
HEALTH RISK FACTORS AMONG PARTICIPANTS OF THE 33RD BULGARIAN ANTARCTIC EXPEDITION

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Abstract: Polar expeditions are physically and psychologically demanding, requiring participants to maintain optimal health and functional capacity. Lifestyle and diet can significantly influence human health outcomes and performance in extreme environments. Health organizations offer unified recommendations for reducing health risks, such as eating balanced diets rich in fruits, vegetables, and whole grains, and limiting salt, sugars, and unhealthy fats, while avoiding smoking and excess alcohol drinking. Regular physical activity and adequate sleep are also emphasized. This study aimed to examine the health habits, including typical diet, smoking and alcohol consumption, physical activity, sleep duration, and stress levels of participants in the 33rd Bulgarian Antarctic Expedition, and to provide recommendations for improving health as a basis for disease prevention and enhanced work performance. The study involved a total of 48 individuals (34 men and 14 women, average ages 47.5 and 41.1 years, respectively). Before departing for Antarctica, each participant underwent medical examinations, anthropometric assessments, and completed a health questionnaire covering typical blood pressure, smoking and alcohol habits, diet, sleep duration, stress, and physical activity. Results indicated that, based on calculated body mass index, only 20.6% of men and 64.3% of women were of normal weight. Most men (79.4%) and over a third of women (35.7%) were pre-obese or obese, heightening cardiovascular risk. Blood pressure findings showed 55.8% of men and 28.6% of women had elevated or hypertensive readings. Regarding smoking, 29% of women and 38% of men were non-smokers; 7% of women and 15% of men smoked more than 20 cigarettes daily. Half of the women and 38% of the men were alcohol abstinent; most others drank within recommended levels. Fruit and vegetable consumption was low among many participants, and most rarely ate fish. Women preferred chicken, while men ate more pork and processed meats. Only a small number of participants were vegetarians. Most avoided extra salt, with a minority using it generously. Half of the men and 7% of the women slept less than 6 hours per night; few exceeded 8 hours. Severe psychological stress was rarely reported. About 90% of participants engaged in sufficient physical activity, 58% of women and 23% of men exercised regularly. In conclusion, many expedition members, particularly men, were overweight, with hypertension, and had unhealthy habits such as smoking, low consumption of fruits and fish, high intake of pork and processed meat products, insufficient sleep, and low engagement in physical activity. Therefore, targeted health strategies, including regular monitoring of weight and blood pressure, dietary improvement, limited tobacco and alcohol use, support for sleep and stress management, and consistent physical activity, are recommended to support disease prevention and the well-being of people during Antarctic expeditions. Collaboration among staff will help optimize health and performance in challenging conditions.

Keywords: Antarctic expedition, body mass index, healthy habits, physical activity, sleep

1. INTRODUCTION

Participation in polar expeditions places high physiological and psychological demands on participants (Johnsen & Gjeldnes, 2023). These demands are associated with travel across multiple time and climate zones, prolonged and intensive scientific work under harsh environmental conditions, and social interaction within a limited group of people outside their usual environment. Therefore, expedition members must be in good health and possess adequate functional capacity.

While genetic predispositions largely influence health, they can also be significantly shaped by lifestyle and diet (Institute of Medicine, 2006). Overeating, a sedentary lifestyle, and prolonged stress are major risk factors for the development of chronic diseases. The WHO has established a classification system that links body mass to various health risks (WHO, 2000). Additionally, the American Heart Association (AHA) has introduced a detailed classification system that links specific ranges of blood pressure to corresponding health risks (Jones et al., 2025), offering further guidance for evaluating cardiovascular health.

The World Health Organization (WHO) (WHO, 2025a) and other institutions, such as UK's National Health Service (NHS), Centers for Disease Control and Prevention (CDCP), provide guidelines for maintaining a healthy lifestyle.

These include recommendations for disease prevention (particularly cardiovascular diseases (CVD), which are the leading cause of death), improving mental well-being, and promoting long-term health.

To maintain good health, a balanced diet is recommended, rich in fruits and vegetables, with limited intake of salt, sugar, and unhealthy fats, and sufficient water consumption. Major health organizations offer similar guidance. The WHO advises consuming at least 400g of fruits and vegetables daily, limiting salt, sugars, and fats, and emphasizing whole grains and legumes (WHO, 2025a). The European Food Safety Authority (EFSA) recommends about 300g of fruits and vegetables, moderate consumption of lean meats, dairy, and nuts, along with adequate hydration (EFSA, 2025). U.S. guidelines focus on variety across food groups, prioritizing whole grains and healthy proteins, while limiting added sugars and saturated fats (U.S. Department of Agriculture (USDA) and U.S. Department of Health and Human Services (DHHS) (2020). The NHS promotes a balanced diet based on five food groups, focusing on whole grains, fruits, vegetables, healthy fats, and proper hydration (NHS, 2022).

Regular physical activity, along with minimizing sedentary behavior, is also crucial for health. All organizations emphasize moderation, balance, and consistent movement. According to the WHO (2024a), EFSA (European Commission, 2024), DHHS (2018), and the NHS (2024), adults should aim for at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week, or an equivalent combination. For additional benefits, 300 minutes of moderate activity per week is recommended. Muscle-strengthening activities involving major muscle groups should also be performed at least twice per week. These unified recommendations reflect a global consensus on the minimum level of physical activity required for maintaining and improving overall health.

Other critical recommendations include avoiding smoking and limiting or eliminating alcohol consumption. According to Le et al. (2024), people who continue smoking between the ages of 35 and 75 may lose an average of 9 to 4 years of life, but quitting at any age can recover up to 8 years. All major health authorities, including the WHO (2025c), European Commission (2025a), CDCP (2025a), and NHS (2025a), strongly advocate complete smoking cessation, as smoking remains a leading cause of preventable disease and death. The most effective approach to quitting combines pharmacological and behavioral interventions.

The WHO (2024b) advises minimizing alcohol intake, stating there is no safe level of alcohol consumption. The European Commission (2025b) recommends no more than 10 grams of pure alcohol per day for women and 20 grams for men. The CDCP (2025b) suggests a maximum of 1 drink per day for women and 2 for men, while the NHS (2025b) advises limiting intake to 14 units per week, spread over at least 3 days. All institutions agree that excessive alcohol consumption significantly increases the risk of chronic diseases, including liver disease, cardiovascular conditions, and cancer.

Sufficient sleep is essential for both physical and mental recovery. Recent scientific findings show that insufficient sleep negatively impacts emotional regulation, physical health, and mental well-being. A 2023 meta-analysis (Palmer et al., 2023) revealed that all forms of sleep deprivation reduce positive emotions and increase anxiety, contributing to emotional dysregulation and psychiatric vulnerability. Another review (Shah et al., 2025) linked short sleep duration (<7 hours) to elevated risk of hypertension, stroke, heart disease, obesity, and type 2 diabetes, with both short and long sleep linked to increased mortality. According to data (Blackwelder et al., 2021), adults who sleep 6 hours or less are 2.5 times more likely to experience frequent mental distress. Improving sleep quality significantly reduces symptoms of depression and anxiety, though effects on stress remain unclear (Li et al., 2025). These findings emphasize the vital role of high-quality, adequate sleep for overall health.

Stress management and social support are also vital. Health authorities and recent studies agree that chronic stress has widespread harmful effects on both physical and mental health. The American Psychological Association (APA, 2022, 2023) reports that prolonged stress impairs multiple body systems and contributes to anxiety, depression, cardiovascular disease, digestive problems, weight gain, immune suppression, and cognitive dysfunction. The WHO (2023) warns that excessive stress can worsen existing conditions, increase substance use, and cause mental and physical symptoms. The CDCP (2025c) highlights stress-related emotional distress, chronic pain, poor concentration, and increased use of harmful substances. Scientific research confirms that early-life stress is linked to chronic inflammation and long-term illness, and that chronic stress may accelerate biological aging, even in resilient individuals (Chen & Miller, 2022a, b).

Given that participants in Antarctic expeditions are often middle-aged scientists (Blight & Norris, 2019) with low levels of physical activity, making them more susceptible to cardiovascular (Wu et al., 2025) and metabolic diseases (Chomiuk et al., 2024), and considering the remoteness of Antarctic stations from advanced medical facilities (Mills et al., 2008), pre-expedition health assessments are critically important. For individuals, especially those working annually in polar environments, identifying unhealthy habits can help initiate changes that improve their health and functional capacity.

Thus, the goal of this study was to assess the dietary habits, typical physical activity, sleep duration, and stress levels of participants in the 33rd Bulgarian Antarctic Expedition, and to outline recommendations for improving their health status as a basis for disease prevention and enhanced work capacity.

2. METHODOLOGY

A total of 48 individuals participated in the study, all of whom were members of the 33rd Bulgarian Antarctic Expedition. The group included 34 men and 14 women, with an average age of 47.50 ± 10.84 and 41.14 ± 8.62 years, respectively. Before departing for Antarctica, participants underwent an initial medical examination, and anthropometric measurements, height and weight, were recorded, and the body mass index (BMI) was calculated. For the purpose of this study, a Health Risk Questionnaire (HRQ) was created, based on the recommendations of the WHO, AHA, CDCP, and APA. Participants completed the Health Risk Questionnaire, which included questions about the predominant systolic blood pressure, the frequency of consumption of different food groups, alcohol use, smoking, experienced psychological stress, sleep duration, and level of physical activity.

3. RESULTS

Table 1 displays the BMI distribution of participants, following the WHO's classification system (WHO, 2000). Based on anthropometric measurements and BMI calculations, it was found that among men, 20.6% had a normal weight (BMI 18–25). Among women, 64.3% had a normal weight. The data revealed that a significant majority of male expedition members (27 out of 34, 79.4%), as well as 5 out of 14 women (35.7%), fell into the pre-obese or obese categories, placing them at increased to very severe risk for CVD.

Table 1. Distribution of participants according to the Classification of adults according to BMI

Classification	BMI	Risk of comorbidities	Female (n=14) (%)	Male (n=34) (%)
Underweight	<18.50	Low (but risk of other clinical problems increased)	0 (0.0%)	
Normal range	18.50-24.99	Average	9 (64.3%)	7 (20.6%)
Overweight:	≥ 25.00			
Pre-obese	25.00-29.99	Increased	1 (7.1%)	16 (47.1%)
Obese class I	30.00-34.99	Moderate	3 (21.4%)	8 (23.5%)
Obese class II	35.00-39.99	Severe	0 (0.0%)	2 (5.9%)
Obese class III	≥ 40.00	Very severe	1 (7.1%)	1 (2.9%)

Source: Authors' research

Table 2 presents the distribution of participants according to their predominant systolic blood pressure, based on the classification of the AHA (Jones et al., 2025). The data indicated that the majority of male expedition members (19 out of 34, 55.8%) and 4 (28.6%) of the women had elevated blood pressure and a mildly to highly increased risk for CVD.

Table 2. Distribution of participants according to blood pressure categories and related health risks as defined by the AHA

Category	Systolic (mm Hg)		Diastolic (mm Hg)	Associated Health Risks	Female (n=14) (%)	Male (n=34) (%)
Normal	<120	and	<80	Lowest risk of cardiovascular disease and stroke	10 (71.4 %)	15 (44.1%)
Elevated	120–129	and	<80	Increased risk of heart disease and stroke	0 (0.0 %)	1 (2.9%)
Hypertension Stage 1	130–139	or	80–89	Moderate risk of heart attack, stroke, and kidney disease	4 (28.6 %)	13 (38.2%)
Hypertension Stage 2	≥ 140	or	≥ 90	High risk of heart failure, stroke, cognitive decline, and kidney damage	0 (0.0 %)	5 (14.7%)

Source: Authors' research

The results showed that among the women, 29% were non-smokers, while among the men, this share was 38%. About 7% of the women and 15% of the men reported smoking more than 20 cigarettes per day. Total abstinence from alcohol was reported by 50% of the women and 38% of the men. Moderate alcohol consumption (up to 200 ml of wine or 50 ml of spirits) was reported by 50% of the women and around 50% of the men, while 12% of the men consumed alcohol above these amounts.

Fruit and vegetable consumption was insufficient among a significant portion of participants: 36% of the women and 58% of the men consumed less than the recommended 200 grams of fruit per week, while 21% of the men consumed less than the recommended 200 grams of vegetables.

Fish was rarely consumed – 86% of the women and 88% of the men ate fish less than the recommended twice per week. The preferred meat among women was chicken – 86% consumed it at least once a week, of which 43% consumed it two or more times. Pork was consumed once a week by 21% of the women, and two or more times by another 21%. Among men, 59% consumed pork at least twice weekly, 38% ate processed meats, only 35% ate chicken, and 12% ate beef. Only 7% of the women and 9% of the men identified as vegetarians.

Salt usage also varied: among the women, 14% used salt generously, 29% used it moderately, and 57% avoided it, none completely abstained from salt. Among the men, 6% reported not using salt at all, 3% used it generously, and 62% tried to avoid it.

In terms of sleep, 7% of the women and 50% of the men reported sleeping less than 6 hours per night, while 71% of the women and 29% of the men slept between 6 and 7 hours. Only 3% of the men slept more than 8 hours.

Psychological stress was rare – 93% of the women and 88% of the men reported not experiencing severe stress in the past year.

Light physical work was performed by 64% of the women and 50% of the men, while 29% of the women and 12% of the men reported no physical activity. Moderate and heavy physical labor were reported by 7% of the women and 35% of the men. Physical activity levels averaged between 0.5 and 1 hour per day for 50% of the women and 53% of the men, and more than 1 hour per day for 43% of the women and 41% of the men. Only 7% of the women and 6% of the men had less than 30 minutes of activity per day. Regular physical activity (three or more times per week) was reported by 58% of the women and 23% of the men, while once-weekly activity was reported by 29% of the women and 35% of the men.

4. DISCUSSION

In this study, a considerable part of male participants fell into the pre-obese or obese categories based on their BMI. Overweight individuals are commonly seen in polar expeditions (Premkumar & Sable, 2012; Žáková & Zezulová, 2016). This underscores the critical need for focused weight management strategies both before and during the expedition. In addition, a significant part of the studied participants, particularly among men, had elevated blood pressure. A pooled analysis showed that for every 20 mm Hg rise in systolic BP above 115 mm Hg, the risk of death from heart disease or stroke doubles, regardless of age (Lewington et al., 2002). Thus, special attention during the expedition should be given by the medical team at the Antarctic base to those participants whose predominant systolic blood pressure exceeds the critical value of 140 mmHg. In addition to blood pressure monitoring, it is necessary to control regular medication intake, salt consumption, and other dietary habits in order to reduce the risk of acute cardiovascular disease (Rippe, 2016). Concerning smoking, the Antarctic base commander should establish strict policies that clearly designate smoking areas, ensuring that indoor spaces remain smoke-free. This approach not only protects non-smokers from the harmful effects of secondhand smoke but also indirectly discourages tobacco use among participants (Frazer et al., 2016). When it comes to alcohol consumption, approximately one-third of men and half of the women were abstainers, aligning with WHO (WHO, 2024b) recommendations. Conversely, the remaining participants, comprising the majority of men and women, consumed alcohol within the health guidelines set by the CDCP (CDCP, 2025b). Only 12% of men reported drinking amounts that exceeded these recommended limits. This overall pattern suggested that most expedition members were unlikely to regularly surpass the maximum advised intake, thus supporting better collective health. The results herein suggest that participants' dietary habits did not align well with the recommendations of major health organizations. The meals provided during the expedition must meet essential standards for minimizing health risks. In addition, the specific energy intake requirements of expedition members, shaped by the extreme Antarctic conditions and the demands of their individual tasks, must be carefully considered. This calls for proactive involvement from both medical personnel and cooks, beginning with careful planning of the quality and quantity of food supplies. By ensuring that provisions support a healthy diet tailored to the participants' energy needs, the expedition team can help safeguard the health and well-being of everyone involved. A majority of both male and female participants refrained from adding extra salt to their meals. Considering that most food items already contain significant amounts of salt, minimizing additional use is likely the most effective way to meet the WHO's recommendation of less than 5 grams

of salt per day (Kazi, 2025). For those who do add salt, the expedition's physician should actively encourage them to reduce this habit, while cooks should use only the minimum amount necessary in meal preparation. Of particular concern was the finding that 17 participants, representing 50% of the men, reported sleeping less than 6 hours per night. This not only poses significant health risks but also undermines physical and mental performance (Shah et al., 2025). To address this, efforts should focus on reducing the consumption of black tea and coffee in the hours preceding bedtime and establishing quiet periods within the Antarctic base to support better sleep hygiene. It is advisable to offer a selection of warm, flavorful herbal teas with calming effects as a substitute for caffeinated beverages during rest periods (Baranwalet al., 2023). This approach can help participants unwind and support better sleep quality, while also fostering a more relaxing atmosphere within the base. Most participants did not report experiencing significant stress in the past year. However, for future expeditions, it would be beneficial to more thoroughly examine the potential stressors unique to the Antarctic environment, considering the different roles and responsibilities of both male and female team members. Such research could help tailor support strategies to better address the specific challenges faced by all participants. While psychological stress often requires an individualized approach that considers the crew's sociocultural backgrounds, it can be effectively mitigated through targeted mental healthcare and proactive training in coping strategies (Spinely et al., 2022). Almost 90% of participants had sufficient usual physical activity. However, during the expedition, for participants whose daily routines do not involve enough physical activity, it is recommended to organize various forms of exercise, including suitable games and gymnastics, whenever possible. To facilitate this, it is beneficial for the expedition team to include a member who, in addition to their scientific responsibilities, can take on the role of organizing and leading such activities. This approach will help ensure that everyone remains active and contributes to better overall health during the expedition.

5. CONCLUSIONS

Promoting healthy lifestyle interventions among Antarctic expedition members is vital for disease prevention and overall well-being in challenging environments. The findings highlight the need for targeted strategies such as regular health monitoring, dietary planning, restricted tobacco and alcohol use, support for adequate sleep and stress management, and consistent opportunities for physical activity. Effective collaboration between medical staff, cooks, and team leaders will help ensure that all participants are equipped to maintain optimal health and performance throughout the expedition.

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