NUTRITIONAL EDUCATION TO ENSURE THE ATHLETE'S PHYSICAL AND MENTAL WELL-BEING

Gianluca Gravino
University of Naples Parthenope
giangravino@live.it
https://orcid.org/0009-0001-2025-8899

Emma Saraiello
University of Naples Parthenope
esaraiello@gmail.com
https://orcid.org/0000-0002-8783-6112

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ABSTRACT
The modern food system exposes young people to ultra-processed foods, digital marketing, and unreliable nutritional information. Student-athletes are particularly vulnerable, as their dietary choices are also shaped by sporting demands. This mixed-methods experimental study evaluated an eight-week nutrition education programme involving 60 student-athletes aged 16–20, randomly assigned to an experimental (n = 30) or control group (n = 30). Nutritional knowledge was assessed using the Nutrition for Sport Knowledge Questionnaire (NSKQ), while 15 participants completed semi-structured interviews. The experimental group showed a significant increase in nutritional knowledge, from 48.6 ± 7.9 to 76.4 ± 6.8 ($p < .001$), whereas no significant changes emerged in the control group. Qualitative findings revealed greater dietary awareness, improved understanding of nutrition and performance, and a more critical approach to supplements, social media, and food marketing.

KEYWORDS
Food Education, Psychophysical Well-being, Food Literacy

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1. Introduction

The modern food system is characterised by profound social, economic and cultural contradictions. On the one hand, the growing availability of ultra-processed, high-calorie and low-cost foods has radically altered the eating habits of younger generations; on the other, large sections of the population struggle to access fresh, nutritious and sustainable food. This situation contributes not only to rising levels of obesity and metabolic disorders, but also to widening social and regional inequalities. At the same time, the influence of digital media, food advertising and social networks contributes to the creation of obesogenic environments, in which unhealthy cultural models and consumption patterns are normalised, particularly among adolescents and young adults.

In this context, the issue of nutrition cannot be addressed solely from a medical-nutritional perspective. Promoting nutritional well-being requires an interdisciplinary approach capable of integrating educational, psychological, cultural and social dimensions. Nutrition represents not only a physiological need, but also a behaviour influenced by values, social relationships, cultural affiliations and identity dynamics. For this reason, food education now plays a strategic role in promoting public health and in developing the critical skills needed to navigate increasingly complex food systems. In this context, the concept of Food Literacy (FL) emerges, defined as the set of knowledge, skills and attitudes that enable individuals to plan, select, prepare and consume food in an informed, sustainable and critical manner (Hernandez et al., 2021; Silva et al., 2023). Food literacy is not merely about knowing the nutritional properties of foods, but involves the ability to understand the ethical, environmental and social implications of one's food choices. It is closely linked to health literacy, as it translates the principles of health promotion into concrete daily practices. Adolescence is a particularly sensitive phase in terms of the development of eating habits. During this period, characterised by increasing decision-making autonomy, individuals are more exposed to the influence of peers, the media and social dynamics. For student-athletes, these factors are further intertwined with the demands of sporting performance, aesthetic pressure and the desire to achieve certain body standards. Numerous studies have highlighted that many young athletes have insufficient nutritional knowledge, often based on fragmented or unscientific information regarding supplementation, hydration and macronutrient management (Trakman et al., 2017). Promoting healthy eating therefore means educating for active and global citizenship. Food becomes a lens through which to interpret issues related to environmental sustainability, social justice and the right to health. From this perspective, the Critical Food Systems Pedagogy proposed by Classens and Sytsma

(2020) represents an important theoretical framework, as it considers food not merely as nourishment, but as a tool for understanding the relationships between the individual, the environment and society. From an educational perspective, it is therefore necessary to move beyond traditional, one-way teaching models and to promote transformative and participatory approaches. Recent literature identifies a number of promising practices, including school and community gardens, peer education, service learning, experiential learning and play-based digital methodologies, which foster engagement, motivation and the development of self-efficacy (Bailey et al., 2019; Medeiros et al., 2022). These approaches are particularly effective among young athletes, as they enable nutritional knowledge to be linked to daily life and the practical experience of sporting activity. In light of these considerations, the present study aims to evaluate the effectiveness of a nutrition education intervention targeting student-athletes using a mixed-methods approach. The aim is to analyse not only changes in nutritional knowledge, measured using the Nutrition for Sport Knowledge Questionnaire (NSKQ), but also the students' subjective perceptions and experiences regarding the relationship between diet, physical well-being, mental health and sporting performance.

2. Aims of the study

The main aim of the study is to assess the effectiveness of an educational intervention designed to improve nutritional knowledge, dietary awareness and perceived well-being among student-athletes. In particular, the research aims to determine whether a structured nutrition education programme can lead to a significant increase in nutritional competence, as measured by the Nutrition for Sport Knowledge Questionnaire (NSKQ). At the same time, the study aims to explore students' subjective perceptions regarding the influence of diet on mental health, quality of daily life, stress management and sporting performance. A further objective is to analyse how the educational intervention promotes the development of critical attitudes towards dietary models promoted by digital media and contributes to the development of more informed, autonomous and sustainable eating behaviours.

3. Methodology

The research was conducted using a randomised experimental design with a mixed-methods approach, combining quantitative and qualitative methodologies in order to gain a deeper understanding of the phenomenon under study.

The quantitative component was used to measure changes in the participants' nutritional knowledge before and after the educational intervention. The qualitative component, on the other hand, enabled the exploration of the students' experiences, perceptions and interpretations of the relationship between diet, well-being and sporting activity.

The experimental design involved two groups:

• an experimental group, which underwent the nutrition education programme;

• a control group, which continued with normal school and sporting activities without receiving any nutritional intervention.

The total duration of the study was eight weeks. Data collection took place at two distinct points: a pre-intervention assessment (T0) and a post-intervention assessment (T1).

4. Quantitative data collection

The Nutrition for Sport Knowledge Questionnaire (NSKQ), developed and validated by Trakman et al. (2017), was used for the quantitative assessment. The questionnaire assesses nutritional knowledge relating to:

• sports nutrition;

• macronutrients and micronutrients;

• hydration;

• supplementation;

• post-exercise recovery.

The questionnaire was administered before the start of the educational intervention and at the end of the eight weeks.

5. Qualitative data collection

The qualitative component of the research was conducted through individual semi-structured interviews with 15 participants from the experimental group.

The interviews explored:

• perceptions of the relationship between nutrition and mental wellbeing;

• changes in eating habits;

• the influence of social media on nutritional choices;

• difficulties in managing sports nutrition;

• experiences relating to the educational programme.

The interviews were recorded, transcribed in full and analysed using thematic analysis according to the model by Braun and Clarke (2006).

6. Participants

The study sample consisted of 60 student-athletes from local sports schools and amateur sports clubs. The participants were aged between 16 and 20 and competed in various sports, including football, athletics, volleyball, basketball and swimming.

The students were randomly assigned to:

• experimental group (n=30);

• control group (n=30).

To ensure homogeneity between the groups, randomisation took into account variables such as age, gender, type of sport practised and training frequency.

Specific inclusion and exclusion criteria were defined. Students who had been involved in competitive sport for at least two years, trained at least three times a week and were regularly enrolled in a school programme were included in the study. Informed consent was also required from participants and, in the case of minors, parental authorisation.

Participants diagnosed with eating disorders, chronic metabolic conditions, or currently undergoing specialist nutritional programmes were excluded, as these conditions could have significantly influenced the study results. Students who did

not attend at least 80% of the sessions scheduled in the educational programme were also excluded.

7. Educational programme

The educational programme has been designed as an integrated training course, aimed at promoting among student-athletes not only an increase in nutritional knowledge, but also a broader awareness of the relationship between diet, health, sporting performance, mental wellbeing and social responsibility. Its development was based on the idea that nutrition education, particularly during adolescence, cannot be limited to the transmission of information about nutrients or the prescription of correct behaviours, but must take the form of a participatory process capable of developing autonomy, critical thinking and decision-making skills. This approach is consistent with the concept of Food Literacy, understood as a complex competence encompassing the knowledge, practical skills and attitudes necessary to plan, choose, prepare and consume food in an informed and sustainable manner (Hernandez et al., 2021; Silva et al., 2023).

The programme was aimed exclusively at students in the experimental group and consisted of eight weekly sessions, each lasting ninety minutes, for a total of twelve hours of training. The sessions took place in a school setting, in a space equipped for both theoretical activities and practical, collaborative exercises. The programme was led by a multidisciplinary team comprising a sports nutritionist, a sports psychologist and a physical education teacher, with the aim of combining different areas of expertise and offering students a comprehensive understanding of eating behaviour. The nutritionist covered aspects relating to energy requirements, dietary composition, hydration and nutrition in the context of training; the sports psychologist explored the link between diet, body image, motivation, stress management and mental wellbeing; the physical education teacher facilitated the connection between nutritional content and the practical experience of training and sporting performance.

From a theoretical perspective, the programme was structured with reference to the Critical Food Systems Pedagogy proposed by Classens and Sytsma (2020). The perspective of critical food systems pedagogy allowed the discussion of nutrition to be broadened beyond the biological dimension, incorporating reflections on sustainability, food marketing, inequalities in access to food and collective responsibility. The first phase of the programme focused on establishing a shared foundation of knowledge. The students were guided in understanding the concept of energy requirements and the role of macronutrients in sporting performance. The aim was not to provide rigid dietary plans, but to help participants recognise the relationship between energy intake, energy expenditure, training intensity,

recovery and general well-being. The role of carbohydrates as the primary energy source in high-intensity sports, the importance of protein in muscle repair and adaptation processes, and the function of lipids in hormonal regulation and maintaining health were discussed. This section was linked to international recommendations on nutrition and athletic performance, according to which proper dietary planning helps to support training, optimise recovery and reduce the risk of fatigue and injury (Thomas, Erdman & Burke, 2016). A second phase of the programme focused on nutrient timing, i.e. the distribution of nutrients in relation to training and competition sessions. The students analysed specific situations from their sporting routines, reflecting on what to eat before physical activity, how to manage hydration during exercise, and which dietary choices to prioritise during the recovery phase. Particular attention has been paid to the pre-workout meal, which is often neglected by adolescents due to a lack of time or disorganised school routines, and to post-exercise recovery, during which adequate intake of carbohydrates, protein and fluids can aid the replenishment of energy stores and muscle repair. This approach is consistent with the position of the International Society of Sports Nutrition, which recognises nutritional timing as a useful strategy for supporting performance and training adaptations (Kerksick et al., 2017).

Specific attention was paid to hydration, a topic of particular relevance to student-athletes as inadequate fluid management can negatively affect not only physical performance but also concentration, perception of fatigue and recovery capacity. During the sessions, students reflected on the physical signs of dehydration, the role of sweating, individual variability in fluid requirements, and the importance of electrolytes during prolonged activities or those carried out in unfavourable environmental conditions. Here too, the educational approach was not designed as a simple transmission of rules, but as the development of self-regulation skills. The students were encouraged to observe their own habits, identify any areas of concern and develop realistic strategies to apply during their school and sporting activities.

A significant part of the session focused on the use of dietary supplements, a particularly sensitive topic among adolescent athletes. Many young athletes come into contact with protein products, energy drinks, pre-workout supplements or other supplements promoted via social media, gyms and sporting environments, often without a real understanding of their benefits or potential risks. The programme therefore encouraged critical reflection on supplementation, clarifying the difference between a balanced diet, supplementation necessary under specific conditions, and the inappropriate consumption of commercial products. In line with the consensus of the International Olympic Committee, it was emphasised that the use of supplements should be assessed with caution, taking into account efficacy,

safety, product quality and the risk of contamination with banned substances (Maughan et al., 2018).

Alongside the more strictly nutritional aspects, the session devoted considerable attention to the relationship between diet and mental wellbeing. The students discussed the link between diet quality, energy levels, mood, sleep, concentration, self-esteem and body image. This part was particularly important because, in adolescent athletes, eating behaviour can be influenced by pressure to perform, peer comparison, body image and aesthetic ideals promoted by social media. The programme sought to counter the view of food as merely a tool for weight control or performance enhancement, promoting instead a more balanced and functional relationship with food. From this perspective, food was presented as a resource to support the body, the mind and the quality of daily life, avoiding approaches that induce guilt or are overly prescriptive.

The methodology adopted was predominantly workshop-based and participatory. Each session included guided discussions, case studies, discussions of personal experiences, reading food labels, meal-choice simulations and critical reflection on nutritional content found online. Students were invited to share examples from their own daily lives, such as skipping breakfast, eating meals quickly before training, consuming processed snacks, having doubts about supplements or information learned from social media. These situations have become educational material to be worked on collectively, transforming personal experience into a learning opportunity. This approach is consistent with evidence suggesting that nutrition education programmes aimed at adolescents are most effective when they employ active, experiential methodologies that are closely aligned with the participants' real-life experiences (Bailey, Drummond & Ward, 2019; Medeiros et al., 2022) .

A central element of the programme was the development of critical thinking regarding food marketing and digital media. Students analysed advertisements, social media posts, promotional content from influencers and nutritional claims found on food packaging. Through these activities, the group was guided to recognise persuasive strategies, misleading simplifications and associations between food, body image and sporting success. The aim was to strengthen the ability to distinguish between information based on scientific evidence and content primarily geared towards consumption. This aspect is particularly consistent with the concept of critical food literacy, which is not limited to knowing 'what to eat', but includes the ability to understand why certain food choices are promoted, by whom and for what purposes. Self-assessment activities, such as short food diaries and personal reflection sheets, were also used throughout the programme. These tools were not used for diagnostic or prescriptive purposes, but as a means of

promoting awareness and observation of one's own habits. Students were able to reflect on the regularity of their meals, the quality of their breakfast, hydration, snack management and food choices on training days. The use of self-reflection tools enabled them to link theoretical knowledge to daily life, facilitating the transition from information to practical competence. The programme also emphasised the importance of group dynamics and peer education. Interaction among students fostered mutual identification, the sharing of common challenges, and the development of realistic strategies. At an age when peer groups exert a strong influence on eating and sporting behaviours, this aspect represented a significant educational factor. The students were able to recognise that many difficulties, such as lack of time, pressure to look a certain way, the consumption of fast food, or the confusion caused by online information, were shared experiences rather than isolated individual problems. This helped to reduce feelings of judgement and foster a more open atmosphere of participation. At the end of the programme, students in the experimental group were given summary materials containing practical guidance on meal planning, hydration and dietary management on training and competition days. These materials were not intended to replace personalised nutritional advice, but rather to provide simple, scientifically sound tools that could be easily applied in everyday life. The control group, on the other hand, received no educational intervention during the eight weeks and continued with their normal school and sporting activities. This methodological choice allowed for a clearer assessment of the specific effect of the educational programme on the student-athletes' levels of nutritional knowledge and subjective perceptions.

Overall, the intervention was designed as an integrated nutrition education programme, capable of linking sports nutrition, mental health, critical thinking and food citizenship. Its aim was not simply to improve scores on the Nutrition for Sport Knowledge Questionnaire, but to foster in student-athletes a broader, more stable and transferable competence in daily life.

8. Quantitative findings

Analysis of the quantitative data, collected via the Nutrition for Sport Knowledge Questionnaire prior to the start of the educational intervention and at the end of the eight-week period, revealed a significant improvement in nutritional knowledge in the experimental group compared with the control group. At the time of the initial assessment, the two groups had essentially comparable mean scores, indicating a homogeneous baseline. The experimental group had an average score of 48.6 ± 7.9, whilst the control group had an average score of 49.2 ± 8.1. The difference between the two groups at the pre-test was not statistically significant,

confirming the absence of any relevant initial differences in sports nutrition knowledge.

After the eight-week intervention, the experimental group recorded a marked increase in the average score, reaching a value of 76.4 ± 6.8. This increase indicates a significant improvement in the students' ability to understand the fundamental principles of nutrition as applied to sport, with particular reference to the function of macronutrients, hydration, post-exercise recovery and the critical management of dietary supplementation. In the control group, however, the average post-test score was 51.1 ± 7.6, showing a minimal and statistically insignificant increase compared to the initial assessment. The within-group comparison revealed a statistically significant difference between the pre-test and post-test in the experimental group ($p < 0.001$), whereas no significant changes were observed in the control group ($p > 0.05$). The between-group comparison at the end of the intervention also showed a statistically significant difference in favour of the experimental group ($p < 0.001$). These data suggest that the observed improvement cannot be attributed simply to the students' natural maturation or to normal sporting experience, but is likely associated with participation in the educational programme.

Analysis of the individual sections of the questionnaire showed that the most marked progress in the experimental group concerned the sections relating to nutrient timing, hydration and post-training recovery. In particular, the students demonstrated a greater ability to recognise the importance of nutrient distribution in relation to the timing of sporting activity, showing a better understanding of the role of the pre-workout meal and nutrition in the post-exercise phase. An improvement was also observed in the understanding of the importance of fluid balance and correct fluid intake in relation to the intensity of physical activity, the duration of training and environmental conditions. A further improvement was observed in questions relating to dietary supplements. In the pre-test, many students tended to attribute an overly central role to supplements in improving sporting performance; in the post-test, however, the experimental group demonstrated a greater ability to distinguish between genuine nutritional needs, commercial strategies and the misuse of supplements. This result appears consistent with the design of the intervention, which had focused particularly on the critical reading of nutritional information disseminated via social media, advertising and sporting environments. It can be stated that the quantitative results confirm the effectiveness of the educational intervention in improving student-athletes' nutritional knowledge. The increase in NSKQ scores in the experimental group indicates that a structured, participatory and multidisciplinary programme can promote the acquisition of more robust dietary skills applicable to daily

sporting practice. The stability of scores in the control group further reinforces the interpretation that the intervention was the main factor associated with the observed improvement.

9. Qualitative findings

A qualitative analysis of the semi-structured interviews conducted with 15 students in the experimental group provided an in-depth understanding of the meaning the participants attributed to the educational experience and revealed how the intervention influenced their perception of the relationship between diet, physical well-being, mental health and sporting activity. The interviews, analysed using thematic analysis, revealed a gradual shift in how food was perceived: prior to the intervention, many students tended to view nutrition primarily in terms of body weight, physical appearance or immediate performance; by the end of the programme, however, food was more frequently described as a resource for sustaining energy, concentration, recovery and psychophysical balance. One of the key themes that emerged was an increased awareness of nutrition. Participants reported that they had started paying closer attention to the quality and regularity of their meals, recognising the importance of not skipping breakfast, planning their snacks more effectively, and paying attention to their diet in the hours before and after training. One student said: “I used to often come to train without having eaten properly; I thought it was enough just to tough it out. Now I’ve realised that if I turn up feeling drained, I train worse and recover even more slowly.” Another participant said: “I’ve started preparing a snack before training instead of always buying something from the vending machine. It seems like a small thing, but I feel less tired.” A second significant theme concerns the relationship between diet and mental wellbeing. Many students linked improvements in their eating habits to feeling more energetic throughout the day, greater mental clarity when studying, and reduced fatigue after training. Some participants reported that they had begun to understand how food could influence not only physical performance, but also mood, motivation and the management of stress related to school and sport. One interviewee remarked: “When I eat more regularly, I feel more focused at school too, not just during sport.” Another student said: “I’ve realised that when I skip meals, I’m more nervous and arrive at training already stressed. I didn’t used to link these things to my diet.” A third aspect that emerged from the interviews concerns the development of critical thinking regarding dietary information disseminated by digital media. Before the programme, several students stated that they relied on advice found on social media, videos by sports influencers, or informal guidance from teammates and within training environments. After the educational programme, participants showed greater caution in evaluating such content,

recognising the presence of promotional messages, oversimplifications and information that was not always scientifically sound. One student reported: “I used to follow pages recommending supplements to boost strength, but I’d never asked myself whether they were really necessary or if it was just advertising.” Another participant added: “Now, when I see a video about what to eat before a race, I don’t just take it at face value; I try to understand who’s saying it and why.”

The interviews also highlighted a different perception of dietary supplementation. Some students, particularly before the programme began, believed that supplements played an almost indispensable role in improving sporting performance. By the end of the programme, however, a more cautious and realistic view had emerged: supplements were described as potentially useful only in specific situations, but not as a substitute for a balanced diet. One participant stated: “I used to think that protein powder was almost a must if you do sport. Now I realise that you need to look at what you eat every day first.” This shift is consistent with the quantitative results, in which questions relating to supplementation showed a significant improvement in the experimental group.

A further theme concerns the social and sustainable aspects of nutrition. Although the students initially linked food almost exclusively to individual sporting performance, during the final interviews a greater focus emerged on the origin of food, reducing waste, the consumption of fresh produce, and awareness of inequalities in access to healthy food. One student said: “I’d never thought that choosing what to eat could also affect the environment or waste. I thought it was just a personal thing.” This finding confirms that the intervention has fostered a broader understanding of nutrition, consistent with the concept of food citizenship.

Some practical difficulties were also identified. The students reported that managing their daily diet can be hampered by school timetables, afternoon training sessions, the limited availability of balanced meals outside the home, and the perceived cost of certain healthy foods. Some participants highlighted the difficulty of changing established family habits or resisting peer pressure, particularly in social contexts where the consumption of snacks, sugary drinks or ultra-processed foods is commonplace. One student explained: “It’s not always easy to eat well at school, because what you find is almost always pizza, snack bars or packaged sandwiches”. Another participant added: “At home, I don’t always decide what we buy, so I try to change things, but it’s not all up to me.” The qualitative findings confirm and complement the quantitative data, showing that the educational intervention not only led to an increase in knowledge as measured by the Nutrition for Sport Knowledge Questionnaire, but also brought about a change in the way students interpret their relationship with food. The educational experience fostered greater autonomy in decision-making, a stronger awareness of the link

between diet and physical and mental well-being, and a more critical ability to interpret the contemporary food environment.

10. Discussion

The study's findings highlight the effectiveness of a structured educational intervention in improving student-athletes' nutritional knowledge and fostering a more informed understanding of the relationship between diet, physical well-being and mental health. The significant increase in scores on the Nutrition for Sport Knowledge Questionnaire in the experimental group confirms that an eight-week training programme, designed using a participatory and multidisciplinary approach, can have a positive impact on sports nutrition knowledge. This finding is consistent with the observations of Foo et al. (2021), who noted an improvement in nutritional knowledge among young swimmers following an educational intervention during the competitive season. Similarly, the review by Sánchez-Díaz et al. (2020) shows that nutritional education interventions in team sports can improve athletes' dietary knowledge, eating habits and awareness. The most marked improvement in areas relating to nutrient timing, hydration, post-exercise recovery and the judicious use of supplements appears particularly significant, as these areas often represent points of weakness in young athletes. The literature highlights that the correct distribution of nutrients in relation to training can support energy availability, promote recovery and optimise physiological adaptations to exercise (Kerksick et al., 2017). Similarly, the observed change in the perception of supplements is consistent with the International Olympic Committee's consensus that the use of supplements must be assessed with caution, taking into account efficacy, safety and the risk of contamination, particularly in younger athletes (Maughan et al., 2018).

The qualitative component enriches the interpretation of the quantitative data, showing that the intervention not only led to an increase in knowledge but also to a transformation in the meaning attributed to food. The students began to view nutrition not merely as a tool for weight control or immediate performance enhancement, but as a resource to support energy, concentration, recovery, mood and the quality of daily life. This finding fits within the framework of food literacy, which views food literacy as an integrated set of knowledge, practical skills, critical attitudes and the ability to make informed choices within one's social and cultural context (Silva et al., 2023; Ares et al., 2024).

A particularly significant aspect concerns the development of critical thinking regarding food-related messages disseminated by digital media. Adolescents are constantly exposed to promotional content on diets, supplements, body image and performance, often conveyed by influencers or through marketing strategies not

based on scientific evidence. The fact that students, following the intervention, reported evaluating such information with greater caution suggests that food education may serve a protective function against obesogenic environments and nutritional misinformation. This finding is consistent with recent studies on nutritional literacy in adolescence, which highlight the importance of developing critical skills to navigate a complex food system heavily influenced by commercial interests (Ares et al., 2024).

The results also confirm the value of the participatory approach adopted in the intervention. Workshop activities, peer discussion, the analysis of real-life cases and reflection on daily habits have likely facilitated the transition from theoretical knowledge to practical competence. This finding is consistent with the literature on nutrition education interventions for adolescents, which suggests that experiential and contextualised strategies are more effective than purely didactic models in promoting motivation, self-efficacy and behavioural change (Bailey, Drummond & Ward, 2019; Medeiros et al., 2022). From this perspective, the observed improvement concerns not only what students 'know' about nutrition, but also how they learn to interpret their own needs, their sporting routines and the pressures of their social environment.

However, some critical issues remain. The interviews showed that dietary change does not depend solely on individual knowledge, but also on external factors such as school organisation, financial resources, family habits, the availability of healthy foods and peer group influence. Future interventions should involve not only student-athletes, but also families, coaches, schools and sports clubs, so that the everyday environment effectively supports the skills acquired.

11. Conclusion

This study has shown that a structured, multidisciplinary and participatory nutrition education programme can have a significant positive impact on student-athletes' nutritional knowledge and dietary awareness. The increase in scores on the Nutrition for Sport Knowledge Questionnaire in the experimental group demonstrates that educational programmes based on scientific evidence and active methodologies are effective in improving understanding of the fundamental principles of sports nutrition, with particular reference to hydration, post-exercise recovery, nutrient timing and the informed use of supplements.

Alongside the quantitative results, the qualitative component showed that the educational experience fostered a deeper transformation in the way students interpret the relationship between food, health and sporting performance. Participants progressively developed a greater ability to reflect critically on their

own eating habits, on the influences exerted by digital media, and on cultural models related to the body and performance. Nutrition was perceived not only as a tool for improving athletic performance, but also as a central element in sustaining energy, concentration, emotional well-being and the quality of daily life. The findings confirm the importance of viewing food education as a complex educational process, which is not limited to the transmission of nutritional information but also involves psychological, social and cultural dimensions. From this perspective, the concept of food literacy takes on a central role, as it enables adolescents to develop the practical and critical skills needed to navigate increasingly complex food environments influenced by marketing and social media. The students' ability to recognise non-scientific content, persuasive strategies and unrealistic dietary models represents a particularly significant outcome in a context characterised by the widespread dissemination of nutritional information that is often contradictory and lacks scientific validation.

The participatory approach adopted during the programme appears to have been one of the most significant elements of the intervention. Workshop activities, peer discussion, reflection on everyday experiences and critical analysis of digital content have fostered the active involvement of students and the transition from theoretical knowledge to applied competence. This aspect appears consistent with the most recent scientific evidence, according to which the most effective educational interventions during adolescence are those that enhance personal experience, intrinsic motivation, and collaborative learning (Medeiros et al., 2022; Silva et al., 2023). The study also highlights how changes in eating habits do not depend exclusively on individual willpower, but are influenced by multiple environmental, economic, and social factors. The difficulties reported by students regarding school schedules, the availability of healthy foods, and family habits confirm the need to develop broader and more systemic interventions capable of involving schools, families, coaches, and sports contexts. Indeed, the promotion of nutritional well-being requires coherent and supportive educational environments in which acquired skills can be sustained and consolidated over time.

From an applied perspective, the results suggest the opportunity to integrate nutrition education programs into school and sports pathways aimed at adolescents. Such interventions should be continuous, interdisciplinary, and tailored to the specific needs of student-athletes, with particular attention to mental health, the prevention of eating disorders, and the development of critical thinking. The integration of nutritional education, psychological well-being, and food citizenship could represent an effective strategy not only to improve sports performance, but also to promote healthier, more sustainable, and more conscious lifestyles.

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