British Food Journal

Exploring health, environmental, and psychological drivers of Mediterranean diet adherence: evidence from Italy

Francesco Bimbo
Dipartimento di Scienze Agrarie, Alimenti, Risorse Naturali e Ingegneria (DAFNE), Universita degli Studi di Foggia, Foggia, Italy
Giulia Tiboldo and Veronica Vitali
Dipartimento di Economia Agro-alimentare, Università Cattolica del Sacro Cuore – Campus di Piacenza e Cremona, Piacenza, Italy
Valentina Carfora
Dipartimento di Psicologia, Università Cattolica del Sacro Cuore, Milan, Italy
Daniele Moro
Dipartimento di Scienze Economiche e Sociali (DISES), Università Cattolica del Sacro Cuore, Milan, Italy, and
Elena Castellari
Dipartimento di Economia Agro-alimentare, Università Cattolica del Sacro Cuore – Campus di Piacenza e Cremona, Piacenza, Italy

Received 12 January 2025
Revised 4 August 2025
18 October 2025
Accepted 22 November 2025

Abstract

Purpose – This study examines adherence to the Mediterranean diet (MD) among Italian adults, identifying meaningful determinants, including socioeconomic factors, health and sustainability-related practices, environmental concerns, and psychological well-being.

Design/methodology/approach – Data consist of 103,447 adult individual-level observations from the Multipurpose Household Survey (MHS) collected by the Italian National Institute of Statistics (ISTAT) from a representative sample of Italian households during years 2019–2021. Adherence is measured through three indexes: the Mediterranean Diet Score (MDS), the Mediterranean Diet Serving Score (MDSS), and the Mediterranean Diet Composite Score (MDCS). Ordered logit models have been used to assess the impact of individual, household, and health behaviors.

Findings – The cross-sectional analysis reveals that higher MD adherence is positively associated with older age, female gender, higher education, and elevated socioeconomic status. Individuals engaged in health-promoting behaviors, such as regular physical activity and non-smoking, and those with greater environmental awareness and pro-environmental behaviors are more likely to follow the MD. Psychological well-being plays a relevant

Funding: This work was partially supported by Fondazione Cariplo under the FUN-VEGETABLES grant (Grant No. 2022-4653). Additional funding was provided by the LO-VEg project, supported by the Italian Ministry of University and Research (MUR) under the PRIN 2020 programme. The study was also supported by the PhD programme in Agro-Food Systems (AgriSystem) at the Università Cattolica del Sacro Cuore (Italy) and by the Portus Project, funded by the Romeo and Enrica Invernizzi Foundation.

Francesco Bimbo and Giulia Tiboldo contributed equally to this work as shared first authors.

British Food Journal
Emerald Publishing Limited
e-ISSN: 1758-4108
p-ISSN: 0007-070X
DOI 10.1108/BFJ-01-2025-0046

role, as lower levels of psychological distress correspond with higher MD adherence. Household characteristics, including marital status and the presence of preschool children, also play a role in adherence patterns.
Research limitations/implications – These findings underline the importance of integrating health behaviors, environmental sustainability, and psychological well-being into public health strategies to promote the MD.
Practical implications – Results emerging from this research can assist policymakers to encourage a diet that supports both human and environmental health, in line with the Farm to Fork strategy's objectives and the promotion of sustainable, healthy food systems.
Originality/value – This study offers a novel, integrative analysis of MD adherence by jointly examining psychological well-being, pro-environmental behaviors, and socio-economic characteristics within a single empirical model. Using a nationally representative sample of over 100,000 Italian adults (2019–2021), it captures subclinical psychological distress in a non-clinical population, extending beyond traditional socio-demographic analyses. The study is also the first to simultaneously explore psychological and environmental factors during the COVID-19 period and to compare three widely used MD adherence indices (MDS, MDSS, MDCS), demonstrating how index choice affects prevalence estimates and associations, thus providing key methodological insights for research and policy.

Keywords Mediterranean diet, Food consumption, Psychological well-being, Farm to fork
Paper type Research article

Introduction

In 2022, 2.5 billion adults were overweight, 890 million of whom lived with obesity. This means that in that year, an alarming number of one in eight people in the world lived with obesity (WHO, 2023). Chronic diseases associated with eating habits, such as heart disease, stroke, type 2 diabetes, and certain cancers, represent a significant global health concern. Indeed, 70–80% of healthcare costs are spent on chronic diseases in Europe, where the direct costs of healthcare to treat people with chronic diseases amount to €700 billion (European Commission, 2016). Worldwide, the estimated cost of chronic disease is expected to reach $47 trillion by 2030 (Hacker, 2024). Research has consistently linked excessive consumption of foods rich in saturated and trans fats, refined carbohydrates, and added sugars with a higher prevalence of these chronic diseases in the general population. Fortunately, these diet-related diseases are largely preventable. In this context, the European Commission's Farm to Fork (F2F) strategy prioritizes the promotion of healthy and sustainable food choices across the EU (European Commission, 2020). Consumption of a balanced diet rich in fruits, vegetables, and whole grains provides essential nutrients while limiting unhealthy fats and added sugars. Maintaining a physically active lifestyle further complements dietary modifications, promoting weight management and improving metabolic health. For instance, the Mediterranean diet (MD) promotes consumption of minimally processed foods, healthy fats, and plant-based ingredients that help prevent chronic diseases, facilitating heart health, reducing inflammation, and supporting longevity.

The concept of MD has been discussed in academic literature for several decades. Among early authors contributing to the MD definition were Keys and Aravanis (1980). The MD includes foods low in saturated fat and high in vegetable oils, and has been especially observed in Greece and Southern Italy during the 1960s (Keys and Aravanis, 1980). Nevertheless, to the present day, research on the topic has evolved resulting in the difficulty of providing a univocal definition of MD. The MD is not a rigid set of rules but rather a flexible and balanced approach to eating reflecting cultural and culinary practices of the Mediterranean region (Giacco and Riccardi, 1991). Its main features are: (1) high consumption of fruits and vegetables (Trichopoulou *et al*., 2003), (2) emphasis on whole grains and legumes (Sofi *et al*., 2008), (3) high consumption of olive oil (Martínez-González *et al*., 2004) (4) moderate consumption of fish and poultry (De Lorgeril *et al*., 1999), (5) low to moderate consumption of dairy products (Trichopoulou *et al*., 2007), (6) moderate consumption of red wine (Estruch, 2010), (7) regular physical activity (Sofi *et al*., 2008) and (8) moderate consumption of red meat (Micha *et al*., 2017). Numerous studies have documented the extensive health benefits of the MD. A recent network meta-analysis comparing the efficacy of different dietary patterns for glycemic control in individuals with type 2 diabetes identified the MD as the most effective overall intervention for improving glycemic outcomes (Surface Under the Cumulative Ranking

Curve, SUCRA ≈ 88%). However, other diets, such as low-carbohydrate diets, showed slightly greater effectiveness in reducing anthropometric measures such as body weight and waist circumference (Zhu *et al*., 2024).

Beyond its metabolic effects, the MD has also been associated with better mental health outcomes. High adherence is linked to a lower prevalence of depression and anxiety symptoms, potentially due to the anti-inflammatory and neuroprotective properties of its nutrients (Sánchez-Villegas *et al*., 2009; Estruch, 2010; Jacka *et al*., 2017; Rajizadeh *et al*., 2017; Sadeghi *et al*., 2021). Recent evidence reinforces these associations: Houminer-Klepar and Dopelt (2025), in a cross-sectional study of Israeli adults, found that higher adherence was associated with significantly lower anxiety ($\beta = -0.146$, $p = 0.022$) and depression scores, even after adjusting for demographic and health-related covariates. Similarly, a systematic review by Liu *et al*. (2023) synthesized data from diverse populations, including non-Western cohorts, and confirmed a consistent inverse association between MD adherence and depressive symptoms across age groups and settings.

Adherence to the MD has also been linked to broader aspects of well-being across the life course. Beyond reducing mental health risks, evidence indicates that adherence to the MD is associated with healthier aging and improved quality of life (Godos *et al*., 2025), greater longevity (Trichopoulou *et al*., 2003), and a lower risk of cognitive decline (Godos *et al*., 2023).

Nevertheless, while the MD is widely promoted for its health benefits, certain controversies remain, particularly concerning alcohol consumption. Red wine has traditionally been presented as a distinctive element of the MD, often promoted for its polyphenol content and potential cardioprotective effects when consumed in moderation. Yet, growing evidence calls this narrative into question, suggesting that even low levels of alcohol consumption may not confer net health benefits and that the associated risks, particularly increased cancer incidence, may outweigh any potential advantages (Stockwell *et al*., 2016; Rehm *et al*., 2017).

From a public health perspective, this debate carries important implications. Evidence from younger populations indicates that alcohol consumption often coexists with other unhealthy lifestyle habits, as shown in a study of Spanish university students where more than one in four were high-risk drinkers and two-thirds reported low MD adherence (López-Moreno *et al*., 2021). Moreover, clinical trials demonstrate that the benefits of the MD can be achieved without alcohol, with interventions excluding wine still improving liver health markers such as fatty liver index and liver stiffness (Haigh *et al*., 2022). This indicates that the protective effects of the MD can be fully realized through non-alcoholic components of the diet.

In this context, continued emphasis on wine as a "healthy" feature of the MD is problematic for health policy. Alcohol is a Group 1 carcinogen, causally linked to multiple cancers, while other MD staples— fruits, vegetables, grains, and olive oil—provide comparable polyphenols without health risks (Santos-Buelga *et al*., 2021). Current recommendations remain inconsistent, with some observational evidence suggesting benefits from moderate drinking within a Mediterranean pattern, while international agencies such as the IARC recommend abstinence (Barbería-Latasa *et al*., 2022).

In 2010, the MD was acknowledged by UNESCO as an intangible cultural heritage, being considered as "a set of skills, knowledge, practices and traditions ranging from the landscape to the table, including the crops, harvesting, fishing, conservation, processing, preparation and, particularly, consumption of food" (UNESCO, 2010). Nevertheless, adherence to this pattern has declined in recent years (González-Sosa *et al*., 2023), driven by the growing popularity of alternative dietary trends and by shifting consumer preferences (León-Muñoz *et al*., 2012; Sáez-Almendros *et al*., 2013; Capone *et al*., 2014).

From an environmental standpoint, the MD is considered a model of sustainable eating, primarily because it emphasizes plant-based foods over meat consumption (Dernini *et al*., 2017; Sáez-Almendros *et al*., 2013). As a result, it generates lower greenhouse-gas emissions and requires less land, water, and energy than diets with higher proportions of animal products (Donini *et al*., 2016; Poore and Nemecek, 2018; Grosso *et al*., 2020).

Achieving the objectives of the Farm to Fork Strategy for sustainable food consumption requires a deeper understanding of the factors influencing adherence to the MD. This study investigates the main determinants of MD adherence among Italian adults, with particular attention to innovative dimensions such as engagement in health- and sustainability-related practices. These practices mirror a growing public awareness of how food choices affect both personal health and environmental outcomes. Environmental concern, defined as awareness of and responsiveness to ecological issues, also plays a key role in shaping dietary behaviors. Furthermore, a growing body of research points to a bidirectional relationship between diet quality and psychological well-being, with healthier dietary patterns such as the MD contributing to better mental health outcomes (Jacka *et al*., 2017).

By examining the interplay between these factors, namely engagement in health- and sustainability-related practices, environmental concern, and psychological well-being, this study provides evidence to inform policymakers and stakeholders. Understanding how these determinants influence adherence can support the design of targeted interventions to foster MD adoption and align food consumption patterns with the goals of the Farm to Fork Strategy. In doing so, this research contributes to the growing body of literature on sustainable and healthy diets across the EU, offering a model of how individual dietary choices can advance broader societal objectives in environmental sustainability and public health.

In this study, we extend previous research by combining psychological and environmental factors within a single empirical model of MD adherence, and by comparing three widely used adherence indexes in a nationally representative dataset.

Previous studies have explored a range of factors influencing adherence to the MD. Socioeconomic status, including education and income, has been widely reported as a determinant, with higher socioeconomic groups showing greater adherence due to better access to fresh and healthy foods (Bonaccio *et al*., 2017; Grosso *et al*., 2017; Benedetti *et al*., 2018). Age and gender have also been identified as important predictors, with older adults and women generally adhering more closely to the MD pattern (Trichopoulou *et al*., 2003; León-Muñoz *et al*., 2012; Ruggiero *et al*., 2019). Additionally, environmental concerns have been associated with MD adherence, as individuals with greater awareness of sustainability issues are more likely to choose plant-based and environmentally friendly diets (Biasini *et al*., 2021; Cavaliere *et al*., 2018). Finally, psychological well-being has emerged as a relevant factor, with evidence linking MD adherence to lower prevalence of depression and anxiety symptoms (Sánchez-Villegas *et al*., 2009; Jacka *et al*., 2017). However, most of these studies have assessed mental well-being using clinical outcomes or symptom-based measures, overlooking subclinical distress and the broader spectrum of psychological functioning. Moreover, they have often relied on small or non-representative samples, which limits the generalizability of their findings to the general population. Finally, few have examined mental well-being alongside environmental and behavioral factors, despite their potential interconnection in shaping dietary habits. Moreover, all the aforementioned determinants have typically been examined in isolation, which limits their policy relevance and the design of integrated interventions. To address this gap, the present study develops an integrative framework with three main contributions that hold direct implications for health policy.

First, whereas much of the previous research has concentrated on clinically diagnosed mental health conditions, this study examines general psychological distress in a nationally representative, non-clinical sample of Italian adults. This approach enables the detection of subclinical levels of emotional strain that may nonetheless influence dietary patterns. The study also covers a unique period (2019–2021), encompassing the onset of the COVID-19 pandemic, which profoundly affected population well-being. Capturing these dynamics is essential for informing policies that mitigate the long-term effects of crises on dietary behavior.

Second, to the best of our knowledge, this is the first study to integrate psychological well-being and environmental behaviors within a single empirical model, using a nationally representative dataset of over 100,000 adults. By illustrating how these dimensions jointly

shape dietary choices, the study provides actionable evidence to support holistic strategies for improving both population health and environmental sustainability.

Finally, the study compares three widely used MD adherence indexes within the same dataset, demonstrating that index selection substantially affects both the estimated prevalence and the observed associations with key predictors. This methodological contribution underscores the need for greater standardization in measurement tools, which is crucial for ensuring comparability across studies and for developing coherent, evidence-based dietary guidelines and monitoring systems.

The remainder of the paper is structured as follows: the theoretical framework and hypotheses are presented first, followed by the methods, results, discussion, and conclusions.

Theoretical framework and hypotheses

The present study examines the level of adherence to the MD in the Italian adult population and explores its main determinants. Several factors have been identified in the literature as influencing MD adherence. Among these, socioeconomic status plays a key role: individuals with higher education and income are more likely to follow healthier eating patterns, including greater adherence to the MD. This association may be explained by better access to fresh and healthy foods, as well as greater health literacy and awareness of the benefits of the MD (Bonaccio *et al*., 2017; Benedetti *et al*., 2018). These findings indicate that socioeconomic conditions are likely to shape MD adherence at the population level. Thus, we hypothesized that

H1. Higher socioeconomic status, measured by education, household income, and economic conditions, is positively associated with adherence to the MD among Italian adults.

Previous research has linked sustainability-related practices to healthier and more plant-based dietary patterns. For example, Capone *et al*. (2014) and Ruggiero *et al*. (2019) found that individuals who adopt practices such as energy and water saving, use of green transportation, and the purchase of local or organic food products are more likely to follow sustainable diets, including the MD. Recent cross-sectional evidence from U.S. university students further confirmed that higher adherence to the MD was associated with sustainable dietary behaviors, including willingness to purchase and consume healthy and sustainable dishes (Franchini *et al*., 2024). Likewise, studies from Turkey found that MD adherence was positively associated with sustainable eating practices, awareness of ecological footprint reduction, and environmentally responsible food choices (Kocaadam-Bozkurt and Bozkurt, 2023; Yassıbaş and Bölükbaşı, 2023). These findings suggest that everyday sustainability choices may reinforce adherence to the MD. Thus, we expected that

H2. Engagement in sustainability-focused behaviors is positively associated with adherence to the MD among Italian adults.

Moreover, environmental concern has also been identified as an important driver of food choices. Individuals with greater awareness of ecological issues and climate change are more likely to adhere to sustainable dietary patterns. Cavaliere *et al*. (2018) and Biasini *et al*. (2021) reported that pro-environmental attitudes are consistently linked to MD adherence. At the policy and conceptual level, the updated MD pyramid incorporates an explicit environmental dimension, emphasizing lower consumption of red meat and dairy and greater reliance on legumes and locally grown eco-friendly plant foods, thereby aligning dietary recommendations with sustainability goals (Serra-Majem *et al*., 2020). Extending this evidence, recent research demonstrated that climate change awareness was positively associated with both sustainable dietary behaviors and adherence to the MD, suggesting that environmental concern can act as a direct driver of dietary choices (Metin *et al*., 2024).

This evidence underlines the role of environmental values in shaping dietary behavior; thus we expected that

H3. Higher levels of environmental concern among Italian adults are positively associated with adherence to the MD.

Health-related and environmentally conscious behaviors often cluster together, reflecting a broader lifestyle orientation. Several studies have shown that individuals who are physically active and refrain from smoking are more likely to follow healthy dietary patterns, including the MD (Bonaccio *et al*., 2017; Villodres *et al*., 2024). Evidence from adolescents also supports this pattern: physically active students reported significantly higher adherence to the MD compared with their inactive peers, while smoking status showed no clear association (Zhubaj *et al*., 2024). MD adherence forms part of a wider set of health-promoting practices, therefore we hypothesized that

H4. Individuals who engage in healthy behaviors, such as regular physical activity and non-smoking, are more likely to adhere to the MD.

Lastly, psychological functioning has been increasingly recognized as a factor influencing dietary behavior. Most studies have focused on clinical conditions such as depression or anxiety (Sánchez-Villegas *et al*., 2006; Jacka *et al*., 2017; Sadeghi *et al*., 2021), often relying on diagnostic tools or symptom-specific measures. When broader psychological distress has been considered, it has typically been treated as a composite of depression and anxiety symptoms (D'Cunha *et al*., 2020) or examined indirectly, for example through mediators such as social capital (Mieziene *et al*., 2022). These approaches, although informative, do not capture general psychological functioning in non-clinical populations. Moreover, many of these studies are limited to narrow subgroups, such as young women (Mahmoudzadeh *et al*., 2023) or older adults in Mediterranean settings (D'Cunha *et al*., 2020) or have been conducted in culturally distant contexts (Mieziene *et al*., 2022), restricting their generalizability. To address these limitations, the present study used a nationally representative sample of Italian adults and applied the MHI-5 scale from the SF-36 (Ware and Sherbourne, 1992), a validated and widely used instrument capturing multiple dimensions of psychological well-being, including anxiety, depression, peacefulness, sadness, and happiness. This approach allows the detection of subclinical psychological distress that, while not meeting clinical thresholds, may still shape individuals' ability to sustain health-promoting dietary behaviors, such as MD adherence. Specifically, in the context of public health research, subclinical psychological distress refers to emotional symptoms, such as anxiety, tension, or low mood, that do not meet the threshold for a clinical diagnosis but may still impair daily functioning and predict future mental health problems. This notion aligns with previous large-scale studies adopting continuous or population-based measures of mental well-being (e.g., Keyes, 2002; Kessler *et al*., 2003), where psychological distress is treated as a dimensional construct rather than a binary clinical condition.

H5. Higher levels of psychological well-being are positively associated with adherence to the MD among Italian adults.

Building on these five hypotheses, the present study aims to provide a more comprehensive understanding of the socioeconomic, psychological, and behavioral correlates of MD adherence.

Methods

Sample

In this analysis, we use individual-level observations from the "Multipurpose Household Survey: Aspects of Daily Life" (MHS) collected by the Italian National Institute of Statistics (ISTAT) from a representative sample of Italian households over the period 2019–2021. This

survey is conducted annually by ISTAT on a sample of approximately 25,000 Italian households that are selected to ensure representativeness of the Italian population, and all family members are interviewed. The MHS provides insights into citizens' daily habits and concerns, with a focus on school, work, and family relationships, housing, the area in which they live, leisure time, political and social participation, health, and health and household lifestyles [1]. A specific section of the MHS investigates food consumption patterns in the Italian population by recording the frequency of consumption of different foods and beverages on a 5-point Likert scale. These data can be used to construct different indexes measuring the level of adherence to the MD. The MHS data also include detailed information on household and individual characteristics as well as information regarding respondents beliefs and lifestyles, such as the frequency of adoption of health-related and sustainable behaviors. Moreover, information about the respondents' health and mental health status measured through the five-item Mental Health Index (MHI-5) of the 36-item Short Form Health Survey (SF-36) (Ware and Sherbourne, 1992) is also provided. After dropping all observations that refer to individuals who are less than 18 years of age (e.g., 20,044 observations) or with missing information (e.g., 1967 observations), our sample consists of 103,447 observations.

Variables and measures

Adherence to the MD. Adherence to the MD is approximated by three indexes constructed by using self-reported eating habits information as proposed by Monteagudo *et al*. (2015), Trichopoulou *et al*. (2003) and Benedetti *et al*. (2016). As shown in Table 1, these indexes differ both in terms of their components as well as in the scoring method. First, the *Mediterranean Diet Score (MDS)* by Trichopoulou *et al*. (2003) is widely used for evaluating adherence to the MD focusing on the level of consumption of nine components: high intake of vegetables, legumes, fruits and nuts, cereals, and fish; low intake of meat and dairy products; moderate alcohol consumption; and the ratio of monounsaturated to saturated fats, emphasizing olive oil use. Values of one are assigned to individuals whose consumption of presumed beneficial foods (i.e. vegetables, legumes, fruits, cereals, fish and olive oil) is above the sex-specific medians computed over the sample of participants, while the opposite is true for presumed detrimental components (i.e. meat, dairy products, and alcoholic beverages). Therefore, the MDS ranges from 0 to 9 with higher values of the index indicating greater adherence to the MD (Trichopoulou *et al*., 2003). On the other hand, the *Mediterranean Diet Serving Score (MDSS)*, by Monteagudo *et al*. (2015), provides a description of dietary patterns by emphasizing serving sizes in addition to the types of foods eaten, offering a detailed approach to measuring adherence to the MD. Contrary to the MDS, the MDSS scoring method attributes greater importance to foods that should be consumed in every meal (e.g. fruit, vegetables and cereals), followed by those that should be consumed daily (e.g. dairy products and nuts), and finally, by those that should be consumed weekly (e.g., red meat, white meat, potatoes). A score of 0 is given when the individual's intake of a food category is higher or lower than the recommendation. Finally, the *Mediterranean Composite Score (MDCS)* by Benedetti *et al*. (2016) combines various aspects of the Mediterranean dietary pattern to create a composite indicator. This index is particularly suitable when food consumption data are collected through "Food-Frequency Questionnaires" as the MHS which ask participants how often they eat different types of foods. For each of the 12 components of the MDCS, a score ranging from 0 to 4 is assigned based on the level of adherence to the recommendations with the scoring rule varying for each food. For instance, the maximum score (e.g., 4) is assigned to respondents consuming fruits, vegetables and cereals more than once a day, with the score decreasing with lower frequency of consumption (e.g., 3 for "once a day", 2 for "few times a week", 1 for "less than once a week", 0 for "never"). On the other hand, for other foods, such as red meat, higher scores are assigned to the lowest frequencies of consumption (e.g., 4 for "less than once a week", 3 for "never"), while a value of zero is assigned to respondents who consume these

Table 1. MD indexes comparison: key components and scoring method

Category	MDS (Trichopoulou *et al*., 2003) Recommendation	Score	MDSS (Monteagudo *et al*., 2015) Recommendation	Score	MDCS (Benedetti *et al*., 2016) Recommendation	Score
Cereals	Equal or above median	1	1–2 servings/main meal	3	More than once a day	4
Fruits	Equal or above median	1	1–2 servings/main meal	3	More than once a day	4
Vegetables	Equal or above median	1	≥2 servings/main meal	3	More than once a day	4
Leafy vegetables	–		–		More than once a day	4
Potatoes	–		≤3 servings/week	1	–	
Legumes	Equal or above median	1	≥2 servings/week	1	–	
Nuts	–		1–2 servings/day	2	–	
Fish	Equal or above median	1	≥2 servings/week	1	A few times a week	4
Red meat	Below median	1	<2 serving/week	1	Less than once a week	4
Pork	–		–		Less than once a week	4
Processed meat	–		–		Less than once a week	4
Dairy products	Below median	1	2 servings/day	2	A few times a week	4
Milk	–		–		Once a day	4
White meat	–		2 servings/week	1	A few times a week	4
Eggs	–		2–4 servings/week	1	A few times a week	4
Sweets	–		≤2 servings/week	1	–	
Alcohol	Below median	1	1–2 glass/day	1	–	
Olive oil	Equal or above median	1	1 serving/main meal	3	Use of olive oil for cooking	4
	–		–		Use of olive oil as dressing	4
Total score		9		24[a]		56

Note(s): [a]As data on nuts consumption is not available in the MHS data, the MDSS maximum score is 21 instead of 24

foods more often (e.g., 2 for "a few times a week", 0 for "once a day" or "more than once a day") [2].

Pro-environmental behavior and environmental concern. Following the literature exploring pro-environmental behaviors (Markle, 2013; Laureti and Benedetti, 2018), we use the information collected by the MHS to develop an ad hoc [3] index measuring respondents' level of engagement in environmentally friendly behaviors. In detail, this index (ProEnvBeh_index) accounts for the following eight practices: purchase of local (1) and/or biological (2) foods, attention to energy (3) and water savings (4), use of alternative transportation methods (5), no use of single-use or disposable products (6), paper, plastic, and glass recycling (7) and other materials recycling (e.g. batteries) (8) [4]. As a score of 1 is assigned only to those respondents who declare that they habitually practice these activities, and 0 otherwise, the pro-environmental index we develop ranges from 0 to 8, with a higher level of this index indicating a higher level of engagement in pro-environmental behaviors. Focusing on the environmental concerns, as the MD is considered a sustainable dietary pattern, especially considering its relatively low carbon footprint (Dernini and Berry, 2015), following Aprile and Fiorillo (2023) and Benedetti *et al*. (2018), we define a specific dummy variable to identify respondents who are concerned about

climate change and greenhouse gas emissions. While the first variable is concerned with actual respondents' behavior, this second relates to individual attitudes and beliefs about environmental sustainability issues. In this way, we can also test whether respondents who are more concerned about environmental sustainability are also more likely to adhere to the MD.

Mental health and other health-related behaviors. The MHS also collects information on individuals' level of psychological well-being through the SF-36 MHI-5 score (Ware and Sherbourne, 1992). The MHI value is computed over the scores obtained by each respondent to 5 questions from the SF-36 questionnaire measuring the key mental health dimensions, that is, anxiety, depression, peacefulness, sadness, and happiness. In detail, respondents are asked to rate the frequency of each item during the previous 4 weeks on a 6-point Likert scale (e.g., 1 = always, 2 = most of the time, 3 = a good part of the time, 4 = sometimes, 5 = a little of the time, 6 = never). The final score for the MHI is then obtained by summing up and transforming the five-item scores into a score ranging from 0 to 100, with higher scores corresponding to better psychological well-being (Ware and Sherbourne, 1992; Pfoh *et al*., 2016). Although the SF-36 MHI-5 provides a general measure of psychological well-being, in line with previous research (e.g., Berwick *et al*., 1991; Yamazaki *et al*., 2005), we interpret lower scores as indicative of higher psychological distress. Accordingly, in the present study, psychological distress refers to reduced mental well-being as assessed by the MHI-5. As prior research shows that health-related behaviors, such as diet, physical activity, smoking, and alcohol consumption tend to co-occur (Adorni *et al*., 2022), we define specific variables to account for respondents' engagement in healthy behaviors other than adherence to the MD, that is, practicing physical activity on a regular basis and no smoking.

Statistical analysis

The goal of this analysis is to investigate the level of adherence (e.g., low, medium, or high) to the MD in the Italian adult population as measured by the MDS, MDSS, and MDCS indexes respectively. Given the categorical and ordered nature of the dependent variables, we use an ordered logit model estimation approach (Cameron and Trivedi, 2005). In detail, for all three MD indexes under analysis, adherence to the MD is classified as: (1) *low* if respondent *i*'s score for the MD index *m* is included in the first quartile (Q_1) ($MD_{im} = 1$); (2) *medium* if respondent *i*'s score for the MD index *m is* included in the second or third quartile (Q_2 and Q_3) ($MD_{im} = 2$); (3) *high* if respondent *i*'s score for the MD index *m* is included in the fourth quartile (Q_4) ($MD_{im} = 3$). We run three separate ordinal logistic regressions to investigate adherence to the MD as measured by the MD index *m* as a function of individual-level and household level socioeconomic characteristics (e.g., age, gender, level of education, economic condition), aspects related to food purchase behaviors (e.g., attention to labels, easiness of access to food stores) as well as ad-hoc variables capturing individuals' level of engagement in pro-environmental and health-related behaviors, the level of psychological distress, and climate concern. Time and area fixed effects are also included to account for potential systematic differences across time periods and geographical areas. The probability of observing outcome *j (j = low, medium, high)* for the MD index *m (m = MDS, MDSS, MDCS)* for individual *i* can be derived as follows:

$\Pr(MD_{im} = j) = F(\alpha_j - \mathbf{X}_i\beta) - F(\alpha_{j+1} - \mathbf{X}_i\beta)$ (1) where F is the logistic cumulative density function, $\mathbf{X}_i$ is a matrix of respondent *i*'s characteristics and beliefs, β are the regression parameters of interest, and α_j is the threshold parameters obtained through maximum likelihood estimation (Cameron and Trivedi, 2005). A detailed description of the variables included in our analysis is provided in Table 2 and Table 3 [5].

Results

Sample characterization

The summary statistics of the three MD indexes employed in the current analysis are reported in the Appendix (Table A1), together with the average score by item, while Figure A1,

Table 2. Class definition and frequency (%) by MD index: MDS, MDSS, MDCS

MD index	Class definition	Frequency (%)
MDS[a]	low = respondent's MDS is below or equal 5 (Q_1)	36.3
	medium = respondent's MDS is between 5 and 7 (Q_2 and Q_3)	28.8
	high = respondent's MDS is above or equal 7 (Q_4)	34.9
MDSS[b]	low = respondent's MDSS is below or equal 10 (Q_1)	27.2
	medium = respondent's MDSS is between 10 and 15 (Q_2 and Q_3)	43.4
	high = respondent's MDSS is above or equal 15 (Q_4)	29.4
MDCS[c]	low = respondent's MDCS is below or equal 40 (Q_1)	29.5
	medium = respondent's MDCS is between 40 and 46 (Q_2 and Q_3)	42.1
	high = respondent's MDCS is above or equal 46 (Q_4)	28.4

Note(s): [a]0–9 Mediterranean Diet Score (Trichopoulou *et al*., 2003), [b]0–21 Mediterranean Diet Serving Score (Monteagudo *et al*., 2015), [c]0-56 Mediterranean Diet Composite Indicator (Benedetti *et al*., 2016)

Table 3. Description and summary statistics of the key variables employed in the analysis

Variable name	Variable description	Mean	St. dev
Female	1 = female respondent	0.52	0.50
Age18_34	1 = respondent aged 18–34	0.19	0.39
Age35_54	1 = respondent aged 35–54	0.33	0.47
Age55_64	1 = respondent aged 55–64	0.18	0.38
Age_over65	1 = respondent aged over 65	0.30	0.46
Low_edu	1 = respondent with a middle-school degree or lower	0.43	0.50
Middle_edu	1 = respondent with a high-school degree	0.40	0.49
High_edu	1 = respondent with a university degree or higher	0.17	0.38
Married	1 = married	0.51	0.50
No_child	1 = no children in the household	0.80	0.40
Child_0_5	1 = presence of children aged 0–5 in the household	0.06	0.25
Child_6_13	1 = presence of children aged 6–13 in the household	0.10	0.30
Child_14_17	1 = presence of children aged 14–17 in the household	0.08	0.28
EcoSit_Satisf	1 = respondent is satisfied with the household's economic situation	0.68	0.47
Diff_FoodAccess	1 = difficulty in reaching food stores	0.05	0.21
Label	1 = respondent pays attention to food labels	0.39	0.49
CronicDisease	1 = respondent has a chronic disease	0.48	0.50
MentalHealth_Ind	normalized mental health index (MHI) ranging from 0 to 1	0.68	0.18
Sport	1 = respondent practices physical activity regularly	0.19	0.39
noSmoke	1 = respondent does not smoke	0.81	0.39
ProEnvBeh_Ind	normalized index of pro-environmental behaviors	0.50	0.20
Climate_conc	1 = respondent is concerned about climate change	0.71	0.45
North_West	1 = respondent lives in the North-West of Italy	0.23	0.42
North_East	1 = respondent lives in the North-East of Italy	0.21	0.41
Centre	1 = respondent lives in the Centre of Italy	0.19	0.39
South_Isles	1 = respondent lives in the South of Italy or in the Isles	0.37	0.48
2019	1 = data collection of the survey 2019	0.34	0.47
2020	1 = data collection of the survey 2020	0.32	0.47
2021	1 = data collection of the survey 2021	0.34	0.48

A2 and A3 show their distribution in the study population. We use the quartile upper and lower bounds to define the respondent's level of adherence to the MD as reported in Table 2. In detail, individuals showing a medium level of adherence to the MD correspond to respondents scoring between 5 and 7 on the MDS, 10 and 15 on the MDSS, and 40 and 46 on the MDCS.

Individuals with a score below (above) the lower (upper) limit represent individuals in the first (last) quartile of the distribution, that is, individuals showing a low (high) level of adherence to the MD. Overall, the percentage of Italian adults showing a high level of adherence to the MD slightly varies with the index definition going from 28.4% when using the MDCS to as high as 35% when using the MDS. On the other hand, the proportion of Italian adults showing the lowest level of adherence to the MD (e.g., low) ranges from 27.2% as defined by the MDSS to 36.3% when following the MDS definition.

Table 3 provides a description of the explanatory variables used in this analysis, including the key demographic characteristics required for sample characterization, along with their summary statistics. In detail, our sample is almost equally divided between female (52%) and male (48%) respondents, and reflects the age distribution of the Italian adult population (ISTAT, 2023), with about half of the respondents being under 55 years old (e.g., 19% aged 18–34 years old and 33% aged 35–54 years old), and the remaining half being aged 55 years old or older (ie.g., 18% aged 55–64 years old and 18% being aged 65 years old or older). In line with the official statistics for Italy (ISTAT, 2024), around 60% of respondents have a high school degree (*Middle_edu*) (40.0%) or higher *(High_Edu)* (17.0%), while approximately 40% have a middle school diploma or lower (*Low_Edu*) (43%). Moreover, the high proportion of households with no children in the sample *(No_child*) (80%) accurately reflects the demographic decline recorded for the Italian population especially over the last decade (ISTAT, 2025). While most respondents (68%) are overall satisfied with their household's economic situation (*Eco_Sit_Sat*) [6], only 5% of them report facing some issues with food access (*Diff_Food_Access)*. Focusing on the prevalence of health-related behaviors, only 19% of participants report regularly practicing physical activity, but as many as 80% of them do not smoke. The average values of the normalized[7] mental health (*MentalHealth_Ind*) and of pro-environmental behavior (*ProEnvBeh_Ind)* index in the sample are equal to 0.68 and 0.50, respectively. Most respondents (71%) declare that they are concerned about climate change (*Climate_conc)*, whereas only 39% of them pay great attention to food labels when making their food purchasing decisions (*Label*).

Model estimation results

Table 4 reports the estimated marginal effects of the key variables of interest on the level of adherence to the MD as measured by the MDS, MDSS, and MDCS respectively. The full set of estimation results from the three ordered logistics regressions are provided in Appendix (Table A2).

Individual and household characteristics. Focusing on individual-level characteristics, while female respondents are more likely to show a high level of adherence to the MD than male respondents when measured with the MDSS and MDCS, the opposite is true in the case of the MDS. Our results also show that the likelihood of a high adherence to the MD is positively associated with age. For instance, individuals aged 18–34 years are less likely to show the highest level of adherence to the MD (from −7.7% to 14.3%) than individuals aged 65 or more. Education is also positively associated with adherence to the MD. Specifically, individuals with a university degree or higher have a higher probability (from 2.0% to 5.5%) of showing high adherence compared to those with a middle school diploma or lower. Similarly, participants who report high satisfaction with their economic condition have a higher probability of a high level of adherence to the MD (from 1.8% to 2.4%) compared to those who are less satisfied with their economic situation. Therefore, this may imply that a positive association may exist between household income and adherence to the MD. Respondents who pay close attention to food labels are also more likely to have high adherence to the MD (from 2.7% to 6.9%) than those who do not do so. In terms of household characteristics, we find that being married is also positively associated with a high level of adherence to the MD (from 1.6% to 3.3%). On the other hand, mixed results are found consistently in all three MD regressions for the variables accounting for the presence of children in the household. In detail,

Table 4. Estimated average marginal effects for the key variables of interest from the MDS, MDSS and MDCS ordinal logistic regression

Variable	MDS[a] Low	Medium	High	MDSS[b] Low	Medium	High	MDCS[c] Low	Medium	High
Female	0.062***	−0.001***	−0.061***	−0.026***	0.001***	0.025***	−0.078***	0.001***	0.076***
Age18_34[d]	0.095***	−0.002***	−0.094***	0.081***	−0.004***	−0.077***	0.145***	−0.003***	−0.143***
Age35_54[d]	0.072***	−0.001***	−0.070***	0.088***	−0.004***	−0.084***	0.112***	−0.002***	−0.110***
Age55_64[d]	0.033***	−0.001***	−0.033***	0.054***	−0.003***	−0.051***	0.055***	−0.001***	−0.054***
Middle_edud	−0.006*	0.000*	0.006*	−0.001	0.000	0.001	−0.021***	0.000***	0.020***
High_edud	−0.029***	0.001***	0.028***	−0.021***	0.001***	0.020***	−0.056***	0.001***	0.055***
EcoSit_Satisf	−0.019***	0.000***	0.018***	−0.026***	0.001***	0.024***	−0.025***	0.000***	0.024***
Label	−0.069***	0.000	0.069***	−0.035***	0.001***	0.034***	−0.027***	0.000	0.027***
Married	−0.016***	0.000***	0.016***	−0.034***	0.002***	0.033***	−0.027***	0.001***	0.026***
Child_0_5[d]	−0.013**	0.000**	0.013**	−0.016***	0.001***	0.015***	−0.020***	0.000***	0.020***
Child_6_13[d]	0.011**	−0.000**	−0.011**	0.012***	−0.001***	−0.012***	0.008**	−0.000*	−0.008**
Child_14_17[d]	0.008	0.000	−0.008	−0.009**	0.000**	0.009**	0.004	0.000	−0.004
Diff_FoodAccess	0.015**	−0.001*	−0.014**	0.005	0.000	−0.004	0.016***	−0.001*	−0.015***
ProEnvBeh_Ind	−0.174***	0.003***	0.171***	−0.136***	0.006***	0.129***	−0.163***	0.003***	0.160***
Climate_conc	−0.019***	0.000***	0.019***	−0.024***	0.001***	0.022***	−0.018***	0.000***	0.017***
MentalHealth_Ind	−0.050***	0.001***	0.050***	−0.026***	0.001***	0.025***	−0.073***	0.001***	0.072***
Sport	−0.059***	0.001***	0.058***	−0.043***	0.002***	0.041***	−0.045***	0.001***	0.044***
noSmoke	−0.059***	0.001***	0.058***	−0.051***	0.002***	0.049***	−0.074***	0.001***	0.073***
CronicDisease	−0.008**	0.000**	0.007**	−0.013***	0.001***	0.012***	−0.005*	0.000	0.005*

Note(s): *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Area and time marginal effects omitted for brevity, [a]0–9 Mediterranean Diet Score (Trichopoulou *et al*., 2003), [b]0–21 Mediterranean Diet Serving Score (Monteagudo *et al*., 2015), [c]0-56 Mediterranean Diet Composite Indicator (Benedetti *et al*., 2016), [d]*Age_over65, Low_edu, No_child* are the reference categories for the age, education and household composition (i.e. presence of children) variables

while households with pre-school children are more likely to show a high level of adherence to the MD (from 1.3% to 2%) than households with no children, the opposite is true when school-age children are present (from −0.8% to −1.2%). Food access issues are negatively associated with the level of adherence to the MD.

Pro-environmental behavior and environmental concern. As shown in Table 4, the adoption of pro-environmental behaviors is positively associated with a high level of adherence to the MD. In detail, individuals with the highest level of engagement in pro-environmental behaviors are also from 12.9% to 17.0% more likely to show the highest level of adherence to the MD than individuals who never engage in environmentally friendly behaviors. We also find that a positive relationship exists between environmental concerns and adherence to the MD, as people who are concerned about the climate impacts of human activities are also more likely (from 1.7% to 2.2%) to achieve a high level of adherence to the MD.

Mental health and other health-related behaviors. The last section of Table 4 summarizes the estimated average marginal effects for the variables capturing participants' mental health status and the level of engagement in other health-related behaviors. In line with the existing literature on this topic, our findings show that a positive correlation exists between the level of adherence to the MD and mental health. In detail, respondents with the highest level of mental well-being are from 2.5% to 7.2% more likely to have high adherence to the MD than those with the highest level of psychological distress. Our results also show that health-related behaviors tend to co-occur in the Italian adult population, as individuals regularly practicing physical activity and who do not smoke are also more likely to have a high adherence to the MD than people who engage in less healthy behaviors (from 0.41% to 0.58% and from 0.49% to 0.73% for individuals practicing regularly physical activity and those who do not smoke, respectively).

Discussion

The present study contributes to the exploration of factors associated with adherence to the MD among Italian adults. Specifically, it examines how engagement in health- and sustainability-related practices, environmental concern, and psychological well-being are related to dietary choices. In doing so, the study supports the broader objective of promoting sustainable and healthy diets, addressing global health challenges linked to chronic diseases and obesity, while also considering environmental sustainability.

A key contribution of this research is the integration of psychological well-being and pro-environmental behaviors as central variables in the analysis of MD adherence, providing a more comprehensive perspective that has rarely been addressed in previous studies. Furthermore, by employing and comparing three widely used MD adherence indexes (MDS, MDSS, and MDCS) within the same nationally representative sample, we show that both the estimated prevalence of high adherence and the strength of associations with the determinants under investigation vary according to the index applied. This finding underscores the importance of index selection in the interpretation of adherence studies and in the design of targeted dietary interventions.

In line with previous findings (Benedetti *et al*., 2016), gender and age are associated with adherence to the MD, with women generally exhibiting higher adherence than men, and older individuals being more likely to follow this dietary pattern.

Nevertheless, the estimation results for the MDS show the opposite relationship between gender and adherence to the MD, compared to the MDSS and the MDCS. This may happen because of the way the MDS is computed: the level of adherence to the MD is accounted for men and women separately, differently from the MDSS and the MDCS. More specifically, for the MDS, the reference value for females is the median consumption for the various items only for that gender, while for males it is the same value calculated only for men.

Regarding socioeconomic factors influencing the adherence to the MD, our results confirm that higher levels of education, income, and better economic conditions are significantly associated with higher adherence to such a dietary pattern (Carfora *et al*., 2022b). Hence, we confirm previous literature arguing that individuals with greater educational attainment and financial resources are more likely to have the knowledge and means to adhere to the MD, which often includes more expensive and fresh food items such as fish, fruits, and vegetables (Carfora *et al*., 2022b).

The positive association between the level of engagement in pro-environmental behaviors and MD adherence highlights a potential link between sustainable behaviors and healthy eating (Capone *et al*., 2014; Cavaliere *et al*., 2018; Ruggiero *et al*., 2019). This finding suggests that individuals who prioritize sustainability may also be more inclined toward dietary patterns such as the MD, although further research is needed to explore whether this reflects greater health consciousness or specific awareness of the diet's nutritional benefits (Benedetti *et al*., 2018; Biasini *et al*., 2021).

Additionally, regular physical activity and non-smoking status were positively associated with higher adherence to the MD, suggesting that healthy lifestyles are complementary and reinforcing. Indeed, healthy behaviors appear to reinforce one another.

The negative association between MD adherence and psychological distress observed in this study adds novel evidence to the growing literature on the link between diet and mental health. As this is the first time such a relationship has been documented within a large, representative Italian sample, our findings offer a unique contribution by focusing on general psychological distress, assessed with a reliable measure of general psychological distress, including symptoms of depression and anxiety, as well as positive effects, rather than clinically diagnosed disorders. The use of a validated screening tool in a non-clinical population allows for the identification of subclinical emotional strain, conditions that, although not pathological, may interfere with individuals' ability to adopt and sustain healthy dietary patterns. Although the cross-sectional design prevents any inference of causality, the observed correlation is in line with evidence suggesting a bidirectional relationship between diet quality and psychological functioning. On one hand, poor diet quality, characterized by low intake of anti-inflammatory, antioxidant, and neuroprotective nutrients, has been associated with increased systemic inflammation, oxidative stress, and altered brain plasticity (Pariante, 2017; Lassale *et al*., 2019), all of which are implicated in the pathophysiology of emotional dysregulation. On the other hand, psychological distress can negatively affect eating behavior by impairing executive functioning and self-regulation, increasing emotional eating, and reducing the motivation and energy needed to plan, shop for, and prepare balanced meals (Konttinen *et al*., 2010; Tomiyama, 2019). By highlighting this reciprocal connection in an Italian population, our study emphasizes the importance of addressing mental health when designing dietary interventions and calls for further research using longitudinal or experimental designs to clarify the directionality of the association and develop integrated health promotion strategies.

These findings have important public health implications. Epidemiological evidence consistently shows that higher adherence to the MD is linked to lower risks of cardiovascular disease, type 2 diabetes, certain cancers, and overall mortality (Sofi *et al*., 2008; Estruch, 2010; Trichopoulou *et al*., 2003). Our results reveal significant demographic disparities: older adults and individuals with higher socioeconomic status exhibit greater adherence, reflecting persistent inequalities in access to fresh, healthy foods (Bonaccio *et al*., 2017; Benedetti *et al*., 2018). Younger populations, meanwhile, tend to adopt more Westernized dietary patterns, raising concerns about generational shifts away from traditional diets (Grosso *et al*., 2017). Gender differences further indicate that interventions should be tailored to specific subgroups.

This study advances existing research by jointly examining psychological well-being and pro-environmental behaviors as determinants of MD adherence and comparing three commonly used adherence indexes within a nationally representative sample. The results emphasize the need for integrated public health strategies that promote the MD's health

benefits while addressing the demographic, socioeconomic, psychological, and environmental factors influencing dietary behaviors.

Practical implications

As household economic conditions emerged as a factor influencing MD adherence, policies should aim to address socioeconomic disparities by ensuring equitable access to healthy food options. This could involve initiatives such as subsidies for healthy foods, support for local farmers' markets, and interventions to improve food security in low-income communities. For example, policymakers could facilitate the accessibility and affordability of key components of the MD through targeted food policies. Such policies might include subsidies for farmers growing Mediterranean staples such as olives and legumes, or urban planning that facilitate local gardens and markets providing fresh produce. These measures could help mitigate the economic barriers to healthy eating, thereby supporting public health at the community level. The positive correlation between environmental concerns and MD adherence highlights the potential for aligning dietary recommendations with broader sustainability goals.

Recognizing the negative relationship between psychological distress and MD adherence, public health initiatives could significantly benefit from integrating MD adherence into mental health prevention strategies. From a clinical perspective, healthcare providers might consider the integration of dietary assessments into routine patient care. Recommending the MD as a complementary approach to traditional mental health treatments could enhance patient outcomes. This integration could involve collaborations with nutritionists and dietitians to provide patients with tailored dietary plans that support both mental and physical health, offering a holistic approach to healthcare. Community-based programs also play a crucial role in the practical application of these findings. Local health departments and community centers could offer workshops and cooking classes to educate the public about the MD. By teaching individuals how to incorporate healthy fats, whole grains, and a variety of produce into their daily meals, these programs can empower communities to make dietary choices that enhance mental well-being. Digital communication campaigns could effectively disseminate this information, reaching a broad audience through social media and other online platforms (Carfora *et al*., 2022a). The confirmation of the diet's benefits suggests a need for further research to explore the specific associations between the MD and mental health outcomes and to identify which components are most strongly linked to these benefits.

Limitations and future perspectives

This study has some limitations. First, dietary habits, environmental concerns, and psychological well-being were self-reported, which may introduce recall and social desirability bias.

Moreover, due to data limitations, we developed an ad hoc index for *pro-environmental behaviors* rather than using a standardized and validated measure such as the Pro-Environmental Behavior Scale (PEBS) (Markle, 2013). Although this choice may somewhat limit cross-study comparability, it is important to note that our index captures the most environmentally relevant human activities, transportation, food consumption, and household operations, as well as related behaviors such as the use of alternative means of transport, recycling, and water and energy savings. These domains have been consistently identified as central to pro-environmental engagement in previous research (Markle, 2013; Laureti and Benedetti, 2018). Therefore, we argue that our index provides an efficient and conceptually grounded tool for analyzing behaviors that most directly affect environmental outcomes.

The cross-sectional design limits causal inference; longitudinal or intervention studies are needed to clarify temporal and causal relationships. Finally, the focus on Italian adults restricts generalizability, as dietary patterns and lifestyle behaviors vary across cultural and geographic settings.

Future research should address socioeconomic disparities in access to and adherence to the MD. Lower-income groups face structural barriers to healthy eating, and socioeconomic status

may moderate the influence of psychological distress and other determinants on dietary behavior. Evidence from both older adults and adolescents demonstrates that social position is a strong predictor of well-being (Sweeting and Hunt, 2014; Read *et al*., 2016). Examining these interaction effects, ideally through longitudinal designs, would provide a more nuanced understanding of how psychological and social inequalities shape dietary choices over time.

Another priority is the promotion of healthy food preferences early in life. Evidence suggests that establishing such preferences reduces chronic disease risk later on (Carfora *et al*., 2022b). Public health strategies should therefore engage parents and schools, complementing adult-focused interventions with early preventive measures.

Finally, our results call for further investigation of the links between Mediterranean lifestyle and subclinical psychological distress. Identifying protective psychological resources, such as self-regulation, emotional well-being, and health motivation, could inform the design of targeted and sustainable interventions (Carfora *et al*., 2022b). Comparative studies across regions, including the role of environmental policies, would also clarify whether the health and well-being benefits of the MD extend beyond the Italian context.

Conclusions

In conclusion, while this study confirms the well-documented benefits of the MD, it also contributes to the literature by integrating psychological well-being and environmental behaviors as joint factors associated with MD adherence, providing a broader perspective on the determinants of healthy dietary patterns. Furthermore, by comparing three different MD adherence indexes within the same nationally representative sample, our analysis highlights how index choice influences both estimated adherence levels and associations with key variables. These findings have practical implications for future research and the design of targeted public health interventions aimed at promoting MD adherence across different population groups.

Declaration of generative AI in scientific writing

During the preparation of this work, the authors used ChatGPT to improve the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Table A1. Summary statistics of the MD indexes used in the analysis

	MDS Trichopoulou *et al*. (2003)				MDSS Monteagudo *et al*. (2015)				MDCS Benedetti *et al*. (2016)			
Category	Recommendation	Score	Mean	St.dev	Recommendation	Score	Mean	St.dev	Recommendation	Score	Mean	St.dev
Cereals	Equal or above median	1	0.76	0.43	1–2 servings/main meal	3	0.76	1.31	More than once a day	4	2.97	0.79
Fruits	Equal or above median	1	0.76	0.43	1–2 servings/main meal	3	1.08	1.44	More than once a day	4	2.59	0.94
Vegetables	Equal or above median	1	0.78	0.41	≥2 servings/main meal	3	0.61	1.20	More than once a day	4	2.51	0.88
Leafy vegetables	–				–				More than once a day	4	3.02	0.96
Potatoes	–				≤3 servings/week	1	0.96	0.19	–			
Legumes	Equal or above median	1	0.56	0.50	≥2 servings/week	1	0.56	0.50	–			
Nuts	–				1–2 servings/day	2			–			
Fish	Equal or above median	1	0.63	0.48	≥2 servings/week	1	0.59	0.49	A few times a week	4	3.07	1.21
Red meat	Below median	1	0.40	0.49	<2 serving/week	1	0.96	0.21	Less than once a week	4	2.63	1.07
Pork	–				–		0.42	0.49	Less than once a week	4	3.72	0.77
Processed meat	–				–				Less than once a week	4	2.00	1.46
Dairy products	Below median	1	0.20	0.40	2 servings/day	2	1.07	1.00	A few times a week	4	3.20	1.14
Milk	–				–				Once a day	4	2.26	1.64
White meat	–				2 servings/week	1	0.7	0.46	A few times a week	4	3.44	1.01
Eggs	–				2–4 servings/week	1	0.63	0.48	A few times a week	4	3.49	0.81
Sweets	–				≤2 servings/week	1	0.89	0.31	–			
Alcohol	Below median	1	0.93	0.25	1–2 glass/day	1	0.93	0.25	–			
Olive oil	Equal or above median	1	0.87	0.33	1 serving/main meal	3	2.62	1.00	Use of olive oil for cooking	4	3.71	0.83
	–				–				Use of olive oil as dressing	4	3.90	0.51
Total score		*9*	*5.88*	*1.35*		*24*[a]	*12.76*	*3.52*		*56*	*42.52*	*5.03*

Table A2. Ordered logit estimation results by MD index: MDS, MDSS, MDCS (n = 103,447)

	MDS[a]	MDSS[b]	MDCS[c]
Female	−0.281*** (0.012)	0.128*** (0.012)	0.396*** (0.012)
Age18_34[d]	−0.434*** (0.022)	−0.399*** (0.022)	−0.741*** (0.022)
Age35_54[d]	−0.325*** (0.018)	−0.438*** (0.018)	−0.570*** (0.018)
Age55_64[d]	−0.152*** (0.018)	−0.265*** (0.018)	−0.281*** (0.018)
Middle_edu[d]	0.027* (0.014)	0.006 (0.014)	0.105*** (0.014)
High_edu[d]	0.131*** (0.018)	0.105*** (0.018)	0.287*** (0.018)
Married	0.072*** (0.013)	0.170*** (0.013)	0.137*** (0.013)
Child_0_5[d]	0.060** (0.025)	0.079*** (0.025)	0.103*** (0.025)
Child_6_13[d]	−0.050** (0.021)	−0.061*** (0.021)	−0.042** (0.021)
Child_14_17[d]	−0.035 (0.022)	0.047* (0.022)	−0.022 (0.022)
EcoSit_Satisf	0.085*** (0.013)	0.126*** (0.013)	0.126*** (0.013)
Diff_FoodAccess	−0.068** (0.027)	−0.023 (0.028)	−0.081*** (0.028)
Label	0.317*** (0.013)	0.174*** (0.013)	0.138*** (0.013)
CronicDisease	0.034** (0.013)	0.063*** (0.013)	0.024* (0.013)
MentalHealth_Ind	0.229*** (0.033)	0.131*** (0.033)	0.372*** (0.033)
Sport	0.267*** (0.016)	0.214*** (0.016)	0.231*** (0.016)
noSmoke	0.269*** (0.015)	0.254*** (0.015)	0.377*** (0.015)
ProEnvBeh_Ind	0.791*** (0.032)	0.671*** (0.032)	0.829*** (0.032)
Climate_conc	0.086*** (0.013)	0.117*** (0.013)	0.089*** (0.013)
North_East[e]	−0.121*** (0.018)	−0.167*** (0.018)	−0.131*** (0.018)
Centre[e]	0.481*** (0.018)	0.306*** (0.018)	0.426*** (0.018)
South_Isles[e]	0.617*** (0.016)	0.125*** (0.016)	0.280*** (0.016)
2020[e]	−0.022 (0.014)	0.011 (0.014)	0.055*** (0.014)
2021[e]	−0.025* (0.014)	−0.017 (0.014)	0.007 (0.014)
cut1	0.472*** (0.038)	0.018 (0.038)	0.474*** (0.038)
cut2	1.723*** (0.039)	1.935*** (0.039)	2.383*** (0.039)

Note(s): Standard errors in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01, [a]0–9 Mediterranean Diet Score (Trichopoulou *et al*., 2003), [b]0–21 Mediterranean Diet Serving Score (Monteagudo *et al*., 2015) [c]0-56 Mediterranean Diet Composite Indicator (Benedetti *et al*., 2016), [d]*Age_over65, Low_edu, No_child* are the reference categories for the age, education and household composition (i.e. presence of children) variables, [e]*North_West* and *2019* are the reference categories for the area and year variables

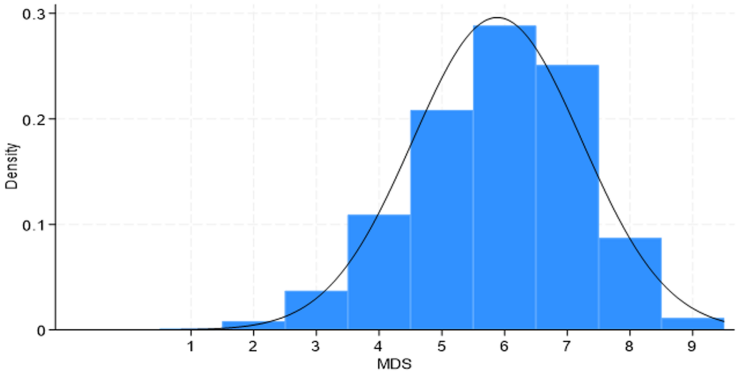

Figure A1. Frequency distribution of the MDS[a] in the study population: histogram and normal density plot (n = 103,447). Notes: [a]0-9 Mediterranean Diet Score (Trichopoulou *et al*., 2003)

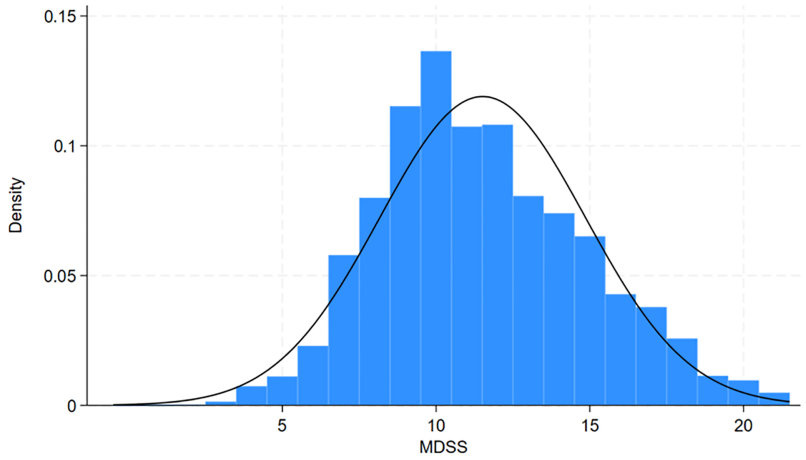

Figure A2. Frequency distribution of the MDSS[a] in the study population: histogram and normal density plot (n = 103,447). Notes: [a]0-21 Mediterranean Diet Serving Score (Monteagudo *et al.*, 2015)

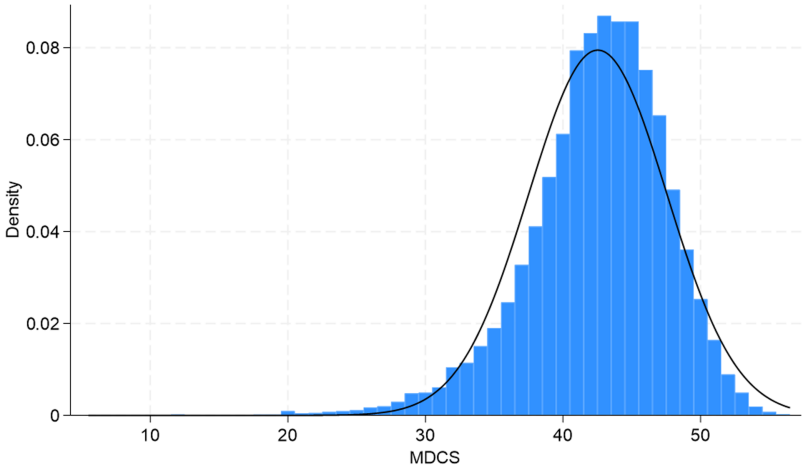

Figure A3. Frequency distribution of the MDCS[a] in the study population: histogram and normal density plot (n = 103,447). Notes: [a]0-56 Mediterranean Diet Composite Indicator (Benedetti *et al.*, 2016)

Notes

1. Information regarding the Multipurpose Household Survey (MHS) can be found at: https://www.istat.it/informazioni-sulla-rilevazione/aspetti-della-vita-quotidiana-informazioni-sulla-rilevazione-anno-2013/
2. For more details on the MDCS scoring rule see Table 1 in Benedetti *et al*. (2016), p. 435.
3. As this analysis relies on secondary data, we lack some of the information needed to derive a validated pro-environmental behaviors index, such as the PEBS developed by Markle (2013). For instance, the PBES index uses the answers to seven questions to compute a score for respondents' "conservation" attitude (i.e. "How often do you turn off the lights when leaving the room?"; "How often do you switch off standby modes of appliances or electronic devices?"; "How often do you cut down on heating or air conditioning to limit energy use?"; "How often do you turn off the TV when leaving a room?"; "How

often do you limit your time in the shower in order to conserve water?"; "How often do you wait until you have a full load to use the washing machine or dishwasher?"; "At which temperature do you wash most of your clothes?"). On the other hand, only two questions in the MHS investigate individuals' water and energy savings (i.e. "How often do you take care not to waste energy?"; "How often do you take care not to waste water?"). Therefore, we use the information available in the MHS to construct an "ad hoc" index measuring the intensity of respondents' behaviors aimed at reducing environmental stress. Specifically, our pro-environmental index focuses on key pro-environmental behaviors that are widely recognized in the existing literature as such, as increase recycling and energy and water use efficiency to reduce waste, increase consumption of local and organic foods, use of alternative means of transportation (Markle, 2013; Laureti and Benedetti, 2018; Grilli and Curtis, 2021; Mateer *et al*., 2022; Aprile and Fiorillo, 2023; Binder *et al*., 2025).

4. We distinguish between 7) and 8) to capture two levels of respondents' involvement in recycling activities. While plastic, paper and glass recycling in most municipalities is door-to-door, for other materials recycling requires people to look for a specific bin which may also be quite a distance away, therefore requiring a higher level of effort.

5. As normalization of continuous covariates is a common practice in quantitative research to ease the interpretation of the coefficients and assess their relative degree (Oka, 2021), we develop normalized scales (i.e. from 0 to 1) for the pro-environmental behavior (*ProEnvBeh_Ind*) and the mental health (*MentalHealth_Ind*) indexes by dividing the corresponding continuous variable by their maximum achievable value (i.e. 6 and 100, respectively).

6. As the MHS data do not provide information on actual household income levels, we use the information about individuals' self-evaluation of their household's economic situation as a proxy for their income level. Recent statistics published by EUROSTAT (2023) confirm that a positive relationship exists between individual economic satisfaction and the corresponding income quintile in all EU member states, including Italy.

References

Adorni, R., Lonati, E., Zanatta, F., Belingheri, M., Rossetti, M., Colleoni, M., Riva, M.A., Palestini, P. and Steca, P. (2022), "Lifestyle profiles and their sociodemographic correlate in an academic community sample", *International Journal of Environmental Research and Public Health*, Vol. 20 No. 1, p. 231, doi: 10.3390/ijerph20010231.

Aprile, M.C. and Fiorillo, D. (2023), "Other-regarding preferences in pro-environmental behaviours: empirical analysis and policy implications of organic and local food products purchasing in Italy", *Journal of Environmental Management*, Vol. 343, 118174, doi: 10.1016/j.jenvman.2023.118174.

Barbería-Latasa, M., Gea, A. and Martínez-González, M.A. (2022), "Alcohol, drinking pattern, and chronic disease", *Nutrients*, Vol. 14 No. 9, 1954, doi: 10.3390/nu14091954.

Benedetti, I., Biggeri, L., Laureti, T. and Secondi, L. (2016), "Exploring the Italians' food habits and tendency towards a sustainable diet: the Mediterranean eating pattern", *Agriculture and Agricultural Science Procedia*, Vol. 8, pp. 433-440, doi: 10.1016/j.aaspro.2016.02.040.

Benedetti, I., Laureti, T. and Secondi, L. (2018), "Choosing a healthy and sustainable diet: a three-level approach for understanding the drivers of the Italians' dietary regime over time", *Appetite*, Vol. 123, pp. 357-366, doi: 10.1016/j.appet.2018.01.004.

Berwick, D.M., Murphy, J.M., Goldman, P.A., Ware, J.E., Barsky, A.J. and Weinstein, M.C. (1991), "Performance of a five-item mental health screening test", *Medical Care*, Vol. 29 No. 2, pp. 169-176, doi: 10.1097/00005650-199102000-00008.

Biasini, B., Rosi, A., Menozzi, D. and Scazzina, F. (2021), "Adherence to the Mediterranean diet in association with self-perception of diet sustainability, anthropometric and sociodemographic factors: a cross-sectional study in Italian adults", *Nutrients*, Vol. 13 No. 9, 3282, doi: 10.3390/nu13093282.

Binder, M., Blankenberg, A.K. and Nickel, J. (2025), "Pro-environmental behavior and life satisfaction: how strong is our evidence?", *Ecological Economics*, Vol. 237, 108684, doi: 10.1016/j.ecolecon.2025.108684.

Bonaccio, M., Pounis, G., Cerletti, C., Donati, M.B., Iacoviello, L., de Gaetano, G. and Study Investigators, MOLI.-SANI (2017), "Mediterranean diet, dietary polyphenols and low grade inflammation: results from the MOLI-SANI study", *British Journal of Clinical Pharmacology*, Vol. 83 No. 1, pp. 107-113, doi: 10.1111/bcp.12924.

Cameron, A.C. and Trivedi, P.K. (2005), *Microeconometrics: Methods and Applications*, Cambridge University Press, Cambridge University Press, Cambridge, available at: https://books.google.it/books?hl=en&lr=&id=TdlKAgAAQBAJ&oi=fnd&pg=PP1&dq=cameron+and+trivedi&ots=yLioNYgFts&sig=swkGgNL3XBqYMPT_w8cBbrfwhi8&redir_esc=y#v=onepage&q=cameron%20and%20trivedi&f=false

Capone, R., El Bilali, H., Debs, P., Cardone, G. and Driouech, N. (2014), "Mediterranean food consumption patterns sustainability: setting up a common ground for future research and action", *American Journal of Food Science and Nutrition*, Vol. 1 No. 2, p. 37, doi: 10.12966/ajnfs.04.04.2014.

Carfora, V., Morandi, M., Catellani, P., Van Loey, A. and Foubert, I. (2022a), "The effect of message framing in promoting the Mediterranean diet: the moderating role of eating self-efficacy", *Foods*, Vol. 11 No. 10, 1461, doi: 10.3390/foods11101461.

Carfora, V., Morandi, M., Jelić, A. and Catellani, P. (2022b), "The psychosocial antecedents of the adherence to the Mediterranean diet", *Public Health Nutrition*, Vol. 25 No. 10, pp. 2742-2757, doi: 10.1017/s1368980022000878.

Cavaliere, A., De Marchi, E. and Banterle, A. (2018), "Exploring the adherence to the Mediterranean diet and its relationship with individual lifestyle: the role of healthy behaviors, pro-environmental behaviors, income, and education", *Nutrients*, Vol. 10 No. 2, p. 141, doi: 10.3390/nu10020141.

De Lorgeril, M., Salen, P., Martin, J.L., Monjaud, I., Delaye, J. and Mamelle, N. (1999), "Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon diet heart study", *Circulation*, Vol. 99 No. 6, pp. 779-785, doi: 10.1161/01.cir.99.6.779.

Dernini, S. and Berry, E.M. (2015), "Mediterranean diet: from a healthy diet to a sustainable dietary pattern", *Frontiers in Nutrition*, Vol. 2, 130610, doi: 10.3389/fnut.2015.00015.

Dernini, S., Berry, E.M., Serra-Majem, L., La Vecchia, C., Capone, R., Medina, F.X., Aranceta-Bartrina, J., Belahsen, R., Burlingame, B., Calabrese, G., Corella, D., Donini, L., Lairon, D., Meybeck, A., Pekcan, A., Piscopo, S., Yngve, A. and Trichopoulou, A. (2017), "Med diet 4.0: the Mediterranean diet with four sustainable benefits", *Public Health Nutrition*, Vol. 20 No. 7, pp. 1322-1330, doi: 10.1017/s1368980016003177.

Donini, L.M., Dernini, S., Lairon, D., Serra-Majem, L., Amiot, M.J., Del Balzo, V., Giusti, A.M., Burlingame, B., Belahsen, R., Maiani, G., Polito, A., Turrini, A., Intorre, F., Trichopoulou, A., Berry, M.E. and Berry, E.M. (2016), "A consensus proposal for nutritional indicators to assess the sustainability of a healthy diet: the Mediterranean diet as a case study", *Frontiers in Nutrition*, Vol. 3, p. 37, doi: 10.3389/fnut.2016.00037.

D'Cunha, N.M., Foscolou, A., Tyrovolas, S., Chrysohoou, C., Rallidis, L., Polychronopoulos, E., Matalas, A.L., Sidossis, L.S., Naumovski, N. and Panagiotakos, D.B. (2020), "The association between protein consumption from animal and plant sources with psychological distress in older people in the Mediterranean region", *Nutrition and Healthy Aging*, Vol. 5 No. 4, pp. 273-285, doi: 10.3233/nha-190079.

Estruch, R. (2010), "Anti-inflammatory effects of the Mediterranean diet: the experience of the PREDIMED study", *Proceedings of the Nutrition Society*, Vol. 69 No. 3, pp. 333-340, doi: 10.1017/s0029665110001539.

European Commission (2016), *Towards Better Prevention and Management of Chronic Diseases*, Publications Office of the European Union, European Commission, Brussels, available at: https://ec.europa.eu/health/newsletter/169/focus_newsletter_en.htm (accessed 2 January 2025).

European Commission (2020), *Farm to fork strategy action plan: 2020 strategyinfo [Commission communication]*, Publications Office of the European Union, available at: https://

food.ec.europa.eu/document/download/472acca8-7f7b-4171-98b0-ed76720d68d3_en?filename=f2f_action-plan_2020_strategy-info_en.pdf

EUROSTAT (2023), "Quality of life indicators – material living conditions", available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Quality_of_life_indicators_-_material_living_conditions (accessed 13 October 2025).

Franchini, C., Biasini, B., Sogari, G., Wongprawmas, R., Andreani, G., Dolgopolova, I., Gómez, M.I., Roosen, J., Menozzi, D., Mora, C., Scazzina, F. and Rosi, A. (2024), "Adherence to the Mediterranean diet and its association with sustainable dietary behaviors, sociodemographic factors, and lifestyle: a cross-sectional study in US university students", *Nutrition Journal*, Vol. 23 No. 1, p. 56, doi: 10.1186/s12937-024-00962-0.

Giacco, R. and Riccardi, G. (1991), "Comparison of current eating habits in various Mediterranean countries", in *The Mediterranean Diets in Health and Disease*, Springer US, Boston, MA, pp. 3-9.

Godos, J., Grosso, G., Ferri, R., Caraci, F., Lanza, G., Al-Qahtani, W.H., Caruso, G. and Castellano, S. (2023), "Mediterranean diet, mental health, cognitive status, quality of life, and successful aging in southern Italian older adults", *Experimental Gerontology*, Vol. 175, 112143, doi: 10.1016/j.exger.2023.112143.

Godos, J., Guglielmetti, M., Ferraris, C., Frias-Toral, E., Domínguez Azpíroz, I., Lipari, V., Di Mauro, A., Furnari, F., Castellano, S., Galvano, F., Iacoviello, L., Bonaccio, M. and Grosso, G. (2025), "Mediterranean diet and quality of life in adults: a systematic review", *Nutrients*, Vol. 17 No. 3, p. 577, doi: 10.3390/nu17030577.

González-Sosa, S., Ruiz-Hernández, J.J., Puente-Fernández, A., Robaina-Bordón, J.M. and Conde-Martel, A. (2023), "Adherence to the Mediterranean diet in medical students", *Public Health Nutrition*, Vol. 26 No. 9, pp. 1798-1806, doi: 10.1017/s1368980023000964.

Grilli, G. and Curtis, J. (2021), "Encouraging pro-environmental behaviours: a review of methods and approaches", *Renewable and Sustainable Energy Reviews*, Vol. 135, 110039, doi: 10.1016/j.rser.2020.110039.

Grosso, G., Marventano, S., D'Urso, M., Mistretta, A. and Galvano, F. (2017), "The Mediterranean healthy eating, ageing, and lifestyle (MEAL) study: rationale and study design", *International Journal of Food Sciences and Nutrition*, Vol. 68 No. 5, pp. 577-586, doi: 10.1080/09637486.2016.1262335.

Grosso, G., Fresán, U., Bes-Rastrollo, M., Marventano, S. and Galvano, F. (2020), "Environmental impact of dietary choices: role of the Mediterranean and other dietary patterns in an Italian cohort", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 5, 1468, doi: 10.3390/ijerph17051468.

Hacker, K. (2024), "The burden of chronic disease", *Mayo Clinic Proceedings: Innovations, Quality and Outcomes*, Vol. 8 No. 1, pp. 112-119, doi: 10.1016/j.mayocpiqo.2023.08.005.

Haigh, L., Kirk, C., El Gendy, K., Gallacher, J., Errington, L., Mathers, J.C. and Anstee, Q.M. (2022), "The effectiveness and acceptability of Mediterranean diet and calorie restriction in non-alcoholic fatty liver disease (NAFLD): a systematic review and meta-analysis", *Clinical Nutrition*, Vol. 41 No. 9, pp. 1913-1931, doi: 10.1016/j.clnu.2022.06.037.

Houminer-Klepar, N. and Dopelt, K. (2025), "Associations between Mediterranean diet, processed food consumption, and symptoms of anxiety and depression: cross-sectional study among Israeli adults", *Foods*, Vol. 14 No. 9, 1485, doi: 10.3390/foods14091485.

ISTAT (2023), "Popolazione residente e dinamica demografica-Anno 2022", *Comunicato Stampa*, 18 Dicembre 2023, available at: https://www.istat.it/comunicato-stampa/popolazione-residente-e-dinamica-demografica-anno-2022 (accessed 28 July 2025).

ISTAT (2024), "Livelli di istruzione e ritorni occupazionali-Anno 2023", Report, 17 Luglio 2024, available at: https://www.istat.it/wp-content/uploads/2024/07/REPORT-livelli-istruzione.pdf (accessed 28 July 2025).

ISTAT (2025), "Indicatori demografici-Anno 2024", Report, 31Marzo 2025, available at: https://www.istat.it/comunicato-stampa/indicatori-demografici-anno-2024/ (accessed 28 July 2025).

Jacka, F.N., O'Neil, A., Opie, R., Itsiopoulos, C., Cotton, S., Mohebbi, M., Castle, D., Dash, S., Mihalopoulos, C., Chatterton, M.L., Brazionis, L., Dean, O.M., Hodge, A.M. and Berk, M. (2017), "A randomised controlled trial of dietary improvement for adults with major depression (the 'SMILES'trial)", *BMC Medicine*, Vol. 15 No. 1, p. 23, doi: 10.1186/s12916-017-0791-y.

Kessler, R.C., Barker, P.R., Colpe, L.J., Epstein, J.F., Gfroerer, J.C., Hiripi, E., Howes, M.J., Normand, S.L., Manderscheid, R.W., Walters, E.E. and Zaslavsky, A.M. (2003), "Screening for serious mental illness in the general population", *Archives of General Psychiatry*, Vol. 60 No. 2, pp. 184-189, doi: 10.1001/archpsyc.60.2.184.

Keyes, C.L.M. (2002), "The mental health continuum: from languishing to flourishing in life", *Journal of Health and Social Behavior*, Vol. 43 No. 2, pp. 207-222, doi: 10.2307/3090197.

Keys, A. and Aravanis, C. (1980), *Seven Countries: A Multivariate Analysis of Death and Coronary Heart Disease*, Harvard University Press, Cambridge, MA and London, pp. 1-381, doi: 10.4159/harvard.9780674497887.

Kocaadam-Bozkurt, B. and Bozkurt, O. (2023), "Relationship between adherence to the Mediterranean diet, sustainable and healthy eating behaviors, and awareness of reducing the ecological footprint", *International Journal of Environmental Health Research*, Vol. 33 No. 4, pp. 430-440, doi: 10.1080/09603123.2023.2172384.

Konttinen, H., Männistö, S., Sarlio-Lähteenkorva, S., Silventoinen, K. and Haukkala, A. (2010), "Emotional eating, depressive symptoms and self-reported food consumption. A population-based study", *Appetite*, Vol. 54 No. 3, pp. 473-479, doi: 10.1016/j.appet.2010.01.014.

Lassale, C., Batty, G.D., Baghdadli, A., Jacka, F., Sánchez-Villegas, A., Kivimäki, M. and Akbaraly, T. (2019), "Healthy dietary indices and risk of depressive outcomes: a systematic review and meta-analysis of observational studies", *Molecular Psychiatry*, Vol. 24 No. 7, pp. 965-986, doi: 10.1038/s41380-018-0237-8.

Laureti, T. and Benedetti, I. (2018), "Exploring pro-environmental food purchasing behaviour: an empirical analysis of Italian consumers", *Journal of Cleaner Production*, Vol. 172, January, pp. 3367-3378, doi: 10.1016/j.jclepro.2017.11.086.

León-Muñoz, L.M., Guallar-Castillón, P., Graciani, A., López-García, E., Mesas, A.E., Aguilera, M.T., Banegas, J.R., Rodríguez-Artalejo, F. and Rodríguez-Artalejo, F. (2012), "Adherence to the Mediterranean diet pattern has declined in Spanish adults, 3", *The Journal of Nutrition*, Vol. 142 No. 10, pp. 1843-1850, doi: 10.3945/jn.112.164616.

Liu, Y., Zhang, J., Chen, Z. and Wang, X. (2023), "Adherence to the Mediterranean diet and depression: a systematic review of recent studies", *SHS Web of Conferences*, Vol. 163, 04003.

López-Moreno, M., Garcés-Rimón, M., Miguel, M. and Iglesias López, M.T. (2021), "Adherence to Mediterranean diet, alcohol consumption and emotional eating in Spanish university students", *Nutrients*, Vol. 13 No. 9, 3174, doi: 10.3390/nu13093174.

Mahmoudzadeh, S., Mohammadifard, M., Khorasanchi, Z., Karbasi, S., Ferns, G.A. and Bahrami, A. (2023), "Adherence to a Mediterranean diet style and psychological distress and quality of life in young women", *Psychiatry/Psychiatria*, Vol. 20 No. 2, doi: 10.18502/ppj.v20i2.13097.

Markle, G.L. (2013), "Pro-environmental behavior: does it matter how it's measured? Development and validation of the pro-environmental behavior scale (PEBS)", *Human Ecology*, Vol. 41 No. 6, pp. 905-914, doi: 10.1007/s10745-013-9614-8.

Martínez-González, M.Á. and Sánchez-Villegas, A. (2004), "The emerging role of Mediterranean diets in cardiovascular epidemiology: monounsaturated fats, olive oil, red wine or the whole pattern?", *European Journal of Epidemiology*, Vol. 19 No. 1, pp. 9-13, doi: 10.1023/b:ejep.0000013351.60227.7b.

Mateer, T.J., Melton, T.N., Miller, Z.D., Lawhon, B., Agans, J.P. and Taff, B.D. (2022), "A multi-dimensional measure of pro-environmental behavior for use across populations with varying levels of environmental involvement in the United States", *PLoS One*, Vol. 17 No. 10, e0274083, doi: 10.1371/journal.pone.0274083.

Metin, Z.E., Çelik, Ö.M. and Koç, N. (2024), "Relationship between adherence to the Mediterranean diet, sustainable and healthy eating behaviors, and climate change awareness: a cross-sectional study from Turkey", *Nutrition*, Vol. 118, 112266, doi: 10.1016/j.nut.2023.112266.

Micha, R., Peñalvo, J.L., Cudhea, F., Imamura, F., Rehm, C.D. and Mozaffarian, D. (2017), "Association between dietary factors and mortality from heart disease, stroke, and type 2 diabetes in the United States", *JAMA*, Vol. 317 No. 9, pp. 912-924, doi: 10.1001/jama.2017.0947.

Mieziene, B., Emeljanovas, A., Novak, D. and Kawachi, I. (2022), "Social capital promotes a healthier diet among young adults by reducing psychological distress", *Nutrients*, Vol. 14 No. 23, 5187, doi: 10.3390/nu14235187.

Monteagudo, C., Mariscal-Arcas, M., Rivas, A., Lorenzo-Tovar, M.L., Tur, J.A. and Olea-Serrano, F. (2015), "Proposal of a Mediterranean diet serving score", *PLoS One*, Vol. 10 No. 6, e0128594, doi: 10.1371/journal.pone.0128594.

Oka, M. (2021), "Interpreting a standardized and normalized measure of neighborhood socioeconomic status for a better understanding of health differences", *Archives of Public Health*, Vol. 79, December, p. 226, doi: 10.1186/s13690-021-00750-w.

Pariante, C.M. (2017), "Why are depressed patients inflamed? A reflection on 20 years of research on depression, glucocorticoid resistance and inflammation", *European Neuropsychopharmacology*, Vol. 27 No. 6, pp. 554-559, doi: 10.1016/j.euroneuro.2017.04.001.

Pfoh, E.R., Chan, K.S., Dinglas, V.D., Cuthbertson, B.H., Elliott, D., Porter, R., Bienvenu, O.J., Hopkins, R.O. and Needham, D.M. (2016), "The SF-36 offers a strong measure of mental health symptoms in survivors of acute respiratory failure. A tri-national analysis", *Annals of the American Thoracic Society*, Vol. 13 No. 8, pp. 1343-1350, doi: 10.1513/annalsats.201510-705oc.

Poore, J. and Nemecek, T. (2018), "Reducing food's environmental impacts through producers and consumers", *Science*, Vol. 360 No. 6392, pp. 987-992, doi: 10.1126/science.aaq0216.

Rajizadeh, A., Mozaffari-Khosravi, H., Yassini-Ardakani, M. and Dehghani, A. (2017), "Effect of magnesium supplementation on depression status in depressed patients with magnesium deficiency: a randomized, double-blind, placebo-controlled trial", *Nutrition*, Vol. 35, pp. 56-60, doi: 10.1016/j.nut.2016.10.014.

Read, S., Grundy, E. and Foverskov, E. (2016), "Socio-economic position and subjective health and well-being among older people in Europe: a systematic narrative review", *Aging and Mental Health*, Vol. 20 No. 5, pp. 529-542, doi: 10.1080/13607863.2015.1023766.

Rehm, J., Gmel Sr, G.E., Gmel, G., Hasan, O.S., Imtiaz, S., Popova, S., Probst, C., Roerecke, M., Room, R., Samokhvalov, A.V., Shield, K.D. and Shuper, P.A. (2017), "The relationship between different dimensions of alcohol use and the burden of disease—an update", *Addiction*, Vol. 112 No. 6, pp. 968-1001, doi: 10.1111/add.13757.

Ruggiero, E., Di Castelnuovo, A., Costanzo, S., Persichillo, M., Bracone, F., Cerletti, C., Donati, M.B., de Gaetano, G., Iacoviello, L., Iacoviello, L., Bonanni, A., Bonanni, A., Costanzo, S., de Gaetano, G., Donati, M.B., Iacoviello, L., Persichillo, M., Zito, F., Aurisano, L., Barisciano, P., Bonaccio, V., Aversa, F.D., De Lucia, F., Galuppo, G., Panzera, T., Petrucci, F., Sciarretta, A., Verna, A., Di Castelnuovo, A., Olivieri, M. and Bonaccio, M. (2019), "Socioeconomic and psychosocial determinants of adherence to the Mediterranean diet in a general adult Italian population", *The European Journal of Public Health*, Vol. 29 No. 2, pp. 328-335, doi: 10.1093/eurpub/cky127.

Sadeghi, O., Keshteli, A.H., Afshar, H., Esmaillzadeh, A., Adibi, P. and Pouraram, H. (2021), "Adherence to Mediterranean dietary pattern is inversely associated with depression, anxiety and psychological distress", *Nutritional Neuroscience*, Vol. 24 No. 3, pp. 248-259, doi: 10.1080/1028415x.2019.1620425.

Sáez-Almendros, S., Obrador, B., Bach-Faig, A. and Serra-Majem, L. (2013), "Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet", *Environmental Health*, Vol. 12, pp. 1-8, doi: 10.1186/1476-069x-12-118.

Sánchez-Villegas, A., Henríquez, P., Bes-Rastrollo, M. and Doreste, J. (2006), "Mediterranean diet and depression", *Public Health Nutrition*, Vol. 9 No. 8A, pp. 1104-1109, doi: 10.1017/s1368980007668578.

Sánchez-Villegas, A., Delgado-Rodríguez, M., Alonso, A., Schlatter, J., Lahortiga, F., Serra Majem, L. and Martínez-González, M.A. (2009), "Association of the Mediterranean dietary pattern with the incidence of depression: the Seguimiento Universidad de Navarra/University of Navarra follow-up (SUN) cohort", *Archives of General Psychiatry*, Vol. 66 No. 10, pp. 1090-1098, doi: 10.1001/archgenpsychiatry.2009.129.

Santos-Buelga, C., Gonzalez-Manzano, S. and Gonzalez-Paramas, A.M. (2021), "Wine, polyphenols, and Mediterranean diets. What else is there to say?", *Molecules*, Vol. 26 No. 18, 5537, doi: 10.3390/molecules26185537.

Serra-Majem, L., Tomaino, L., Dernini, S., Berry, E.M., Lairon, D., Ngo de La Cruz, J., Bach-Faig, A., Donini, L.M., Medina, F.X., Belahsen, R., Piscopo, S., Capone, R., Aranceta-Bartrina, J., La Vecchia, C. and Trichopoulou, A. (2020), "Updating the Mediterranean diet pyramid towards sustainability: focus on environmental concerns", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 23, 8758, doi: 10.3390/ijerph17238758.

Sofi, F., Cesari, F., Abbate, R., Gensini, G.F. and Casini, A. (2008), "Adherence to Mediterranean diet and health status: meta-analysis", *BMJ*, Vol. 337 No. sep11 2, a1344, doi: 10.1136/bmj.a1344.

Stockwell, T., Zhao, J., Panwar, S., Roemer, A., Naimi, T. and Chikritzhs, T. (2016), "Do 'moderate' drinkers have reduced mortality risk? A systematic review and meta-analysis of alcohol consumption and all-cause mortality", *Journal of Studies on Alcohol and Drugs*, Vol. 77 No. 2, pp. 185-198, doi: 10.15288/jsad.2016.77.185.

Sweeting, H. and Hunt, K. (2014), "Adolescent socio-economic and school-based social status, health and well-being", *Social Science and Medicine*, Vol. 121, pp. 39-47, doi: 10.1016/j.socscimed.2014.09.037.

Tomiyama, A.J. (2019), "Stress and obesity", *Annual Review of Psychology*, Vol. 70 No. 1, pp. 703-718, doi: 10.1146/annurev-psych-010418-102936.

Trichopoulou, A., Costacou, T., Bamia, C. and Trichopoulos, D. (2003), "Adherence to a Mediterranean diet and survival in a Greek population", *New England Journal of Medicine*, Vol. 348 No. 26, pp. 2599-2608, doi: 10.1056/nejmoa025039, available at: https://www.nejm.org

Trichopoulou, A., Psaltopoulou, T., Orfanos, P., Hsieh, C.C. and Trichopoulos, D. (2007), "Low-carbohydrate–high-protein diet and long-term survival in a general population cohort", *European Journal of Clinical Nutrition*, Vol. 61 No. 5, pp. 575-581, doi: 10.1038/sj.ejcn.1602557.

UNESCO (2010), "The Mediterranean diet [Intangible cultural heritage]", available at: https://www.unesco.org/archives/multimedia/document-1680-eng-2

Villodres, G.C., Salvador Pérez, F. and Muros, J.J. (2024), "Factors associated with Mediterranean diet adherence in a sample of high socio-economic status children from southern Spain", *Public Health Nutrition*, Vol. 27 No. 1, pp. 51-59, doi: 10.1017/s136898002400003x.

Ware, J.E. and Sherbourne, C.D. (1992), "The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection", *Medical Care*, Vol. 30 No. 6, pp. 473-483, doi: 10.1097/00005650-199206000-00002.

World Health Organization (2023), "Obesity and overweight", available at: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight#:~:text=In%202022%2C%201%20in%208,million%20were%20living%20with%20obesity

Yamazaki, S., Fukuhara, S. and Green, J. (2005), "Usefulness of five-item and three-item mental health inventories to screen for depressive symptoms in the general population of Japan", *Health and Quality of Life Outcomes*, Vol. 3, August, p. 48, doi: 10.1186/1477-7525-3-48.

Yassıbaş, E. and Bölükbaşı, H. (2023), "Evaluation of adherence to the Mediterranean diet with sustainable nutrition knowledge and environmentally responsible food choices", *Frontiers in Nutrition*, Vol. 10, 1158155, doi: 10.3389/fnut.2023.1158155.

Zhu, D., Li, Y., Sun, L., Zhang, X., Wang, M. and Wang, Y. (2024), "Comparative efficacy of dietary interventions on glycemic control and anthropometric outcomes in type 2 diabetes: a network

meta-analysis of randomized controlled trials", *Diabetes Research and Clinical Practice*, Vol. 209, 111522.

Zhubaj, V., Gontarev, S., Stojmanovska, D.S. and Georgiev, G. (2024), "Physical activity, Mediterranean diet and smoking in adolescents from the Republic of Kosovo", *Research in Physical Education, Sport and Health*, Vol. 13 No. 2, pp. 135-142, doi: 10.46733/pesh24132135z.

Corresponding author
Veronica Vitali can be contacted at: veronica.vitali1@unicatt.it