



HYPERTENSION IN MILITARY AIRCREW: AN ANALYSIS OF MEDICAL MANAGEMENT AND CERTIFICATION REGULATIONS IN POLAND

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Introduction: Hypertension is one of the most common lifestyle disease and is also observed among military flying personnel. Service factors such as G-forces, stress, and circadian rhythm disturbances may contribute to its development. The aim of this study is to discuss the current principles of diagnosis, treatment, and medical certification related to arterial hypertension in military flying personnel in Poland.

Method: This paper presents a review of the scientific literature and an analysis of medical certification data from the Military Aviation Medical Board for 2024, covering four groups of aviation personnel. The study takes into account applicable regulations, current clinical guidelines, and pharmacotherapy protocols used in the assessment of aeromedical fitness.

Results: Among the 1,575 certifications analysed, arterial hypertension was diagnosed in 2.44% of jet pilots and up to 7.17% of cabin crew. All individuals were cleared to return to service following the implementation of pharmacological treatment.

Discussion: Effective pharmacotherapy enables the majority of personnel to continue service. In military aviation, ACE inhibitors, sartans, and thiazide diuretics are the preferred medications. The use of beta-blockers and calcium channel blockers in high-maneuvre pilots is limited due to their impact on G-force tolerance.

Conclusions: Early diagnosis, appropriate drug selection, and effective blood pressure control are essential for maintaining aeromedical fitness. ABPM monitoring improves diagnostic accuracy. Individual clinical assessment remains the basis for certification decisions and operational safety.

Keywords: hypertension, flying personnel, prevention, pharmacotherapy, military certification

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INTRODUCTION

Hypertension (HT) remains one of the most common chronic diseases globally and constitutes a significant public health concern. According to data from the World Health Organization (WHO), the number of people diagnosed with this condition increased from 650 million in 1990 to over 1.3 billion in 2019, representing nearly one-third of the world's adult population [7]. The prevalence of HT increases with age [20]. In Poland, according to the latest data, hypertension affects 6–9% of individuals aged 16–18, 10–14% in the 35–44 age group, and as many as 38.8% of those over the age of 65. In younger age groups, a clear predominance is observed among men [2,13,19].

Although hypertension is most often associated with the general population, it also presents a significant diagnostic and certification challenge among aviation personnel, particularly military pilots and aircrew members. A number of risk factors for the development of hypertension have been identified (Table 1) [29]. Military aviation service involves additional physiological and environmental stressors, including G-forces, vibration, psychological stress, circadian rhythm disturbances, and limited recovery time. These factors may contribute to both the development of hypertension and difficulties in achieving effective control [4,8,9,14,25].

Importantly, effective diagnosis and treatment of HT in this population encounter particular challenges. Due to concerns among flying personnel regarding temporary or permanent suspension from duty, the condition may be deliberately concealed or underreported. Conversely, overly restrictive certification procedures may result in the unjustified disqualification of individuals with well-controlled hypertension or elevated blood pressure not meeting diagnostic criteria for HT. In this context, diagnostic methods that minimise the white coat effect—such as 24-hour ambulatory blood pressure monitoring (ABPM)—are of particular importance and should be

considered standard in the health evaluation of flying personnel [7,17].

Untreated or poorly controlled hypertension may lead to serious complications, including accelerated atherosclerosis, heart failure, arrhythmias, and hypertensive microangiopathy-related damage. HT also increases the risk of acute cardiovascular events such as myocardial infarction, stroke, aortic aneurysm, and hypertensive emergency [16,17,30]. Despite this, WHO reports indicate that only 18% of men and 23% of women receive effective treatment and achieve adequate blood pressure control [7]. The situation in Poland is even less favourable: according to the NATPOL III PLUS study, only 12% of patients attain proper blood pressure control and receive appropriate treatment [2]. Effective pharmacotherapy allows many pilots to continue their flight duties, provided the treatment is well tolerated and no organ damage is present. Drug selection should consider the safety profile in the context of aviation work, particularly its effect on psychophysical performance, the ability to operate in extreme conditions, and G-force tolerance.

The current certification guidelines, as set out in the Regulation of the Minister of National Defence of 25 March 2024, are based on the 2019 classification of hypertension by the Polish Society of Hypertension. They define three grades of hypertension based on blood pressure values (Table 2) [24,29]. However, the latest recommendations of the European Society of Cardiology (2024) advocate moving away from rigid hypertension grading in favour of comprehensive cardiovascular risk assessment that accounts for coexisting risk factors and target organ damage [17]. This underscores the need to update both certification and therapeutic practices in accordance with the new guidelines and the specific requirements of aviation medicine.

The aim of this study is to review current principles of diagnosis, clinical guidelines, and standards of care in the treatment of hypertension

Tab. 1. Risk factors for the development of hypertension [29].

| Non-modifiable | Modifiable |
|---|--|
| Male sex | Nicotine use |
| Age (men ≥ 55 , women ≥ 65) | Lipid disorders |
| Premature menopause | Hyperuricaemia |
| Family history of cardiovascular disease (men < 55 years of age, women < 65 years of age) | Overweight and obesity |
| Early-onset hypertension in family history | Sedentary lifestyle |
| | Psychosocial and socioeconomic factors |
| | Resting heart rate > 80 /min |

Tab. 2. Regulation of the Minister of National Defence of 25 March 2024 on the assessment of fitness for military service and the procedures of military medical boards in these matters, Annex No. 2 I – List of diseases and disabilities considered in the evaluation of fitness for military service in aviation, ground flight support, and aviation engineering services, and the conditions for issuing decisions in these cases. Chapter X – Cardiovascular system.

| § 39, item 1 | I A | I B | I C | II |
|----------------------------------|-------------|-------------|-------------|-------------|
| Grade I hypertension (mild) | Fit / Unfit | Fit / Unfit | Fit / Unfit | Fit / Unfit |
| § 39, item 2 | | | | |
| Grade II hypertension (moderate) | Unfit | Unfit | Fit / Unfit | Fit / Unfit |
| § 39, item 3 | | | | |
| Grade III hypertension (severe) | Unfit | Unfit | Unfit | Unfit |

I A – Subgroup comprising candidates for supersonic jet pilot positions and current supersonic jet pilots;

I B – Subgroup comprising candidates for subsonic jet pilot positions, current subsonic jet pilots, candidates for turboprop aircraft with ejection seat positions, and current turboprop aircraft pilots with ejection seats;

I C – Subgroup comprising candidates for pilots of turboprop aircraft, pilots of turboprop aircraft, candidates for pilots of transport aircraft, pilots of transport aircraft, candidates for helicopter pilots, helicopter pilots and candidates and soldiers for parachute jumps from altitudes above 4,000 meters

II – Subgroup comprising candidates for aircrew and current flight personnel: navigators, flight engineers, cabin crew members, pilots of class II and III unmanned aerial vehicles and operator of sensors on class II and III unmanned aerial vehicles

Tab. 3. Demographic characteristics of the study group.

| Certification group | Mean age (years) | Men (%) | Prevalence of hypertension (%) |
|---------------------|------------------|---------|--------------------------------|
| I A | 51.75 | 100 | 2.44 |
| I B | 48.67 | 100 | 4.76 |
| I C | 39.74 | 100 | 5.86 |
| II | 47.9 | 100 | 7.17 |

I A – Subgroup comprising candidates for supersonic jet pilot positions and current supersonic jet pilots;

I B – Subgroup comprising candidates for subsonic jet pilot positions, current subsonic jet pilots, candidates for turboprop aircraft with ejection seat positions, and current turboprop aircraft pilots with ejection seats;

I C – Subgroup comprising candidates for pilots of turboprop aircraft, pilots of turboprop aircraft, candidates for pilots of transport aircraft, pilots of transport aircraft, candidates for helicopter pilots, helicopter pilots and candidates and soldiers for parachute jumps from altitudes above 4,000 meters

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in aviation personnel, with particular attention to the safety of pharmacotherapy, the impact of the condition on flight fitness, and an analysis of certification data from the Military Aviation Medical Board.

METHODS

A review of the scientific literature was conducted using electronic databases such as PubMed® and Google Scholar. The analysis focused on the epidemiology, diagnosis, and treatment of hypertension, with particular emphasis on the safety of antihypertensive pharmacotherapy in military personnel. The literature search employed keywords including: “hypertension,” “antihypertensive drugs,” and “aviation medicine,” which enabled the selection of relevant scientific sources. Additionally, the article presents statistical data from 2024 concerning the number of medical certifications issued with a diagnosis of

hypertension among flying personnel of the Polish Air Forces, serving as a key element in evaluating the impact of this condition on fitness for duty in military aviation.

RESULTS

Based on periodic medical examinations, which are mandatory for Polish Air Force personnel at the Military Institute of Aviation Medicine, an analysis was performed to assess the prevalence of hypertension in this group. The diagnosis was most often made on the basis of medical history and office blood pressure measurements, and in some cases confirmed by ABPM. In 2024, the Military Aviation Medical Board issued a total of 1,575 medical certifications for flying personnel. All individuals examined were Caucasian men aged 25 to 59 years (mean: 46.1; median: 48; SD: 8.5). The age distribution indicated that the largest subgroup consisted of individuals aged 45–49

years. The age characteristics of the personnel in each certification group are presented in Table 3. Due to the protection of sensitive data, no further demographic details are provided.

The prevalence of diagnosed hypertension was:

- 2.44% among supersonic jet pilots (I A),
- 4.76% among subsonic jet pilots (I B),
- 5.86% among transport and helicopter pilots (I C),
- 7.17% among cabin crew personnel (II).

In all cases, antihypertensive treatment was initiated or continued, lifestyle modifications were recommended, and the personnel were deemed fit to continue performing flight duties.

DISCUSSION

The prevalence of diagnosed HT among aviation personnel was significantly lower than in the general population, where, according to epidemiological data from Poland, it reaches 10–14% in the 35–44 age group [19].

This marked discrepancy requires further analysis and likely has multifactorial origins. Military personnel represent a medically preselected population, and regular physical fitness assessments encourage the maintenance of good physical condition [15]. Physical activity and normal body weight are well-established protective factors against the development of hypertension. However, available data show that overweight and obesity—though less common than in the general population—still affect a notable proportion of professional soldiers [5,6]. Therefore, physical fitness alone does not fully explain the low rate of hypertension diagnoses. Differences in HT prevalence are also observed between categories of flying personnel. Pilots in certification category IA are subject to the most stringent medical requirements, which translates into higher health awareness. This group tends to exhibit greater physical activity, lower rates of overweight and obesity, and reduced use of harmful substances (e.g. tobacco, alcohol) compared to other certification groups. This results from full awareness of strict health standards applicable to this occupational group and the necessity of meeting them to maintain flight fitness. The less restrictive the medical requirements in a given group, the higher the incidence of hypertension—hence the rising trend across successive personnel categories. Routine medical examinations, preventive programmes, and timely initiation of treatment—core elements of the aviation medical surveillance system—play a crucial role in maintaining low HT rates in this specific population. These factors

contribute significantly to the lower prevalence of HT compared to the general population, where no similar system of regular screening exists. Another possible explanation for the observed discrepancy is intentional concealment of symptoms or illness by military personnel out of fear of losing medical fitness. This phenomenon has also been documented in the international literature, including studies on US Air Force and Royal Air Force personnel [27,28], where the pressure to maintain flight status may lead to underreporting of health problems or seeking treatment outside the military system. Treatment resulting in normotension without informing the military medical board may contribute to underestimation of true HT prevalence among pilots.

In the study group, ABPM was used relatively infrequently, although this test should be recommended in nearly all suspected cases of HT in aviation personnel. Office measurements may be elevated due to stress associated with the certification process and fear of being grounded, leading to the so-called “white coat effect.” ABPM eliminates this confounding factor and allows for more accurate assessment of blood pressure in daily life [7,17].

Particular attention should also be given to detecting elevated blood pressure—defined as systolic values of 120–129 mmHg and/or diastolic values of 80–84 mmHg. When non-pharmacological interventions are introduced early (e.g. dietary changes, increased physical activity, weight reduction), the progression to full hypertension can often be halted or delayed [1,26]. Recommended non-pharmacological treatments for HT also include smoking cessation, reduction in alcohol and salt intake, increased dietary potassium, improved sleep hygiene, and adherence to diets rich in fruits and vegetables while limiting saturated fats (e.g. DASH or Mediterranean diets). The effectiveness of these interventions varies individually and depends largely on adherence. Nevertheless, their role should be emphasised alongside pharmacological treatment [3,7,17].

Providing effective education to raise awareness of these strategies is likely to be more successful in this group, given the high standards of discipline and physical fitness expected of professional soldiers.

A diagnosis of hypertension does not necessarily mark the end of a military pilot’s career, provided that blood pressure is effectively controlled. In addition to lifestyle changes, modern pharmacotherapy offers a broad range of effective and safe options suitable for use in aviation

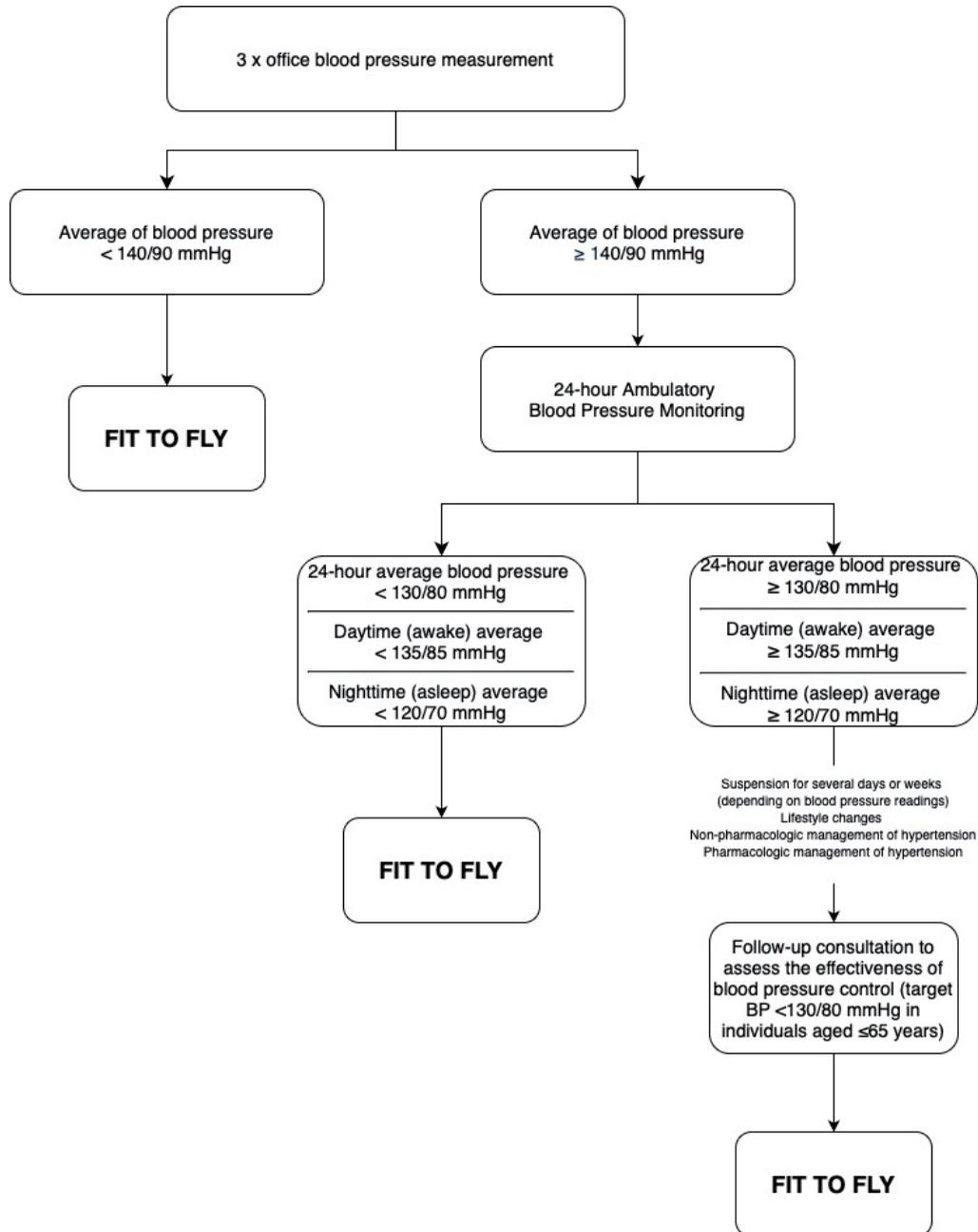


Fig. 1. Proposed algorithm for managing suspected hypertension in Polish military aviation personnel (own study).

personnel. Many of these agents have been positively evaluated for safety in this occupational group [3,12,18,23].

The five main drug classes used in the pharmacological treatment of hypertension are: diuretics (primarily thiazide), angiotensin-converting enzyme inhibitors (ACE-Is), angiotensin II receptor blockers (ARBs), beta-blockers, and calcium channel blockers. Drug selection must account for the specific demands of flight operations and the potential impact on G-force tolerance.

Thiazide diuretics are considered safe if electrolyte levels are adequately monitored. Loop diuretics, on the other hand, are contraindicated in pilots due to the risk of electrolyte imbalances. ACE-Is and ARBs are widely used, effective, and well tolerated in this group. Although some reports suggest a possible reduction in G-force tolerance, no conclusive clinical evidence supports this concern [21].

Calcium channel blockers—especially dihydropyridines—may cause vasodilation and reduce G-force tolerance, and are therefore

contraindicated in pilots of high-maneuvre aircraft, with the exception of amlodipine, which may be permitted in specific cases. Similar limitations apply to beta-blockers, which may negatively affect G-force tolerance by reducing heart rate and causing vasodilation [22].

In selected cases, medications outside the primary drug classes—such as alpha-blockers—are used to improve blood pressure control. Although they may be helpful, for example, in treating benign prostatic hyperplasia, their use in pilots is limited due to the risk of orthostatic hypotension and reduced tolerance to high G-forces [22].

According to Federal Aviation Administration (FAA) guidelines in the United States, monotherapy with selected antihypertensive drugs—such as ACE-Is, ARBs, and thiazide diuretics—is permitted in certification decisions for achieving target blood pressure. Calcium channel blockers may also be used to a limited extent, excluding jet pilots, except for amlodipine. After initiating pharmacotherapy, a minimum observation period of seven days is recommended, during which the pilot is grounded. If target blood pressure is achieved and the medication is well tolerated, the individual may return to duty [10,11].

The diagnosis of hypertension leading to a medical certification decision should be based on repeated in-office measurements and ABPM results. Once the diagnosis is confirmed, the individual is temporarily suspended from flying duties until blood pressure is effectively controlled and the treatment is evaluated for safety.

The grounding period typically lasts from several days to several weeks, depending on baseline values, treatment response, and any side effects. Following the observation period and confirmation of effective therapy, the Military Aviation Medical Board may revise the medical classification to a less restrictive category—enabling return to flight duty—provided that blood pressure is well

controlled, there are no organ complications, and pharmacotherapy is well tolerated.

Based on the findings, a management algorithm for suspected hypertension in Polish military flying personnel has been proposed (Fig. 1).

CONCLUSIONS

Although hypertension is highly prevalent in the general population, it remains relatively infrequently diagnosed among flying personnel. This may be attributed to both the stringent medical requirements for service candidates and the phenomenon of intentional concealment of illness due to concerns over temporary or permanent suspension from duty. While a diagnosis of hypertension does not necessarily result in disqualification, achieving effective blood pressure control with safe and well-tolerated medications is essential.

Modern pharmacotherapy offers a range of effective and approved therapeutic options that enable aviation personnel to maintain full psychophysical performance. According to current certification regulations, individuals diagnosed with hypertension may return to flight duties once optimal disease control is achieved—provided there are no target organ complications and the treatment is well tolerated.

Appropriate monitoring, particularly through ABPM, plays a critical role in accurate diagnosis and evaluation of treatment efficacy. It helps to eliminate the influence of the white coat effect and prevents unnecessary disqualification.

The findings of this study confirm that, in cases of hypertension among aviation personnel, individual clinical assessment, a conscious approach to treatment, and active collaboration with medical staff are essential to ensuring the safety not only of pilots, but of the entire aviation system.

AUTHORS' DECLARATION

Study Design: Magdalena Rola, Michał A. Kurek, Łukasz Dziuda. **Data Collection:** Magdalena Rola, Michał A. Kurek, Łukasz Dziuda. **Manuscript Preparation:** Magdalena Rola, Michał A. Kurek, Łukasz Dziuda. The authors declare that there is no conflict of interest.

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