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Evaluation of dietary intake of the School of Sports Championship students

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Abstract

Introduction and purpose: Nutrition plays an important role in the lives of young athletes. A well-balanced diet is crucial not only for their sports performance, but also for their proper growth and optimal health. The aim of this study is to evaluate the dietary intake of the School of Sports Championship students.

A brief description of the state of knowledge: When compared to the nutritional needs of regular teenagers, young athletes have higher caloric requirements. They need to follow precise meal scheduling, must maintain proper hydration, and sometimes need to use dietary supplements. Moreover, adolescent athletes, especially females, have a higher risk of athlete triad, anemia, or eating disorders. In addition, young athletes seem to be unaware of the importance of their diet and how it directly affects their overall health and athletic performance.

Conclusions: The results of this study indicate that the dietary choices of young athletes significantly affect their sports performance. We found a correlations between the duration of trainings and the intake of sequentially: protein, fiber, and vitamin D. Also, we discovered that female athletes consume less vitamin D and iron compared to male athletes, which may

lead to a dangerous health implications, including anemia or the female athlete triad. However, there is a need for more prospective randomized clinical trials conducted on a larger sample size to reach final conclusions.

Keywords: athletes, supplementation, nutrition, sport

Introduction

Nutrition plays a crucial role in the lives of young athletes. A well-balanced diet is important not only for their sports performance, but also for their proper growth and development. Providing optimal amounts of macronutrients and micronutrients is key for highly active youth [1]. Macronutrients are the fundamental substances that are consumed in large amounts, serving as the main source of energy for the human body. They are primarily categorized into carbohydrates, proteins, and fats. Micronutrients consist of both fat-soluble and water-soluble vitamins, as well as minerals [2].

When compared to the nutritional needs of typical teenagers, young athletes require more calorie intake, specific timing of meal consumption, adequate hydration, and sometimes the use of dietary supplements [3]. Moreover, adolescent athletes have a higher risk of calcium, vitamin D, and iron deficiency [4]. Therefore, their main health problems include anemia and compromised bone health, but also disordered eating or eating disorders [5]. A common combination of risk factors is known as the female athlete triad. It consists of inadequate food intake, decreased bone mineral density, and amenorrhea [6]. Menstrual dysfunction occurs in a range of 6% to 79% of female athletes, while reduced bone density is observed in 10–20% of them [7]. The long-term consequences of the female athlete triad might be osteoporosis, fractures, and the development of eating disorders [8]. Furthermore, studies suggest that young athletes lack nutrition knowledge. The misinformation in media is dangerous, and it is particularly targeting athletes. It is necessary to educate athletes, their parents, and coaches about a well-balanced diet with optimal amounts of macronutrients and micronutrients, as well as their special nutritional needs. This would help to enhance their dietary and health habits and reach their full potential in sports [3] [5] [9] .

Since nutritional status has a significant impact on young athletes' health and sports performance, the present study aimed to evaluate the dietary intake and selected health behaviors of the School of Sports Championship students from the Lodz Voivodeship.

Material and methods

The study was conducted in September 2016, and it involved 46 students (girls: 73.9%; boys: 26.1%) of the School of Sports Championship High School in the age of 16–18 years, located in the area of Lodz. The inclusion criteria were: 1. Being a student at the School of Sports Championship High School in September 2016, 2. Age range of 16 to 18 years, 3. Training one of the following sports disciplines: basketball, athletics, or swimming. All the participants met those criteria and were included in the study.

The group of respondents consisted of athletes of such disciplines as:

- basketball – 26 girls (56.5%),
- athletics (LA) – 8 girls (17.4%) and 7 boys (15.2%),
- swimming – 5 boys (10.9%).

The data have been collected using Paper-and-Pencil Interviewing. The research tool used to obtain information was an anonymous authorship questionnaire and a 48-hour Dietary Intake Questionnaire have been provided as a paper form for students of the School of Sports Championship from the Lodz Voivodeship. The authorship questionnaire contained questions regarding general data such as gender, year of birth, body weight, height, and sport disciplines, as well as 7 points referring to the characteristics of training and nutrition of young athletes (e.g. a 48-hour Dietary Intake Questionnaire). I part of the interview consisted of closed-ended questions with the possibility of choosing one or more answers or adding extra information other than the given alternatives, as well as one open-ended question with a short form of answer (duration of training in particular days of the week). Based on the weight and height data provided by the students, the BMI [weight [kg]/(height [m])^2] was calculated. Healthy weight range was assumed when the result belonged to the range of 18.5-24.9 kg/m^2, underweight below, and overweight, obesity I degree, II degree, and III degree, respectively at the given values: 25,0-29.9 kg/m^2, 30,0-34.9 kg/m^2, 35,0-39.9kg/m^2, ≥40,0 kg/m^2 [World Health Organization]. In the case of adolescents under the age of 18 years, the values we compared with BMI-for-age growth charts [Mother and Child Institute] – in the range between 25 and 85 centiles the ratio of weight to height was correct, under 25 there was body weight deficiency, and above there was overweight (between 90 and 97) or obesity (>97 centiles).

II part of the questionnaire was a 48-hour Dietary Intake Questionnaire with elements of a medical history questionnaire (menstrual disorders, tendency to injury, and functioning of the immune system). This section gathered information about the intake of food products, the use of dietary supplements, and the number of meals consumed during the day. Two nutritional interviews were collected from each student, taking into account the food intake during the last two days prior to the study. The results obtained from the 48-hour Dietary Intake Questionnaire were analyzed using the computer program Diet 5.0 created by the Institute of Food and Nutrition [10]. The portions of the products and dishes were subjectively determined by the participants using cooking measurements or a precise indication of the weight (in grams). Respondents have also been provided an "Album of photographs of food products and dishes" to facilitate the estimation of servings [11]. Then, the data about energy and nutrient intake (considering the age and sex of the subjects) were compared with the nutritional standards of Recommended Dietary Allowances, which are the specific amounts of nutrients, such as vitamins and minerals, that the average person's body requires to obtain through food within 24 hours [12]. The results were compared with the Dietary guidelines for the Polish population: Adequate intake (AI) was used, and in case if the absence of it, Estimated Average Requirements (EAR) were used [13].

The results were encoded and we performed qualitative and quantitative analysis using Statistica ver. 13.1 (Tibco Software Inc., Palo Alto, CA, United States) and Microsoft Office Excel. We computed and examined Pearson's correlation coefficient, conducted simple linear regression, and determined mean values and standard deviations. Additionally, we evaluated the significance level using Student's t-tests.

Results

Among the studied population, 87.0% of the students had a normal BMI, 10.9% had a too high weight/height ratio, and just 2.1% had a low weight/height ratio. Based on the BMI calculations, 88,24% of the girls had a normal weight, 8,82% were underweight and only 2,94% were overweight. Just 8,33% of the boys were underweight, while 91,67% of them were of normal weight.

Some students took daily dietary supplements, which were: vitamin-mineral complexes (used by 14.7% of girls and 41.7% boys), protein nutrients (used by 20.6% of girls and 8.3% of boys), carbohydrate nutrients (used by 20.6% of girls and 16.7% of boys), and BCAAs (used by 32.4% of girls and 25.0% of boys).

Table 1: Anthropometric assessment of the study subjects.		
Characteristics	Females (n = 34)	Males (n = 12)
Age (years)	16.765±0.78	16.75±0.62
Weight (kg)	63,85±8,47	72,58±8,58
Height (m)	173,47±6,77	180,83±6,93
BMI (kg/m^2)	21,16±1,89	22,13±1,84

Table 2: Implementation of nutritional recommendations as regards selected nutrients by surveyed students.				
Nutrient	Implementation of nutritional recommendations	Females [%]	Males [%]	Total [%]
Protein [% E]	Below recommended level	14,7	16,7	15,22
	As recommended	29,4	16,7	26,09
	Above recommended level	55,9	66,7	58,7
Carbohydrates [% E]	Below recommended level	58,82	41,67	54,35
	As recommended	32,4	33,3	32,61
	Above recommended level	8,82	25	13,04
Fat [% E]	Below recommended level	14,71	25	17,39
	As recommended	20,6	25	21,74
	Above recommended level	64,7	50	60,87
Vitamin C [mg]	Below recommended level	26,5	50	32,61
	As recommended	73,5	50	67,39
Vitamin D [mg]	Below recommended level	85,3	83,3	84,78
	As recommended	14,7	16,7	15,22
Calcium [mg]	Below recommended level	88,2	100	91,3
	As recommended	11,8	0	8,7
Iron [mg]	Below recommended level	85,3	66,67	80,43
	As recommended	14,7	33,33	19,57
Sodium [mg]	As recommended	17,6	25	19,57
	Above recommended level	82,4	75	80,43
Potassium [mg]	Below recommended level	38,2	41,7	39,13
	As recommended	58,82	50	56,52
	Above recommended level	2,9	8,3	4,35
Energy [kcal]	Below recommended level	61,8	75	65,22
	As recommended	20,6	25	21,74
	Above recommended level	17,6	0	13,04

We analyzed correlations between the amount of training hours, sport disciplines, and dietary intake (Tab. 3). It revealed a strong correlation between amount of training hours

and protein intake (Fig. 1), as well as between amount of training hours and fiber intake (Fig. 2). Also, we found a very strong correlation between amount of training hours and vitamin D intake (Fig. 3). Moreover, there was a strong correlation between amount of training hours, sport discipline, and carbohydrate intake. After a further analysis of this correlation, we found that there is a strong positive correlation between the amount of training hours, basketball, and carbohydrate consumption (Fig. 4) – the students who engaged in more training hours also ate more carbohydrates. The correlation between amount of training hours, athletics, and carbohydrate intake was not statistically significant (Fig. 5). However, there was a strong negative correlation between the amount of training hours, swimming, and carbohydrate intake (Fig. 6). The more swimmers trained, the less carbohydrates they consumed.

Table 3: Correlations between the amount of training hours, sport disciplines, dietary intake.

Tested correlations	**Correlation coefficient**	**Interpretation of correlation coefficient**
Amount of training hours – **Energy expenditure**	0.512	Moderate positive correlation
Amount of training hours – **Protein intake**	0.65	**Strong positive correlation**
Amount of training hours – Sport discipline – **Protein intake**	-0.45	Moderate negative correlation
Amount of training hours – **Fat intake**	0.45	Moderate positive correlation
Amount of training hours – Sport discipline – **Fat intake**	0.5	Moderate positive correlation
Amount of training hours – **Carbohydrate intake**	0.5	Moderate positive correlation
Amount of training hours – Sport discipline – **Carbohydrate intake**	0.6	**Strong positive correlation**
Amount of training hours – **Fiber intake**	0.75	**Strong positive correlation**
Sport discipline – **Fiber intake**	-0.45	Moderate negative correlation
Amount of training hours – Sport discipline – **Sodium intake**	0.5	Moderate positive correlation
Amount of training hours – **Vitamin D intake**	0.891	**Very strong positive correlation**

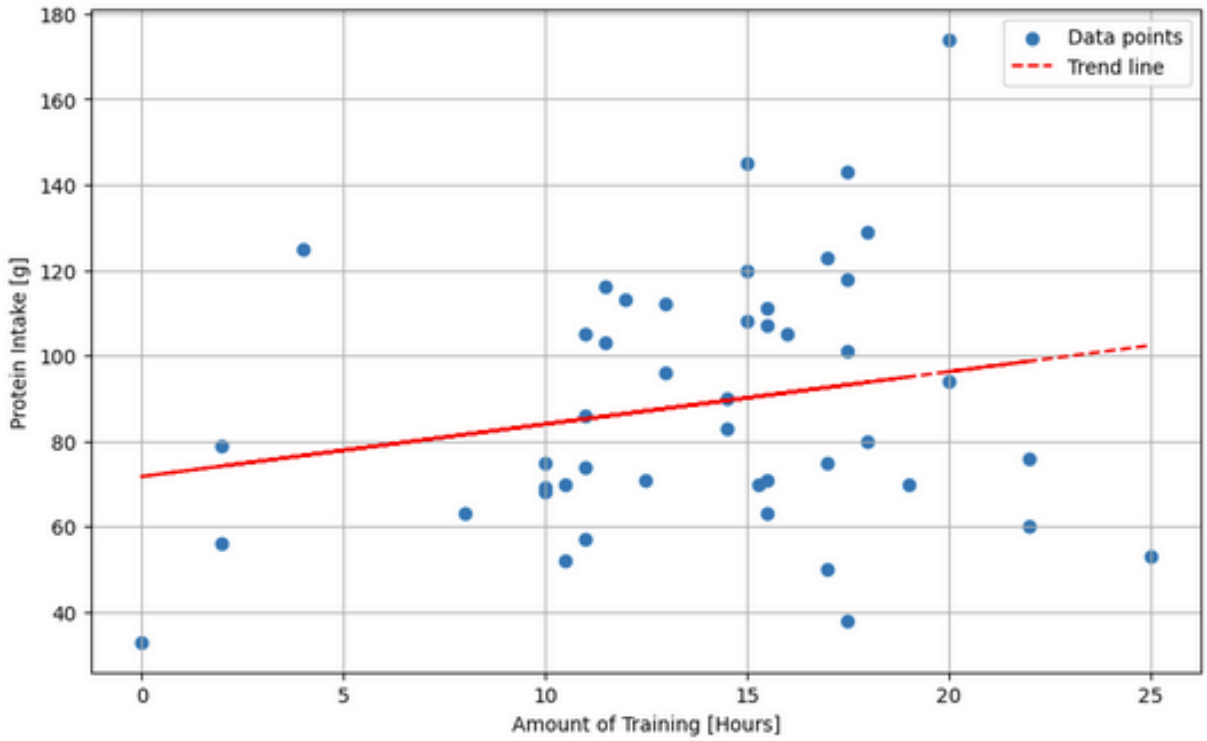

Figure 1. A scatter plot showing the correlation between amount of training hours and protein intake.

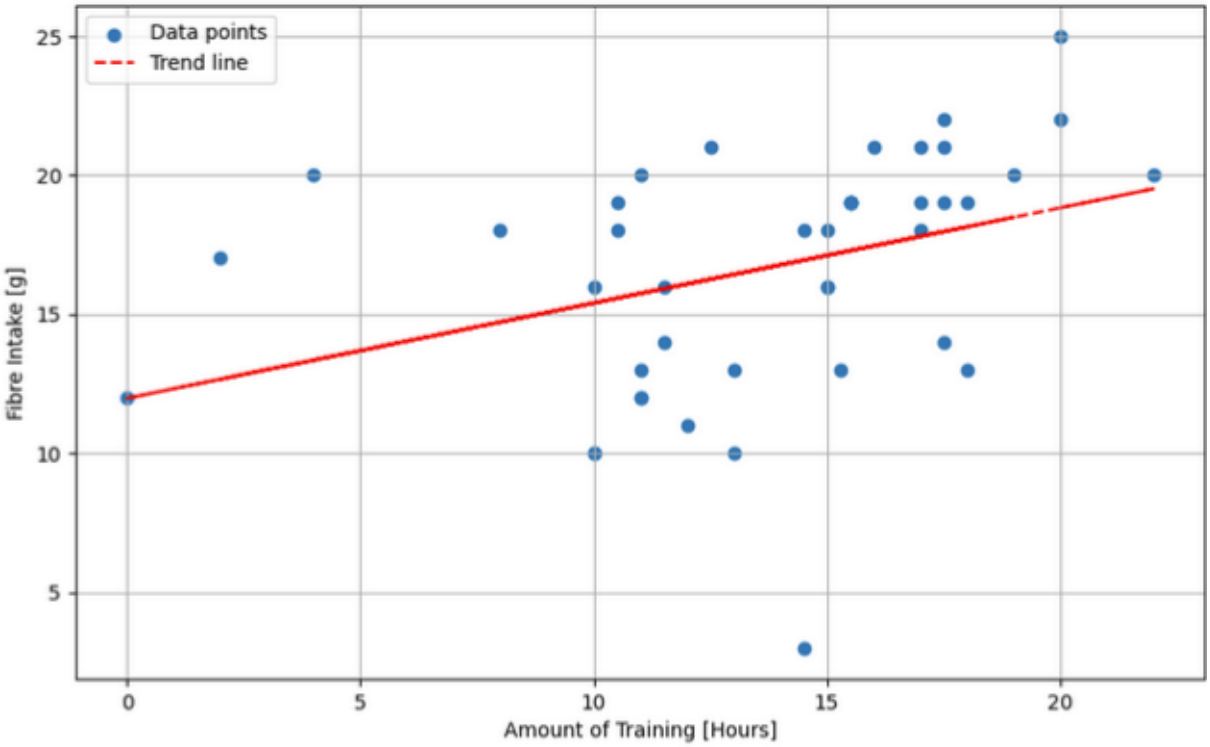

Figure 2. A scatter plot showing the correlation between amount of training hours and fiber intake.

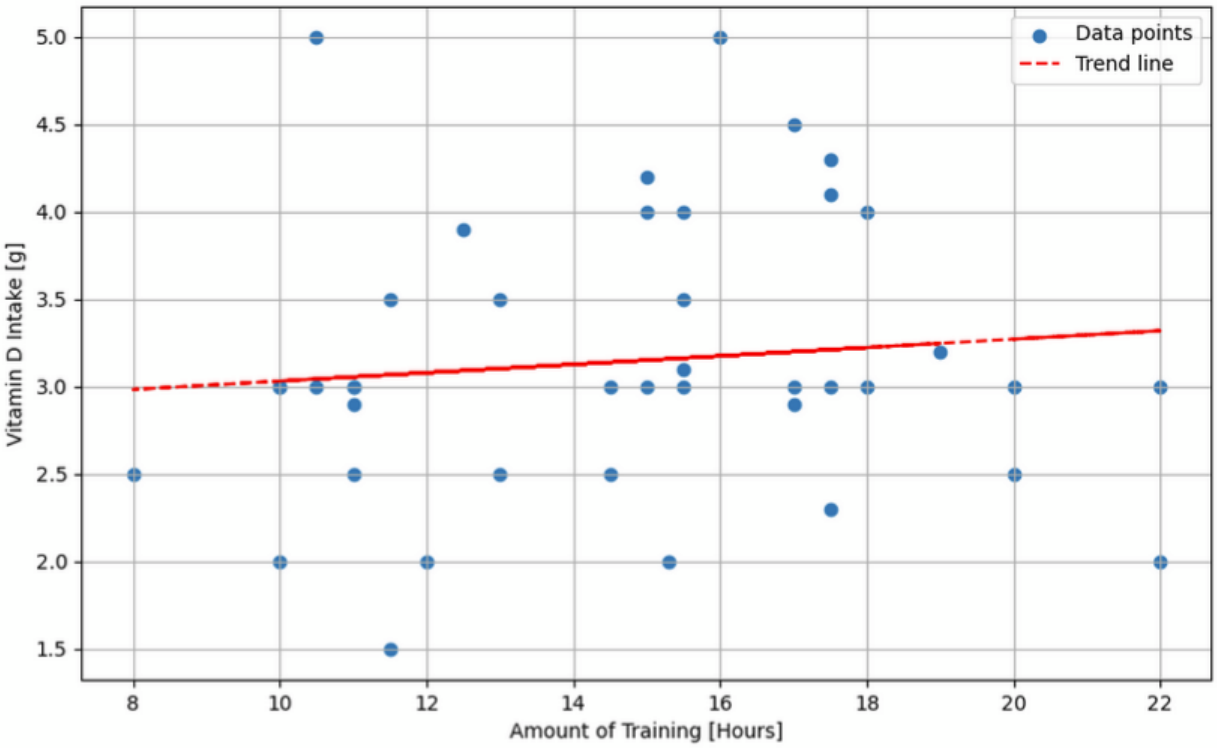

Figure 3. A scatter plot showing the correlation between amount of training hours and vitamin D intake.

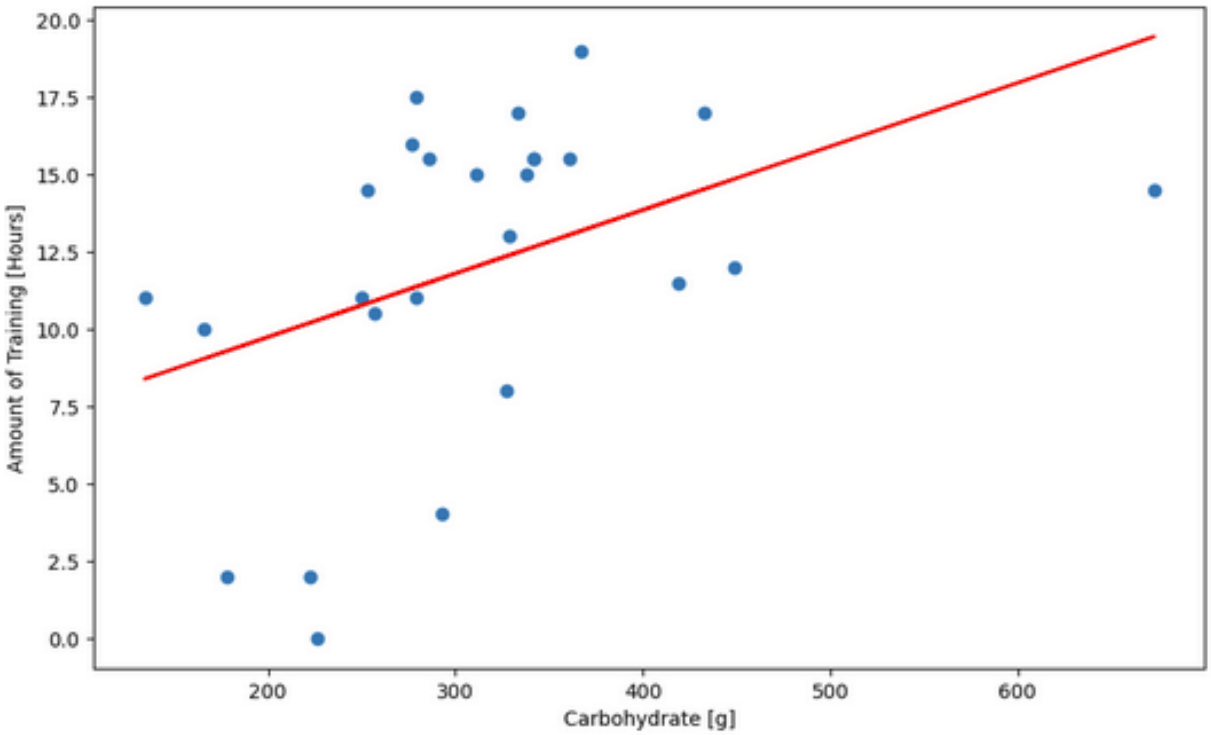

Figure 4. A scatter plot showing the correlation between the amount of training hours, basketball, and carbohydrate intake.

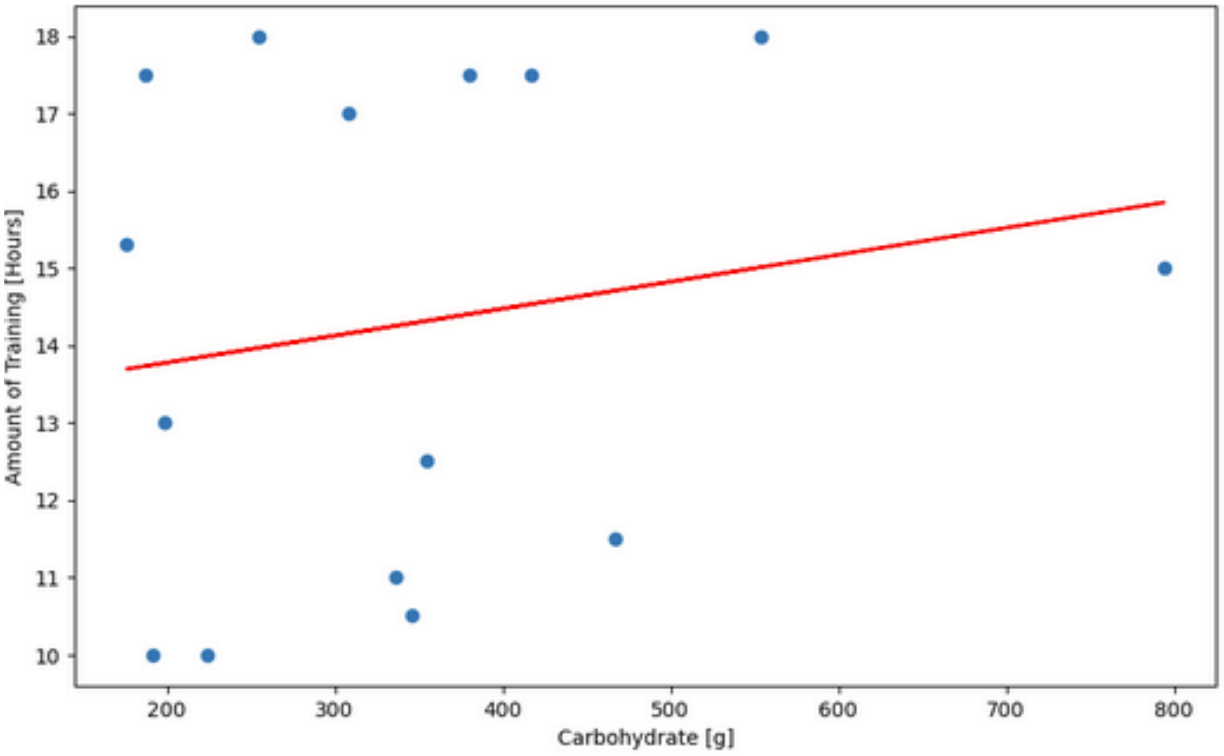

Figure 5. A scatter plot showing the correlation between the amount of training hours, athletics, and carbohydrate intake.

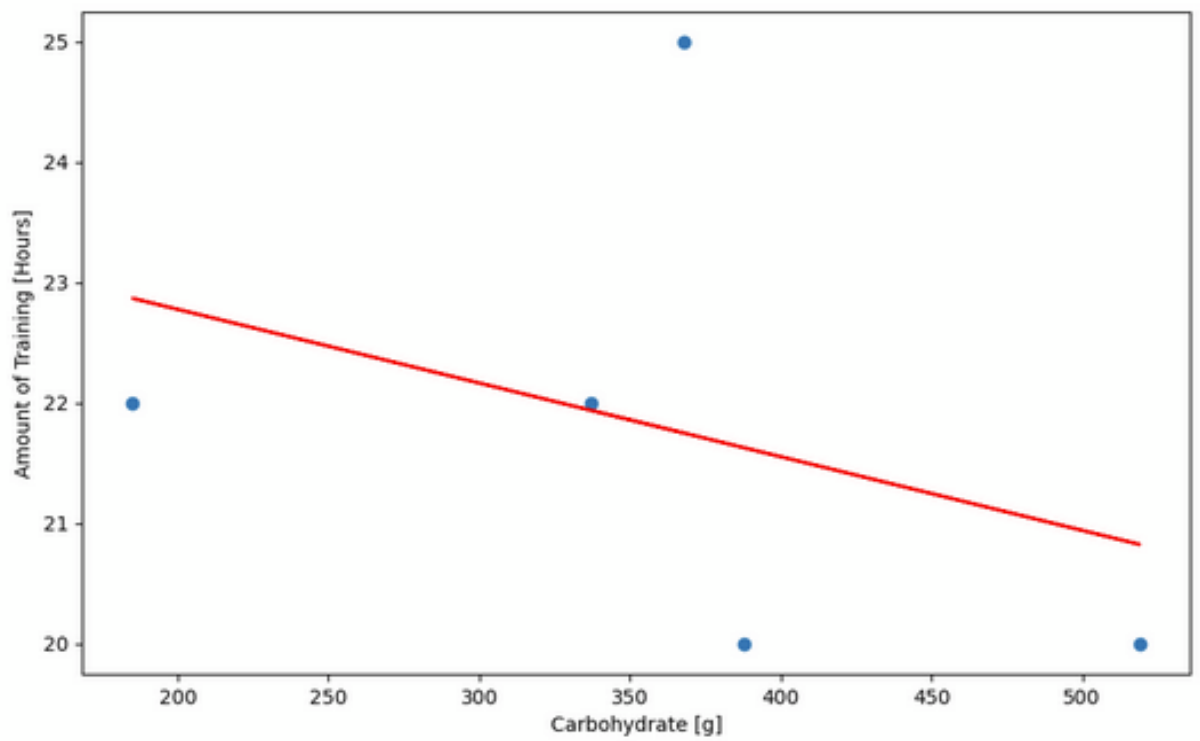

Figure 6. A scatter plot showing the correlation between the amount of training hours, swimming, and carbohydrate intake.

In our study, analyzing the relationship between the amount of training hours, BMI, and dietary intake did not reveal any strong correlation (Tab. 4).

Table 4: Correlations between the amount of training hours, BMI, dietary intake.

Tested correlations	**Correlation coefficient**	**Interpretation of correlation coefficient**
Amount of training hours - BMI - **Fibre intake**	−0.554	Moderate negative correlation
Amount of training hours - BMI - **Iron intake**	−0.435	Moderate negative correlation
Amount of training hours - BMI - **Vitamin D intake**	0.426	Moderate positive correlation

In our study's participants, the average iron intake was significantly higher in men compared to women. Also, on average, men consumed more vitamin D than women (Tab. 5).

Table 5: Correlations between sex and calcium, iron, vitamin D intake or energy expenditure.

Correlation	**Coefficient of determination**	**P-values**	**P-value interpretation**
Sex – Calcium intake	0.077	**p=0.0611**	Correlation statistically not significant
Sex – Iron intake	0.162	**p=0.006**	Correlation statistically significant
Sex – Vitamin D intake	0.138	**p=0.0111**	Correlation statistically significant
Sex – Energy expenditure	0.003	**p=0.739**	Correlation statistically not significant

Discussion

Our study found a strong correlation between amount of training hours and protein intake (Fig. 1). It suggests that the most disciplined athletes prioritize consuming a higher amount of protein compared to other students. Athletes tend to have higher demands for dietary protein intake compared to people who are not physically active [14]. Other study has demonstrated that the consumption of protein before and/or after a workout leads to a notable increase in muscle protein synthesis [15]. Combining protein supplementation with training enhances muscle strength [16]. Moreover, our study revealed a correlation between amount of training hours and the consumption of dietary fiber (Fig. 2). Wu et al. demonstrated an independent relationship between dietary fiber intake and improvement in sports performance [17]. However, other study has shown that soluble dietary fiber does not enhance neuromuscular performance or cardiovascular endurance in the short term [18]. Thus, the impact of fiber consumption on athletic performance requires further research.

Also, our study found a very strong correlation between amount of training hours and vitamin D intake (Fig. 3). Vitamin D is crucial for athletes' overall well-being, training, and performance. Studies have proven that insufficient levels of vitamin D negatively impact muscle strength, power, and endurance. They can also contribute to an increased risk of stress fractures and other injuries to the musculoskeletal system. Furthermore, vitamin D deficiency can exacerbate acute muscle injuries and inflammation caused by high-intensity exercise [19].

Furthermore, in our study, on average, women had a lower intake of vitamin D compared to men (Tab. 5). It is truly concerning that 85.3% of the girls had an insufficient vitamin D intake in their diet (Tab. 2). It is important to educate young female athletes about the potential dangers of the female athlete triad and the importance of adequate vitamin D intake or supplementation in cases of deficiency. Otherwise, they might be exposed to the risk of stress fractures [20]. In our study's participants, the average iron intake was significantly lower in women compared to men (Tab. 5). The fact that 85.3% of the surveyed females in our study did not meet the recommended dietary intake of iron is alarming (Tab. 2). Young female athletes are especially prone to iron deficiency. According to another study, iron deficiency is a prevalent health problem in athletics, affecting around 3–11% of male athletes and 15–35% of female athletes. Low iron levels can contribute to health issues and may impair athletic performance. It is highly dangerous to females due to blood loss during menstruation, so they have higher dietary iron needs [21]. Moreover, during intense training sessions, they also experience blood loss through mechanical hemolysis and sweating [22].

The correlation analysis between the amount of training hours, sport discipline, and carbohydrate intake revealed that there is a strong positive correlation between the amount of training hours, basketball, and carbohydrate intake (Fig. 4). Basketball is classified as a high-intensity sport, which means that students who dedicate more time to basketball training require a greater energy expenditure [23]. Consequently, they consume more carbohydrates. The other link that we found – a strong negative correlation between the amount of training hours, swimming, and carbohydrate consumption (Fig. 6) – is unexpected since swimming belongs to medium intensity sports [23]. Unfortunately, the sample size of swimmers in our research was very small (5 participants). Thus, the relationship between the amount of training hours, swimming, and carbohydrate intake requires more prospective randomized clinical trials on a larger sample for a final conclusion.

Conclusion

The results of this study suggest that the diet of young athletes significantly affects their sports performance. We found a correlations between the duration of trainings and the intake of sequentially: protein, fiber, and vitamin D. Additionally, we discovered that female athletes consume less vitamin D and iron compared to male athletes. The majority of the surveyed students had insufficient calcium, iron and vitamin D intake in their diet. This poses a threat in terms of the risk of aneamia and the female athlete triad, which could lead to serious health implications. At the same time, most the students exceeded the recommended dietary

consumption of sodium. We should educate young athletes about the importance of their diet and its impact on their health and sports performance. Nevertheless, there is a need for more prospective randomized clinical trials conducted on a larger sample size to reach final conclusions.

Author's contribution:

Conceptualization, OŁ, and KS; methodology, JK, EW; software, KC; check, KC, AMK, AK and KB; formal analysis, JK, EO; investigation, EW; resources, OS, KC, EW; data curation, OŁ, KS, AMK, KC, AK, JJ, OS, EO, EW, KB; writing – rough preparation, OŁ, KS, EW, AK, JJ; writing – review and editing, OŁ, KS, AMK, KC, AK, JJ, OS, EO, EW, KB, JK; visualization, JJ and AMK; supervision, OŁ and KS; project administration, OŁ, KS, AK, OS; All authors have read and agreed with the published version of the manuscript.

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