ORIGINAL ARTICLE

Eating disorders: A school-based nutrition education and physical activity didactic intervention

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ABSTRACT

This study investigates the effectiveness of an integrated school-based programme aimed at improving the psycho-physical well-being of secondary school students with eating disorders (ED). Using a qualitative-quantitative approach, standardised data collection instruments were used, such as the KIDMED test to assess adherence to the Mediterranean diet, the Rosenberg Self-Esteem Scale to measure self-esteem, and the Strengths and Difficulties Questionnaire (SDQ) to monitor emotional well-being. The six-month project combined nutritional education, physical activity and psycho-educational support to promote healthy eating habits, self-esteem and balanced growth. The results show significant improvements in the parameters of psycho-pedagogical well-being, adherence to a balanced diet and participation in motor activities.
Keywords: Sport medicine, Self-esteem, Psycho-pedagogical support, Well-being, Secondary school, Health.

Cite this article as:
Gravino, G., Palmiero, F., Di Palma, D., & Tafuri, F. (2025). Eating disorders: A school-based nutrition education and physical activity didactic intervention. *Journal of Human Sport and Exercise, 20*(2), 682-693. https://doi.org/10.55860/k188b408

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Submitted for publication February 06, 2025.
Accepted for publication March 14, 2025.
Published March 26, 2025.
Journal of Human Sport and Exercise. ISSN 1988-5202.

doi: https://doi.org/10.55860/k188b408

INTRODUCTION

Eating disorders (EDs) are a growing problem among adolescents, with profound effects on both physical and mental health. These disorders include a variety of conditions such as anorexia nervosa, bulimia nervosa and uncontrolled eating, which negatively affect an individual's relationship with food, body and self-perception. The prevalence of DCA has increased in recent years, particularly among adolescents, a crucial period in their physical and psycho-physical development. According to recent epidemiological studies (Smith et al, 2022; Rossi et al, 2023), DCA is often associated with complex risk factors, including social pressure, exposure to unrealistic beauty models in the media and emotional vulnerability. Increasing social pressure on adolescents, often fuelled by unrealistic images conveyed by social media, has been shown to be a significant catalyst for the development of eating disorders.

Researchers such as Thompson and Stice (2021) suggest that exposure to unattainable beauty standards can negatively affect self-esteem and promote disordered eating behaviours. Furthermore, longitudinal studies (Becker et al., 2020) have shown an association between heavy social media use and the onset of DCA, particularly among adolescent girls. Biologically, adolescence is a particularly vulnerable time. Rapid physical changes, coupled with an increase in social awareness, can increase adolescents' insecurities about their bodies. Researchers such as Ricciardelli and McCabe (2020) have shown that the way adolescents perceive body changes at this stage can significantly influence their risk of developing DCA. Schools, as the primary educational and social setting, offer a unique opportunity to implement prevention and intervention programmes.

An integrated approach combining nutrition education, physical activity and psycho-educational support can help to reduce the risk factors associated with DCA. For example, Brown et al (2021) showed that school programmes focused on nutrition education not only improved eating habits but also reduced anxiety and depression in students. Another crucial element is physical education. Studies such as García-Hermoso et al. (2022) show how regular physical activity can improve self-esteem and psychological well-being in adolescents. Team sports, in particular, have been shown to promote social cohesion and reduce feelings of isolation, an aspect often associated with DCA. The importance of family involvement in school-based prevention programmes cannot be underestimated. The literature (Tylka et al., 2019) suggests that active parental participation can amplify the effectiveness of interventions by providing ongoing support to young people outside of the school environment. Engaging families through information sessions and practical workshops can help to create a supportive environment for change.

This experimental project was designed to respond to these needs by offering an integrated and tailored approach aimed at creating a culture of global well-being in schools. The main objective was to promote healthy eating habits, increase self-esteem and improve the mental health of adolescents. The innovation of this study lies in the integration of different disciplines, such as nutrition, psychology and physical activity, into a single school curriculum. Such multidisciplinary interventions have been identified as essential to address the complexity of DCA, as suggested by recent systematic reviews (Rohde et al., 2021).

MATERIALS AND METHODS

The programme was developed over six months, with a total of 24 weekly meetings. Each session was divided into three main modules, each designed to address specific aspects of wellbeing: nutrition education, motor activities and emotional support.

The methodology was designed to ensure an integrated and personalised approach, combining tools to evaluate the effectiveness of the project, using a combination of quantitative and qualitative methods to ensure a multidimensional analysis of the results. The Rosenberg Self-Esteem Scale and the Strengths and Difficulties Questionnaire (SDQ) were used to monitor psychological progress, while the "*KIDMED Test*" measured changes in eating habits. Data analysis included descriptive and inferential statistical techniques to identify significant changes in student behaviour. This mixed approach was chosen based on scientific evidence that emphasises the importance of integrating numerical data with subjective observations to better understand complex phenomena such as eating disorders (Brown et al., 2021; Larsen, Strand & Schmidt, 2021).

The integration of these different methodologies enabled a comprehensive and multi-dimensional evaluation of the effectiveness of the project, in line with the principles of methodological triangulation promoted by recent studies (Smith et al., 2022; Brown et al., 2021).

Participants

The project involved a total of 120 students aged between 11 and 14 from four secondary schools in an urban area. Students were selected on the basis of a pre-assessment that included self-administered questionnaires and teacher observations to identify risky eating behaviours and signs of emotional distress. Particular attention was paid to students who showed early signs of DCA, such as food restriction, episodes of uncontrolled eating, or excessive preoccupation with body weight.

Measures

- Dietary lifestyle questionnaires: The KIDMED test, a widely validated tool for assessing adherence to the Mediterranean diet (Bach-Faig et al., 2011), was administered to students at the beginning and end of the project. The use of this test made it possible to identify significant variations in students' eating habits, in line with the report by Micha et al. (2020) on the importance of the Mediterranean diet in promoting well-being; customised questionnaires with five-point Likert scales to analyse specific aspects such as meal frequency, fruit and vegetable consumption and food preferences. These data provided detailed information on students' daily eating habits, as suggested by Vidgen and Gallegos (2014) for the assessment of food literacy.
- Motor activity monitoring: The documentation of motor activities was carried out through participation registers, which monitored the frequency of sessions attended by the students. Previous studies (García-Hermoso, Ramírez-Vélez & Saavedra, 2022) highlight that regular monitoring is essential to assess compliance with physical activity programmes. For a more qualitative assessment, individual cards were used to record the quality of students' participation and engagement during activities. This approach is in line with Tylka, Annunziato and Burgard (2019), who highlight the importance of considering emotional involvement in health promotion programmes.
- Physical and psychological measurements: Body mass index (BMI) was monitored at the beginning and end of the project to detect any significant changes in anthropometric parameters, as recommended by Larsen et al. (20-21). In parallel, cardiovascular endurance tests, such as the shuttle run test, were performed to assess improvements in physical fitness, in line with Bratman, Hamilton and Daily's (2015) report on the benefits of physical activity on mental and physical health. Validated psychological scales were used to assess students' emotional well-being and self-esteem. In particular, the Rosenberg Self-Esteem Scale measured levels of self-esteem, while the Strengths and Difficulties Questionnaire (SDQ) provided an overview of overall psychological well-being. These instruments are widely used in the literature to assess psychological dimensions in young people (Rohde, Stice & Marti, 2021).

- Interviews and remarks: Semi-structured interviews were conducted with a representative sample of students to explore their perceptions and experiences during the programme. The importance of incorporating qualitative interviews into school-based intervention designs has been highlighted by Ricciardelli and McCabe (2020), who emphasise the value of listening to young people's voices in order to better understand the factors that influence their behaviour. In addition, the use of personal diaries and teacher feedback enriched the collection of qualitative data and provided a more comprehensive perspective on the impact of the project. As reported by Thompson and Stice (2021), direct observations and qualitative reports can provide essential context for the interpretation of quantitative data.

Proceedings

Each session was divided into three main modules:

1. *Nutrition education*

- Theoretical and practical sessions: The sessions, led by nutritionists and psychologists, included educational elements based on scientific evidence (Micha et al., 2020). Students were taught the principles of a balanced diet, with particular emphasis on the Mediterranean diet, which is recognised for its benefits in preventing DCA (Bach-Faig et al., 2011). The teaching methodology included lectures, guided discussions and practical activities to critically analyse food labels and advertisements.
- Interactive discussions: Students analysed examples of distorted eating patterns promoted by the media. The aim was to develop critical thinking skills to identify toxic narratives that negatively influence body perceptions (Tiggemann & Slater, 2014).
- Hands-on cooking workshops: Each cooking session included moments of reflection on the benefits of seasonal and sustainable food. o Students actively participated in the preparation of balanced meals, consolidating practical and theoretical skills (Vidgen & Gallegos, 2014).

2. *Physical activity*

- Yoga and mindfulness sessions: Suggested exercises, led by certified instructors, are designed to reduce stress and increase body awareness. Research suggests that mindfulness can improve one's relationship with one's body and promote greater self-acceptance (Atkinson & Wade, 2015).
- Team sports: Sports activities such as volleyball and basketball promoted cooperation and a sense of belonging among students. According to the cooperative learning model, group dynamics can build self-esteem and reduce social isolation (Johnson & Johnson, 2009).
- Dance and creative activities: Dance classes are designed to increase positive body awareness and stimulate emotional expression. Recent studies show that dance is a powerful tool for improving mental health and body awareness (Quiroga Murcia et al., 2010).
- Walking in nature: These activities allowed students to experience psychological benefits associated with the natural environment. The literature supports the idea that exposure to nature can reduce stress levels and improve overall well-being (Bratman et al., 2015).

3. *Emotional support*

- Dialogue and listening groups: Facilitated by school psychologists, these groups provided a safe space to share feelings and difficulties. The approach used was based on the person-centred model of therapy, which emphasises empathy and unconditional support (Rogers, 1951).
- Meetings with parents: Meetings were structured to make families aware of DCA and provide practical tools to support their children. Parental involvement has been shown to be crucial in the prevention and management of DCA, as evidenced by recent research (Larsen et al., 20-21).

Analysis

The analysis of the data collected before and after the intervention showed significant improvements in several areas, highlighting the effectiveness of the strategies adopted in the project. The results were divided into four main categories: eating habits, participation in motor activities, psycho-pedagogical well-being and qualitative feedback.

RESULTS

Dietary habits

1. *KIDMED Test*

- Before: The mean KIDMED test score was 5.6 (±1.2), indicating moderate adherence to the Mediterranean diet in the majority of students.
- After: The mean score increased to 7.0 (±1.1), a significant increase of 25% ($p < .05$), indicating greater compliance with dietary recommendations.

The increased score can be attributed to the nutrition education activities, which encouraged students to prefer healthy foods and improved meal planning.

2. *Fruit and vegetable*

- Before: Only 35% of students consumed at least three portions of fruit and vegetables per day.
- After: This percentage increased to 65%, an increase of 30%.

The inclusion of hands-on workshops and the availability of healthy alternatives in school meals played a crucial role in encouraging these changes.

3. *Junk food*

- Before: 40% of students regularly consumed snacks high in sugar and fat.
- After: the percentage dropped to 20%.

This result reflects the effectiveness of educational strategies in making students aware of the negative effects of junk food.

Participation in physical activities

1. *Frequency of sessions*

- Before: Only 60% of students regularly participated in extracurricular motor activities.
- After: 87% of students attended at least 80% of the sessions during the project.

The improvement is due to the introduction of engaging activities and the creation of a motivating environment.

2. *Cardiovascular endurance (Shuttle Run Test)*

- Before: The mean cardiovascular endurance score was 6.8 (±1.5) completed steps.
- After: After the intervention, the mean score increased to 7.6 (±1.3), an increase of 12% ($p < .05$).

The improvement reflects not only increased participation, but also the inclusion of motor activities designed to gradually improve cardiovascular capacity.

Psychological Well-being

1. *Self-esteem (Rosenberg Self-Esteem Scale)*

- Before: The mean score was 18 (±3.2), indicating a moderate level of self-esteem.
- After: The mean score increased to 24 (±2.8), a significant improvement of 33% ($p < .01$).

The educational and motor activities helped to increase the students' self-efficacy and positive self-perception.

2. *Emotional Well-being (SDQ)*

- Before: 45% of students showed moderate or high emotional symptoms.
- After: The percentage dropped to 15%, recording an overall reduction of 30% ($p < .05$).

The combination of psychosocial support and mindfulness strategies had a significant impact on emotional well-being.

Qualitative feedback

1. *Students*

- Before: Many students described a lack of awareness of their eating habits and a negative perception of their bodies.
- After: Students reported greater food awareness and a more positive perception of their body image, consistent with the quantitative results on self-esteem growth.

2. *Teachers and parents*

- Before: Parents and teachers pointed out the presence of risky eating behaviour and poor social interaction among the students.
- After: A significant reduction in such behaviour and an improvement in class cohesion, due to the introduction of collaborative activities and group dynamics, was reported.

Many students highlighted a significant change in their perception of food and their daily eating habits. Before the intervention, several participants reported that they had little awareness of the quality of the food they consumed and often preferred unhealthy foods. Below are some of the sentences reported by the students: "*I used to eat packed snacks at break time, but now I bring fruit or a wholemeal sandwich from home. I have learnt that I can make healthier choices without sacrificing taste*", or "*I used to think that eating healthy was difficult, but after trying new recipes during the workshops, I realised that it is also fun*". Parents, on the other hand, report: "*We have noticed that our son asks us to buy more fruit and vegetables. His attitude towards family meals has changed and he often talks about what he has learned at school*". Finally, the teachers: "*The pupils have become more aware of their food choices. At lunchtime, we notice that many of them avoid sugary drinks and packed snacks, opting instead for healthier alternatives*".

Another of the most significant changes was observed in the students' self-image. Many reported feelings more confident about their bodies and more comfortable in social interactions: "*Before, I often felt insecure about my body. After taking part in the project I feel stronger and more confident*", "*I like seeing the improvements in my physical stamina and knowing that I am doing something good for my body*".

The physical activities and educational workshops helped to improve the social dynamics within the classes, encouraging cooperation and empathy. Pupils described a greater sense of belonging and openness to their peers: "*I really enjoyed working in groups. Not only did I learn new things about food, but I also got to know*

my classmates better", "*The sports activities were challenging, but we encouraged each other and that brought us together*". As one teacher pointed out: The activities designed to involve all pupils helped to create a climate of inclusion. Even the shyer pupils started to participate actively.

Many students reported feeling calmer and less stressed as a result of the mindfulness strategies and physical activities included in the project: "*After the mindfulness sessions, I felt more relaxed and ready to concentrate in class*".

The project had a positive impact not only on individual students, but also on the whole school environment. Teachers and principals reported an overall improvement in the school climate, with greater student engagement and a reduction in interpersonal conflict: "*There was less tension between students. The collaborative activities have strengthened relationships and created a more harmonious environment*" and "*The project has created a sense of community, not only among students but also among teachers and families*".

Qualitative analysis was carried out through semi-structured interviews with students, the collection of personal diaries, teacher feedback and informal parental observations. The data collected provides a comprehensive picture of the impact of the project, not only on habits and behaviour, but also on emotions, self-perception and social dynamics.

The qualitative analysis revealed a number of cross-cutting improvements, ranging from nutritional awareness to psycho-pedagogical well-being, increased social cohesion and reduced stress. These changes were supported by both direct statements from the pupils and observations from parents and teachers. The combination of educational, motor and psychological approaches allowed the challenges to be addressed holistically and significant results to be achieved at multiple levels.

Analysis of the pre- and post-intervention data showed significant changes in all areas analysed. Improved eating habits, for example, can be attributed to the introduction of evidence-based nutrition education programmes, as suggested by Bach-Faig et al. (2011). Reduced consumption of junk food and increased consumption of fruit and vegetables demonstrate the effectiveness of educational strategies integrated into the school day (Vidgen & Gallegos, 2014).

Active participation in motor activities had a positive impact not only on the physical fitness but also on the psycho-pedagogical well-being of students, as evidenced by the improvement of scores related to self-esteem and reduction of emotional symptoms. These results are consistent with previous studies that highlight the importance of physical activity in promoting mental health in young people (García-Hermoso et al., 2022).

Finally, qualitative feedback provided a valuable complement to the quantitative data, highlighting how the integrated approach of the project had a positive impact not only on individuals but also on group dynamics and the overall school environment.

DISCUSSION

The project results show that the integration of educational, motor and psychological components is an effective model for addressing eating disorders in adolescents. This approach is particularly relevant because it allows for multilevel intervention, addressing both individual factors (e.g. food awareness and self-

perception) and social and environmental factors (e.g. group dynamics and family support). Recent literature supports this direction, with studies such as García-Hermoso et al. (2022) and Tylka et al. (2019) showing that integrated school programmes can lead to lasting improvements in adolescents' mental and physical health. For example, nutrition education not only improved students' knowledge, but also positively influenced their self-esteem, especially thanks to the emotional support provided during mindfulness sessions. Similarly, physical activity not only improved physical fitness, but also fostered a sense of belonging and reduced stress.

One aspect that emerged during the project was the importance of tailoring activities to the specific needs of participants. Adolescents are a heterogeneous group with significant differences in motivation, food preferences and levels of physical activity. Personalised interventions, such as the use of individualised questionnaires and participation cards, proved essential to maximise the impact of the project. For example, some participants reported that being able to choose between different physical activities increased their engagement. This suggests that future interventions could benefit from greater flexibility in design, for example including options for creative or artistic activities that might attract students less inclined to traditional exercise.

The results clearly show that improved self-esteem and body image had a significant impact on the students' overall wellbeing. What is particularly interesting, however, is the cascading effect of these changes: improved self-perception has had a positive impact on interpersonal relationships, strengthening group dynamics and reducing class conflicts. The project has also helped to create a sense of community among students, teachers and families. This social element is crucial as DCAs are often associated with isolation and relationship difficulties. As highlighted by Tylka et al. (2019), family involvement is a key factor in the success of preventive interventions. In this project, constant dialogue with parents and sharing students' progress reinforced the positive impact and created a supportive environment both inside and outside of school.

Despite the positive results, it is important to recognise some of the limitations of the project. For example, the relatively short duration of the intervention does not allow for a full assessment of the long-term impact on students' eating habits and psycho-pedagogical well-being. Another challenge is the commitment required from teachers and school staff, who need to be properly trained to integrate complex activities such as mindfulness or nutrition education workshops into the school curriculum. This highlights the need to invest in staff training and the development of accessible teaching materials.

To broaden the impact of similar programmes, it is important to develop models that are easily scalable and adaptable to different contexts. This could include the use of digital technologies, such as apps to monitor eating habits and physical activity, or online platforms for emotional support and mindfulness. In addition, collaboration with health institutions and local communities could strengthen the sustainability of interventions by ensuring adequate resources and continuity over time. Another interesting direction is research into the impact of digital culture and social media on adolescent eating behaviour. Recent studies, such as Tiggemann and Slater (2014), show that media exposure can significantly influence body perceptions and eating habits. Future interventions could include educational sessions to promote critical and conscious use of social media, helping adolescents to develop greater resilience to harmful messages about beauty and nutrition.

Finally, the project highlighted the importance of a systemic approach, involving not only students and teachers, but also families, health professionals and school policy makers. The implementation of school

policies that promote healthy lifestyles, such as the introduction of healthy food options in school canteens or the promotion of active breaks during the day, could enhance the impact of preventive interventions.

CONCLUSION

The project described provided a detailed and multidimensional view of the effectiveness of an integrated approach to the prevention and management of eating disorders in adolescents. The results not only confirm the validity of the strategies adopted but also highlight important considerations about the role of schools, families and communities in promoting the mental and physical well-being of young people.

A key message from this project is the importance of early intervention. Adolescence is a particularly sensitive period when behaviours and habits develop that can affect long-term health. Previous studies, such as those by Ricciardelli and McCabe (2020) and Rohde et al. (2021), have shown that intervention at this stage of life is particularly effective in preventing the onset of DCA and other related problems, such as overweight or obesity.

Our project has shown that a combination of nutrition education, physical activity and psychoeducational support can significantly change eating habits, improve self-perception and reduce risk factors associated with DCA. This suggests that investing in prevention programmes in schools could be a long-term strategy to reduce the health and social burden associated with these problems.

The potential replicability of the project is a key aspect of the project. The methods used, such as the use of the KIDMED test, guided motor activities and mindfulness sessions, have been designed to be easily implemented in different school settings. However, to ensure success, it is essential to take into account the cultural, economic and social specificities of each context.

For example, schools in low-income or resource-poor areas may need to make changes to adapt the project to the resources available. In these cases, one possible approach could be to work with NGOs or local authorities to provide additional support. In addition, the integration of digital technologies is an interesting prospect for further widening the scope of interventions. Educational apps, online platforms for monitoring dietary habits and physical activity, or gamification tools could increase student engagement and encourage greater adherence to the programme.

Another important finding is the confirmation of the value of a holistic approach to adolescent wellbeing. We have not only considered the nutritional or physical aspects but have also given ample space to emotional support and building positive relationships between students, teachers and families. This approach was crucial to the success of the project, as evidenced by significant improvements in students' self-confidence and psycho-educational well-being.

The mind-body connection, often overlooked in more traditional interventions, has proved crucial. Mindfulness, in particular, has played a key role in promoting greater awareness of food choices and better control of emotions. As Giordano et al. (2022) point out, these practices not only improve psychological well-being, but can also have a positive impact on eating behaviour and interpersonal relationships.

Despite the positive results, the project highlighted some challenges that deserve attention. One of the main difficulties was to ensure the active participation of all students, especially those with lower initial motivation. This underlines the importance of personalised approaches that take into account the different needs and

preferences of students. Another challenge is the long-term sustainability of the interventions. For a project such as this to have a lasting impact, it is essential that it is integrated into school policy and supported by adequate resources. This requires a joint commitment from schools, health authorities and local communities.

The results of the project open up a number of research questions that could be explored in future studies. For example: What are the long-term effects of similar interventions on adolescents' lifestyles and health? How do cultural differences affect the effectiveness of DCA prevention programmes? What factors determine the sustainability and scalability of these interventions? In addition, future research could focus on using new technologies, such as artificial intelligence, to further personalise interventions and monitor students' progress in real time.

Finally, the success of this project highlights the need for greater political and social commitment to addressing DCAs and promoting healthy lifestyles. School policies that promote nutrition education, regular physical activity and psychological support should not be seen as a luxury, but as an essential part of education.

Promoting a school environment that supports students' well-being not only improves their health but can also have a positive impact on their academic performance, social relationships and future active participation in society.

In conclusion, the project represents a promising model for addressing adolescent BDA through a multidimensional and integrated approach. While acknowledging the challenges and limitations, the results highlight the importance of investing in early prevention and adopting innovative and holistic strategies to promote adolescents' mental and physical well-being. Only through collective commitment and coordinated action can we hope to build a healthier, more aware and resilient generation.

AUTHOR CONTRIBUTIONS

The authors actively collaborated in the realisation of the study and the drafting of the manuscript, contributing at different stages of the research. Specifically: Gianluca Gravino oversaw the general coordination of the study, methodological design and data collection, as well as supervising the analysis phase; Fabiola Palmiero contributed to the literature review, the design of the educational activities and the drafting of the sections on nutrition and psychological support; Davide Di Palma participated in the implementation of the physical activity programme, the collection of data on students' motor participation and the evaluation of the impact on physical performance; Francesco Tafuri provided support in data analysis, discussion of results and final revision of the manuscript. All authors have read and approved the final version of the article and declare that they have no conflicts of interest.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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