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RESEARCH ARTICLE



The impact of perceived stress on adherence to the Mediterranean diet, eating behaviour and quality of life in a group of Italian adolescents

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ABSTRACT

This cross-sectional study assessed perceived stress levels in a group of Italian adolescents and examined potential relationships with diet quality, eating behaviours and health-related quality of life (HR-QoL). A total of 1627 adolescents (52% male, median age 16 years) completed a survey including the Perceived Stress Scale (PSS-10), the KIDMED for Mediterranean diet (MD) adherence, the KIDSCREEN-10 for HR-QoL, and the Dutch Eating Behaviour Questionnaire for Children. Only 16.5% reported low stress levels, while 21.8% exhibited high perceived stress. Perceived stress was inversely associated with MD adherence ($\beta = -0.06$; $p < 0.0001$) and HR-QoL ($\beta = -0.45$; $p < 0.0001$), and positively associated with dysregulated eating behaviours, including emotional eating ($\beta = 0.02$; p value < 0.0001), external eating ($\beta = 0.01$; $p < 0.0001$) and restrained eating ($\beta = 0.01$; $p < 0.0001$). These results reinforce the importance of adolescent mental health and the need for strategies aimed at reducing stress and promoting balanced dietary patterns as MD.

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Introduction

Adolescence is a critical period characterised by rapid physical, psychological and social changes, in which essential skills for developing a healthy lifestyle and individual well-being are consolidated (Hargreaves et al. 2022). Multiple factors influence youth well-being, including parental socioeconomic status, family dynamics, peer relationships and school-based educational programs (Tabrizi et al. 2024; Silva et al. 2025). Emerging evidence identifies perceived stress as a key factor affecting adolescents' well-being, underscoring the need to better understand and support mental health in this population (Grasaas et al. 2022).

Mediterranean diet (MD), characterised by high consumption of fruits, vegetables, whole grains, legumes

and olive oil, has been widely associated with numerous health benefits (Dinu et al. 2018). Nevertheless, recent evidence indicates a progressive decline in adherence to traditional dietary patterns across Mediterranean countries. In Italy, although adherence remains moderate, it appears to have further decreased in recent years, partly due to increased consumption of animal-based foods (Damigou et al. 2023; Lotti et al. 2024). This trend seems to be influenced by multiple factors, including economic, social and environmental determinants, as well as lifestyle changes, with growing attention to the potential role of mental health in shaping food choices and overall dietary quality (Godos 2023). Several studies have demonstrated that MD adherence is linked to better mental health outcomes, including reductions

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in symptoms of depression, anxiety and stress (Quarta et al. 2023; Jiménez-López et al. 2024; Dakanalis et al. 2025). Conversely, higher levels of perceived stress are often associated with poorer diet quality and a greater reliance on Westernised eating behaviours, such as increased consumption of fast food (De Vriendt et al. 2012; Chowdhury et al. 2025). Stress has also been identified as a key factor influencing eating behaviours, shaping how individuals relate to food and contributing to an increased prevalence of emotional eating, restrained eating and external eating (Hou et al. 2013; Shah et al. 2023). These behaviours can have long-lasting effects on both physical health and mental well-being. However, the factors moderating the stress-eating relationship can vary, and further research is needed to distinguish between the effects of healthy versus unhealthy eating (Hill et al. 2022; Sifre et al. 2024).

The impact of stress extends beyond eating behaviours, affecting broader dimensions of quality of life. According to the World Health Organization (WHO), quality of life encompasses individuals' perception of life position within the context of cultural values, personal goals and expectations (WHO 2012). High perceived stress has been associated with diminished quality of life, including lower life satisfaction, impaired mental health and strained social relationships (Mikkelsen et al. 2020; Grasaas et al. 2022; Yoon et al. 2023).

Despite the growing interest of the scientific community in understanding how young people's mental health influences their overall well-being and lifestyle, the literature remains limited and often inconsistent, especially in the adolescent population. Therefore, the aim of this study was to assess perceived stress levels in a group of Italian adolescents and to investigate their potential impact on lifestyle, with particular attention to diet quality, eating behaviours and quality of life.

Materials and methods

Study design and participants

This cross-sectional study investigated the association between perceived stress, dietary habits, eating behaviour and health-related quality of life (HR-QoL) among Italian adolescents. A total of 500 participants were initially targeted for recruitment, in line with evidence from the existing literature and according to the following inclusion criteria: age 14–17 years old, willingness to spend approximately 20–25 min completing the survey, and consent to share lifestyle-related information. The study was carried

out in accordance with the principles of the Declaration of Helsinki and received approval from the Ethics Committee of the University of Florence, Florence, Italy (No. 339/2024, protocol 0161824).

Data collection procedure

Data were collected via a self-administered online questionnaire created using SurveyMonkey®. Approval for recruitment was first obtained from schools and sports associations nationwide. After institutional approval, researchers established contact with teachers and sports trainers, who subsequently shared the survey link with the adolescents. Data collection was conducted between June 2024 and May 2025. Participation was voluntary and anonymous. Upon accessing the questionnaire, participants first viewed an information sheet describing the study objectives. Consent was implied through the voluntary completion of the survey.

Sociodemographic characteristics, anthropometric parameters and physical activity

The first section of the questionnaire collected socio-demographic information, including age, sex, and place of residence. Based on their municipality of residence, adolescents were categorised by geographical area (North, Centre, or South and Islands) and degree of urbanisation (large cities, small towns or rural areas), in accordance with the Statistical Classifications and Municipal Size guidelines provided by the Italian National Institute of Statistics (ISTAT 2025). Participants were also asked for their anthropometric data (weight and height), which were used to calculate body mass index (BMI).

Physical activity was self-reported by using the short form of the International Physical Activity Questionnaire (IPAQ) questionnaire (Craig et al. 2003). The following information was included: the time spent sitting, walking and engaging in moderate and/or vigorous physical activity in the last seven days. Physical activity levels were classified using the IPAQ system score: low (<600 MET-min/week), moderate (600–2999 MET-min/week) and high (≥3000 MET-min/week) (IPAQ Research Committee 2025).

Perceived stress

The 10-item version of the Perceived Stress Scale (PSS-10) was used to appraise the level of stress perceived by adolescents in response to life events (Cohen

et al. 1983). The PSS-10 consists of 10 items questioning the frequency of stressful feelings and thoughts over the last month, which are rated on a five-point Likert scale, ranging from 0 (never) to 4 (very often). Scores range from 0 to 40, with higher scores indicating greater perceived stress. Scores between 0 and 13 were categorised as low levels of perceived stress, those between 14 and 26 as moderate levels, and those between 27 and 40 as high levels (Cohen S and Williamson 1988; NH Department of Administrative Services 2020).

Adherence to Mediterranean diet

Adherence to MD was assessed using the MD Quality Index for Children and Adolescents (KIDMED), a validated 16-item tool consisting of dichotomous (yes/no) items that evaluate dietary habits in children and adolescents (Serra-Majem et al. 2004). Of these, 12 items reflect positive adherence to the MD, including regular consumption of fruits, vegetables, legumes, cereals, fish and olive oil, while the remaining four items represent negative dietary behaviours, such as skipping breakfast, frequent consumption of pastries or sweets, and eating at fast-food restaurants. Items positively associated with the MD scored +1, while those reflecting a negative association scored −1. The overall KIDMED score was calculated as the sum of all responses, ranging from 0 to 12. Based on the total score, adherence was categorised as follows: optimal adherence (≥ 8), intermediate adherence (4–7) and poor adherence (≤ 3).

Eating behaviour

Eating behaviour was assessed using the Dutch Eating Behavior Questionnaire (DEBQ) for children (van Strien and Oosterveld 2008), which measures emotional eating (seven items), external eating (six items) and restrained eating (seven items). Participants reported the frequency of episodes based on emotions, external food cues (e.g. sight, smell, or taste of food), and attempts to restrict intake, regardless of hunger or satiety. Responses were rated on a three-point Likert: 1 = no, 2 = sometimes and 3 = yes. Subscale scores were calculated by dividing the sum of item scores by the total number of items in the subscale, with higher scores indicating a stronger tendency towards that eating behaviour.

Health-related quality of life

The KIDSCREEN-10 index, a short version of the KIDSCREEN questionnaire, was used to assess the HR-QoL (Ravens-Sieberer et al. 2010). It comprises

10 items covering: (1) physical and (2) psychological well-being, (3) mood/emotions, (4) self-perception, (5) autonomy, (6) home life, (7) parent relations, (8) peers/social, (9) school environment and (10) concentration/learning. Items were rated on a five-point Likert scale ranging from 0 (not at all) to 5 (always). Total score ranges between 10 and 50, with higher scores indicating better HR-QoL.

Statistical analysis

Descriptive statistics were computed for all study variables. Continuous variables were reported as medians and interquartile ranges (IQRs), while categorical variables were reported as absolute and relative frequencies (percentages). The association between each outcome and PSS-10 was examined using multiple linear regression models, adjusting for urbanisation level, sex, age, BMI, geographical area and physical activity (IPAQ METs). For eating behaviour (three subdomains: restrained, emotional and external eating), a multivariate analysis of variance (MANOVA) was performed using the same set of covariates. Estimated marginal means (EMMs) for each outcome were calculated with PSS-10 as the main predictor, adjusting for the same covariates included in the regression and MANOVA models. Statistical significance was set at p values < 0.05 . Analyses were conducted using R software (version 4.5.1) (R Foundation for Statistical Computing, Vienna, Austria).

Results

Characteristics of the participants

The characteristics of the participants are summarised in Table 1. A total of 1627 adolescents were included, with a median age of 16 years (IQR 15–16); 52% were male and 48% female. Most participants resided in Northern Italy (64.7%), followed by Central Italy (25.4%) and Southern Italy, including the Islands (9.9%). Approximately, 40% lived in small towns or cities, while the rest of the participants were evenly split between large cities and rural areas. The median BMI was 21 kg/m² (IQR 19.2–23.4), falling within the normal weight range. Overall, adolescents were sufficiently active (IPAQ median 2400 MET-min/week), with 47.5% classified as highly active.

Perceived stress levels were moderate (PSS-10 median score of 20; IQR 16–22), with girls reporting higher levels 24 (IQR 19–29) than boys 18 (IQR 14–22). High perceived stress was observed in 21.8% of participants, whereas only 16.5% had low stress levels. The median KIDMED score was 5 (IQR 3–7),

Table 1. Descriptive characteristics of participants stratified by sex.

	All ^a (n = 1627)	Male ^a (n = 848)	Female ^a (n = 779)
Age (years)	16.0 (15.0–16.0)	16.0 (15.0–16.0)	16.0 (15.0–17.0)
Geographical area			
Northern Italy (n (%))	1053 (64.7)	579 (68.3)	474 (60.8)
Central Italy (n (%))	413 (25.4)	208 (24.5)	205 (26.3)
Southern Italy and Islands (n (%))	161 (9.9)	61 (7.2)	100 (12.8)
Urbanisation level			
Large cities (n (%))	457 (29.2)	225 (26.5)	250 (32.1)
Towns or small cities (n (%))	659 (40.5)	366 (43.2)	293 (37.6)
Rural areas (n (%))	493 (30.3)	257 (30.3)	236 (30.3)
BMI (kg/m ²)	21.0 (19.2–23.4)	21.3 (19.5–23.9)	20.7 (18.9–22.9)
IPAQ (score)	2400.0 (1080.0–4020.0)	2966.3 (1590.0–4537.5)	1800.0 (820.0–3180.0)
Level physical activity			
Low (n (%))	259 (15.9)	95 (11.2)	164 (21.1)
Moderate (n (%))	595 (36.6)	261 (30.8)	334 (42.9)
High (n (%))	773 (47.5)	492 (50.8)	281 (36.1)
PSS-10 (score)	20.0 (16.0–26.0)	18.0 (14.0–22.0)	24.0 (19.0–29.0)
Perceived stress levels			
Low (n (%))	268 (16.5)	205 (24.2)	63 (8.1)
Moderate (n (%))	1004 (61.7)	566 (66.7)	438 (56.2)
High (n (%))	355 (21.8)	77 (9.1)	278 (35.7)
KIDMED (score)	5.0 (3.0–7.0)	5.0 (3.0–7.0)	5.0 (3.0–6.0)
MD adherence			
Low (n (%))	489 (30.1)	213 (25.1)	276 (35.4)
Medium (n (%))	828 (51.8)	452 (53.3)	390 (50.1)
High (n (%))	296 (18.2)	183 (21.6)	113 (14.5)
DEBQ			
Restrained eating (score)	1.00 (0.57–1.43)	0.86 (0.43–1.14)	1.14 (0.71–1.57)
Emotional eating (score)	0.29 (0.0–0.86)	0.14 (0.00–0.71)	0.43 (0.14–1.0)
External eating (score)	1.00 (0.67–1.33)	1.0 (0.67–1.33)	1.67 (0.67–1.5)
KIDSCREEN-10 (score)	33.0 (28.0–38.0)	35.0 (30.0–39.0)	32.0 (27.0–37.0)

BMI: body mass index; DEBQ: Dutch Eating Behaviour Questionnaire; IPAQ: International Physical Activity Questionnaire; KIDMED: Quality Index for Children and Adolescents; KIDSCREEN-10: abridged version of the KINDSCREEN questionnaire; MD: Mediterranean diet; PSS-10: Perceived Stress Scale.

^aData are expressed as medians with interquartile ranges (IQRs) or number and percentage (%), as appropriate.

indicating moderate MD adherence. Regarding eating behaviours, both restrained eating (1.0; IQR 0.57–1.42) and external eating (1.0; IQR 0.67–1.33) obtained the highest median score. Finally, the median KIDSCREEN score for HR-QoL was 33.0 (IQR 28.0–38.9).

Perceived stress and adherence to MD

Figure 1 illustrates the EMMs of the KIDMED score across levels of PSS-10, adjusted for urbanisation level, sex, age, BMI, geographical area and physical activity. The plot shows a clear negative trend: as perceived stress increased, average adherence to MD decreased. This visual pattern is consistent with the results of the regression model, where perceived stress was significantly associated with lower KIDMED scores ($\beta = -0.06$; 95% CI -0.07 to -0.04 ; p value < 0.0001). Additionally, higher levels of physical activity were linked to greater adherence to the MD (see Supplementary Table S1).

Perceived stress and eating behaviour

The multivariate model indicated that all covariates collectively contributed to explaining eating behaviour

(see Supplementary Table S1). When examining the subscales individually and adjusting for all model confounders, the PSS-10 showed a positive association with each dimension of eating behaviour. Specifically, higher perceived stress was associated with a greater tendency towards overeating in response to emotions ($\beta = 0.02$; 95% CI: 0.02–0.03; p value < 0.0001), external eating in response to food cues ($\beta = 0.01$; 95% CI: 0.01–0.01; p value < 0.0001) and attempts to refrain from eating ($\beta = 0.01$; 95% CI: 0.01–0.01; p value < 0.0001). These associations are visually reflected in the EMMs trends shown in Figure 2.

Perceived stress and HR-QoL

Figure 3 shows the EMMs of the KIDSCREEN-10 score in relation to the PSS-10 score, adjusted for all covariates. Consistently, higher levels of perceived stress were associated with a lower average of HR-QoL, confirming the results of the regression model, where perceived stress was significantly associated with lower KIDSCREEN-10 scores ($\beta = -0.45$; 95% CI -0.49 to -0.41 ; p value < 0.0001). Supplementary Table S1 further indicates that adolescents living in large cities reported higher HR-QoL compared to those residing

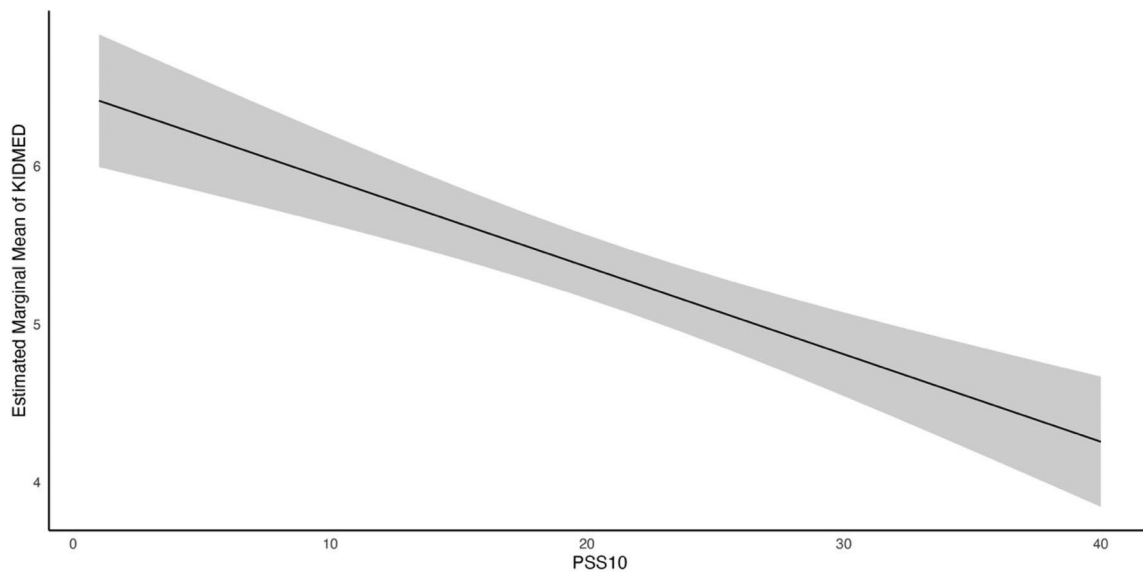


Figure 1. EMMs of KIDMED score across levels of PSS-10. EMMs are adjusted for urbanisation, sex, age, BMI, geographical area and physical activity. The plot shows a negative association between perceived stress and adherence to the Mediterranean diet, with lower KIDMED scores observed at higher levels of stress. BMI: body mass index; EMMs: estimated marginal means; KIDMED: Mediterranean Diet Quality Index for Children and Adolescents; PSS-10: Perceived Stress Scale.

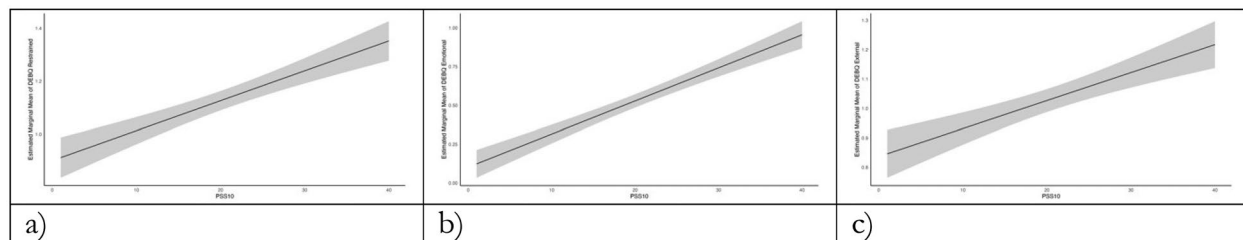


Figure 2. EMMs of DEBQ subscale scores (a) restrained, (b) emotional and (c) external eating across levels of PSS-10. EMMs are adjusted for urbanisation, sex, age, BMI, geographical area and physical activity. All three subscales show increasing scores with higher levels of perceived stress, suggesting that stress is broadly associated with more dysregulated eating behaviours. BMI: body mass index; DEBQ: Dutch Eating Behaviour Questionnaire; EMMs: estimated marginal means; PSS-10: Perceived Stress Scale.

in small cities or rural areas. Regional differences also emerged, with higher HR-QoL scores observed in Central, Southern and Island regions compared to Northern Italy. Moreover, physical activity was positively associated with HR-QoL, whereas age showed an inverse relationship: as age increased, HR-QoL decreased.

Discussion

In recent years, increasing attention has been given to the importance of mental health in young people and its impact on overall well-being. In this study, which involved more than 1600 adolescents from across Italy, we investigated how perceived stress may influence lifestyle factors, specifically in terms of diet quality, eating behaviour, and quality of life. Our results suggest that perceived stress exerts a strong

negative impact on adolescents' HR-QoL, a modest but consistent effect on MD adherence, and small yet significant influences on dysfunctional eating behaviours.

Dietary habits during adolescence play a key role in growth, development, and the prevention of future chronic diseases. Several European studies have shown that high levels of stress in young people are associated with a poorer diet quality, characterised by lower adherence to dietary guidelines and less healthy food choices (De Vriendt et al. 2012; Ramón Arbués et al. 2019). Consistent with this evidence, we observed that higher stress levels were associated with lower adherence to the MD. Although the effect size was modest, the narrow confidence interval and strong significance suggest a robust association that, while small at the individual level, may carry meaningful implications at the population level. Similar trends have been

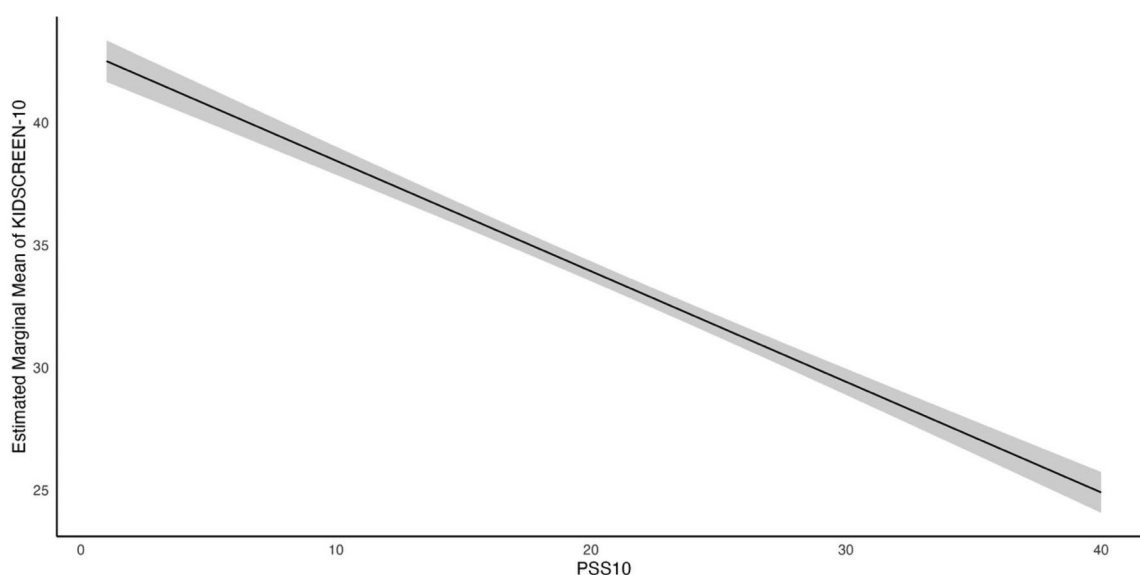


Figure 3. EMMs of KIDSCREEN-10 score across levels of PSS-10. EMMs are adjusted for urbanisation, sex, age, BMI, geographical area and physical activity. A clear inverse relationship, with higher perceived stress associated with lower health-related quality of life. BMI: body mass index; EMMs: estimated marginal means; KIDSCREEN-10: abridged version of the KINDSCREEN questionnaire; PSS-10: Perceived Stress Scale.

reported among university students in Mediterranean countries such as Greece and Lebanon (El Mikkawi et al. 2024; Dakanalis et al. 2025). Chowdhury et al. (2025) further support these findings, showing that higher stress is linked to reduced consumption of typical MD components such as whole grains, fish, fruit, vegetables and legumes, while simultaneously increasing reliance on Western dietary elements, particularly fast food. However, the literature is not entirely consistent. For example, Jiménez-López et al. (2024) found no significant association between perceived stress and adherence to the MD in adolescents, though they did report that greater adherence was linked to fewer depressive symptoms, suggesting mental health benefits related to this dietary pattern.

Adolescence is also a formative stage for eating behaviours, patterns that reflect how individuals relate to food (Das et al. 2017). These behaviours are shaped by individual, social and environmental influences, including taste preferences, family habits, peer influence and technology use. Mental health factors, including stress, also play a significant role (Vidal et al. 2024). It is scientifically recognised that stress can act through two main mechanisms: a direct, biological mechanism involving neuroendocrine and autonomic processes, and an indirect, behavioural mechanism that influences health-related habits (O'Connor et al. 2021). Our findings show that higher perceived stress was associated with all three dysfunctional eating behaviours measured, specifically emotional eating, restrained eating and external eating,

consistent with two observational studies conducted on adolescents in Malaysia (Shah et al. 2023) and China (Hou et al. 2013). The latter also identified a positive association between depressive and anxiety symptoms and each of these behaviours. Stress-related changes in food intake are well documented, though directionality varies between individuals (O'Connor et al. 2021). The link between stress and external eating (i.e. eating in response to sensory cues like the sight or smell of food, regardless of physiological hunger) remains less explored. Evidence from a sample of U.S. university students suggests stress may heighten sensitivity to such cues. For example, stressed students were more likely to purchase food after being exposed to appealing smells or visual stimuli (Okumus and Ozturk 2020). However, further investigation is needed to better understand the mechanisms and various factors involved in the relationship between mental health and eating behaviour.

The strongest association in our study was between stress and HR-QoL, analysed using the KIDSCREEN questionnaire, a validated tool that investigates subjective health and the psychological, mental and social well-being of children and adolescents (Ravens-Sieberer et al. 2010). This aligns with Grasaas et al. (2022), who found that stress was negatively correlated with multiple well-being domains, including physical and psychological well-being, autonomy, family relationships, peer support and the school environment in a sample of Norwegian adolescents. Comparable findings have been reported among European university

students, including those in Italy (Cena et al. 2021), underscoring the vulnerability of young people's quality of life to stress.

We also observed variations in HR-QoL according to demographic and lifestyle factors. In particular, perceived quality of life tended to decrease with age, in line with a longitudinal study on children aged 11–14, which found a significant decline in subjective well-being over time (Yoon et al. 2023). Regional and urbanisation patterns were also evident: adolescents from Central-Southern Italy and large cities reported higher well-being than their peers from the North or rural/small town areas. The Italian Health Behaviour in School-Aged Children (HBSC) study similarly found higher life satisfaction in Southern regions, particularly among males, though it also noted more psychosomatic health complaints in these areas (Bersia et al. 2022). As for the level of urbanisation, this may be explained by the fact that cities may offer more opportunities for socialisation and community engagement, which can enhance perceived well-being (Collins et al. 2024). A higher perception of quality of life among adolescents was also positively associated with levels of physical activity. This finding is consistent with existing literature, which shows that higher levels of physical activity in children and adolescents are linked not only to better well-being, but also to a reduction in mental health issues such as stress and depression (Rodriguez-Ayllon et al. 2019).

Therefore, promoting healthy lifestyles during adolescence is essential, as interventions at this developmental stage are more likely to produce sustained behavioural changes over time (UNICEF 2020). Across Mediterranean countries, several initiatives have been developed to increase adherence to the MD and promote healthier lifestyles (Degli Innocenti et al. 2024). For instance, the DELICIOUS project aims to improve dietary adherence through school-based interventions, combined with physical activity programs and digital tools targeting school canteens and families (DELICIOUS Project 2024; Grosso et al. 2024). Similarly, projects such as PROMEDLIFE and SWITCHtoHEALTHY focus on improving knowledge and promoting sustainable healthy eating habits among young populations in both home and school settings (PROMEDLIFE Project 2024; SWITCHtoHEALTHY Project 2024). Such initiatives represent important and promising approaches to promote healthy lifestyles among adolescents, addressing multiple determinants of diet and well-being through integrated and context-specific approaches. Evaluating their impact over time will be of considerable interest, particularly

in understanding their potential effects on both dietary patterns and mental health outcomes. At the same time, future efforts should ensure that these interventions are not implemented in isolation but are integrated within broader strategies that explicitly address the interplay between mental health and diet quality, including the incorporation of stress management and resilience-building components.

This study presents several strengths. The large and diverse sample included adolescents from different areas of Italy, taking into account variables such as geographic origin and level of urbanisation. These factors, known to be associated with differences in lifestyle and dietary habits, were considered in the analyses, adding validity to the results. Moreover, the large sample size enhances the generalisability of the study findings to the wider adolescent population. Furthermore, data collection was conducted using scientifically validated questionnaires, which ensure a good level of reliability in measuring the investigated variables. Nonetheless, some limitations should be considered. First, the self-administered questionnaires allowed broad and efficient recruitment, but may have introduced recall bias or socially desirable responding. Anthropometric measures were also self-reported, which could affect accuracy; however, these were not primary outcomes. Finally, the cross-sectional design limits causal inference, restricting the interpretation to associations rather than causality.

Conclusions

In conclusion, this study reinforces the central role of mental health in shaping adolescents' lifestyle and well-being. Higher levels of perceived stress were associated with lower adherence to the MD, a dietary pattern widely recognised for its beneficial effects on both current health and the prevention of chronic diseases. Stress was also linked to greater engagement in dysfunctional eating behaviours, pointing to its connection with maladaptive food-related patterns. Most notably, higher stress was consistently associated with lower HR-QoL, underscoring its broad and detrimental influence on adolescent well-being. Taken together, these findings underscore the need for integrated public health strategies that address stress management while, simultaneously, promote balanced dietary patterns such as the MD. Approaches that combine mental health promotion with lifestyle support may offer the greatest potential to enhance both current well-being and long-term health in young people.

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Permission to use the DEBQ for children was obtained from the copyright holder, and the corresponding licensing fee was paid prior to data collection.

Author contributions

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Data availability statement

Additional data are available from the corresponding author on reasonable request.

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