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Original Scientific Paper

Nutritional status and dietary habits of 15–17-year-old adolescents in Bosnia and Herzegovina: findings from the EU menu national survey

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ABSTRACT

Proper nutrition during adolescence is essential for healthy growth, development, and long-term well-being. From 2018 to 2021, the Food Safety Agency of Bosnia and Herzegovina conducted a national dietary survey of the population, following the EU Menu methodology. For this study, a subsample of adolescents aged 15–17 years was analyzed, given the physiological similarity of this age group to adults, which allows for the application of standard adult BMI classification. A total of 250 participants were assessed using standardized tools, including the Diet Assess and Plan (DAP) software, collecting data on anthropometry and dietary intake. The majority of adolescents had a normal BMI; however, a concerning proportion of females were underweight. Furthermore, fat intake exceeded recommended levels in both sexes, suggesting potential future health risks. These findings highlight the importance of targeted nutritional education and interventions to promote balanced dietary habits and address both undernutrition and excessive fat intake among adolescents in Bosnia and Herzegovina.

1. Introduction

Adolescence is a critical stage of development during which lasting lifestyle habits are established. Adopting healthy behaviours, such as regular physical activity and a balanced diet, can offer numerous advantages, including enhanced academic performance (*Doku et al*., 2013). Adolescence is a critical developmental stage bridging childhood and adulthood, marked by profound physiological changes associated with puberty, as well as accelerated emotional, cognitive, and social maturation. This period is embedded within a broader, lifelong continuum of human development that originates in foetal life and is shaped throughout childhood by a range of environmental and sociocultural factors—both protective and adverse. The culmination of adolescence involves the attainment of complete somatic and sexual maturity, the consolidation of individual personality, the achievement of economic independence, and integration into the broader social structure (*Heald*, 1985).

However, adolescence is also a period of increased vulnerability to nutritional deficiencies and the adoption of unhealthy dietary patterns. These factors may have long-term health implications,

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including an elevated risk of developing osteoporosis, obesity, hyperlipidaemia, delayed sexual maturation, and failure to reach full adult stature. Extensive research over the years has consistently demonstrated a strong connection between nutrition and overall health. Evidence continues to grow, indicating that following a healthy dietary pattern as part of a balanced lifestyle can support long-term well-being and lower the risk of chronic illnesses at every stage of life (*USDA*, 2020–2025). Nutrition and dietary habits are of critical importance during adolescence, a period characterized by accelerated physical growth and increased physiological demands. To support optimal development, it is essential for adolescents to adopt healthy eating behaviours and adhere to evidence-based dietary recommendations.

Estimating dietary intake of foods and nutrients is a commonly employed indirect method for evaluating an individual's nutritional status. Ultimately, such assessments aim to safeguard and improve overall human health (*Šatalić & Alebić*, 2008). National dietary surveys are a critical source of evidence that support the development of nutrition and health policies. They offer essential population-level insights into eating habits, nutrient intake and adequacy, diet-related health risks, and contribute to the formulation of dietary guidelines and recommendations (*Zhang et. al*., 2019). The aim of this study was to determine the body mass index (BMI) and nutritional status of a select adolescent group in Bosnia and Herzegovina, based on data collected from the Bosnia and Herzegovina Menu national survey.

2. Materials and methods

The methodology used for conducting the food consumption survey was aligned with the European Food Safety Authority's guidelines (*EFSA*, 2014). The national study on dietary habits in Bosnia and Herzegovina (B&H MENU) aimed to establish a system and database on the population's dietary habits, as well as related indicators such as health status, anthropometric characteristics, and physical activity, following the EU Menu methodology (*Arar et. al*., 2021).

The Food Safety Agency of Bosnia and Herzegovina served as the main coordinating institution, responsible for the development of survey tools, project management, and ensuring full compliance with contractual obligations and project timelines. The sampling framework was developed in collaboration with the Agency for Statistics of Bosnia and Herzegovina, based on their established methodological standards.

The broader study included individuals from households across Bosnia and Herzegovina, including adolescents aged 10 to 17 years, who were divided into two age groups: 10–14 and 15–17 years. However, for the purposes of this paper, a subsample of adolescents aged 15–17 years was selected for analysis. This age group was chosen because the 15–17 year age group is physiologically more comparable to adults, allowing the use of standard adult BMI categories. A total of 250 adolescents aged 15–17 years participated in this subgroup analysis, comprising 124 females and 126 males.

For dietary intake assessment, data storage, and processing, the study employed the Diet Assess and Plan (DAP) software platform, a standardized tool developed in accordance with EU Menu guidelines, ensuring accuracy and consistency in data handling (*Gurinović et al*., 2018).

The B&H MENU study was conducted at the individual level, with households selected through a two-stage stratified random sampling method. The sampling design ensured a representative cross-section of the population by including participants from both urban and rural areas, all geographic regions, and major ethnic groups. All age and sex groups were proportionally represented.

Data collection was conducted over the course of a full year, covering all four seasons. The scheduling of interviews was structured to capture seasonal and weekly variations in dietary intake, with appropriate distribution across weekdays, weekends, and public holidays. Anthropometric data (body weight and height) were self-reported during face-to-face interviews, rather than directly measured.

Body mass index (BMI) was determined by dividing weight in kilograms by height in meters squared, with classification according to WHO criteria: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obesity (>30.0 kg/m²) (*Connor et al*., 2023).

3. Results

The dietary habits database for residents of Bosnia and Herzegovina includes data from 250 adolescents (124 females and 126 males) aged 15-17 years. The nutritional status of male and female adolescents, as determined by BMI classification, is summarized in Table 1.

Table 1. Nutritional status of adolescents, BMI classification

Gender	Underweight	Normal weight	Overweight	Obese
Female adolescents	15 (12%)	101 (81%)	8 (6%)	0 (0%)
Male adolescents	8 (6%)	105 (83%)	10 (8%)	3 (2%)

Respondents were grouped by sex and age group. The results show that the majority of adolescents in Bosnia and Herzegovina had a normal weight, both among males and females. Specifically, 101 female adolescents (81%) and 105 male adolescents (83%) were classified as having a normal weight according to the BMI. The prevalence of underweight was higher among females (12%) compared to males (6%). Conversely, the proportions of overweight and obesity were slightly higher in males (8% overweight and 2% obese) compared to females (6% overweight and 0% obese). The distribution of BMI categories among adolescents by gender is illustrated in Figure 1, highlighting the higher prevalence of underweight among females and greater overweight/obesity in males.

These results suggest that underweight is more common among female adolescents, whereas excess body weight (overweight and obesity) is more prevalent among male adolescents. In addition to nutritional status, the study evaluated median daily energy intake and the distribution of macronutrients by sex, as shown in Table 2.

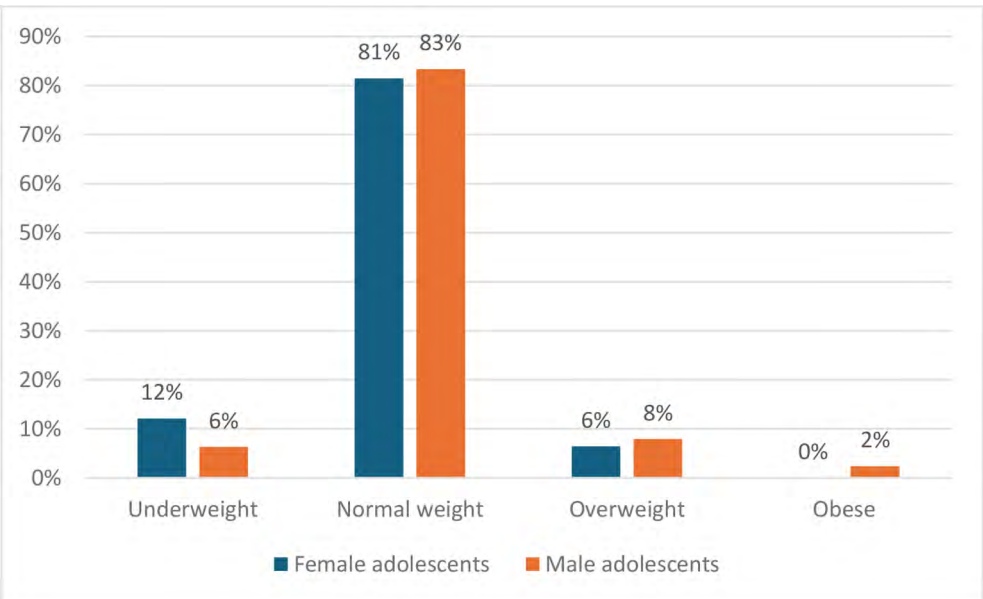

Figure 1. Distribution of BMI categories among adolescents by gender

Table 2. Median daily energy intake and macronutrient distribution among adolescents by sex

Sex	Median Energy Intake (kcal)	Protein (%)	Carbohydrates (%)	Fat (%)
Male	2230.75 kcal	15.00%	41.15%	43.85%
Female	1899.49 kcal	13.82%	43.66%	42.51%

Median daily energy intake was higher in males (2230.75 kcal) than in females (1899.49 kcal). Regarding macronutrient distribution, males derived 15% of their energy from protein, 41.15% from carbohydrates, and 43.85% from fat. Females obtained 13.82% of energy from protein, 43.66% from carbohydrates, and 42.51% from fat. While protein intake was similar across genders, females consumed a higher proportion of carbohydrates, and males had a slightly higher fat intake. Figure 2 presents median daily energy intake and macronutrient distribution by sex, visually illustrating these differences.

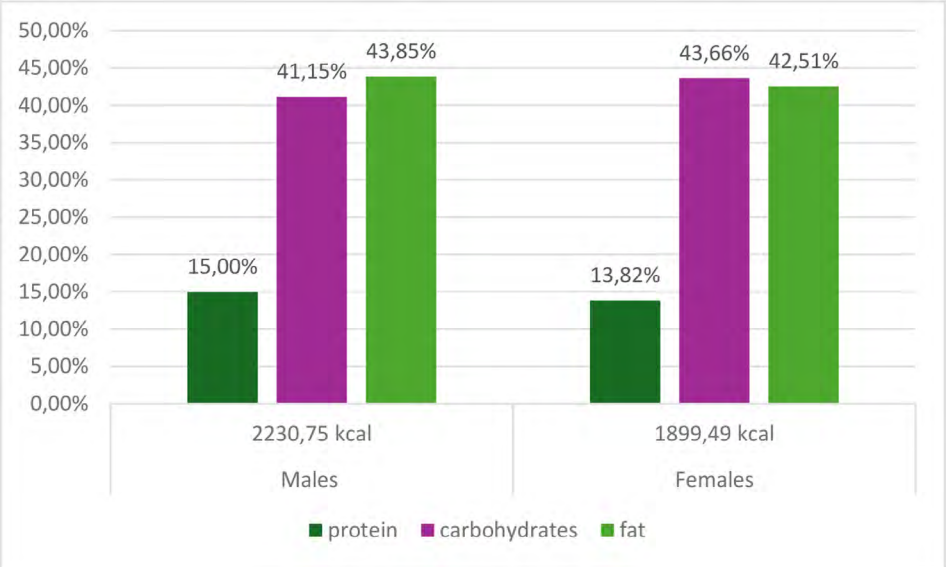

Figure 2. Median daily energy intake and macronutrient distribution by sex

4. Discussion

This study provides a comprehensive overview of the nutritional status and dietary intake of adolescents aged 15-17 years in Bosnia and Herzegovina, based on a representative national survey following the EU Menu methodology. It is important to note that due to insufficient detailed data on the exact ages of participants within the adolescent age range, BMI classification was applied according to adult standards rather than age-specific BMI-for-age references. The subgroup of older adolescents (15-17 years) was selected because their physiological characteristics closely approximate those of adults, making the adult BMI classification appropriate for this analysis.

The findings reveal that the majority of adolescents maintain a normal BMI. However, the higher prevalence of underweight among female adolescents is a notable concern, as it may indicate issues related to inadequate nutritional intake. Conversely, overweight and obesity were more prevalent among male adolescents, consistent with global trends that suggest a rising burden of excess body weight among youth.

The dietary intake analysis revealed that median daily energy intake was higher in males than females, which is expected given physiological differences and energy requirements. The macronutrient distribution showed that fat intake exceeded the recommended 35% of total daily energy intake (*WHO*, 2023) in both sexes, with males consuming slightly more fat and females more carbohydrates. Excessive fat consumption in adolescence is concerning due to its association with future cardiovascular risks and metabolic disorders.

These results underscore the urgent need for targeted nutritional interventions and educational programs that address both undernutrition among females and the prevention of overweight and obesity among males. Promoting balanced dietary habits and increasing awareness about healthy food choices can contribute to better long-term health outcomes for Bosnian and Herzegovinian adolescents.

Limitations of this study include reliance on self-reported anthropometric data, which may introduce bias.

5. Conclusion

This study highlights important aspects of adolescent nutrition in Bosnia and Herzegovina. While most adolescents aged 15-17 fall within the normal BMI range, a significant proportion of females are underweight, and males show higher rates of overweight and obesity. It is important to emphasize that BMI classification was based on adult standards, due to limited data on participants' exact ages, and the subgroup of older adolescents was chosen because their physiological characteristics closely resemble those of adults, making this approach appropriate.

Dietary assessments indicate that fat intake surpasses recommended guidelines in both sexes, posing potential health risks. Addressing these issues requires comprehensive public health strategies focusing on nutritional education and lifestyle modifications tailored to the needs of adolescents.

By fostering healthy eating habits and balanced nutrient intake, it is possible to improve growth, development, and long-term well-being in this vulnerable population.

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