



PREVALENCE OF CARDIOVASCULAR DISEASE RISK FACTORS AMONG MILITARY SENIOR OFFICERS – AN EPIDEMIOLOGICAL ANALYSIS AND PREVENTIVE IMPLICATIONS



Występowanie czynników ryzyka chorób sercowo-naczyniowych wśród kierowniczej kadry wojska – analiza epidemiologiczna i implikacje profilaktyczne

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Abstract

Introduction and objective: Cardiovascular diseases remain the leading cause of death worldwide, including in Poland, where they account for 35% of total mortality. A high prevalence of risk factors such as hypertension, hypercholesterolemia, obesity, and chronic stress is particularly evident among military personnel. Due to the nature of their work, senior military officers may be especially vulnerable to these health threats. The aim of the study was to assess cardiovascular risk factors among senior military officers and identify potential preventive measures to reduce the risk of cardiovascular events. **Materials and methods:** A retrospective analysis of medical records of military personnel, including laboratory findings, blood pressure measurements, BMI, and a health questionnaire. The study group consisted of 34 officers (100% male) aged 40–58 years (mean 51 ± 4.2 years). **Results:** Hypertension was diagnosed in 54% of participants, with 23% having stage II or III hypertension. Overweight or obesity ($\text{BMI} \geq 25 \text{ kg/m}^2$) was present in 83% of participants. Hypercholesterolemia ($\text{LDL} > 115 \text{ mg/dL}$) was found in 65%, while elevated non-HDL cholesterol levels ($> 130 \text{ mg/dL}$) in 68% of participants. A high or very high 10-year cardiovascular event risk (based on SCORE2) was observed in 62% of officers. **Conclusions:** Senior military officers exhibit a high prevalence of cardiovascular risk factors, including hypertension, obesity, and lipid disorders. The findings highlight the need to implement preventive programs, including health education, stress reduction strategies, and lifestyle modification support, which may contribute to improved health and operational readiness of the armed forces.

Streszczenie

Wprowadzenie i cel: Choroby układu sercowo-naczyniowego pozostają główną przyczyną zgonów na świecie, także w Polsce, gdzie stanowią 35% całkowitej śmiertelności. Wysoka częstość występowania czynników ryzyka, takich jak nadciśnienie tętnicze, hipercholesterolemia, otyłość i przewlekły stres, jest szczególnie widoczna w populacji żołnierzy. Kadra kierownicza wojska, z uwagi na charakter pracy, może być szczególnie narażona na te zagrożenia. Celem badania była ocena czynników ryzyka sercowo-naczyniowego wśród kierowniczej kadry wojska oraz określenie potencjalnych działań profilaktycznych zmniejszających ryzyko incydentów sercowo-naczyniowych. **Materiał i metody:** Przeprowadzono retrospektywną analizę danych z dokumentacji medycznej żołnierzy, obejmującą wyniki badań laboratoryjnych, pomiary ciśnienia tętniczego, BMI oraz kwestionariusz zdrowotny. Badana grupa liczyła 34 oficerów (100% mężczyzn) w wieku 40–58 lat (średnia $51 \pm 4,2$ roku). **Wyniki:** Nadciśnienie tętnicze stwierdzono u 54% badanych, z czego 23% miało II lub III stopień tego schorzenia. Nadwagę lub otyłość ($\text{BMI} \geq 25 \text{ kg/m}^2$) stwierdzono u 83% uczestników. Hipercholesterolemię ($> 115 \text{ mg/dl}$ LDL) rozpoznano u 65%, a 68% miało podwyższony poziom cholesterolu nie-HDL ($> 130 \text{ mg/dl}$). Wysokie lub bardzo wysokie 10-letnie ryzyko incydentu sercowo-naczyniowego (według SCORE2) występowało u 62% oficerów. **Wnioski:** Kadra kierownicza wojska charakteryzuje się wysokim rozpowszechnieniem czynników ryzyka sercowo-naczyniowego, w tym nadciśnienia tętniczego, otyłości i zaburzeń lipidowych. Wyniki wskazują na konieczność wdrożenia programów profilaktycznych, obejmujących edukację zdrowotną, strategie redukcji stresu oraz wsparcie w zakresie zmiany stylu życia, co może przyczynić się do poprawy zdrowia i zdolności operacyjnej sił zbrojnych.

Keywords: obesity; cardiovascular risk factors; military epidemiology; health prevention; hypercholesterolemia

Słowa kluczowe: otyłość; czynniki ryzyka sercowo-naczyniowego; epidemiologia wojskowa; profilaktyka zdrowotna; hipercholesterolemia

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Introduction

Cardiovascular diseases (CVDs) still remain the leading cause of death worldwide, with their prevalence in Poland being particularly high. According to data from the Central Statistical Office, CVDs accounted for 35% of all deaths in 2020–2021, surpassing cancer at 20% [1, 2]. The most significant scientifically proven CVD risk factors include hypercholesterolemia, chronic stress, smoking, hypertension (HT), and obesity, all of which are prevalent in the Polish population [3].

Similar trends are seen among Polish military personnel, where CVD risk factors are alarmingly prevalent. The MIL-SCORE study, which was conducted among 6,500 soldiers, revealed high rates of HT, hypercholesterolemia, and obesity [4]. The European Society of Cardiology (ESC) classifies Poland as a high-risk country for CVD, with a mortality rate nearly twice the European Union average [5, 6].

The leadership staff are a particularly vulnerable military group. Military commanders are exposed to high levels of chronic stress, which, combined with HT, lipid disorders, and obesity, creates a serious health risk. Studies have shown that more than 50% of officers have abnormal blood pressure, and 62% of them are at high or very high 10-year cardiovascular risk. The health of this group is essential for the functioning of the armed forces and maintaining operational readiness.

The aim of this study was to comprehensively assess CV risk factors among senior military officers, identify key threats, and develop recommendations for preventive programmes, the implementation of which may help reduce the prevalence of CV events and improve both long-term health and operational capacity of the armed forces.

Methods

The study was a retrospective analysis of medical records of Polish soldiers holding leadership positions. Due to the specific nature of their duties, this group is particularly exposed to chronic occupational stress.

Data were collected during a preventive campaign conducted among volunteers at the Military Institute of Medicine in 2023. The inclusion criteria were as follows: holding a leadership position in military structures and providing informed consent to participate.

Participants underwent a comprehensive health assessment, including:

- standard laboratory tests, including lipid profile (total cholesterol, LDL, HDL, triglycerides) and fasting glucose;

- structured questionnaire survey, including medical and family history, smoking status;
- anthropometric measurements, including height, weight, and BMI;
- haemodynamic measurements, including blood pressure (ESC guidelines).

The data were analysed statistically, comparing the results among participants with varying levels of CV risk.

Results

The study group included men aged 40–58 years (mean: 51 ± 4.2 years) (Tab. 1). Medical history showed a prior diagnosis of HT in 35.3% ($n = 12$), type 2 diabetes mellitus (T2DM) in 2.9% ($n = 1$), and hypercholesterolemia in 11.8% ($n = 4$) of subjects. Family history of CVD, which was reported by 26% of participants, represented an important component of the study. Documented cases included coronary heart disease, cerebrovascular incidents, and HT among first-degree relatives.

Analysis of blood pressure measurements taken during the study visit showed abnormal values in more than 50% of participants (Fig. 1, Fig. 2). When stratifying the observed haemodynamic disturbances, values consistent with grade III HT ($\geq 180/110$ mmHg) were found in 1 participant, while five participants presented with values classified as grade II HT (160–179/100–109 mmHg) as per ESC guidelines (Tab. 2) [7].

The analysis of anthropometric parameters showed normal body weight (BMI 18.5–24.9 kg/m²) in only 14.7% of participants ($n = 5$) (Tab. 3). The distribution of abnormal BMI values in the study population was as follows: overweight (BMI 25.0–29.9 kg/m²) in 50% of participants ($n = 17$), obesity class I (BMI 30.0–34.9 kg/m²) in 23% ($n = 8$), and obesity class II (BMI 35.0–39.9 kg/m²) in 10% ($n = 3$). The observed distribution of body weight disorders indicates a high prevalence of overweight and obesity (important risk factors for CVD) in the study group.

Table 1. Characteristic of the study group

Parameter	<i>n</i>	%
Gender (male/female)	34/0	100/0
Mean age (years)	51 (40–58)	-
History of hypertension	12	35
History of diabetes mellitus	1	3
History of hypercholesterolemia	4	12
Positive family history of cardiovascular disease	9	26

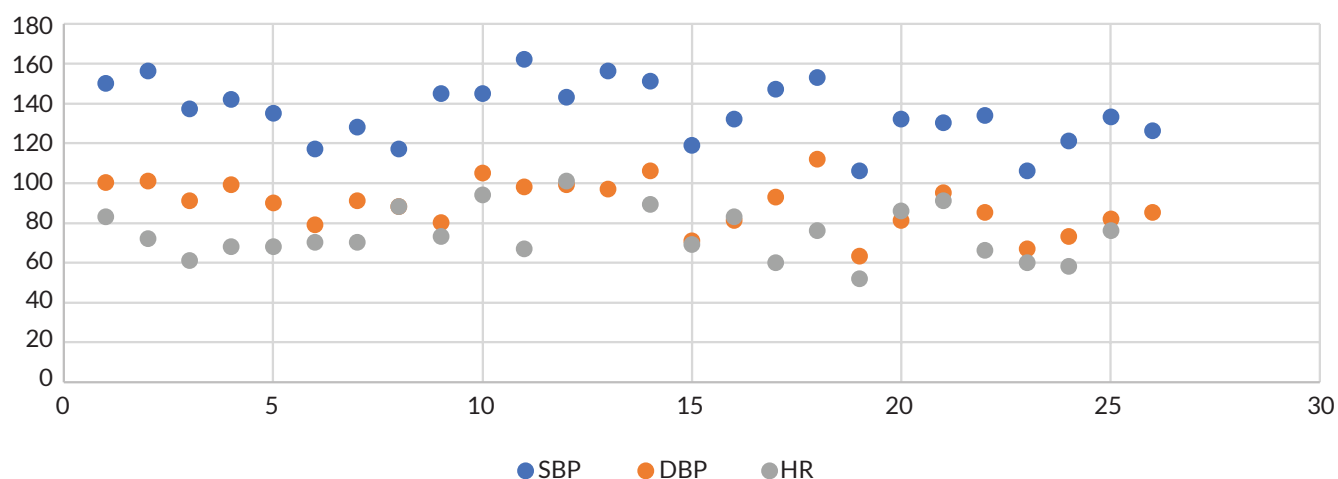


Figure. 1. Blood pressure and heart rate at the visit. SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate

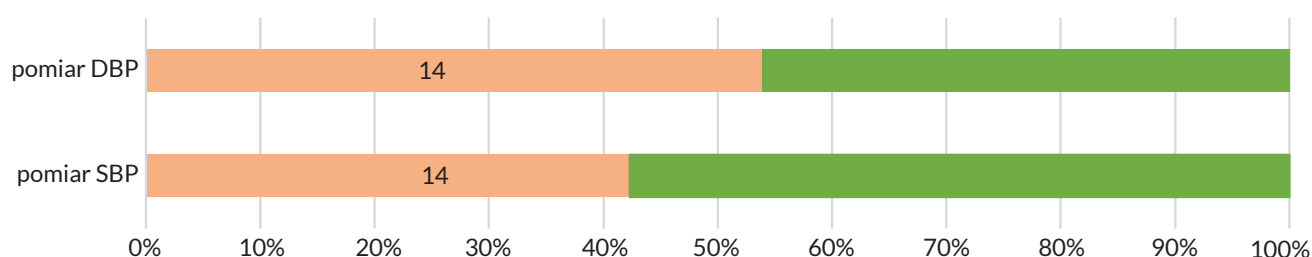


Figure. 2. Number of abnormal BP values at the visit . DBP – diastolic blood pressure; SBP – systolic blood pressure

The analysis of nicotine dependence in the study population showed a relatively low prevalence of this behavioural CVD risk factor (11.8%, $n = 4$).

As part of the research protocol, all participants underwent a comprehensive assessment of lipid and carbohydrate metabolism parameters, including fasting glucose (Tab. 4). The analysis showed normal biochemical parameters in only 11.8% of participants ($n = 4$). Lipid profiles were evaluated using individualized reference values, considering each participant's cardiovascular risk stratification [5].

A detailed analysis of lipid parameters revealed significant abnormalities in the study population. LDL cholesterol >115 mg/dL (low CV risk threshold) was observed

in 65% of participants ($n = 22$). Furthermore, 68% of participants ($n = 23$) had elevated non-HDL cholesterol

Table 2. Blood pressure at the visit

Parameter	Value
Mean systolic blood pressure	$135,5 \pm 14,97$ mmHg
Mean diastolic blood pressure	$88,9 \pm 12,2$ mmHg

Blood pressure classification	n	% ($n = 26$)
Systolic BP ≥ 140 mmHg	11	42
Diastolic BP ≥ 90 mmHg	14	54
Grade I hypertension	8	31
Grade II hypertension	5	19
Grade III hypertension	1	4

Table 3. BMI measurements in the study group of soldiers

BMI category	BMI range (kg/m ²)	Number of people ($n = 30$)	%
Normal	18,5–24,99	5	17
Overweight	25–29,99	15	50
Grade I obesity	30–34,99	7	23
Grade II obesity	35–39,99	3	10

BMI – body mass index

Table 4. Laboratory findings

Parameter	Value	n	%
Number of subjects with normal lipid profile and fasting glucose		4	12
LDL (mg/dL)	<55	2	6
	55–69	1	3
	70–99	3	9
	100–115	6	18
	>115	22	65
Mean LDL (mg/dL)	131,2		
Non-HDL (mg/dL)	<85	3	9
	85–99	3	9
	100–129	5	15
	≥130	23	68
Mean non-HDL (mg/dL)	154,1		
Triglycerides (TGs, mg/dL)	<150	23	67
	150–199	6	18
	200–499	4	12
	>500	1	3
Mean TGs (mg/dL)	156,6		
Fasting glucose (mg/dL)	<100	27	79
	100–125	6	18
	126–199	1	3
	≥200	0	0
Mean glucose (mg/dL)	94,2		
LDL – low density lipoprotein; HDL – high density lipoprotein, TG – triglycerides			

(>130 mg/dL), exceeding the reference threshold for moderate CV risk.

Analysis of the overall 10-year risk of CV events (fatal and nonfatal), performed using the updated SCORE2 algorithms, revealed a concerning risk profile in the study population. Only 38% of participants ($n = 13$) were classified as low or moderate CV risk (Tab. 5). The remaining 62% of participants ($n = 21$) were identified as having a high or very high 10-year risk of CV events [5].

Discussion

The epidemiological analysis showed a significant prevalence of both modifiable and non-modifiable cardiovascular risk factors in the study group of military officers. Of particular note is that, due to the specific nature of their duties, this group is inherently exposed to chronic psychological stress, a recognized independent risk factor for CVD. The accumulation of chronic occupational stress, combined with additional risk factors identified in this study, may accelerate atherogenesis and increase susceptibility to CV events in this professional group.

These observations highlight the need to implement dedicated preventive programmes that encompass interventions targeting both classic risk factors and occupational stress management strategies.

A detailed analysis of haemodynamic parameters revealed a significant discrepancy between the declared and actual prevalence of HT. While 35% of respondents reported a history of HT in the health questionnaire (Tab. 1), abnormal blood pressure (BP) was observed at the study visit in 54% of participants, with 23% exhibiting values consistent with grade II and III HT (Tab. 2). Comparison of the obtained results with the MIL-SCORE findings indicates a lower prevalence of HT in the study cohort compared to the corresponding age categories: 63.5% in the 41–50 age group and 68% in the >50 age group [4]. From a broader international perspective, the prevalence of HT in the Polish Armed Forces is notably higher than in allied armies. HT was found in 5% of soldiers in the US Armed Forces and 2% of soldiers in the French Army, despite the latter's slightly older average age than in the MIL-SCORE group [8, 9].

Table 5. 10-year risk of CVD (fatal and non-fatal) calculated in the study group according to Score2

Age group	Low-to-moderate risk of CVD (<2.5%; <5%)	High risk of CVD (2.5–7.5%; 5–10%)	Very high risk of CVD (≥7.5%, ≥10%)
<50 years	5 (42%)	2 (17%)	1 (8%)
50–69 years	5 (50%)	10 (45%)	2 (9%)
Total	10 (38%)	12 (46%)	4 (15%)
CVD – cardiovascular diseases, Score2 – tools for assessing 10-year risk of cardiovascular event			

Analysis of anthropometric parameters demonstrated a disturbing body weight distribution in the study population (Tab. 3). Only 17% of participants had a healthy weight, while 50% were overweight and 33% were obese (mean BMI: 28.6 kg/m²). The prevalence of obesity in this group is comparable to that in the general U.S. population (33.6%), but significantly exceeds the rates reported in the U.S. Armed Forces (18%), the MIL-SCORE cohort (14.1%), and the French Army (10%).

Assessment of metabolic parameters revealed normal lipid profile and fasting blood glucose in only 12% of participants, which indicates a high risk of atherosclerosis and cardiovascular complications (Tab. 4). Detailed analysis of the lipid profile revealed elevated LDL cholesterol (>115 mg/dL) in 65%, hypertriglyceridemia (>150 mg/dL) in 33%, and elevated non-HDL cholesterol levels (>130 mg/dL) in 68% of participants.

A positive aspect is the relatively low prevalence of nicotine dependence in the study population (approximately 10%), which is much lower compared to 46.2% reported in the MIL-SCORE study and rates observed in other military formations (USA: 19.9%, Germany: 25%). This percentage is only 10.5% among Polish pilots [10]. According to Centre for Public Opinion Research data from 2019, the percentage of smokers in the general population decreased from 31% to 26% (including from 40% to 31% among men) between 2012 and 2019 [11]. Furthermore, the prevalence of smoking is correlated with the level of education, with 33% of smokers declaring vocational education, and only 17% having higher education. Smoking was reported by 15% of specialists and management staff. These trends align with the nationwide decline in nicotine dependence, particularly evident among individuals with higher education and those in management positions.

Epidemiological analysis of NATO military health reports also shows significant differences in the prevalence of CV risk factors between pilots and other soldiers [10, 12–14]. The prevalence of overweight and obesity (40.8%) is lower in military pilots compared to the overall military population, where it exceeds 50%. Likewise, HT is less common among pilots (14.7%) compared to other soldiers (29.5%). A different pattern is seen with hypercholesterolemia, which affects 53.9% of pilots compared to only 24.4% of the rest of the military population. Smoking rates are similar in both groups, with a slight upward trend among pilots (31.7%).

Analysing these differences, several factors can be identified that explain this distribution and should be considered when developing recommendations for the conditions and organization of a cardiac prevention model in the military. Pilots undergo more rigorous health screening and regular, detailed examinations, which enable earlier diagnosis and treatment of metabolic disorders. However, their work is associated with high stress levels, which may contribute to unfavourable changes in lipid profiles and an increased risk of hypercholesterolemia. Age and experience are also important differentiators, with older pilots (over 45–50 years) being less likely to show accumulation of risk factors, which may reflect greater health awareness and more effective preventive strategies [13, 14].

Researchers at the Institute of Aerospace Medicine in Cologne (Germany) also assessed the overall CV risk among military pilots using the PROCAM score adapted to the German population. The results showed that the overall CV risk was lower in this group compared to the general German population, with high (≥5%) and very high (≥10%) risk observed in 0.8% and 0.1% of participants, respectively [11]. This risk was also significantly lower than that observed in the Polish military. Similar findings were reported in studies involving NATO air personnel, highlighting the effectiveness of dedicated educational programme and health monitoring in reducing CV risk.

SCORE2 risk tables, developed for high-risk populations, were used to assess the overall risk of CV events among the surveyed officers. About 28% of participants were classified as low or moderate risk (<5%), 46% as high risk (≥5%), and 15% as very high risk (≥10%) (Tab. 5). For comparison, 93.5%, 5.5%, and 1% of soldiers from the same age group, assessed with the PolSCORE 2015 tool as part of the MIL-SCORE study, were classified as low-to-moderate, high, and very high risk, respectively [4].

Study limitations

This was a retrospective analysis of medical records from preventive health screenings conducted among volunteers. Participants were officers holding leadership positions, with a mean age of 51 years. Therefore, the results are applicable only to this group and should not be generalized to the entire military population.

The incompleteness of data in the medical records and the lack of standardization for blood pressure measurements (e.g., missing information on devices used and measurement conditions), which could have affected result accuracy was a significant limitation of the study. Additionally, the relatively small study group limits the generalizability of the findings.

Body composition was assessed using the BMI, which, although widely used in medicine, not always accurately differentiates between excess fat and increased muscle mass. This limitation is particularly relevant for physically active individuals, as confirmed by previous analyses from the Military Institute of Aviation Medicine [10].

Conclusions

The study provided valuable public health data on the prevalence of cardiovascular risk factors in a selected group of Polish officers in leadership positions.

Our findings highlight the need to implement comprehensive preventive programmes in the Armed Forces. Regular screenings, increasing personnel awareness of healthy lifestyle principles, fostering habit development, and maintaining motivation to apply these habits during military service are essential. Tailoring dietary and training interventions to the specific professional requirements of officers is equally important. Preventive measures should include individually tailored nutritional strategies, appropriately planned physical activity, and, when justified, pharmacological management of metabolic disorders.

The data emphasize the need for further prospective studies to evaluate the effectiveness of implemented preventive interventions and their impact on long-term prognosis in this professional group. Analyses should include indicators such as changes in lipid profiles, blood pressure stabilisation, weight reduction, and improved physical performance. At the same time, given the benefits of technological advancements, the development and implementation of ICT tools for collecting, processing, and analysing behavioural, metabolic, and environmental health risk factors appear fully justified. Such solutions can support education, promote a healthy lifestyle, and monitor health status as well as adherence to health-oriented recommendations. Incorporating stress biomarkers and subjective assessments of quality of life could provide a more accurate evaluation of the efficacy of preventive measures.

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