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Optimization of Nutrition intake for High School Students from Rural Environments

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Abstract: Adolescence, spanning from ages 13 to 18 years, is a crucial period of physical development and growth. During this time, the body undergoes significant changes in composition, metabolism, hormones, and organ system maturation, as well as nutrient deposit establishment. These changes may impact future health. In terms of nutrition, adolescence is also a critical time for establishing a lifelong relationship with food, particularly with regards to the connection between diet, exercise, and body image. During adolescence, individuals face challenges related to time management due to school, training, work, and social commitments. Peers become increasingly influential in shaping an adolescent's behaviour, including their eating habits. Additionally, fluctuating emotions can also be a feature of this period. These patterns should be consistent with proven principles of sports nutrition. It is important to note that athletes require better nutrition than non-athletes. Meeting the nutritional needs of adolescent athletes is crucial for their performance, energy, growth, and recovery. This article aims to explain the key components that must be considered, including calorie needs, macronutrients, hydration, and timing. All aspects of providing adequate nutrition for adolescent athletes are crucial for supporting their performance and overall quality of life. Medical analyses were conducted on a group of 40 students before and after the administration of natural supplements. The students were given one 500mg Spirulina capsule and one Safflower Oil capsule daily for three months, followed by a one-month break.

Keywords: secondary school students; nutrition; natural supplements

1. Introduction

The purpose of the study regular exercise offers numerous benefits to adolescents, such as social interaction, improved physical health, and the development of self-identity and self-esteem. Additionally, the second decade of life is a crucial time for establishing an individual's relationship with food and the lifelong connection between diet, exercise, and body image (Desbrow et al., 2014).

This review incorporates physiology, psychology, training science, and sociology to describe the current understanding of nutrition priorities for developing adolescent athletes. It is important to prioritize sound nutrition to support holistic athlete health during this period, as the pathway to elite adult performance is multifaceted and non-linear. Success at the junior level is rarely a predictor of elite performance as an

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adult (Pizzuto et al., 2017). The responsibility for providing appropriate nutrition care to developing adolescent athletes is shared among sporting organizations, coaches, parents, teachers, and the athletes themselves.

Adolescence is a period of significant physical development that includes changes in body composition, metabolic and hormonal fluctuations, maturation of organ systems, and establishment of nutrient deposits. Participation in sports can play an important role in supporting psychological well-being and developing a healthy self-image for most adolescents. However, sports that emphasize leanness have shown increased rates of disturbed eating attitudes and behaviours, as well as body dissatisfaction, for many years (Martinsen et al., 2010). Although athletes may possess intrinsic characteristics such as perfectionism, high pain tolerance, and motivation that are valued in competitive sports, these qualities may also contribute to the development of disordered eating. Previous research indicates that coaches' careless comments regarding weight or appearance can trigger or perpetuate disordered eating or eating disorders in athletes. This evidence, combined with advocacy from former athletes and a greater understanding of the long-term health consequences of mismanaging the diet and exercise relationship in adolescent athletes, has led to recent calls for a fundamental change in how sports manage aspiring athletes (Ackerman et al.,2020).

In response, some sports organizations have tried to protect their responsibility for young athletes by publishing expected stakeholder behaviour. For instance, in 2019, Gymnastics Australia released Body Positive Guidelines. These guidelines provide specific recommendations on appropriate language, the frequency and delivery of nutrition education, and body composition assessment within gymnastic environments. According to the guidelines, body composition assessments, which include weight, height, skinfold or physique assessments, should only be carried out by a certified anthropometrist with experience, after providing education and obtaining written consent from gymnasts and their parents or guardians.

Nutrition is a fundamental aspect of athletic performance (Desbrow et al., 2019). Post-workout nutritional recommendations are crucial for effective recovery and adaptive processes. The adaptive immune response is provided by lymphocyte functions (acquired immunity) and plays an important role in the defence from infection and elimination of exogenous pathogens in vivo (Stoyel et al., 2020).

New directions in dietetics are currently being developed, with a focus on creating personalised diets. These studies include genetic research to determine an individual's predisposition to certain foods and the associated risk of food-related diseases. Additionally, research on the diversity of the human microbiota, digestive characteristics, and the state of the intestinal barrier is crucial. Finally, studying individual responses of the immune system to food antigens can help identify changes in food tolerance and reactivity of the adaptive immune response (Kheirvary et al., 2022).

This article examines the impact of food intolerance on sports performance and the health of elite athletes. An individual elimination diet was drawn up based on the results of a food intolerance test. The blood test revealed a decrease in food intolerance levels in each athlete after the diet. This suggests that the elimination diet significantly improved the athletes' well-being, enabling a faster decrease in heart rate after cardiopulmonary testing.

Optimising nutrition intake is crucial for supporting athletic performance and adapting to training (Berg et al. (2019). Athletes frequently use micronutrient supplements to correct vitamin and mineral deficiencies, improve immune function, enhance recovery, and optimise performance. This review aims to investigate recent literature on micronutrients, specifically iron, vitamin C, vitamin E, vitamin D, and calcium, and their effects on physical performance. Over the last decade, numerous studies have

examined the effects of micronutrients on athletic performance, and several reviews have attempted to summarise their current use and effectiveness. Current literature suggests that micronutrient supplementation does not improve physical performance in well-nourished athletes. Excessive intake of dietary supplements can hinder the body's physiological responses to exercise, which support adaptation to training stress.

The basis of sport performance is the athlete's training and nutrition. Nutritional strategies play a supportive role in enhancing training adaptation. As training prescriptions have evolved, so have nutrition strategies for athletes. Nutritional consensus statements promote the periodisation of nutritional intake to optimise the adaptation to the athlete's prescribed training programme (Burke et al., 2020).

Nutritional periodisation involves planned energetic and macronutrient strategies to target individual exercise sessions and the overall training programme, aiding in obtaining long-term performance gains in athletes

Another approach is to optimise protein intake to support hypertrophic responses in skeletal muscle. However, many metabolic processes and reactions involved in extracting energy from macronutrients, delivering and transferring oxygen, repairing tissues, and promoting growth and development depend on essential vitamins and minerals.

Micronutrients are vital for sustaining life. They include vitamins, which are organic compounds that support health, growth, and reproduction. Vitamins are required in small amounts to prevent clinical deficiencies and declines in health. It is important to note that the human body is unable to synthesise most vitamins, hence they must be obtained from dietary intake. Vitamins are classified based on their solubility in vivo. A, D, E and K are classified as fat-soluble, while vitamins B and C are classified as water-soluble. Minerals are inorganic substances that support physiological function. Healthy individuals require approximately 100 mg/day of macrominerals (sodium, potassium, calcium, phosphorus, and magnesium) and approximately 20 mg/day of trace elements (iron, zinc, copper, chromium, and selenium) based on their daily physiological needs.

Micronutrient supplementation is prevalent among athletes, with a meta-analysis revealing that around 50% of athletes use vitamin or mineral supplements. Research indicates that the athlete's diet's macronutrient requirements are influenced by the intensity, duration, and mode of exercise, and so are their micronutrient needs. Athletes competing in sports with higher energy requirements may have increased micronutrient needs (Kathryn et al., 2021).

However, there is currently insufficient data to accurately quantify these requirements. If an athlete's overall energy requirement is high due to their training load, their macro- and micronutrient intake should reflect this.

Athletes often require a high energy intake to support their training. If they obtain this increased energy intake from a well-balanced diet, then the dietary reference intakes for vitamins and minerals may be sufficient. However, there are circumstances where athletes may require increased amounts of vitamins and minerals.

Athletes with high sweat and urine losses, as well as those with low energy intakes or specific dietary preferences such as a vegetarian or vegan dietary pattern and haem iron, may require exogenous supplementation with vitamins and minerals to support their health and performance. Athletes with high sweat and urine losses, as well as those with low energy intakes or specific dietary preferences such as a vegetarian or vegan dietary pattern and haem iron, may require exogenous supplementation with vitamins and minerals to support their health and performance (Firmansyah & Prasetya, 2021). It is

important to note that any such supplementation should be based on individual needs and should be discussed with a qualified healthcare professional. Alternatively, athletes may consider taking supplements to support their adaptation to training. For instance, iron supplements may be necessary to support adaptation to altitude training. Some micronutrients may be more relevant to certain sports. For instance, athletes who train and compete in winter sports or indoors may have low vitamin D concentrations, while those who engage in high-intensity and endurance-based exercise may have more compromised iron stores.

This review aims to investigate the effect of key micronutrients, including iron, antioxidants (vitamin C and E), vitamin D, and calcium, on exercise performance. The search was focused on literature published in the past 10 years using the Pubmed database. Several review papers were located and used, and citations from relevant papers were searched. The study focused on the effects of iron, antioxidants, oxidative stress, vitamin C, vitamin E, vitamin D, calcium, exercise, athlete, sport, and performance on adolescents. Only full manuscripts published in English were included, while abstracts, theses, and conference proceed were excluded.

Adolescence is defined as the period of human growth and development that occurs between childhood and adulthood, typically between the ages of 10 and 19. To ensure that adolescents meet their macro and micronutrient requirements, it is crucial to maintain optimal nutrition (Desbrow et al., 2021).

It is important to note that these requirements differ between males and females. In order to address the issue of nutritional imbalances among adolescents, the World Health Organization (WHO) recommends a healthy diet that includes sufficient amounts of fruits and vegetables. These recommendations have been promoted to all age groups to help minimise the risk of developing heart disease, cancer, and other chronic diseases (Stoyel et al., 2020).

Over-nutrition and poor lifestyle choices can lead to obesity. Although the aetiology of obesity is complex, many researchers (Majid et al., 2016) de assert that the main cause of obesity is an energy imbalance between calories consumed and calories expended. There has been a global shift in dietary preferences towards energy-dense foods that are high in fats and sugars but low in vitamins and minerals (Kathryn et al., 2021).

Globally, the most significant dietary risk factors are high sodium intake and low consumption of whole grains, fruits, and vegetables. In Canada, 92% of children consume excessive amounts of sodium, and on average, they do not consume the recommended servings of whole grains, vegetables, and fruits. These findings are consistent with those of most other developed countries. These dietary risk factors are particularly relevant for children, as they require high-quality diets to support growth, development, and academic success. Healthy eating habits are established during childhood (Brown et al.,2020).

Mobile health (mHealth) innovations offer new opportunities to tackle public health challenges. Systematic reviews and individual studies have shown that mHealth interventions can improve a range of dietary and health-related outcomes. These factors include knowledge of nutrition, overall eating habits, consumption of fruits and vegetables, intake of nutrients that are of public health concern (such as dietary sodium), body weight, blood pressure, and blood cholesterol levels across various populations and age groups, including children and adolescents. In addition to their health benefits, mHealth interventions offer a promising and innovative way to facilitate nutrition education for children and adolescents who increasingly have access to mobile devices at home and school. In Canada, almost half of children aged 0 to 11 years and 80% of adolescents aged 12 to 17 years own a mobile device. However, there are currently few evidence-based mHealth nutrition apps for children available on the app marketplace. Additionally, there are no known apps available to support educators in facilitating

nutrition education in the classroom or clinic settings. These findings highlight a significant gap and an opportunity to address an important public health issue by using evidence-based and engaging mHealth nutrition interventions to educate children about healthy eating (Kheirvary et al., 2022).

Athletes have higher energy requirements than non-athletes. Providing adequate nutrition for adolescent athletes is crucial to supplement their energy needs and improve performance, as well as speed up the recovery process (Garthe & Ramsbottom, 2020). Proper nutrition is not only essential for maximizing performance during training, but also for meeting growth and development requirements. Adolescent athletes are a crucial demographic in sports coaching, particularly in terms of technique. Therefore, it is essential to attend to their needs to enhance their performance during training (Panggabean, 2020). The developmental stages can be broadly categorised into early childhood, middle childhood, and adolescence.

The goal of each exercise is to prepare athletes to compete and achieve their best performance. In order for athletes to benefit from exercise, it is essential that both the coach and athlete understand their proper nutritional and hydration needs before and after training sessions (Cherian et al., 2020). Additionally, coaches should ensure they maintain good nutrition and hydration habits before and after matches to contribute to the performance and recovery process after competition. Proper nutrition is crucial for the health of adolescent athletes. Sports nutrition can also enhance performance during training and competition, potentially reducing injuries and expediting the recovery process (Moore et al., 2020). Encouraging healthy habits from a young age and comprehending the athlete's growth and development are key factors in cultivating a champion athlete. Previous research has not yet described the aspects that need to be considered when fulfilling nutrition for athletes, particularly adolescent athletes.

Several articles and studies have been found that discuss the nutritional needs of adolescent athletes, but they may overlook certain important aspects that need to be considered. These articles should address questions about the specific needs of adolescent athletes, as outlined by (Anggita et al.,2021).

An athlete must consume sufficient calories every day to meet their weight and body composition goals, whether it is to maintain, lose, or gain weight. To maintain energy balance, they consume food, fluids, and supplements for energy expenditure (Firmansyah et al., 2021).

Calorie requirements for adolescent athletes depend on their age, gender, and level of physical activity. In certain types of sports, adolescents on average spend about 10-25% more energy than adults. The calorie needs of athletes by age category, based on estimated energy needs (EER), are as presented in Table 1 and Table 2.

Table1. Calorie Requirements for Men Based on Age and Activity Level (U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020- 2025. 9th Edition. 2020)

Age	Normal	Active	Very active
12	1.8	2.2	2.4
13	2.0	2.2	2.6
14	2.0	2.4	2.8
15	2.2	2.6	3.0
16	2.4	2.8	3.2
17	2.4	2.8	3.2
18	2.4	2.8	3.2
19-20	2.6	2.8	3.0

Table 2. Calorie Requirements for Women Based on Age and Activity Level (U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020- 2025. 9th Edition. 2020)

Age	Normal	Active	Very active
12	1.6	2.0	2.2
13	1.6	2.0	2.2
14	1.8	2.0	2.4
15	1.8	2.0	2.4
16	1.8	2.0	2.4
17	1.8	2.0	2.4
18	1.8	2.0	2.4
19-20	2.0	2.0	2.4

Macronutrients are the primary sources of energy for the body, consisting of three main components: fat, protein, and carbohydrates. They provide a significant amount of energy to the body. The term 'macroscopic' refers to chemicals that provide calories for energy, including carbohydrates, proteins, and fats. The body requires these nutrients in large quantities (Gaudiani, 2019).

It is crucial to note that understanding the body's nutritional needs requires distinguishing between macronutrients and micronutrients. Micronutrients refer to vitamins and minerals. In the field of nutrition science, macronutrients refer to essential nutrients required by the body in relatively large amounts. Different types of energy are provided by these three macronutrients: carbohydrates, proteins and fats. Carbs and protein contain about 4 calories/gram, fat about 9 calories/gram.

Additionally, macronutrients play a crucial role in growth, metabolism, and regulation of bodily functions. Both substances are essential elements in a daily diet, and their adequacy is key to an athlete's performance. In general, macronutrient needs are determined by the individual's occupation. However, for athletes, their needs must be determined based on the type of sport, duration of exercise, and body weight.

It is important to determine the appropriate macronutrient type to support athletes who are not experiencing an energy deficit or surplus from their diet. The article "Relationship between Energy Drink Consumption and Nutrition Knowledge in Student Athletes" (Hardy et al., 2017) provides specific macronutrient recommendations for adolescent athletes, recommendations that are shown in Table 3.

Table 3. Basic Macronutrient Requirements for Adolescent Athletes (Hardy et al., 2017).

Macronutrients	Needs
Carbohydrate	50% of calorie, with total 3-8 g/kg body weight, 1-1,5 g/kg post workout body weight/exercise.7
Protein	0,8-1,2g /sd 1,2-1,8/kg weight or about 10% to 30% of the total energy intake
Fat	20-25% of calorie intake, no less than 15%

This section provides an overview of the macronutrient needs of adolescent athletes to support their energy requirements during exercise. Carbohydrates should make up 50% of calorie intake, equating to 3-8 g/kg body weight, and when exercise takes place, the amount of carbohydrates should increase (Table 4). Post-exercise, carbohydrate intake should be 1-1.5 g/kg body weight. Protein intake should be 0.8-1.2 g/sd or 1.2-1.8 g/kg body weight, which is approximately 10% to 30% of the total energy intake. Fat intake should be 20-25% of calorie intake, but not less than 15%. It is important to note that nutritional needs during adolescence are higher than those of adults (Jagim, 2021).

Even for teenagers who do not exercise, they require a balanced intake of calories, carbohydrates, fats, and proteins to support their body's growth and trigger physical activity.

Studies indicate that consuming carbohydrates every day, particularly after exercise, is essential. It is important to provide carbohydrates, like calories, in a balanced and proportionate manner, especially to adolescent athletes. However, consuming insufficient carbohydrates can lead to fatigue and negatively impact performance (Jovanov et al., 2019). It is crucial for athletes and parents to understand how to achieve a balance in nutrition.

Table 4. Carbohydrate requirements (g) per kg of body weight (Smith , et al.).

Exercise duration(hour)	Carbohydrates(g) per kg of body weight
0 to1	5 to 6
1 to2	6 to 7
2 to3	7 to 8
More than4	8 to 10

Carbohydrates that are rich in nutrients can be found in bread, rice, corn, nuts, whole grains, vegetables, and cereals. Nuts and whole grains are particularly high in nutrients and fibre, while fruits and vegetables provide essential vitamins and minerals. Foods with a low glycaemic index help to maintain stable blood sugar levels throughout the day and during exercise.

Protein is essential for building and repairing muscles, hair, nails, skin, and other tissues. For light and short-duration exercise, protein is not the primary source of energy. However, as the duration of exercise increases, protein helps to maintain blood glucose levels through liver gluconeogenesis (Moore et al., 2020). The daily protein requirements for each individual vary widely. When determining the necessary protein intake for adolescent athletes, it is important to establish the appropriate amount of protein needed. For adolescent athletes who exercise 3-4 days per week, a minimum of 1.0 gram of protein per kilogram of body weight per day is recommended. Athletes who engage in high-intensity workouts and aim to increase muscle volume require a higher protein intake of at least 1.7 grams per kilogram per day (Bentley et al., 2020).

Fat is necessary for the absorption of fat-soluble vitamins (A, D, E, and K), to provide essential fatty acids, protect vital organs, and provide insulation (De la Puente, 2020). Additionally, it provides a feeling of fullness and is a calorie-dense source of energy (one gram provides nine kilocalories), although it is more difficult to use. It is important to understand the role of fat as a source of energy for humans, especially for carrying out daily activities.

The human body requires a balanced level of fat to maintain energy reserves. While carbohydrates are known to be the best fuel for muscle work, fat is also an important source of fuel during activities, particularly in young athletes. However, excessive fat in the body can lead to obesity and various types of diseases. It is recommended that fat should comprise 20% to 25% of the total energy intake for children aged four to 18 years. The recommended maximum intake of saturated fat is 10% of total energy intake.

Macrominerals are minerals that the body requires at least 100 mg per day, such as calcium and phosphorus. Microminerals, also known as trace elements, are minerals that the body requires in amounts less than 100 mg per day, such as zinc and iron. Adolescent athletes may find it challenging to maintain a balanced diet, which can put them at risk of micronutrient deficiencies. This deficiency is more commonly observed in girls than in boys and is related to mineral intake rather than vitamin intake (Firmansyah et al., 2021).

Adolescent athletes are more likely to achieve sufficient vitamin intake than non-athletic teens due to their increased calorie intake. Minerals such as sodium, potassium, iron, and calcium play a crucial role

in the body. However, it is important to replace the sodium lost through sweat during exercise In Table 5 are outlined the macronutrient requirements for adolescent athletes, based on gender and age.

Table 5. Micronutrient Requirements Based on Gender and Age (Ryan et al.2020)

Age	Calcium	Folate	Vitamin B6	Vitamin B6	
				Min	Max
All children 4-8 years	800mg/d	200mg/d	0,6 mg/d	10mg/d	40mg/d
Male 9-13 years	1,3 mg/d	300mg/d	1mg/d	8mg/d 40mg/d	
Female 14-18 years	1,3 mg/d	400mg/d	1,2 mg/d	11mg/d 45mg/d	

Information: mg / d = milligram / day, mcg / d = microgram / day

Hydration is the maintenance of fluid balance in the body, which is essential for the metabolic function of cells. Dehydration, on the other hand, occurs when the body loses more fluid than it takes in. This is particularly relevant for outdoor sports such as athletics and triathlon, where the body is exposed to external heat and perspiration can lead to significant fluid loss. It is also possible for indoor sports to present similar risks. It is important to maintain a balance of fluids in the body for athletes during training and competition to prevent dehydration. This is especially crucial for adolescent athletes with high activity levels and body temperature. According to Desbrow et al.2020, adolescent athletes tend to become dehydrated by up to 2.5% of their body weight through sweating and experience a decrease of up to 45% in capacity when doing high-intensity exercise.

Dehydration symptoms include dry lips and tongue, sunken eyes, light or dark coloured urine, or urine with a strong odour, frequent urination, small urine volume, lack of energy, and a sudden decrease in performance. To avoid dehydration, it is recommended to consume a minimum of 13 mL/kg (6 mL/lb) of fluid per hour of body weight, with an additional 4 mL/kg (2 mL/lb) for each hour of exercise. It is also recommended to drink at least 2 glasses or 480 millilitres of water 2 hours before exercising. During exercise, it is recommended to consume 1/2 to 1 glass (120 to 240 millilitres) of fluid every 15 to 20 minutes. Proper hydration for athletes requires fluid intake before, during, and after exercise or activity. The amount of fluid needed depends on various factors, including age and body size (Desbrow et al., 2020) as shown in Table 6.

Table 6. Minimum Fluid Intake Needs for Adolescents (Moore et al. 2020).

Body Weight (kg)	Liquid During Exercise (ml/hour)	Fluid Replacement After Practice (ml/hour)
25	325	100
30	390	120
35	455	140
40	520	160
45	585	180
50	650	200
55	715	220
60	780	240

Moore et al. (2020) recommends a minimum fluid intake of 13 mL/kg during training and 4 mL/kg after training for adolescent athletes. To meet fluid needs, athletes can consume drinks such as sports drinks, energy drinks, vitamin water, and high-caffeine drinks. It is important to note that subjective evaluations should be avoided. The text should adhere to conventional structure and formatting features, including consistent citation and footnote style. Additionally, the text should be free from grammatical errors,

spelling mistakes, and punctuation errors. No changes in content should be made beyond what is necessary to meet the desired characteristics. Drinks designed to boost energy levels typically contain sugar (carbohydrates) and electrolytes, such as sodium and potassium. However, for most athletes, water is sufficient to maintain hydration. Similarly, most teenagers can stay hydrated by drinking water before, during, and after exercise. It is advisable to avoid energy drinks as they contain ingredients with potentially harmful side effects that have not been fully studied.

Adolescent athletes prioritize fulfilling a balanced diet, but determining mealtimes is equally important for optimizing exercise performance and recovery. To meet nutritional needs, experts recommend eating frequently outside of breakfast, lunch, and dinner. Athletes should consume food about every three hours, especially with activities outside of the training schedule, to minimize energy deficits each day. In general, it is important to maintain consistency between energy intake and expenditure during physical activities. Many athletes lack access to a coach or expert nutritionist who can guide them on when to eat before, during, and after exercise or competition. Consuming food or snacks before exercise can help increase or store energy (in the liver and muscles as glycogen) and ensure that athletes feel comfortable and neither hungry nor too full.

During training or competition, the consumption of fuel is necessary to sustain energy and maximize performance. For drills or matches that last less than 60 minutes, fuel intake during workouts is often unnecessary. However, when training or competing in competitions that last longer than 60 minutes, it is recommended to consume sports drinks that contain carbohydrates and electrolytes with levels of 6–8% sugar. This is because they are quickly absorbed and used for energy (Moore et al., 2020). After training or competing, athletes need to consume material fuel to support the restoration and repair network. This is necessary for growing and replacing the glycogen stores in the liver and muscles. It is recommended to consume food that contains carbohydrates and protein after training or competition. Consuming a high-carbohydrate, high-protein diet after exercise helps restore muscle glycogen.

The food consumed three hours after exercise should be high in carbohydrates but low in fat and fibre. This will allow the sugar to quickly enter the bloodstream and replenish glycogen stores. It is recommended to avoid fast food, fried foods, and processed foods after exercise. In adolescent athletes, meeting energy needs is a crucial requirement during training or competition. It is not uncommon for athletes to use shortcuts, such as substances or supplements, which can be harmful to their bodies. Therefore, it is important for parents, coaches, and athletes to understand which supplements are suitable and safe to use for quick energy intake. Coaches must also be aware of which supplements to avoid in order to prevent doping in matches. The impact of supplements on the growth and development of adolescent children remains uncertain. Therefore, it is advisable for adolescents, particularly athletes, to avoid using them. Another supplement to consider is energy drinks and caffeine (Gaudiani, 2019).

The effects of caffeine on children and adolescents have not been extensively studied. Adolescent athletes who take medication for disorders or hyperactivity should exercise caution when consuming energy drinks that contain stimulants. This article outlines important considerations for meeting the nutritional needs of adolescent athletes. This is an explanation of the considerations for meeting the nutritional needs of adolescent athletes by sports nutritionists. Adolescent athletes have unique nutritional needs due to their physical activity levels. Proper nutrition is necessary to meet the energy demands of physical activity. Proper nutrition is essential for maintaining energy during exercise, normal blood glucose concentrations, preventing hunger, preserving muscle mass, and expediting recovery.

When provided to adolescent athletes, proper nutrition can have a significant impact on their appearance during training and competition. Additionally, nutrition can greatly enhance athletic performance by

generating energy, delaying fatigue, increasing strength and focus, and expediting the recovery process. Athletes who aim to achieve optimal performance must pay close attention to their nutritional intake (Moore et al., 2020). Adequate nutrition is crucial for adolescent athletes not only to maintain their health and optimize their sports performance but also to meet the requirements of growth and development. It is important to take into account the time before and after training, as these components are also essential for meeting increased nutritional needs. It is recommended to carry out activities or exercises as expected. When determining appropriate nutrition, it is important to consider calorie needs, macronutrients, hydration, timing, and supplements (Zhao et al., 2021). Additionally, factors such as the type of exercise, genetics, gender, and age should be taken into account (Moore et al., 2020).

Athletes have unique physical activity and energy requirements compared to the general population. Athletes have unique physical activity and energy requirements compared to the general population. To meet these requirements, athletes need to consume a well-balanced diet that provides adequate energy. Proper nutrition not only helps maintain energy levels during exercise but also ensures normal blood glucose concentrations, prevents hunger, preserves muscle mass, and accelerates recovery (Rothschild et al., 2020). Although adolescent athletes require more energy, their recommended food sources do not differ significantly from the general recommendations for optimal health.

2. Methodology

Scope

The aim of the research is to find a natural way to reduce the levels of triglycerides and cholesterol in secondary school students included in the study, by using natural products. To achieve this goal, we tested the effects of natural treatments on the levels of triglycerides and serum cholesterol. Measurements of these two parameters were made before and after the period of using natural supplements.

Participants

The study group consisted of 40 healthy volunteers, both girls and boys. Of the 40 students included in the study, 24 are from Baia Elementary School and 16 are from Jurilovca Elementary School, in Tulcea County.

The duration of the natural supplements use is 12 months. The students were given one 500 mg Spirulina capsule and one Safflower Oil capsule daily for three months, followed by a one-month break. The serum levels of triglycerides and cholesterol were evaluated. Blood tests were taken from the students in the study, before and after the use of Spirulina and Safflower oil capsules, to evaluate their effects.

Instruments

Medical analyses of the students in the study were performed before the use of natural supplements (initial results) and after their use (final results). The blood tests were carried out at the S.C. Promedica Tulcea medical analysis laboratory.

3. Results

This study aimed to investigate the impact of a natural treatment on triglyceride and serum cholesterol levels. Measurements of these parameters were taken before and after an 11-month treatment period on 40 healthy volunteers of both genders (Table 7).

In Tabel 7 are presented the initials of the 40 middle school students who took part in the study, their date of birth and the results of cholesterol and triglycerides before and after the administration of natural supplements, Spirulina 500 mg capsules and Safflower oil capsules.

The data was divided into four distributions, representing serum cholesterol and triglyceride levels before and after treatment with natural supplements. The distributions were analysed and compared using appropriate statistical tests.

Table 7. Preliminary Medical Test Results

Order nr.	Initials	Sex	Birth Year	Cholesterol Initial	Cholesterol Final	Triglyceride Initial	Triglyceride Final
1	A.B.J	f	2010	183	177	74	68
2	A.F.A	m	2010	185	179	88	81
3	A.I.A.M	f	2010	185	180	85	74
4	B.A.I	f	2011	188	178	96	89
5	B.F.A	m	2011	188	183	83	78
6	B.F.V	m	2009	175	169	86	81
7	B.I.C	m	2010	174	168	96	87
8	B.L.G	f	2010	178	172	88	81
9	B.R.G	m	2010	182	176	91	83
10	B.T	f	2011	178	173	75	69
11	C.A.F	f	2010	163	159	74	69
12	C.M.	f	2011	163	159	74	68
13	C.N.M.	m	2011	182	177	85	79
14	C.V.N	f	2011	181	176	76	71
15	C.S.E	m	2010	183	175	93	88
16	D.B.I.	f	2011	184	177	79	73
17	D.M.	f	2010	185	181	88	83
18	D.M.A.	m	2010	178	171	89	84
19	D.M.G.	m	2010	174	171	88	84
20	D.S.D	m	2011	170	163	78	72
21	J.B.C.	f	2009	188	183	96	91
22	G.C	f	2010	163	157	78	75
23	H.M.N.	m	2011	176	169	78	72
24	M.E.mac1	m	2011	188	180	85	81
25	M.E.moc2	m	2011	181	175	88	84
26	M.P.F	m	2010	188	179	74	68
27	N.M.G	m	2010	163	169	70	68
28	P.A	m	2010	179	173	63	77
29	P.O.E	f	2011	178	171	85	78
30	P.V.	f	2011	186	178	74	68
31	P.V.M	m	2011	182	177	88	83
32	R.A.V	m	2010	174	167	79	73
33	S.L.N	m	2009	174	169	79	73
34	T.A.G	m	2011	174	168	82	76
35	T.P.R	f	2011	174	168	76	72
36	V.A.G	m	2011	188	182	85	77
37	V.D	m	2010	182	175	74	71
38	V.D.A	m	2009	185	178	82	76
39	Z.A.M	m	2010	169	161	105	97

40	U.A.V	f	2011	186	181	88	83

Figure 1. Shows a Decrease in Cholesterol and Triglycerides after Taking Natural Supplements in Girls from Baia and Jurilovca Secondary Schools

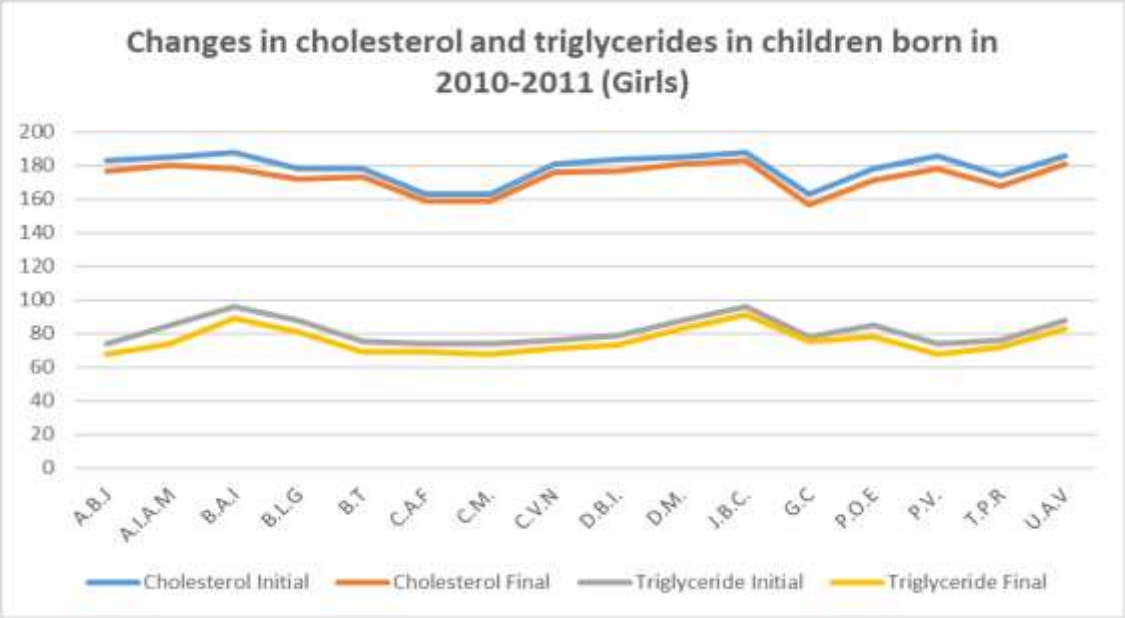

Figure 1. Changes in Cholesterol and Triglycerides in Children Born in 2010-2011 (Girls)

Also in the boy's case, a decrease in cholesterol and triglycerides is observed after administration natural supplements (Figure 2.)

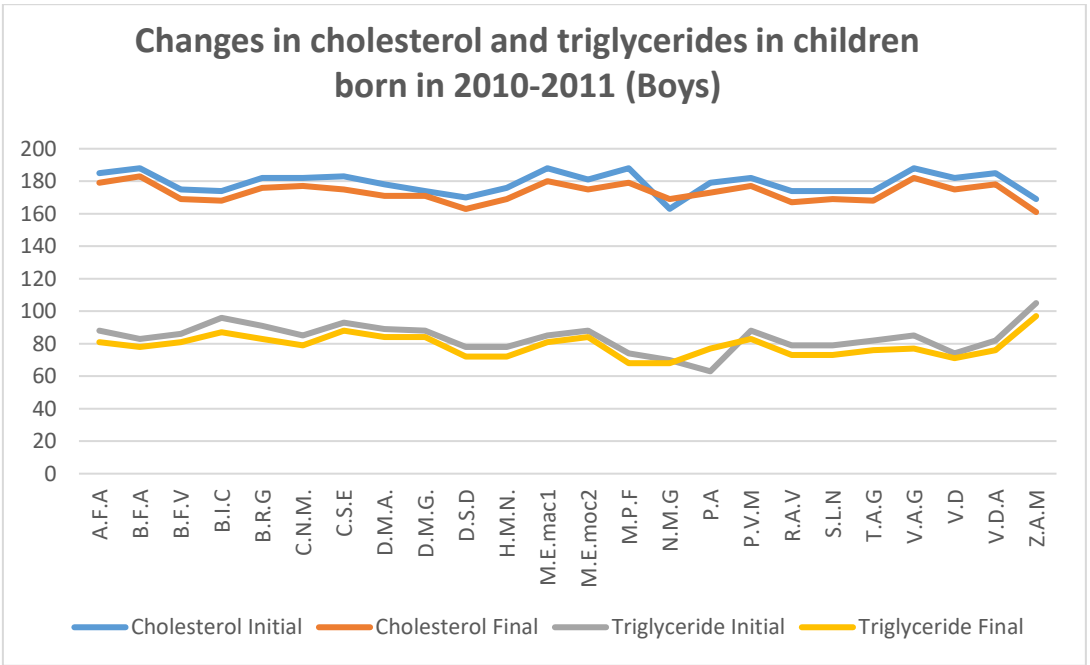

Figure 2. Changes in Cholesterol and Triglycerides in Children Born in 2010-2011 (Boys)

4. Conclusion

Significant differences were observed in the decrease of cholesterol and triglyceride levels after the use of natural supplements, particularly between the initial and final results of the participants regarding the level of triglycerides. It should be noted that the effects of spirulina and safflower oil may vary depending on the dosage, duration of treatment, lifestyle, and overall health. It is important to maintain a clear and concise structure with causal connections between statements, avoiding biased or emotional language and adhering to grammatical correctness and conventional formatting. The study will continue to observe the trend in cholesterol and triglyceride values following dietary supplementation over an extended period and draw final conclusions and recommendations.

Informed Consent Statement: The written informed consent for the athletes to participate in the study was obtained.

Data Availability Statement: Data are available upon request to the contact author.

Conflicts of Interest: The authors declare no conflict of interest.

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