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*Research article*

## **Loneliness, social participation, and adherence to the Mediterranean diet among adults in Greece: A cross-sectional study**

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**Abstract:** *Background:* Loneliness is increasingly recognized as a public health concern and may be associated with health-related behaviors, including dietary habits. The Mediterranean diet is a well-established dietary pattern with recognized health benefits, yet adherence has declined in Mediterranean populations. This study examined the association between loneliness, social participation, and adherence to the Mediterranean diet among adults in Greece. *Methods:* A cross-sectional study was conducted from January to February 2026 involving 288 adults in Greece recruited through convenience sampling. Participants completed a structured anonymous questionnaire including sociodemographic, work-related, and lifestyle characteristics, the UCLA loneliness scale version 3, and the MEDAS-GR questionnaire. Descriptive statistics, bivariate analyses, correlation tests, and multiple linear regression analyses were performed. *Results:* The mean age of participants was 35.5 years (SD = 12.1), and 76.7% were women. Most participants lived in urban areas (76.0%) and were employed full-time (73.5%). The mean loneliness score was 2.1 (SD = 0.5) on a 1–4 scale, while the mean Mediterranean diet adherence score was 6.6 (SD = 2.0) out of 14. Loneliness was negatively correlated with Mediterranean diet adherence ( $r = -0.202$ ,  $p = 0.001$ ). In multivariable analysis, older age ( $b = 0.037$ , 95% CI: 0.017 to 0.056,  $p < 0.001$ ), place of residence ( $b = -0.552$ , 95%

CI:  $-0.975$  to  $-0.129$ ,  $p = 0.011$ ), home meal preparation ( $b = -0.858$ , 95% CI:  $-1.368$  to  $-0.348$ ,  $p = 0.001$ ), and systematic social participation ( $b = 0.665$ , 95% CI:  $0.394$  to  $0.936$ ,  $p < 0.001$ ) were independently associated with Mediterranean diet adherence. Systematic social participation was also independently associated with lower loneliness ( $b = -0.356$ , 95% CI:  $-0.308$  to  $-0.165$ ,  $p < 0.001$ ). *Conclusions:* Among adults in Greece, Mediterranean diet adherence was moderate and loneliness was low to moderate. Social participation emerged as a key correlate of both lower loneliness and higher Mediterranean diet adherence, suggesting that public health strategies promoting healthy dietary behaviors may benefit from incorporating social and community-based components.

**Keywords:** loneliness; mediterranean diet; social participation; dietary behavior; public health; adults; cross-sectional study

## 1. Introduction

Loneliness is a subjective and distressing experience arising from a discrepancy between desired and actual social relationships, and it is conceptually distinct from objective social isolation [1]. Over the past decade, loneliness has been increasingly recognized as a major public health concern due to its consistent associations with adverse health outcomes. A substantial body of evidence indicates that loneliness is linked to increased risk of depression and anxiety, cardiovascular disease, cognitive decline, and all-cause mortality [2–4]. Large-scale epidemiological studies and meta-analyses have demonstrated that the health risks associated with loneliness and social isolation are comparable to those of established behavioral risk factors, highlighting their importance for population health [2,4,5]. Consequently, international organizations and recent reports have emphasized the need to address loneliness within public health frameworks and preventive strategies [3].

While early research primarily focused on the direct health consequences of loneliness, more recent approaches emphasize the role of behavioral pathways linking psychosocial factors to health outcomes. Loneliness has been associated with a range of health-related behaviors, including reduced physical activity, poorer sleep quality, increased substance use, and lower engagement in preventive health practices [5,6]. These findings suggest that loneliness may influence health not only through biological mechanisms, such as chronic stress and inflammation, but also by shaping daily behaviors that are critical for long-term health. However, among these behavioral pathways, dietary behavior remains relatively underexplored, despite its central role in the development and prevention of chronic diseases.

Diet is a key modifiable determinant of health, and among dietary patterns, the Mediterranean diet is one of the most extensively studied and well-documented. Characterized by high consumption of fruits, vegetables, whole grains, legumes, nuts, and olive oil; moderate intake of fish and wine; and low consumption of red and processed meat, the Mediterranean diet has been consistently associated with reduced risk of cardiovascular disease, metabolic disorders, certain cancers, and overall mortality [7–9]. In addition to its well-established physical health benefits, emerging evidence suggests that adherence to the Mediterranean diet may also be associated with better mental health outcomes, including lower risk of depression and improved psychological well-being [8,10]. Despite these benefits, adherence to

the Mediterranean diet has been declining in both Mediterranean and non-Mediterranean populations, reflecting broader lifestyle changes and the increasing adoption of Westernized dietary patterns [9].

The relationship between loneliness and dietary behavior is complex and likely multifactorial. Several mechanisms have been proposed to explain how loneliness may influence eating patterns. Individuals experiencing loneliness may be more likely to eat alone, skip meals, or rely on convenience and ultra-processed foods, leading to lower dietary quality [11–13]. Psychosocial distress associated with loneliness may reduce motivation for meal planning and preparation, while emotional coping strategies may favor the consumption of energy-dense, less nutritious foods. At the same time, the social context of eating plays a crucial role in shaping dietary habits. Shared meals and social interactions have been associated with healthier food choices, better diet quality, and more regular eating patterns [14]. In this context, social participation may act as an important protective factor, reflecting an individual's engagement in social activities and networks that facilitate both emotional support and health-promoting behaviors.

Indeed, social participation has been linked to a variety of positive health outcomes, including improved mental well-being, reduced loneliness, and healthier lifestyle behaviors [15,16]. Individuals who are more socially engaged are more likely to adopt and maintain healthy behaviors, including balanced dietary patterns, possibly due to social norms, shared routines, and increased access to resources and support [16,17]. These observations suggest that loneliness and social participation should not be examined in isolation, but rather as interconnected dimensions of social experience that may jointly influence dietary behavior. Recognizing loneliness as a multidimensional public health issue is also relevant for health professional education, as improving professionals' understanding of its clinical, social, and emotional dimensions may facilitate more comprehensive and person-centered approaches to prevention and care [18].

Despite the growing interest in loneliness and health, important gaps remain in the literature. First, although loneliness has been extensively studied in relation to health outcomes, relatively few studies have specifically examined its association with dietary behavior as a primary outcome [11,12]. Second, existing studies are heterogeneous in terms of design, population, and measurement of dietary intake, often relying on fragmented indicators rather than validated indices of overall dietary patterns. Third, even fewer studies have focused on adherence to well-defined dietary patterns, such as the Mediterranean diet, which integrates multiple dimensions of diet quality [7,9]. Finally, the potential role of social participation as a complementary or interacting factor in the relationship between loneliness and dietary behavior has not been sufficiently integrated into empirical models. The novelty of the present study lies in the simultaneous examination of loneliness, social participation, and adherence to the Mediterranean diet within the Greek adult population, using a validated measure of Mediterranean diet adherence. By integrating psychosocial, social, and dietary dimensions within a single analytical framework, this study provides context-specific evidence from a Mediterranean country where adherence to the traditional dietary pattern has been declining.

Addressing these gaps may contribute to a more comprehensive understanding of how psychosocial factors are linked to dietary behavior and may inform the development of more effective public health interventions that integrate social and behavioral components. We hypothesized that higher levels of loneliness would be associated with lower adherence to the Mediterranean diet, whereas regular social participation would be associated with higher Mediterranean diet adherence.

This study aimed to examine the association between loneliness and adherence to the Mediterranean diet among adults, and to explore the role of social participation and selected sociodemographic and lifestyle factors in these associations.

## 2. Materials and methods

### 2.1. Study design

We conducted a cross-sectional study in Greece. Data were collected from January to February 2026 through an online survey distributed electronically using convenience sampling. The questionnaire was disseminated through digital communication channels and personal/professional networks. To minimize duplicate responses, participants were informed that they should complete the questionnaire only once.

Participants were eligible if they were aged  $\geq 18$  years, able to understand the Greek language, and willing to participate in the study. Participation was voluntary and anonymous. We followed the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines in the reporting of this study.

### 2.2. Measurements

We used a structured questionnaire to collect data on sociodemographic characteristics, lifestyle behaviors, social participation, loneliness, and adherence to the Mediterranean diet.

We collected data on gender, age (continuous variable), marital status, educational level, employment status, place of residence (urban/semi-urban/rural), and household composition. Additional variables included lifestyle and meal-related behaviors, such as meal preparation at home, eating alone, eating while watching television or using digital devices, and social participation. Home meal preparation was assessed using a study-specific question regarding the usual place or method of meal preparation. For the analyses, responses were recoded into two categories: meals prepared by the participant at home and meals not prepared at home by the participant, including meals prepared by others, food from workplace or school facilities, ordering food, or preparation in a small kitchen. Social participation was assessed using a single study-specific (ad hoc) question asking participants whether they systematically participated in social activities, with three response options (“yes”, “no”, and “occasionally”). For the regression analyses, responses were dichotomized into regular participation (“yes”) and not regular participation (“no” or “occasionally”). Because this variable was assessed using a single ad hoc question rather than a validated multidimensional instrument, it should be interpreted as a behavioral indicator of regular engagement in social activities rather than a comprehensive measure of social participation. Information on diagnosed mental health conditions (e.g., depression or anxiety), body mass index, and physical activity was not collected in the present study and therefore these variables were not included in the statistical analyses.

Loneliness was assessed using the UCLA loneliness scale version 3 [1]. In the present study, a modified 16-item version of the scale was used. Responses were recorded on a four-point Likert scale, and positively worded items were reverse-coded prior to analysis. Higher scores indicated greater

perceived loneliness. The scale has demonstrated high internal consistency, with a Cronbach's alpha coefficient of 0.901 in the present study.

Adherence to the Mediterranean diet was assessed using the Mediterranean diet adherence screener (MEDAS-GR) [10], a 14-item instrument evaluating the frequency of consumption of key components of the Mediterranean diet. Total scores range from 0 to 14, with higher scores indicating greater adherence. Adherence was categorized as low ( $\leq 5$ ), moderate (6–9), and high ( $\geq 10$ ). The Greek version of the MEDAS has been validated for use in adult populations.

### 2.3. Ethical issues

We conducted our study in accordance with the Declaration of Helsinki. The Ethics and Deontology Committee of the Department of Nursing, National and Kapodistrian University of Athens approved the study protocol (approval number: 28, November 28, 2025). Data were collected on an anonymous and voluntary basis. Participants were informed about the aim and the design of the study and provided their informed consent prior to participation.

### 2.4. Statistical analysis

We presented categorical variables as numbers and percentages, and continuous variables as means and standard deviations (SD), medians, and interquartile ranges, as appropriate. We assessed the normality of continuous variables using the Kolmogorov-Smirnov test and Q-Q plots. We used independent samples t-tests and analysis of variance (ANOVA) to examine differences in continuous variables between groups. We assessed correlations using Pearson's or Spearman's correlation coefficients, as appropriate. We performed multiple linear regression analyses to identify factors associated with Mediterranean diet adherence and loneliness. Mediterranean diet adherence and loneliness scores were treated as dependent variables. Sociodemographic, lifestyle, and social participation variables were included as independent variables based on theoretical relevance and statistical significance in bivariate analyses. A backward stepwise linear regression approach was applied to construct the final models. We reported regression coefficients (b), 95% confidence intervals (CI), and p-values. P-values  $< 0.05$  were considered statistically significant.

All statistical analyses were performed using IBM SPSS Statistics, version 30.0.

## 3. Results

### 3.1. Demographic and lifestyle characteristics

A total of 288 adults participated in the study. The demographic and lifestyle characteristics of participants are presented in Table 1. The mean age of participants was 35.5 years (SD = 12.1), and the majority were women (76.7%). Most participants lived in urban areas (76.0%) and were employed full-time (73.5%). A high proportion had tertiary or postgraduate education. Additionally, a considerable proportion of participants reported preparing meals at home and participating regularly in social activities.

**Table 1.** Demographic and lifestyle characteristics of participants (N = 288).

| Characteristics          | n    | %    |
|--------------------------|------|------|
| Age (years) <sup>a</sup> | 35.5 | 12.1 |
| Gender                   |      |      |
| Male                     | 67   | 23.3 |
| Female                   | 221  | 76.7 |
| Place of residence       |      |      |
| Urban                    | 219  | 76.0 |
| Semi-urban/rural         | 69   | 24.0 |
| Employment status        |      |      |
| Full-time                | 212  | 73.5 |
| Other                    | 76   | 26.5 |
| Education level          |      |      |
| Secondary                | 52   | 18.1 |
| Tertiary/postgraduate    | 236  | 81.9 |
| Social participation     |      |      |
| Regular                  | 168  | 58.3 |
| Not regular              | 120  | 41.7 |

Note: <sup>a</sup>: standard deviation.

### 3.2. Loneliness and Mediterranean diet adherence

Descriptive statistics for loneliness and Mediterranean diet adherence are presented in Table 2. The mean loneliness score was 2.1 (SD = 0.5) on a scale ranging from 1 to 4, with higher scores indicating greater perceived loneliness. The mean Mediterranean diet adherence score was 6.6 (SD = 2.0) out of 14. Based on established MEDAS-GR cut-off values, this score corresponds to moderate adherence to the Mediterranean diet. A statistically significant negative correlation was observed between loneliness and Mediterranean diet adherence ( $r = -0.202$ ,  $p = 0.001$ ), indicating that higher levels of loneliness were associated with lower adherence to the Mediterranean diet. Although loneliness was negatively correlated with Mediterranean diet adherence in the bivariate analysis, it was not retained in the final backward stepwise multivariable model after adjustment for sociodemographic, lifestyle, and social participation variables.

**Table 2.** Descriptive statistics for loneliness and Mediterranean diet adherence (N = 288).

| Variable/scale               | Mean | Standard deviation | Median | Interquartile range |
|------------------------------|------|--------------------|--------|---------------------|
| Loneliness score             | 2.1  | 0.5                | 2.0    | 0.7                 |
| Mediterranean diet adherence | 6.6  | 2.0                | 6.0    | 3.0                 |

### 3.3. Factors associated with Mediterranean diet adherence

The multivariable linear regression analysis identified several factors associated with Mediterranean diet adherence (Table 3). Older age was positively associated with Mediterranean diet adherence ( $b = 0.037$ , 95% CI = 0.017 to 0.056,  $p < 0.001$ ). Place of residence was also associated with Mediterranean diet adherence ( $b = -0.552$ , 95% CI = -0.975 to -0.129,  $p = 0.011$ ). Home meal preparation was also associated with Mediterranean diet adherence. Participants whose meals were not

prepared at home by themselves had lower Mediterranean diet adherence scores than those who usually prepared their meals at home ( $b = -0.858$ , 95% CI =  $-1.368$  to  $-0.348$ ,  $p = 0.001$ ). Additionally, systematic participation in social activities was positively associated with Mediterranean diet adherence ( $b = 0.665$ , 95% CI =  $0.394$  to  $0.936$ ,  $p < 0.001$ ).

**Table 3.** Linear regression model with Mediterranean diet adherence as the dependent variable (N = 288).

| Independent variable  | Coefficient b | 95% CI for b     | p-value |
|-----------------------|---------------|------------------|---------|
| Age                   | 0.037         | 0.017 to 0.056   | <0.001  |
| Place of residence    | -0.552        | -0.975 to -0.129 | 0.011   |
| Home meal preparation | -0.858        | -1.368 to -0.348 | 0.001   |
| Social participation  | 0.665         | 0.394 to 0.936   | <0.001  |

Note: CI: confidence interval; b: regression coefficient;  $R^2$  for the multivariable model = 17.8%; p-value for ANOVA < 0.001.

### 3.4. Factors associated with loneliness

The multivariable linear regression analysis identified several factors associated with loneliness (Table 4). Female sex was associated with higher loneliness scores ( $b = 0.126$ , 95% CI =  $0.024$  to  $0.299$ ,  $p = 0.022$ ). Employment status was also associated with loneliness ( $b = 0.115$ , 95% CI =  $0.008$  to  $0.321$ ,  $p = 0.039$ ). Participants who reported that working hours affected meal quality had higher loneliness scores ( $b = 0.166$ , 95% CI =  $0.062$  to  $0.297$ ,  $p = 0.003$ ). In contrast, systematic participation in social activities was negatively associated with loneliness ( $b = -0.356$ , 95% CI =  $-0.308$  to  $-0.165$ ,  $p < 0.001$ ).

**Table 4.** Linear regression model with loneliness as the dependent variable (N = 288).

| Independent variable              | Coefficient b | 95% CI for b     | p-value |
|-----------------------------------|---------------|------------------|---------|
| Female sex                        | 0.126         | 0.024 to 0.299   | 0.022   |
| Employment status                 | 0.115         | 0.008 to 0.321   | 0.039   |
| Working hours affect meal quality | 0.166         | 0.062 to 0.297   | 0.003   |
| Social participation              | -0.356        | -0.308 to -0.165 | <0.001  |

Note: CI: confidence interval; b: regression coefficient.

## 4. Discussion

The present study examined the association between loneliness, social participation, and adherence to the Mediterranean diet among adults. The main findings were that loneliness was negatively correlated with Mediterranean diet adherence, while social participation was independently associated with both higher adherence to the Mediterranean diet and lower loneliness. Older age, place of residence, and home meal preparation were also associated with Mediterranean diet adherence. These findings indicate that adherence to the Mediterranean diet should not be interpreted only as an individual nutritional choice, but also as a behavior shaped by social participation, household routines, residential context, and daily food practices [11,15,17,19,20].

The mean MEDAS score observed in the present study (6.6/14) indicates moderate adherence to the Mediterranean diet and is consistent with contemporary evidence from Greece showing a gradual decline in adherence to the traditional Mediterranean dietary pattern. In the nationally representative HYDRIA survey, only 28.3% of Greek adults had high adherence to the Greek traditional Mediterranean diet, while adherence was lower among adults younger than 65 years compared with older adults [21]. Similarly, longitudinal evidence from the ATTICA study has shown a decline in Mediterranean diet adherence among Greek adults over time [22]. Taken together, these findings support the interpretation that the moderate adherence observed in our sample reflects current dietary trends in Greece rather than an isolated finding.

The relatively low-to-moderate loneliness levels observed in our sample should be interpreted with caution. Although previous studies conducted in Greece have identified loneliness as an important public health issue among adults and primary care populations [23], direct numerical comparisons are not appropriate because these studies employed the original 20-item UCLA loneliness scale, whereas the present study used a modified 16-item version.

The moderate adherence to the Mediterranean diet observed in this study is consistent with evidence showing that adherence to Mediterranean dietary patterns is influenced by socioeconomic, environmental, behavioral, and cultural factors [7,9,20]. A recent systematic review of adults in Mediterranean countries highlighted that adherence to the Mediterranean diet is shaped across multiple socio-ecological levels, including individual characteristics, interpersonal influences, and environmental conditions [20]. Similar findings have been reported in populations with chronic disease, where age, education, body mass index, physical activity, and broader contextual factors appear to influence adherence to the Mediterranean diet [24]. Therefore, the moderate adherence observed in this study may reflect broader lifestyle transitions rather than limited awareness of the Mediterranean diet alone [7,9,20,24].

The negative association between loneliness and Mediterranean diet adherence is consistent with emerging evidence linking loneliness and social isolation with poorer food and eating behaviors [11,13,17,25]. Hanna et al. reported that loneliness and social isolation are associated with multiple food-related outcomes, including diet quality, meal patterns, and eating motivation [11]. Recent qualitative evidence further suggests that loneliness and social isolation can influence food choices, cooking routines, and shared eating practices, often resulting in less nutritious diets and reduced food-related sociability [25]. These findings support the interpretation that loneliness may influence dietary behavior through both psychological and practical pathways [11,17,25].

Several mechanisms may explain the relationship between loneliness and Mediterranean diet adherence. Loneliness may reduce motivation for shopping, cooking, and meal planning, while emotional distress may increase reliance on convenience foods or irregular eating patterns [11,13,25]. In parallel, social disconnection may reduce opportunities for shared meals and weaken food-related routines that support diet quality [15,19,25]. This is particularly relevant for the Mediterranean diet because it is not only a nutrient-based dietary model but also a culturally embedded pattern involving home-prepared meals, commensality, shared routines, and minimally processed foods [7,9,19,20].

Social participation was one of the strongest and most conceptually important findings of this study. It was positively associated with Mediterranean diet adherence and negatively associated with loneliness. This dual association suggests that social participation may operate as a bridging factor

between psychosocial well-being and dietary behavior. Previous evidence has shown that social relationships are associated with healthier dietary behavior [15], while loneliness and social isolation are associated with poorer physical and mental health outcomes [2,4,6,16]. The present findings extend this literature by showing that social participation is linked not only to general health behavior, but also to adherence to a validated dietary pattern [10,15,20].

The association between social participation and Mediterranean diet adherence may be explained through exposure to healthier social norms, increased opportunities for shared meals, greater structure in daily routines, and stronger motivation for self-care [15,19,25]. Socially active individuals may be more likely to prepare or share meals, exchange food-related practices, and maintain regular dietary routines [19,25]. Conversely, lower social participation may increase the likelihood of eating alone and relying on less structured food practices [11,25]. These mechanisms are consistent with the conceptual framing of the Mediterranean diet as a social and cultural dietary pattern, not merely a sum of individual food items [7,9,19,20].

Older age was positively associated with Mediterranean diet adherence. This finding is consistent with evidence suggesting that older adults may be more likely to preserve traditional eating patterns, whereas younger adults may be more exposed to westernized dietary habits, time pressure, eating outside the home, and convenience foods [9,20,24]. Age should not be interpreted as a causal factor, but rather as a marker of generational differences in cooking skills, food culture, and familiarity with traditional dietary practices [20,24]. This has practical importance because interventions for younger adults may need to focus on feasible implementation of the Mediterranean diet in everyday working life rather than on general nutritional information alone [20,24,26].

Usually preparing meals at home was independently associated with higher adherence to the Mediterranean diet. This finding is strongly supported by evidence showing that cooking at home is associated with better diet quality, healthier food choices, and higher healthy eating index scores [26–31]. Wolfson and Bleich found that frequent home cooking was associated with healthier dietary intake [26], while later work using nationally representative data showed that more frequent home cooking was associated with higher healthy eating index-2015 scores across income groups [27]. Mills et al. also reported that more frequent consumption of home-cooked meals was associated with better dietary quality and lower adiposity [28]. These findings support the interpretation that home meal preparation may be a practical mechanism through which adults maintain adherence to healthier dietary patterns, including the Mediterranean diet [26–31].

The finding regarding place of residence also deserves careful interpretation. Residential context may reflect access to traditional foods, food availability, work patterns, household routines, and exposure to urbanized food environments [20,24]. Studies on Mediterranean diet adherence suggest that environmental and contextual determinants are important but often underexplored [20]. Therefore, place of residence should not be treated merely as a geographic descriptor; it may represent a broader socio-ecological context affecting food access, cooking practices, and maintenance of traditional dietary routines [20,24,29].

The factors associated with loneliness further support the argument that psychosocial well-being and dietary routines are interconnected. Female sex, employment status, perceived impact of working hours on meal quality, and social participation were associated with loneliness. The higher loneliness scores observed among women should be interpreted cautiously. Previous evidence suggests that

gender differences in loneliness are generally small and may vary by age, cultural context, social roles, and the way loneliness is perceived and reported [32,33]. Therefore, this finding may reflect not only gender itself, but also differences in social expectations, emotional labor, caring responsibilities, and the subjective reporting of loneliness. Employment status may also be understood as a marker of daily structure, economic security, social exposure, and work-related demands, rather than as a purely occupational variable. Evidence indicates that unemployment and adverse work-related conditions may be associated with loneliness, while the broader work context can shape opportunities for social connection or social disconnection [34,35]. In our study, the association between working hours affecting meal quality and higher loneliness is particularly relevant because it suggests that work organization may influence both eating behavior and social connection. Demanding or irregular schedules may reduce time for cooking, disrupt shared meals, and limit opportunities for participation in social activities [11,25–28,35]. This finding reinforces the need to examine loneliness and diet within the structure of everyday life rather than as isolated individual outcomes [11,25,28].

The practical implications of these findings should be translated into specific actions. First, community-based health promotion programs could combine Mediterranean diet education with structured cooking sessions, group meal preparation, and shared meals. Such programs could focus on low-cost Mediterranean meals using legumes, vegetables, whole grains, olive oil, and fish, with practical meal plans adapted to adults with limited time [26–31]. Second, primary care and community health professionals could screen for loneliness, low social participation, and poor meal routines during dietary counseling, particularly among individuals reporting frequent eating alone or reduced home cooking [3,11,25]. Third, local authorities and community centers could develop Mediterranean diet and social connection programs, such as weekly cooking groups, intergenerational meal clubs, neighborhood shared-meal initiatives, and peer-led food preparation sessions [19,25,28–31].

Workplace-based actions are also warranted. Because working hours affecting meal quality were associated with loneliness, employers and occupational health services could support regular meal breaks, access to healthier food options, and brief workplace nutrition sessions focused on feasible Mediterranean diet choices during working days [26–28]. Universities and workplaces could also provide practical toolkits, including simple weekly Mediterranean meal-preparation plans, guidance for healthy meals outside the home, and low-cost recipes for people living alone [26–31]. These actions are more concrete than general advice to eat healthier and are more likely to address the structural and routine-based barriers identified in this study.

Social prescribing may offer a useful public health framework for integrating dietary behavior and social participation. Social prescribing connects individuals with non-clinical community resources, such as activity groups, volunteering, cultural activities, peer-support groups, and community-based programs [36–41]. Systematic reviews suggest that social prescribing may improve loneliness, social connectedness, and mental well-being, although the evidence remains heterogeneous and implementation quality varies [36–41]. In the context of this study, social prescribing could be adapted to include food-related activities, such as community kitchens, cooking groups, shared-meal programs, and culturally tailored Mediterranean diet workshops [36–41]. This would address both social disconnection and dietary behavior within the same intervention pathway.

The present study has several strengths. To our knowledge, this is among the first studies conducted in Greece to examine loneliness, social participation, and adherence to the Mediterranean diet within a

single analytical framework. The use of established instruments for assessing loneliness and Mediterranean diet adherence strengthens the methodological quality of the study. In addition, the inclusion of meal-related behavioral variables, such as home meal preparation and the perceived impact of working hours on meal quality, allows a more contextualized interpretation of dietary behavior. By examining psychosocial, social, and meal-related factors together, the study provides a broader perspective on the determinants of Mediterranean diet adherence and highlights the potential value of public health interventions that combine nutritional guidance with social and behavioral components.

## **5. Limitations**

Several limitations should be acknowledged. The cross-sectional design does not allow causal inference; therefore, it cannot be determined whether loneliness contributes to lower Mediterranean diet adherence, whether poorer dietary routines contribute to loneliness, or whether both are influenced by other unmeasured factors [5,6,11]. Convenience sampling and online data collection may have introduced selection bias, while the high proportion of women and highly educated participants limits generalizability. Self-reported data may also be affected by recall bias and social desirability bias, especially regarding dietary behaviors [10,11,26]. Moreover, the UCLA loneliness scale was used in a modified 16-item form, which should be considered when comparing the findings with studies using the full version [1]. In addition, information on diagnosed mental health conditions (e.g., depression and anxiety), body mass index, and physical activity was not collected. These factors may influence both loneliness and dietary behaviors and may therefore represent potential sources of residual confounding. Future studies should include these variables to provide a more comprehensive understanding of the relationship between loneliness, social participation, and adherence to the Mediterranean diet.

## **6. Conclusions**

The findings suggest that loneliness, social participation, and adherence to the Mediterranean diet are interrelated. Social participation appears to be particularly important, as it was associated with both higher Mediterranean diet adherence and lower loneliness. Public health strategies should therefore move beyond individual dietary advice and incorporate social participation, home meal preparation, shared meals, and community-based support. Interventions that combine Mediterranean diet promotion with structured opportunities for social connection may be more actionable and relevant than nutrition education alone.

## **Use of AI tools declaration**

The authors declare that Artificial Intelligence (AI) tools were used solely for English language editing and improvement of readability, while all scientific content, interpretations, analyses, and conclusions were developed and verified by the authors.

## Authors' contributions

TP: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing-original draft preparation, writing-review and editing, visualization. EK: conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing-original draft preparation, writing-review and editing, visualization. OK: methodology, software, validation, data curation, writing-review and editing. PA: conceptualization, writing-review and editing, visualization, supervision.

## Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Conflict of interest

The authors declare no conflict of interest.

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