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Lipid content analysis in naval cadets at admission: variations across academic years

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Lipids play a crucial role in human physiology, particularly for maritime professionals who require optimal physical endurance, fatigue resistance, and effective thermoregulation. This study evaluates the lipid content among cadets at the Nikola Vaptsarov Naval Academy to assess their physiological adaptation and preparedness for maritime activities. A total of 113 cadets from various specializations were assessed between 2021 and 2023 using bioimpedance analysis. The results indicate a significant decrease in lipid content from first-year cadets (average: 23.7%) to fifth-year cadets (average: 19.0%), corresponding to a reduction in BMI from 25.1 kg/m² to 22.8 kg/m². These findings underscore the effectiveness of structured physical training and nutritional programs in improving cadets' physical fitness and readiness for maritime duties.

Keywords: lipids, lipid content, maritime professionals, cadets

INTRODUCTION

Lipids are fundamental components of the human body, serving as key elements in energy metabolism, protection of internal organs, and thermoregulation [1]. For individuals engaged in maritime professions, maintaining appropriate lipid levels is vital due to the demanding physical and environmental conditions they encounter. Adequate lipid reserves contribute to buoyancy and effective thermoregulation, which are critical for survival during maritime incidents and exposure to cold water environments [2, 3]. Moreover, optimal lipid content enhances physical endurance and reduces fatigue, directly impacting the performance and safety of maritime personnel [4].

Previous studies have explored the anthropometric and body composition profiles of various athletes and professionals, emphasizing the importance of tailored physical conditioning [5, 6]. However, there is limited research specifically focusing on the lipid content of naval cadets during their training period. Understanding these parameters can inform the development of targeted interventions to improve the health and operational readiness of future maritime professionals.

This study aims to evaluate the lipid content among cadets at admission to the Nikola Vaptsarov Naval Academy, analyzing variations across different academic years and providing insights into their physical preparedness for maritime duties.

MATERIALS AND METHODS

Study design and participants

This study was conducted between 2021 and 2023 and included 113 cadets from the Nikola Vaptsarov Naval Academy in Varna, Bulgaria. All participants voluntarily took part in the study across different academic years, from the first to the fifth year, allowing for a comprehensive assessment of lipid content changes throughout their training.

The inclusion criteria required cadets to be enrolled at the Naval Academy during the study period, to have provided informed consent for participation, and to have no known medical conditions affecting lipid metabolism.

Data collection

Data were collected during scheduled physical assessments at the Academy's facilities. The following parameters were measured and recorded for each participant:

- Age
- Gender
- Height (cm)
- Weight (kg)
- Body mass index (BMI)
- Body fat percentage (lipid content)

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Measurement techniques

- *Anthropometric measurements*

Height and weight were measured using standardized equipment with participants barefoot and wearing light clothing. BMI was calculated using the formula: BMI = weight (kg) / [height (m)]².

- *Bioimpedance analysis (BIA)*

Lipid content (body fat percentage) was assessed using bioimpedance analysis, a non-invasive and reliable method for estimating body composition [8]. Measurements were conducted using standardized bioimpedance scales. Participants were instructed to avoid food and intense physical activity for at least 2 hours prior to assessment to ensure accuracy.

- *Data analysis*

Comparative analyses were performed to identify differences in lipid content across academic years and between genders.

RESULTS AND DISCUSSION

Overall findings

The study revealed that the average BMI among cadets across all academic years was within the normal range (18.5–24.9 kg/m²) as defined by the World Health Organization. However, variations in lipid content were observed, with certain groups exhibiting higher than optimal levels.

First-year cadets

The first-year cadets demonstrated the highest average lipid content and BMI, with values slightly exceeding the normal range. This may be attributed to the transition from civilian to military lifestyle, decreased physical activity prior to admission, and lack of established fitness routines. These findings suggest the need for early intervention programs focusing on physical conditioning and nutritional education upon admission.

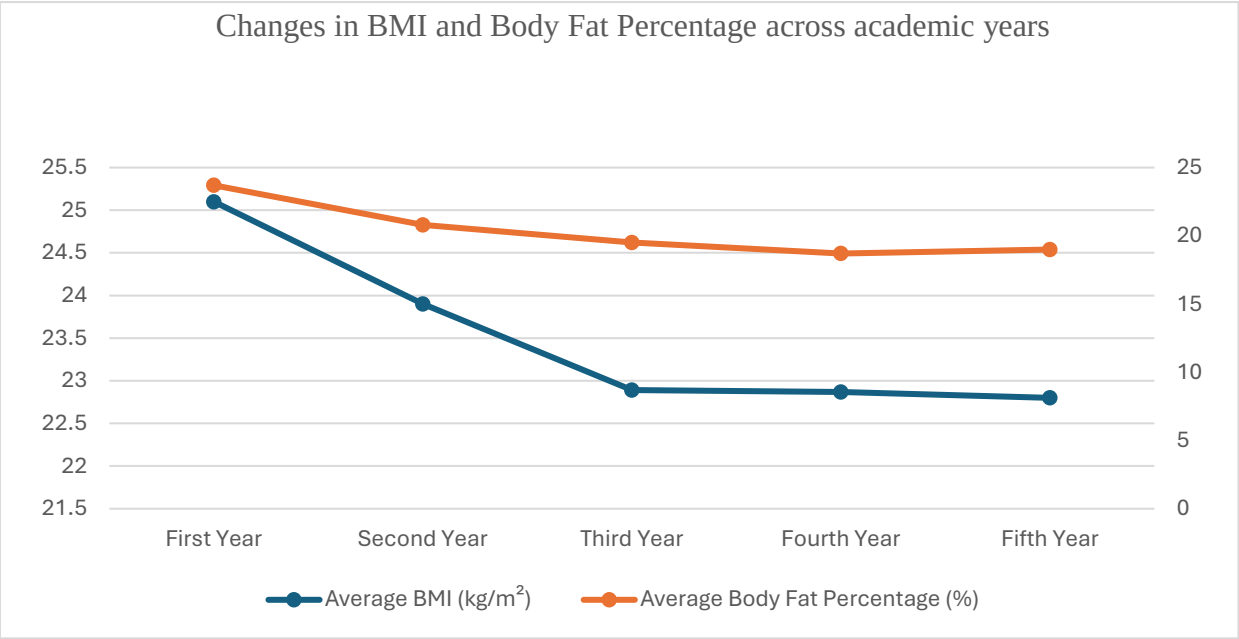
Upper-year cadets

As cadets progress through their training, they demonstrate the effectiveness of structured physical activity and nutritional guidance. The second year marks a notable decrease in BMI and lipid content compared to the first year, reflecting early adaptation to the rigorous training regimen. This trend continues into the third year, where cadets maintain a stable BMI of 23.9 kg/m² while further reducing their lipid levels, reinforcing the impact of sustained physical engagement.

By the fourth year, cadets exhibit a further reduction in lipid content, achieving an average BMI of 22.9 kg/m², indicating a stable physical condition suitable for the demands of their training and future maritime responsibilities. Some isolated cases of slightly elevated BMI are observed, potentially due to reduced physical activity caused by increased academic workload. In the fifth year, these trends remain consistent, with cadets reaching an average BMI of 22.8 kg/m². This stability suggests that they have achieved physical maturity and conditioning that aligns with the requirements of their maritime careers.

Table 1. Summary of cadet measurements across academic years

Academic Year	Number of Participants	Gender (M/F)	Age (Min/Avg/Max)	Height (cm) (Min/Avg/Max)	Weight (kg) (Min/Avg/Max)	BMI (Min/Avg/Max)	Body Fat % (Min/Avg/Max)
First Year	25	22M / 3F	18 / 19 / 20	165 / 176 / 191	50 / 79.5 / 105.9	20.7 / 25.1 / 30.2	12.9 / 23.7 / 34.1
Second Year	22	19M / 3F	19 / 20 / 21	160 / 174 / 182	50 / 76 / 100	18.8 / 24.5 / 30.2	12.6 / 20.8 / 34.5
Third Year	21	18M / 3F	20 / 21 / 22	160 / 173 / 182	53 / 74 / 100	18.9 / 23.9 / 30.2	12.9 / 19.5 / 29.1
Fourth Year	23	19M / 4F	21 / 22 / 23	154 / 174 / 192	45 / 74 / 105	18.6 / 22.9 / 31.6	15.0 / 18.7 / 41.1
Fifth Year	22	17M / 5F	22 / 23 / 24	152 / 175 / 188	49 / 73 / 100	17.9 / 22.8 / 30.0	16.9 / 19.0 / 39.6



Graph 1. Changes in BMI and body fat percentage across academic years

The comprehensive analysis presented in Graph 1 illustrates a steady decline in BMI and body fat percentage across academic years, indicating the impact of naval training on cadets' body composition.

BMI decreases from 25.1 kg/m² in first-year cadets to 22.8 kg/m² in fifth-year cadets, suggesting gradual weight regulation and adaptation to physical training.

Body fat percentage follows a similar trend, dropping from 23.7% to 18.7% by the fourth year, before slightly increasing to 19.0% in the fifth year.

The sharpest decline occurs between the first and third years, likely due to the initial impact of structured physical activity.

The small increase in body fat in the final year may be linked to reduced physical training as academic demands rise.

Overall, the data reflect effective physical conditioning, with early-year cadets experiencing the most significant changes in BMI and body fat.

Gender differences

Analysis across genders revealed that male cadets generally had higher lipid content compared to female cadets, although both remained within acceptable ranges. These differences highlight the importance of gender-specific training and nutrition programs to ensure optimal health outcomes.

CONCLUSION

This study demonstrates a progressive decrease in lipid content and BMI among naval cadets from their first to final academic year, reinforcing the effectiveness of the Academy's structured physical training and nutritional programs. The transition from civilian life to a regimented training schedule significantly impacts body composition, with first-year cadets displaying the highest BMI and lipid content. The gradual decrease in these metrics throughout the training period suggests that continuous physical conditioning and lifestyle modifications play a crucial role in achieving optimal body composition. Maintaining appropriate lipid levels is essential for buoyancy, thermoregulation, and overall endurance in maritime operations. These findings highlight the necessity of tailored fitness and nutrition programs throughout cadets' academic tenure, ensuring their preparedness for the physically demanding conditions of maritime service.

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