cholesterol levels in obese individuals (22). Additionally, there is a notable association between triglyceride and cholesterol levels and obesity as a cardiovascular disease risk factor, consistent with Mirzaeipour et al (17). Compared to the general population (23) and Khoshdel et al (16), military personnel showed higher cholesterol frequency but lower triglyceride frequency. Therefore, increased education and screening programs are needed for obese military personnel to effectively reduce these risk factors.

A significant positive relationship between hemoglobin and LDL was observed in obese military personnel. Moreover, the results of Arshad Hussain et al study in diabetic people showed a significant relationship between the amount of hemoglobin and blood lipid profile (24). The results of Ghari Arab et al.'s also showed a significant relationship between hemoglobin and blood lipids in type 2 diabetics (25). Hemoglobin is related to oxygen-carrying capacity, blood flow, and inflammatory processes, both decrease and increase can be associated with cardiovascular risks (26). The link between diabetes and obesity was significant in this study, as it had been in a previous investigation (27). Our findings, akin to those of Oliveira et al, showed the association between marital status and diabetes was significant. Those who stayed single had a significantly higher risk of developing diabetes compared to those married (28). In this study, the frequency of diabetes among military personnel was higher than in the general population (16), and this was the finding of the Quertier et al (29).

Our results, similar to Sunyue et al, suggest that a rise in hemoglobin levels is linked to a higher likelihood of developing metabolic syndrome (30). However, when compared to other studies (31), the prevalence of metabolic syndrome among military personnel was lower (41).

Obesity and overweight were relatively common among military personnel. This result agreed with the findings of Wenzel et al (32). Another piece of evidence showed that the prevalence of obesity and overweight among military members was high (33). Overweight and obese military members are more likely to have CVD-risk factors.

## Conclusion

Diabetes, hyperlipidemia, high blood pressure, obesity, and metabolic syndrome were all associated with cardiovascular disease risk factors in military personnel. While metabolic syndrome prevalence was lower compared to other countries, other CVD risk factors were common. Therefore, routine screening for cardiovascular risk factors is recommended for military personnel.

## Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission,

redundancy, etc.) have been completely observed by the authors.

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## Conflict of Interest

The authors declare that there is no conflict of interests.

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