ORIGINAL RESEARCH ARTICLE

Mediterranean diet adherence, self-rated health, body mass index, and unhealthy alcohol use in Italian university students: A cross-sectional study

FLAVIA PENNISI[1,2], ANTONIO PINTO[1], DANIELE NUCCI[2,3], LORENZO STACCHINI[4], NICOLA VERONESE[5], STEFANIA MAGGI[6], VINCENZO BALDO[7], VINCENZA GIANFREDI[7]

[1]Faculty of Medicine, University Vita-Salute San Raffaele, Milan, Italy; [2]PhD National Program in One Health Approaches to Infectious Diseases and Life Science Research, Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy; [3]Struttura Semplice Dipartimentale Igiene Alimenti e Nutrizione, Dipartimento di Igiene e Prevenzione Sanitaria, Agenzia di Tutela della Salute (ATS) Brescia, Brescia, Italy; [4]Department of Community Healthcare Network, Health District Toscana ASL Nord Ovest, Pisa, Italy; [5]Saint Camillus International University of Health Sciences, Faculty of Medicine, Rome, Italy; [6]Neuroscience Institute, Aging Branch, National Research Council (CNR), Padua, Italy; [7]Department of Cardiac Thoracic Vascular Sciences and Public Health, University of Padua, Padua, Italy.

ABSTRACT

Background: University students are at increased risk for unhealthy behaviours, including poor diet and hazardous alcohol use. Mediterranean Diet (MD) adherence has been linked to favourable health outcomes, but evidence in young adults is scarce. This study examined the association of MD adherence with self-rated health (SRH), body mass index (BMI), and alcohol-related risk in Italian university students, considering also food delivery app use.

Methods: A cross-sectional study was conducted among 2,697 students (70.6% female) at the University of Milan during the academic year 2021/2022. MD adherence was assessed with the validated Medi-Lite questionnaire (score range 0–18, with higher scores indicating greater adherence), SRH with a single-item indicator, BMI from self-reported data, and alcohol-related risk with the AUDIT-C. Multivariable logistic and multinomial regression models were applied.

Results: Compared with students with low MD adherence, those with high MD adherence (≥12 score) had higher odds of good SRH (aOR = 3.16, 95% CI = 1.23–8.11) and lower odds of overweight/obesity (aOR = 0.66, 95% CI = 0.52–0.85), with no significant association with alcohol risk. Greater consumption of fruits, vegetables,

Received: 25 November 2025 | Accepted: 12 February 2026

Correspondence: Daniele Nucci / PhD National Program in One Health Approaches to Infectious Diseases and Life Science Research Department of Public Health, Experimental and Forensic Medicine / University of Pavia, 27100 Pavia, Italy / E-mail: daniele.nucci@ats-brescia.it / ORCID: 0000-0003-4546-213X

legumes, cereals, and olive oil predicted better SRH and lower BMI. Food delivery app use was associated with overweight/obesity and alcohol risk.

Discussion: Higher MD adherence is linked to improved perceived health and lower odds of overweight/obesity among university students. Public health strategies should promote MD and improve digital food environments by limiting unhealthy food marketing and facilitating healthier online choice.

Key words: mediterranean diet, self-rated health, body mass index, unhealthy alcohol use, university students, digital food environment.

Introduction

University students represent a population subgroup particularly vulnerable to the adoption of unhealthy behaviours during the transition to adulthood (1). This period is marked by a growing autonomy over food choices, changes in social environments, academic pressures, and limited food literacy, all of which may promote sedentary behaviours, irregular eating patterns, and excessive alcohol consumption (2–4). Concurrently, digital transformations in the food environment have reshaped how young adults access and consume food (5,6). These unhealthy behaviours are associated with a departure from the Mediterranean Diet (MD) model (3,7). Adopting healthy dietary habits from early adulthood is crucial, as inadequate nutrition during youth may have long-term repercussions that manifest in later life (8). This nutritional transition is particularly concerning given the increasing rates of overweight and obesity in university cohorts. Recent data show that the prevalence of overweight in this population ranges from 16% to 32%, and obesity from 4% to 20% (9,10). In this context, body mass index (BMI) is a widely used measure to monitor weight status and assess the risk of associated health conditions (11). Excessive alcohol consumption represents another major risk behaviour among young adults, often associated with unhealthy lifestyles and poor dietary choices (12). Evidence suggests that greater adherence to the MD may be linked to more moderate and mindful alcohol intake (13). However, this association remains underexplored in university populations. Self-rated health (SRH) is a widely used indicator of overall health (14) and shows strong associations with objective health measures and long-term outcomes (15,16). Because it integrates multiple physical and psychosocial dimensions, SRH is particularly useful for capturing the impact of lifestyle factors in young adults (17). Although several studies have examined the association between MD adherence and individual health indicators, findings in young adult populations remain limited and heterogeneous. Given these gaps, the present study aims to investigate the associations of adherence to the MD with three key health outcomes, BMI, SRH, and alcohol-related risk, in a large sample of Italian university students. Additionally, the study examines the role of digital food behaviours, including food delivery and food waste app use, and explores potential sex-specific differences across associations.

Methods

Study design and data collection

The UniFoodWaste study utilized a cross-sectional approach involving students aged 18 years and older, enrolled at the University of Milan. Data were collected between July and October 2023, and obtained through an anonymous online questionnaire created with Microsoft Forms. The survey was distributed via the university's official mailing system, and access was limited to users with institutional email

credentials to ensure that only eligible students could participate. Participation was voluntary, and informed consent was obtained electronically before the commencement of the survey. To minimize missing data, all questions were made mandatory, requiring respondents to complete the entire questionnaire prior to submission. A comprehensive overview of the study protocol has been published elsewhere (18).

Adherence to the Mediterranean Diet

Adherence to the MD was assessed using the Medi-Lite questionnaire. The Medi-Lite questionnaire is a validated dietary assessment tool developed by Sofi et al. (19), it is based on evidence from cohort studies examining the relationship between dietary patterns and health outcomes. The questionnaire includes nine food categories: fruit, vegetables, cereals, legumes, fish and seafood, meat and meat products, dairy products, olive oil, and alcohol. For each food group, participants receive a score ranging from 0 to 2 based on consumption frequency, with higher scores reflecting greater adherence to Mediterranean dietary principles. For high-adherence food groups (fruit, vegetables, cereals, legumes, and fish), consumption was scored as 2 points for the highest intake category, 1 point for the intermediate category, and 0 points for the lowest category. For low-adherence food groups (meat and dairy products), the scoring was reversed (2 points for the lowest intake category, 1 point for intermediate intake, and 0 points for the highest intake category). Olive oil consumption was scored as 2 points for regular use, 1 point for frequent use, and 0 points for occasional use. Alcohol intake was scored as 2 points for 1–2 units/day, 1 point for <1 unit/day, and 0 points for >2 units/day. The total Medi-Lite score was obtained by summing item scores, with higher values indicating greater adherence to the Mediterranean Diet. The total adherence score ranges from 0 (low adherence) to 18 (high adherence). In line with previous publications (20,21), a score of 12 or above was classified as high adherence.

Self-rated health

SRH is a widely used, single-item measure that assesses an individual's overall perception of their health status through the question: "In general, how would you rate your health?" Response options include "excellent," "very good," "good," "fair," and "poor" (22,23). For analytical purposes, responses were categorized into two groups: "high" ("excellent," "very good," and "good") and "low" ("fair" and "poor").

Body mass index

BMI was calculated for each participant by dividing weight in kilograms by the square of height in meters (kg/m^2). Self-reported values for weight and height were used when available. The resulting BMI values were categorized according to the World Health Organization (WHO) classification system: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obesity (≥30.0 kg/m^2).

Alcohol abuse

Alcohol consumption patterns have been evaluated using the Alcohol Use Disorders Identification Test - Consumption (AUDIT-C) (24,25). The AUDIT is a 10-item instrument: the first three items (AUDIT-C) assess alcohol consumption and are commonly used to screen for hazardous or problematic drinking, whereas the remaining seven items capture alcohol-related consequences and symptoms suggestive of alcohol dependence. In line with the aims of the present study, we administered the Italian version of the short 3-item AUDIT-C only. Specifically, the three AUDIT-C items cover frequency of alcohol consumption, typical quantity consumed, and frequency of binge drinking. Each item is scored on a scale from 0 to 4, yielding a total score ranging from 0 to 12. A threshold score of ≥5 for males and ≥4 for females is indicative of potentially risky drinking behaviour.

Covariates

The first section of the survey gathered information on participant characteristics, including gender (female, male, prefer not to say), age, geographical area (referred to the student's place of origin: North, Center-South, defined based on the geographical distribution of ISTAT), education level (High school diploma, Bachelor's degree, Master's degree

or higher), smoking status (yes/no, where only current smokers were classified as 'smokers' and former smokers were included in the 'not smoker' category), and usage of food-related mobile applications (including food delivery apps and food-waste–related apps. For instance applications aimed at purchasing/redistributing surplus food or supporting food-waste reduction).

Statistical analysis

Descriptive statistics were used to summarize sample characteristics. Categorical variables were reported as frequencies and percentages and compared using Pearson's chi-square or Fisher's exact tests when appropriate. Continuous variables were expressed as means and standard deviations; normality was assessed using the Kolmogorov–Smirnov test, and group differences evaluated using one-way ANOVA or Welch's t-test, as appropriate. Associations between continuous variables were examined using Pearson's correlation coefficients. Associations with sociodemographic and health indicators (BMI, SRH, AUDIT-C) were evaluated using chi-square tests for categorical variables and Pearson's r for continuous ones. Bonferroni correction was applied to adjust for multiple comparisons throughout the analysis. The primary objective was to evaluate the association between Mediterranean diet adherence (total Medi-Lite score, both categorical and continuous) and three key outcomes: SRH, BMI, and AUDIT-C These associations were assessed using multivariable logistic and multinomial logistic regression models, as appropriate. Models were adjusted for age group, sex and educational level. Results were expressed as odds ratios (OR) or relative risk ratios (RRR), with 95% confidence intervals. To further describe patterns across the full range of adherence, the distribution of BMI categories, SRH levels, and AUDIT-C risk was examined across all Medi-Lite score values using chi-square tests with post-hoc comparisons. In addition, to explore dietary quality at the component level, responses to each Medi-Lite food group were dichotomized as "optimal" (i.e., receiving the maximum score of 2 points), and the proportion of optimal responses was compared across SRH, BMI, and AUDIT-C categories. Additionally, exploratory multivariable logistic regression models were conducted to explore associations between individual food components of the Medi-Lite and each outcome domain (SRH, BMI, AUDIT-C). These models, stratified by outcome, included all food items as independent variables and were adjusted for age and sex. All statistical analyses were conducted using Stata version 18.5, with significance set at $p < 0.05$.

Sample size estimation

The sample size was determined assuming a 95% confidence level and a 5% margin of error. The target population comprised the total number of students enrolled at the University of Milan during the 2021/2022 academic year, totalling 60,988 individuals (26). A conservative estimate of 50% was used for the expected proportion, as this value maximises the required sample size and ensures adequate statistical power. Based on these assumptions, the minimum sample size was calculated to be 382 participants.

Ethical considerations

The study received ethical approval from the Ethics Committee of the University of Milan (Approval ID: 71.23).

Results

Descriptive characteristics

A total of 2,779 questionnaire responses were initially collected in this cross-sectional survey. After excluding 54 participants who did not provide informed consent and 34 participants with missing BMI or Medi-Lite score data, the resulting sample included 2,691 individuals (Figure 1). The sample comprised 70.6% females and 29.4% males; the most frequent age category was 18–23 years, including 1,431 participants (53.2%).

Among these, 1,928 (71.6%) were classified as normal weight, 339 (12.6%) as under-weight, 337

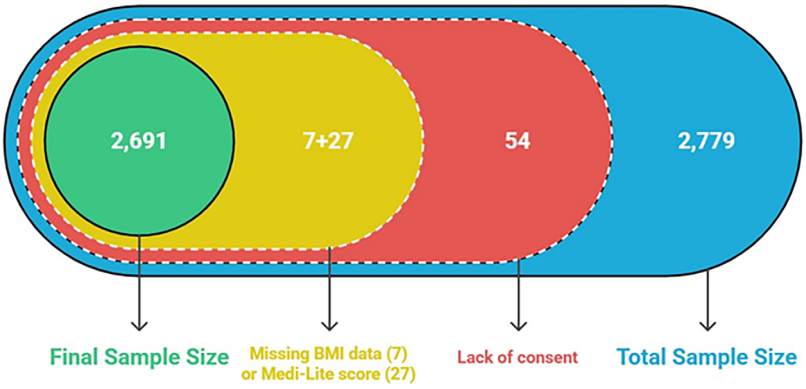

Figure 1. Flow chart of participant selection.

(12.5%) as overweight, and 87 (3.3%) as obese/very obese (Table 1).

Distribution of sociodemographic and health-related characteristics across BMI categories is reported in Table 1. Significant differences emerged for gender, age, geographical area, and educational level (all $p < 0.01$). Higher BMI categories included a greater proportion of older participants, while underweight and normal-weight groups were predominantly composed of younger women. Smoking status did not differ significantly across BMI groups ($p=0.452$). Self-rated health worsened progressively with increasing BMI, with "fair/poor" ratings most common among individuals with obesity (32.2%; $p < 0.001$). Mean BMI values increased in a graded manner across categories, from 17.5 kg/m² in underweight participants to 33.4 kg/m² in the obese/very obese group ($p < 0.001$).

Associations of Mediterranean Diet Adherence with BMI, Self-Rated Health, and Alcohol Abuse

The Medi-Lite score showed a positive correlation with SRH ($r = 0.22$, $p < 0.001$), no significant correlation with AUDIT-C ($r = 0.02$, $p = 0.25$), and a weak negative correlation with BMI ($r = -0.09$, $p < 0.001$) (Figure 2).

Analysis of individual dietary components showed significant differences by SRH and BMI categories. In the SRH-stratified analysis (Figure 3a), optimal responses for fruit (23.9% vs. 7.1%), vegetables (28.9% vs. 9.5%), legumes (36.0% vs. 9.5%), and oil (77.2% vs. 57.1%) consumption were more frequent among participants with excellent vs. poor/fair SRH (all $p < 0.05$). In the BMI-stratified analysis (Figure 3b), significant differences emerged only for meat consumption ($p < 0.05$), with optimal responses more frequent among underweight (58.5%) and normal weight (54.2%) than obese/very obese participants (35.9%). In the AUDIT-C stratified analysis (Figure 3c), participants at no risk showed higher proportions of optimal responses for most food groups, although differences were not significant after Bonferroni correction.

The distribution of Medi-Lite scores varied significantly across SRH categories ($\chi^2 = 212.84$, $df = 56$, $p < 0.001$) (Figure 4a). Post-hoc analysis with Bonferroni correction revealed that participants reporting "Excellent/Very good" SRH were overrepresented at higher Medi-Lite scores (12, 14, and 15; all $p < 0.05$), whereas those with "Fair" or "Poor" SRH were more frequent at lower scores (3, 6, and 7; all $p < 0.05$). A significant deviation was also observed at score 9 ($p < 0.05$), with a greater proportion of "Good" SRH participants compared to other categories. Importantly, in the additional high-adherence group (≥12), participants were significantly more likely to report "Very good" or "Excellent" SRH and less likely to report "Fair" or "Poor" SRH ($p < 0.001$ after Bonferroni correction). BMI categories showed significant associations with Medi-Lite scores at four specific values. Participants classified as underweight or normal

Table 1. Distribution of sociodemographic and health-related characteristics by BMI category. Percentages are column percentages and represent the distribution of each characteristic within BMI categories. p-values refer to chi-square tests (categorical variables) or one-way ANOVA (continuous variables).

	Underweight < 18.5 kg/m^2 N=339 (12.6)	**Normal weight ≥ 18.5 and ≤ 24.9 kg/m^2 N=1,928 (71.6)**	**Overweight ≥ 25 and ≤ 29.9 kg/m^2 N=337 (12.5)**	**Obese/very obese ≥ 30 kg/m^2 N= 87 (3.2)**	**p-value**
Gender					
Women	285 (84.1)	1,356 (70.3)	197 (58.5)	61 (70.1)	<0.001
Men	50 (14.8)	541 (28.1)	133 (39.5)	24 (27.8)	
Prefer not to say	4 (1.2)	31 (1.6)	7 (2.1)	2 (2.3)	
Age, years					
18-23	209 (61.7)	1037 (53.8)	136 (40.4)	30 (34.5)	<0.001
24-29	99 (29.2)	618 (32.1)	109 (32.3)	29 (33.3)	
≥30	31 (9.1)	273 (14.2)	92 (27.3)	28 (32.2)	
Geographical area					
North	321 (94.7)	1,776(92.1)	299 (88.7)	84 (96.6)	0.029
Center and South	15 (4.4)	131 (6.8)	36 (10.7)	3 (3.5)	
Abroad	3 (0.9)	21 (1.1)	2 (0.6)	0 (0.0)	
Educational level					
High school diploma	212 (62.5)	997 (51.7)	163 (48.4)	43 (49.4)	0.001
Bachelor's degree	64 (18.9)	513 (26.6)	84 (24.9)	30 (34.5)	
Master's degree or higher	63 (18.6)	418 (21.7)	90 (26.7)	14 (16.1)	
Smoking status					
Non-smoker	253 (74.6)	1375 (71.3)	234 (69.4)	60 (69.0)	0.452
Smoker	86 (25.4)	553 (28.7)	103 (30.6)	27 (31.0)	
SRH[1]					
Excellent	22 (6.5)	158 (8.2)	17 (5.0)	0 (0.0)	<0.001
Very good	113 (33.3)	726 (37.7)	63 (18.7)	15 (17.2)	
Good	161 (47.5)	815 (42.3)	161 (47.8)	44 (50.6)	
Fair	38 (11.2)	212 (11.0)	84 (24.9)	20 (23.0)	
Poor	5 (1.5)	17 (0.9)	12 (3.6)	8 (9.2)	
AUDIT-C[2]					
At risk (≥5 for men or ≥4 for women)	43 (12.7)	321 (16.7)	58 (17.2)	14 (16.1)	0.305
No risk	296 (87.3)	1,607(83.4)	279 (82.8)	73 (83.9)	
BMI[3] (continuous; mean and standard deviation)	17.5 (0.85)	21.5 (1.7)	26.8 (1.3)	33.4 (3.7)	<0.001

Abbreviations: [1]SRH: Self-rated health; [2]BMI: Body mass index; [3]AUDIT-C: Alcohol Use Disorders Identification Test – Consumption

weight were more frequent at score 3 ($p < 0.001$) and score 4 ($p = 0.049$), whereas overweight and obese/very obese individuals were underrepresented at these lower scores. Conversely, significant differences were detected at score 5 ($p = 0.034$) and score 9 ($p = 0.003$), with overweight participants showing higher proportions compared to other BMI groups. Similarly, the high-adherence group (≥12) showed a significantly greater proportion of underweight and normal-weight individuals, and a lower prevalence of overweight and obese/very obese participants ($p < 0.05$ after Bonferroni correction) (Figure 4b). No significant differences in Medi-Lite score distribution were detected according to alcohol-related risk scores (all $p > 0.05$ after Bonferroni correction). Although no significant association between MD adherence and AUDIT-C risk was observed in the low vs. high adherence comparison (Table 2; $p = 0.38$), post-hoc analyses across the

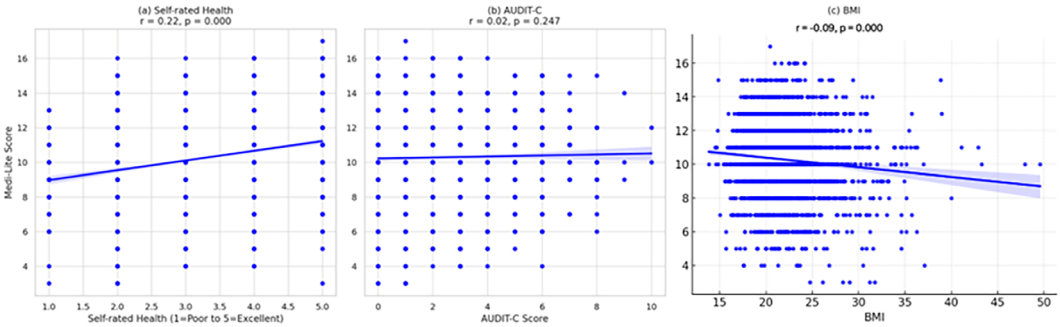

Figure 2. Association between adherence to the Mediterranean diet (Medi-Lite score) and (a) Self-rated Health (SRH), (b) Alcohol Abuse (AUDIT-C score), and (c) Body Mass Index (BMI). Each panel displays a scatter plot with a fitted regression line (blue) and 95% confidence intervals (shaded area). Analyses are adjusted for age and sex. Pearson's correlation coefficient (r) and p-values are re-ported for each association. Higher Medi-Lite scores indicate greater adherence to the Mediterranean diet.

full distribution of Medi-Lite scores showed that participants in the ≥12 category were specifically underrepresented among individuals at alcohol-related risk ($p < 0.001$ after Bonferroni correction). (Figure 4c).

Categorising participants according to MD adherence, a significant association was observed for SRH in both the Chi-Square test ($p < 0.001$) and correlation analysis ($r = 0.1308$; $p < 0.001$) (Table 2). Compared to the low-adherence group, participants with high adherence less frequently reported "Fair" (9.0% vs. 14.7%) and "Good" health (36.8% vs. 46.6%), and more often reported "Very good" (42.9% vs. 30.8%) or "Excellent" health (10.7% vs. 6.0%). For alcohol consumption (AUDIT-C items), Chi-Square tests showed no significant differences (all $p > 0.05$), though correlations with the Medi-Lite score were significant for drinking frequency ($r = 0.06$; $p = 0.002$) and typical amount ($r = –0.04$; $p = 0.043$). BMI category was significantly associated with diet adherence in both tests (Chi-Square: $p = 0.024$; correlation: $r = –0.04$; $p = 0.021$), with higher adherence linked to a greater proportion of underweight (14.2% vs. 12.0%) and normal weight (73.3% vs. 71.0%) individuals, and fewer overweight (10.6% vs. 13.3%) and obese (1.9% vs. 3.8%) cases.

Regression analysis

Multivariate logistic analyses revealed several significant associations between high adherence to MD and individual food items, according to SRH, AUDIT-C risk, and overweight/obesity status (Table 3).

Higher MD adherence was related to higher SRH (aOR = 3.16; $p = 0.017$) and lower odds of overweight/obesity (aOR = 0.66; $p = 0.001$). When treated as a continuous variable, the Medi-Lite score showed a positive association with SRH (aOR = 1.42; $p < 0.001$) and a negative association with BMI (aOR = 0.89; $p < 0.001$).Fruit intake of 1–2 portions/day and >2 portions/day was linked to markedly higher odds of reporting high SRH (aOR = 4.42 and 4.89; $p \leq 0.010$, respectively), and to reduced likelihood of being at risk according to AUDIT-C (aOR = 0.64 and 0.50; both $p < 0.001$). Vegetable consumption above 2.5 portions/day also showed a strong positive association with SRH (aOR = 5.92; $p = 0.002$) and was related to lower odds of being overweight/obese (aOR = 0.66; $p = 0.037$). Similarly, consuming legumes more than twice per week was associated with both higher SRH (aOR = 4.18; $p = 0.010$) and lower odds of overweight/obesity (aOR = 0.55; $p < 0.001$). Participants consuming more than 1.5 portions/day of cereals had reduced odds of overweight/obesity (aOR = 0.63; $p = 0.019$). Meat consumption below 1 portion/day was linked to lower AUDIT-C risk (aOR = 0.67; $p = 0.035$) and lower prevalence of overweight/obesity (aOR = 0.43; $p < 0.001$). Regular use of olive oil was positively associated with SRH (aOR = 2.50; $p = 0.022$). Alcohol intake below 1 AU/day was strongly associated with a substantially lower risk according to AUDIT-C (aOR = 0.14; $p < 0.001$).

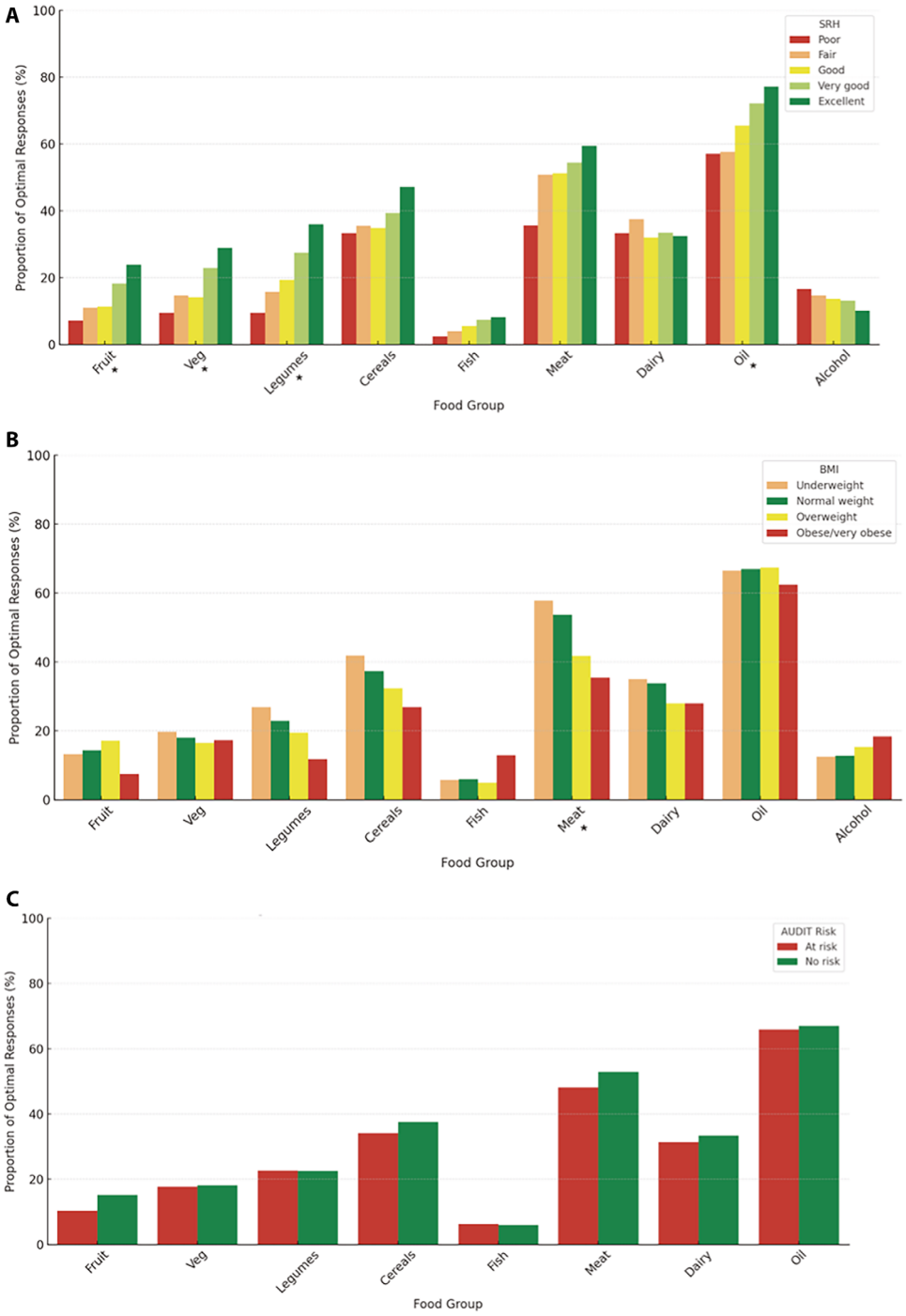

Figure 3. Proportion of participants providing the optimal dietary response for each food group, defined as the response awarding 2 points in the Medi-Lite score, stratified by (**a**) Self-Rated Health (SRH), (**b**) Body Mass Index (BMI), and (**c**) alcohol consumption risk level (AUDIT-C categories). Food categories are ordered according to the Medi-Lite scoring system. The "Alcohol" category was excluded from panel (c) due to being directly related to AUDIT-C classification. Asterisks indicate statistically significant differences in the proportion of optimal responses between each group and the rest of the sample, based on Fisher's exact test or chi-squared test with Bonferroni correction for multiple comparisons. *Abbreviations:* SRH: Self-rated health; BMI: Body mass index; AUDIT-C: Alcohol Use Disorders Identification Test – Consumption

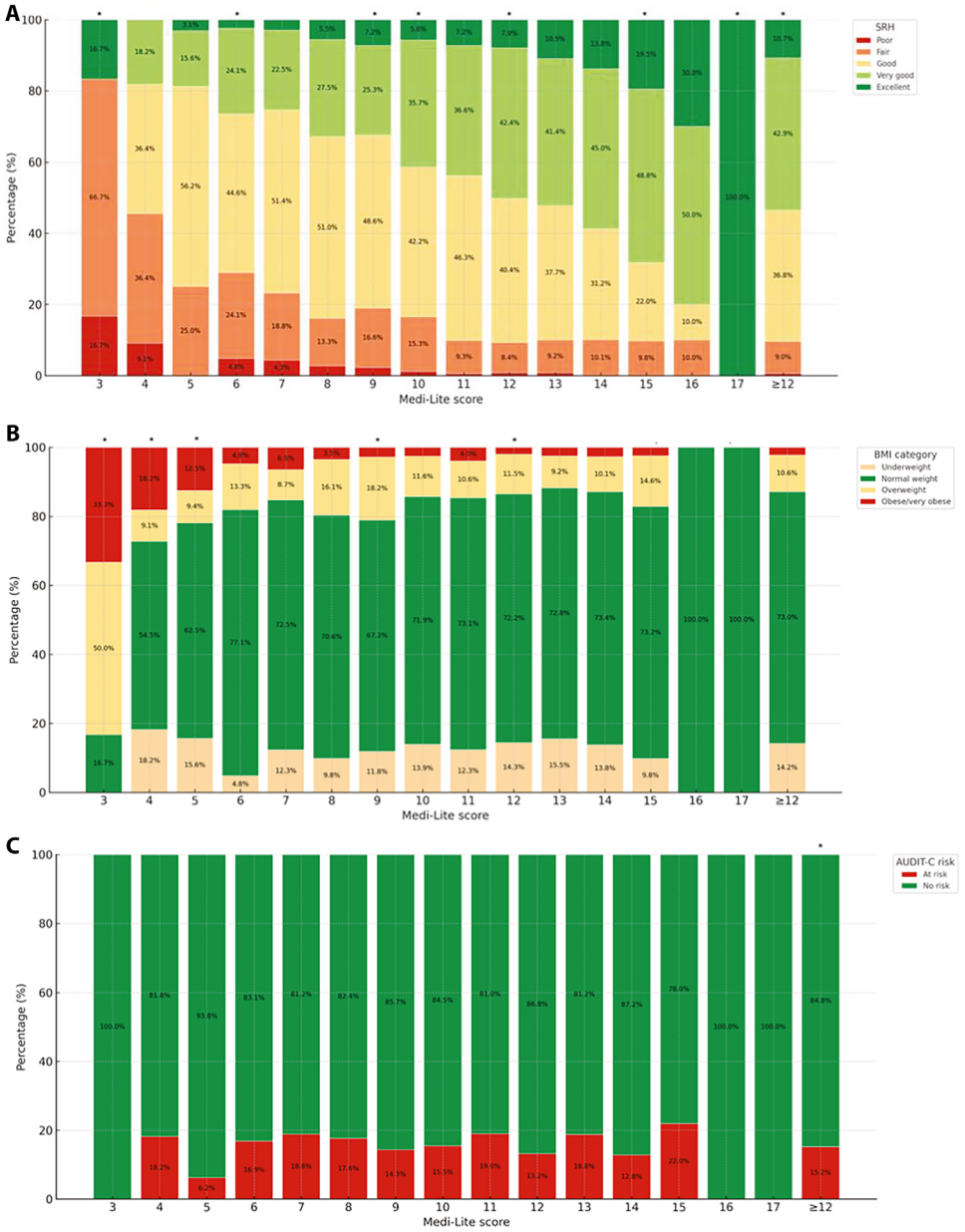

Figure 4. Distribution of (**a**) self-rated health (SRH), (**b**) body mass index (BMI), and (**c**) alcohol-related risk (AUDIT-C) across Medi-Lite scores among university students. For each score from 3–17 and the additional high-adherence category (≥12), the percentage distribution of categories is shown. Asterisks indicate statistically significant differences in category distribution for specific scores after Bonferroni correction. *Abbreviations:* BMI: Body mass index; AUDIT-C: Alcohol Use Disorders Identification Test – Consumption

Use of food delivery apps was associated with increased AUDIT-C risk (aOR = 1.87; p < 0.001) and higher odds of overweight/obesity (aOR = 1.26; p = 0.030), while food waste app users had greater odds of being at AUDIT-C risk (aOR = 1.44; p < 0.001). Finally, higher BMI was linked to lower SRH (p = 0.024), and individuals with high SRH were significantly less likely to be overweight or obese (aOR = 0.21; p < 0.001).

To assess potential gender differences, associations between adherence to the MD and BMI, SRH

Table 2. Distribution of individual SRH-Item, AUDIT-C item responses, and BMI categories by level of adherence to the MD (low vs. high), including column percentages, p-values from Chi-Square Tests, and Correlation Coefficients with the Medi-Lite Score (n =2,697).

Variable	Low adherence Medi-Lite score <12 N=1,941 (72%)	High adherence Medi-Lite score ≥12 N=756 (28%)	p-value	r-correlation; p-value
Self-rated health (SRH)				
Poor	37 (1.9)	5 (0.7)	<0.001	0.1308; < 0.001
Fair	286 (14.7)	68 (9.0)		
Good	904 (46.6)	278 (36.8)		
Very good	598 (30.8)	324 (42.9)		
Excellent	116 (6.0)	81 (10.7)		
AUDIT-C[1] item 1 *(How often drink?)*				
Never	312 (16.1)	104 (13.8)	0.26	0.06; 0.002
<1/month	472 (24.3)	187 (24.7)		
2–4/month	792 (40.8)	301 (39.8)		
2–3/week	308 (15.9)	133 (17.6)		
≥4/week	57 (2.9)	31 (4.1)		
AUDIT-C[1] item 2 *(Typical amount)*				
1–2 drinks	1741 (89.7)	695 (91.9)	0.35	–0.04; 0.043
3–4	169 (8.7)	53 (7.0)		
5–6	25 (1.3)	7 (0.9)		
≥7	6 (0.31)	1 (0.1)		
AUDIT-C[1] item 3 *(≥6 drinks at once)*				
Never	1148 (59.1)	465 (61.5)	0.81	–0.01; 0.554
<1/month	616 (31.7)	230 (30.4)		
Monthly	136 (7.0)	47 (6.2)		
Weekly or more	41 (2.1)	14 (1.9)		
AUDIT-C Risk[2] *(≥5 males/≥4 females)*				
No risk	1619 (83.4)	641 (84.8)	0.38	0.02; 0.254
At risk	322 (16.6)	115 (15.2)		
BMI[3] Category				
Underweight	232 (12.0)	107 (14.2)	0.024	–0.04; 0.021
Normal weight	1376 (71.0)	552 (73.3)		
Overweight	257 (13.3)	80 (10.6)		
Obese/Very obese	73 (3.8)	14 (1.9)		

[1]AUDIT-C: Alcohol Use Disorders Identification Test – Consumption; [2]AUDIT-C risk threshold defined as a score ≥5 for males and ≥4 for females; [3]BMI: Body mass index.

and AUDIT-C risk were examined separately for women and men. Higher adherence was significantly associated with lower odds of overweight or obese in both sexes (Figure 5).

The association was stronger in women (RRR = 0.79 for overweight, p = 0.005; RRR = 0.65 for obese, p < 0.001) than in men (RRR = 0.91 and 0.82; p = 0.025 and 0.002). For SRH, greater adherence was

Table 3. Multivariate logistic regression models (based on 2,697 subjects), reporting adjusted odds ratios (aORs) and 95% confidence intervals, adjusted for age and sex, assessing the association between MD food items, food-related behaviours, and three health outcomes: SRH, AUDIT-C risk, and overweight/obesity (BMI ≥ 25). Statistical significance was set at p ≤ 0.05.

	High SRH[1] (Very well to fair)	**AUDIT-C[2] ≥5 for men or ≥4 for women**	**Overweight/obesity BMI[3] ≥ 25 kg/m²**
Variable	**aOR (95%CI), p-value**	**aOR (95%CI), p-value**	**aOR (95%CI), p-value**
Medi-Lite (high)	3.16 (1.23, 8.11), 0.017	0.87 (0.69, 1.10), 0.24	0.66 (0.52, 0.85), 0.001
Medi-Lite (continuous)	1.42 (1.24,1.63), <0.001	0.99 (0.95, 1.05), 0.95	0.89 (0.85, 0.94), <0.001
Fruit			
<1 portion/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-2 portions/day	4.42 (2.28,8.56), <0.001	0.64 (0.51, 0.81), <0.001	1.07 (0.83, 1.38), 0.59
>2 portions/day	4.89 (1.46,6.35), 0.010	0.50 (0.35, 0.72), <0.001	1.17 (0.83, 1.65), 0.38
Vegetables			
<1 portion/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-2.5 portions/day	3.24 (1.59, 6.57), 0.001	1.13 (0.80, 1.61), 0.49	0.70 (0.51, 0.96), 0.026
>2.5 portions/day	5.92 (1.87, 18.74), 0.002	1.17 (0.78, 1.76), 0.45	0.66 (0.45, 0.98), 0.037
Legumes			
<1 portion/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-2 portions/week	1.78 (0.93, 3.41), 0.080	1.06 (0.83, 1.36), 0.65	0.69 (0.54, 0.88), 0.003
>2 portions/week	4.18 (1.40, 12.49), 0.010	1.11 (0.83, 1.49), 0.47	0.55 (0.41, 0.759, <0.001
Cereals			
<1 portion/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-1.5 portions/day	2.33 (0.97-5.59), 0.058	0.91 (0.62, 1.33), 0.63	0.82 (0.57, 1.19), 0.30
>1.5 portions/day	2.19 (0,87, 5.56), 0.098	0.86 (0.58, 1.28), 0.46	0.63 (0.43, 0.93), 0.019
Fish			
<1 portion/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-2.5 portions/week	0.88 (0.46, 1.67), 0.69	0.79 (0.64, 0.98), 0.030	1.20 (0.95, 1.50), 0.12
>2.5 portions/week	2.66 (0.35, 20.35), 0.35	0.95 (0.61, 1.46), 0.81	1.19 (0.76, 1.86), 0.45
Meat			
>1.5 portions/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-1.5 portions/day	1.23 (0.46-3.31), 0.69	0.69 (0.47, 1.00), 0.051	0.75 (0.52, 1.07), 0.11
<1 portions/day	2.70 (0.96, 7.64), 0.060	0.67 (0.47, 0.97), 0.035	0.43 (0.30, 0.62), <0.001
Dairy products			
>1.5 portions/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
1-1.5 portions/day	2.08 (0.87, 4.98), 0.099	0.97 (0.68, 1.38), 0.86	1.16 (0.80, 1.66), 0.44
<1 portions/day	1.75 (0.70, 4.41), 0.23	0.96 (0.66, 1.39), 0.84	0.88 (0.60, 1.30), 0.52
Alcohol			
>2 AU/day	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
<1 AU/day	3.50 (0.45, 27.10), 0.230	0.14 (0.06,0.33), <0.001	0.46 (0.17, 1.21), 0.114
1-2 AU/day	2.90 (0.33, 25.12), 0.333	0.53 (0.22, 1.29), 0.17	0.49 (0.18, 1.33), 0.16
Olive Oil			
Occasionally	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Frequently	1.95 (0.76, 5.00), 0.16	1.40 (0.93, 2.12), 0.11	0.74 (0.51, 1.09), 0.13
Regularly	2.50 (1.14, 5.49), 0.022	1.40 (0.97, 2.03), 0.075	0.73 (0.53, 1.02), 0.066

Table 3 (*Continued*)

Variable	High SRH[1] (Very well to fair) aOR (95%CI), p-value	AUDIT-C[2] ≥5 for men or ≥4 for women aOR (95%CI), p-value	Overweight/obesity BMI[3] ≥ 25 kg/m^2 aOR (95%CI), p-value
Food Delivery App			
No	0 (Ref)	1.00 (Ref)	1.00 (Ref)
Yes	0.90 (0.49,1.67), 0.74	1.87 (1.53, 2.29), <0.001	1.26 (1.02, 1.56), 0.030
Food Waste App			
No	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Yes	1.65 (0.82, 3.31), 0.16	1.44 (1.17, 1.77), <0.001	1.19 (0.96, 1.48), 0.11
BMI[3] as continuous	0.98 (0.96, 0.99), 0.024	1.00 (0.99, 1.02), 0.762	Not applicable
High SRH[1]	Not applicable	1.78 (0.63, 5.04), 0.276	0.21 (0.11, 0.40), <0.001
AUDIT ≥ 5 for men or ≥4 for women	1.78 (0.63, 5.04), 0.277	Not applicable	1.07 (0.81, 1.41), 0.644

[1]SRH: Self-rated health; [2]AUDIT-C: Alcohol Use Disorders Identification Test – Consumption; Ref = reference category; [3]BMI: Body mass index.

associated with better perceived health in both groups, but more consistently in men. Among men, significant associations were found across all categories from good to excellent health (RRRs 1.41 -1.91, all p < 0.001), whereas in women, the association was significant only for very good and excellent health (RRR = 1.42 and 1.45; p = 0.024 and 0.023). No significant associations were found with AUDIT-C risk in either gender.

Discussion

Main finding of this study

This study examined the relationship between adherence to the MD and three key health indicators, SRH, BMI, and AUDIT-C, in a large sample of Italian university students. To our knowledge, this is one of the first studies among Italian university students to evaluate these three health dimensions within a single framework, while accounting for sex-specific differences and modern food-related behaviours. The findings revealed that higher adherence to the MD was significantly associated with both better perceived health and lower likelihood of being overweight or obese. In sex-stratified analyses, the association between MD adherence and BMI appeared stronger among women, whereas the association with SRH appeared stronger among men; however, these comparisons are descriptive, as formal sex-by-MD interaction tests were not performed. No significant association was observed between overall adherence to the Mediterranean diet and the AUDIT-C score. Greater consumption of fruits, vegetables, legumes, whole grains, and olive oil was significantly associated with improved SRH and lower BMI. In addition, higher meat intake was linked to both increased alcohol-related risk and higher odds of overweight/obesity. The use of food delivery apps was positively associated with higher alcohol-related risk and overweight/obesity.

Interpretation of the main results

These results altogether suggest that adherence to the MD may contribute to both objective health outcomes (e.g., weight status) and SRH, reinforcing the multidimensional benefits of this dietary pattern. Importantly, this interpretation should extend beyond nutritional intake alone. As recognised by UNESCO, the MD encompasses not only food intake but also cultural and social practices, such as home cooking and shared meals, that may themselves support healthier behaviours and well-being (27,28). This multidimensional perspective aligns with evidence showing that health outcomes are shaped by the interaction of behavioural, cultural and environmental factors (29,30).

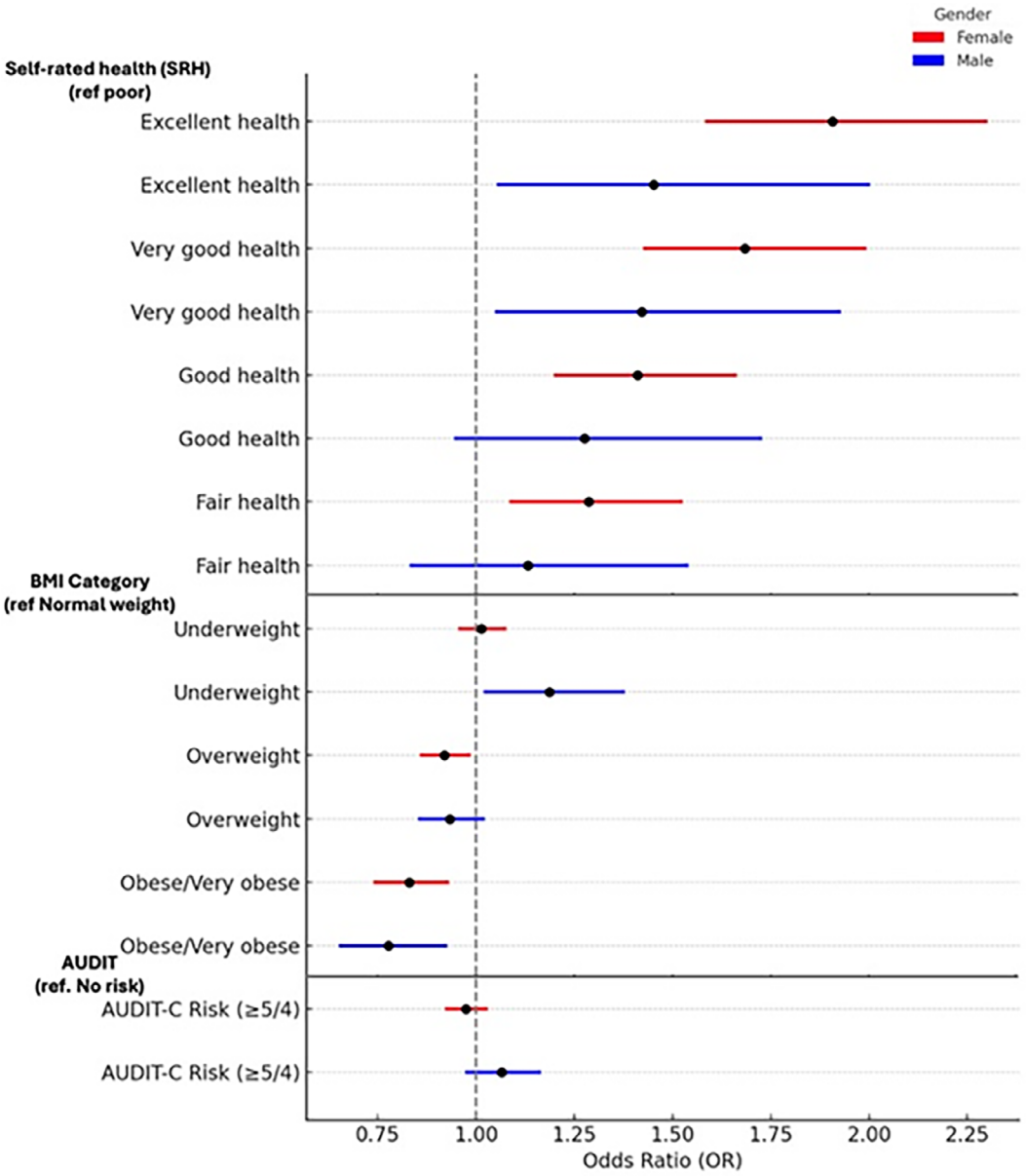

Figure 5. Forest plot showing the associations between AUDIT-C risk, BMI category, self-rated health (SRH), and high MD adherence, stratified by gender. Results are presented as odds ratios (OR) for the AUDIT-C binary outcome and relative risk ratios (RRR) for the multinomial outcomes (BMI and SRH), with 95% confidence intervals. Estimates are adjusted for age and educational level. Women are shown in red, men in blue.

The prevalence of overweight and obesity in our sample was 15.7%, aligning with findings reported in similar populations, such as Spanish medical students (31). Likewise, the proportion of underweight individuals (12.7%) closely mirrors previous research (32,33). Teleman et al. reported a 14% prevalence of underweight among Italian university students, with a markedly higher rate in women (19%) compared to men (2%) (34). This relatively high rate of both underweight and obesity represents a "double burden", which highlights the nutritional challenges within the university setting.

The effect of adherence to the MD on weight status has produced heterogeneous findings across the literature. Nonetheless, our study supports a protective role of this dietary pattern against overweight (35), showing that higher Medi-Lite scores were significantly associated with a lower likelihood of being classified as overweight or obese. These results are in line with previous evidence from an Italian adolescent cohort, where greater adherence to the MD was associated with reduced odds of over-weight/obesity, reinforcing the relevance of this dietary pattern in younger populations (36). Furthermore, large observational studies have demonstrated that it is not associated with weight gain: in the EPIC cohort (n = 373,803) (37), individuals with high adherence to the MD lost an average of 0.16 kg over five years. Similarly, the CARDIA study (38) reported reductions in waist circumference among those following a MD pattern. In contrast, other research has found no significant associations between MD adherence and anthropometric measures, underscoring the variability across study designs, populations, and methods of dietary assessment (39,40).

Several studies have documented the association between unhealthy lifestyle behaviours and poorer SRH (41–43). The Spanish DiSA-UMH study among university students found that lower SRH was significantly linked to reduced adherence to the MD, lower levels of physical activity, overweight, and smoking (44). Similarly, Zarini et al. and Collins et al. reported that fair or poor SRH was associated with higher dietary fat intake, lower consumption of fruits and vegetables, and insufficient physical activity (45,46). These findings are consistent with our results, which indicated that individuals reporting better SRH were more likely to adhere to the MD and to consume greater amounts of key protective food groups, such as fruits, vegetables, legumes, and olive oil.

Although poor eating habits have long been associated with alcohol consumption among university students (47,48), the present study found no relation between the overall adherence to the MD and alcohol related risk according to AUDIT-C. This finding is consistent with previous studies in young adult populations, where overall diet quality does not necessarily correlate with patterns of alcohol intake, particularly those characterized by episodic or binge drinking (49). However, when analysing individual food components, moderate wine consumption as reflected in the Medi-Lite score, was significantly associated with a lower risk of hazardous drinking according to the AUDIT-C. Notably, when considering the additional high-adherence group (Medi-Lite ≥12), a significant association emerged, with students in this group showing a lower prevalence of alcohol-related risk (Figure 3c). Nevertheless, the overall number of individuals classified as "at risk" by the AUDIT-C was relatively low in our cohort. This limited prevalence likely reduced the statistical power of the analyses, helping to explain the lack of significance observed in most comparisons between MD adherence and alcohol-related risk. Another likely explanation lies in the conceptual divergence between the two measures: while MD scores emphasize moderate, regular wine consumption typically integrated into meals and within a broader cultural context that emphasizes conviviality, the AUDIT-C captures broader drinking behaviours, including frequency and quantity, which may reflect riskier patterns, such as weekend binge drinking, that are common in university settings and not adequately captured by the Medi-Lite score. This mismatch may account for the absence of a clear association in our analysis. Moreover, it has been suggested that unhealthy dietary behaviours and alcohol misuse may function as alternative coping mechanisms adopted under stress, rather than co-occurring behaviours (50). Consequently, interventions aimed at promoting healthy coping strategies may be more effective than those that focus solely on individual health behaviours.

A novel contribution of this study is the identification of a relationship between digital food behaviours and health status. Participants who reported frequent use of food delivery and food waste apps were significantly more likely to exhibit overweight and higher alcohol-related risk. This finding is particularly concerning given the increasing integration of these platforms into the daily lives of young adults. Research has shown that frequent use of delivery apps is associated with the intake of ultra-processed, energy-dense foods and nutrient-poor diets (51,52).

The analysis of individual food components provided more granular insights into the relationship

between specific dietary elements and health outcomes. Greater consumption of fruits, vegetables, legumes, whole grains, and olive oil was significantly associated with improved self-rated health and lower body mass index. These findings support the evidence that these nutrient-rich, plant-based foods exert beneficial effects on both physical and mental health outcomes, likely through anti-inflammatory and antioxidant mechanisms, and independently of the overall MD score. This aligns with previous research emphasizing the protective role of minimally processed plant-derived foods in modulating cardiometabolic risk and promoting psychosocial well-being (53). In contrast, higher intake of red and processed meats was associated with increased likelihood of alcohol-related risk and overweight/obesity, reinforcing the detrimental metabolic and behavioural effects of excessive meat consumption (54,55).

Gender-stratified analyses showed differentiated patterns. Among women, the relationship between dietary adherence and BMI categories was stronger, suggesting that diet quality may play a greater role in weight regulation in females. Among men, adherence was more consistently related to better SRH, possibly reflecting a stronger impact of nutritional habits on subjective wellbeing in this subgroup. These observations are consistent with findings from other Mediterranean cohorts (56).

Implications for public health

The results of this study offer relevant public health insights into how adherence to the MD may contribute to improved health outcomes among university students, a population at increased risk of adopting unhealthy lifestyle behaviours during a critical transitional life stage. Our findings indicate that higher adherence to the MD is significantly associated with better SRH and lower odds of overweight and obesity. These associations remained robust across multiple analytical models and were further clarified by food-specific patterns, underlining the role of nutrient-dense, plant-based foods, as protective factors. These findings suggest that adherence to the MD may represent a low-cost and scalable intervention strategy to improve both subjective and objective health metrics in young adult populations. Given the alarming global rise in youth overweight and obesity and the growing burden of mental health concerns in university settings (57), promoting MD adherence could serve as a preventive approach to support psychological and physical well-being during early adulthood (58–60). The results underline the importance of integrating structural and environmental interventions within the university context. Policies should aim to align university canteen offerings, vending machines, and food outlets with MD principles, prioritising fresh produce, whole grains, legumes, healthy fats, and minimally processed foods (61). This shift would foster sustainable food environments, aligned with climate-resilient dietary patterns (62). At the same time, programs that provide students with cooking skills, food literacy, and nutritional knowledge can enhance autonomy and informed decision-making (63). Initiatives such as interactive cooking workshops, MD-themed nutrition education, and peer-led campaigns may encourage the rediscovery of traditional food practices and improve food preparation self-efficacy (64,65). An important additional implication arises from the observed association be-tween digital food acquisition and poorer health outcomes, including higher alcohol-related risk and elevated BMI. The convenience and ubiquity of delivery services may reinforce unhealthy eating habits, especially among time-constrained or stressed students (66). Therefore, public health strategies should consider the regulation of these services within and around university campuses and promote critical engagement with digital platforms preferably offering healthy food. Furthermore, given that the MD encompasses more than nutrient intake, including shared meals, cooking practices, and cultural rituals, its promotion may also support social cohesion, emotional regulation, and a more mindful relationship with food (67).

Strengths and limitations

This study offers several strengths that enhance the validity and generalizability of its findings: its large and representative sample, the use of validated instruments, and a comprehensive analysis of both overall and item-level. The inclusion of multiple confounders and sensitivity analyses enhances the robustness

of findings. However, several limitations should be acknowledged. The cross-sectional design precludes causal inference, and reverse causality cannot be excluded. Self-reported data may also be subject to recall and social desirability biases. The use of an online questionnaire distributed through the university e-mail system may have introduced selection bias, as students more interested in health-related topics or more engaged with institutional communications may have been more likely to participate. Although the sample was relatively large, it was restricted to a single university, limiting the generalizability of the findings. There was also an imbalance between the sexes, which could reduce the representativeness of the sample; however, it should be noted that most Italian university students are women (68,69). Residual confounding due to unmeasured factors cannot be ruled out. In addition, self-rated health was dichotomized for analytical purposes, which may have oversimplified the complexity of students' health perceptions and reduced variability in the outcome. Finally, although the Medi-Lite score is a validated measure of adherence to the Mediterranean diet, it may have limited ability to capture fast-food and convenience-food intake, which are highly prevalent in university populations and may not be fully reflected by the food categories included in the score.

Conclusions

This study adds to the growing evidence supporting the beneficial role of adherence to the MD in promoting both physical and perceived health among young adults. The results highlight the need to encourage MD patterns in youth, given their metabolic, physiological, and subjective health benefits, as well as their associations with healthier risk-related behaviours. Future research should use longitudinal designs to clarify the causal direction of these relationships and assess the long-term effects of MD adherence on health in student populations. Further studies are also warranted to examine how digital behaviours influence dietary choices and whether interventions targeting the digital food environment can improve diet quality and related health outcomes in young adults.

Ethic Approval: Ethics Committee of the University of Milan (Approval ID: 71.23)

Conflict of Interest: The authors declare that they have no conflict of interest.

Author's Contribution: Conceptualization, A.P., D.N., F.P., V.G.; methodology, A.P., F.P., L.S. and V.G.; software, F.P., V.G.; validation, F.P., V.B., V.G.; formal analysis, F.P., V.G.; investigation, V.G.; resources, N.V, F.P., S.M.; data curation, A.P., F.P., V.G.; writing—original draft preparation, A.P, D.N., F.P., V.G.; writing—review and editing, F.P., V.G., D.N., N.V., S.M.; visualization, F.P.; supervision, V.B., V.G.

Declaration on the Use of AI: None.

Funding: Department of Biomedical Sciences for Health, University of Milan, grant number PSR-LINEA2-2022.

References

1. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. Am Psychol. 2000 May;55(5):469–80. PMID: 10842426.
2. Cervera Burriel F, Serrano Urrea R, Vico García C, Milla Tobarra M, García Meseguer MJ. Hábitos alimentarios y evaluación nutricional en una población universitaria. Nutr Hosp. 2013;28(2):438–46. doi:10.3305/NH.2013.28.2.6303
3. Carlos M, Elena B, Teresa IM. Are adherence to the mediterranean diet, emotional eating, alcohol intake, and anxiety related in university students in Spain? Nutrients. 2020 Aug 1;12(8):1–15. doi:10.3390/NU12082224,
4. Pennisi F, Pinto A, Minerva M, Signorelli C. Public health residency education in Italy: an analysis of trends, disparities, and institutional determinants of attractiveness. Journal of Public Health 2026. 2026 Jan 10;1–11. doi:10.1007/s10389-025-02667-y
5. Boyland E, Thivel D, Mazur A, Ring-Dimitriou S, Frelut ML, Weghuber D. Digital Food Marketing to Young People: A Substantial Public Health Challenge. Ann Nutr Metab. 2020 Apr 1;76(1):6–9. doi:10.1159/000506413
6. Stephens J, Miller H, Militello L. Food Delivery Apps and the Negative Health Impacts for Americans. Front Nutr. 2020 Feb 20;7. doi:10.3389/FNUT.2020.00014,
7. González-Sosa S, Ruiz-Hernández JJ, Puente-Fernández A, Robaina-Bordón JM, Conde-Martel A. Adherence to the Mediterranean Diet in medical students. Public Health Nutr. 2023 Sep 11;26(9):1798–806. doi:10.1017/S1368980023000964.

8. Nucci D, Pennisi F, Pinto A, De Ponti E, Ricciardi GE, Signorelli C, et al. Impact of extreme weather events on food security among older people: a systematic review. Aging Clin Exp Res. 2025 Apr 30;37(1):137. doi: 10.1007/s40520-025-03050-3.
9. Hur S, Oh B, Kim H, Kwon O. Associations of diet quality and sleep quality with obesity. Nutrients. 2021 Sep 1;13(9). doi:10.3390/NU13093181
10. Correa-Rodríguez M, Pocovi G, Schmidt-RioValle J, González-Jiménez E, Rueda-Medina B. Assessment of dietary intake in Spanish university students of health sciences. Endocrinol Diabetes Nutr. 2018 May 1;65(5):265–73. doi:10.1016/j.endinu.2018.01.005
11. Sweatt K, Garvey WT, Martins C. Strengths and Limitations of BMI in the Diagnosis of Obesity: What is the Path Forward? Curr Obes Rep. 2024 Sep 1;13(3):584–95. doi:10.1007/S13679-024-00580-1/
12. Fazzino TL, Fleming K, Sher KJ, Sullivan DK, Befort C. Heavy Drinking in Young Adulthood Increases Risk of Transitioning to Obesity. Am J Prev Med. 2017 Aug;53(2):169-175. doi: 10.1016/j.amepre.2017.02.007.
13. Rimm EB, Ellison RC. Alcohol in the Mediterranean diet. American Journal of Clinical Nutrition. 1995; 61(6 SUPPL.). doi:10.1093/ajcn/61.6.1378S
14. Rapinski M, Raymond R, Davy D, Bedell JP, Ka A, Lubszynski J, et al. Associations between dietary diversity and self-rated health in a transverse study of four local food systems (French Guiana, Guadeloupe, Portugal and Senegal). BMC Public Health. 2025 Dec 1;25(1). doi:10.1186/S12889-025-21872-8
15. Lorem G, Cook S, Leon DA, Emaus N, Schirmer H. Self-reported health as a predictor of mortality: A cohort study of its relation to other health measurements and observation time. Sci Rep. 2020 Dec 1;10(1). doi:10.1038/S41598-020-61603-0
16. Pinto A, Minutolo G, Pennisi F, Stacchini L, De Ponti E, Ricciardi GE, et al. Water Quality, Environmental Contaminants and Disease Burden in Europe: An Ecological Analysis of Associations with Disability-Adjusted Life Years. Environments. 2026 Jan 4;13(1):36. doi:10.3390/environments13010036
17. Pinto A, Nucci D, Pennisi F, Stacchini L, Veronese N, Maggi S, et al. The Relationship Between Socio-Demographic and Behavioral Characteristics and Adherence to the Mediterranean Diet: The UniFoodWaste Study Among University Students in Italy. Epidemiologia 2025, Vol 6, Page 53. 2025 Sep 3;6(3):53. doi:10.3390/EPIDEMIOLOGIA6030053
18. Catalini A, Stacchini L, Nucci D, Passeri C, Romano N, Ferranti R, et al. Attitudes and behaviors of household food waste among university students in Milan, Italy: The UniFoodWaste study protocol. Acta Biomed. 2024;95. doi:10.23750/abm.v95i4.15940
19. Sofi F, Dinu M, Pagliai G, Marcucci R, Casini A. Validation of a literature-based adherence score to Mediterranean diet: the MEDI-LITE score. Int J Food Sci Nutr. 2017 Aug 18;68(6):757–62. doi:10.1080/09637486.2017.1287884
20. Wu SE, Chen YJ, Chen WL. Adherence to Mediterranean Diet and Soluble Klotho Level: The Value of Food Synergy in Aging. Nutrients. 2022 Oct 1;14(19). doi:10.3390/NU14193910
21. Bardinet J, Chuy V, Carriere I, Galéra C, Pouchieu C, Samieri C, et al. Mediterranean Diet Adherence and Risk of Depressive Symptomatology in a French Population-Based Cohort of Older Adults. Nutrients. 2022 Oct 1;14(19). doi:10.3390/NU14194121
22. Cislaghi B, Cislaghi C. Self-rated health as a valid indicator for health-equity analyses: Evidence from the Italian health interview survey. BMC Public Health. 2019 May 9;19(1). doi:10.1186/S12889-019-6839-5
23. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992 Jun;30(6):473-83. PMID: 1593914.
24. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. Addiction (Abingdon, England). 1993 Jun;88(6):791–804. doi:10.1111/j.1360-0443.1993.tb02093.x
25. Istituto Superiore di Sanità (Epicentro). A.U.D.I.T.-C (Alcohol Use Disorders Identification Test – Consumption): scheda test (versione italiana) [Internet]. 2014 [cited 2026 Feb 1]. Available from: https://www.epicentro.iss.it/alcol/apd2014/scheda%20test%20audit%20c.pdf
26. Ministero dell'Università e della Ricerca. Portale dei dati dell'istruzione superiore - Università degli Studi Di Milano [Internet]. [cited 2025 Jun 10]. Available from: https://ustat.mur.gov.it/
27. Ascione E, Gianfredi V, Nucci D. Remembering and Promoting Grandma's Cooking through the Mediterranean Diet, Apulia, Southern Italy. In: Food in Memory and Imagination. Bloomsbury Publishing Plc; 2022. p. 267–80. doi:10.5040/9781350096189.ch-020
28. Bonaccio M, Iacoviello L, Donati MB, de Gaetano G. The tenth anniversary as a UNESCO world cultural heritage: an unmissable opportunity to get back to the cultural roots of the Mediterranean diet. Eur J Clin Nutr. 2022 Feb 1;76(2):179–83. doi:10.1038/s41430-021-00924-3
29. Pinto A, Pennisi F, Odelli S, De Ponti E, Veronese N, Signorelli C, et al. Artificial Intelligence in the Management of Infectious Diseases in Older Adults: Diagnostic, Prognostic, and Therapeutic Applications. Biomedicines. 2025 Oct 16;13(10):2525. doi:10.3390/biomedicines13102525
30. Stacchini L, De Ponti E, Ricciardi GE, Pinto A, Pennisi F, Minutolo G, et al. Investigating the impact of demographic, economic, governance, and health indicators on the Global Burden of Disease: a theory-informed exploratory cross-country analysis of 26 European nations. Journal of Public Health 2026. 2026 Feb 13;1–12. doi:10.1007/s10389-026-02685-4
31. Cobo-Cuenca AI, Garrido-Miguel M, Soriano-Cano A, Ferri-Morales A, Martínez-Vizcaíno V, Martín-Espinosa

NM. Adherence to the mediterranean diet and its association with body composition and physical fitness in Spanish university students. Nutrients. 2019 Nov 1;11(11). doi:10.3390/NU11112830

32. López-Moreno M, Garcés-Rimón M, Miguel M, Iglesias López MT. Adherence to Mediterranean Diet, Alcohol Consumption and Emotional Eating in Spanish University Students. Nutrients. 2021 Sep 11;13(9):3174. doi: 10.3390/nu13093174.
33. Syed NK, Syed MH, Meraya AM, Albarraq AA, Al-Kasim MA, Alqahtani S, et al. The association of dietary behaviors and practices with overweight and obesity parameters among Saudi university students. PLoS One. 2020 Sep 1;15(9 September). doi:10.1371/JOURNAL.PONE.0238458
34. Teleman AA, de Waure C, Soffiani V, Poscia A, Di Pietro ML. Physical activity and health promotion in Italian university students. Ann Ist Super Sanita. 2015;51(2):106-10. doi: 10.4415/ANN_15_02_06.
35. Muscogiuri G, Verde L, Sulu C, Katsiki N, Hassapidou M, Frias-Toral E, et al. Mediterranean Diet and Obesity-related Disorders: What is the Evidence? Curr Obes Rep. 2022 Dec 1;11(4):287–304. doi:10.1007/S13679-022-00481-1
36. Mistretta A, Marventano S, Antoci M, Cagnetti A, Giogianni G, Nolfo F, et al. Mediterranean diet adherence and body composition among Southern Italian adolescents. Obes Res Clin Pract. 2017 Mar 1;11(2):215–26. doi:10.1016/j.orcp.2016.05.007
37. Romaguera D, Norat T, Vergnaud AC, Mouw T, May AM, Agudo A, et al. Mediterranean dietary patterns and prospective weight change in participants of the EPIC-PANACEA project. American Journal of Clinical Nutrition. 2010 Oct 1;92(4):912–21. doi:10.3945/ajcn.2010.29482
38. Steffen LM, Van Horn L, Daviglus ML, Zhou X, Reis JP, Loria CM, et al. A modified Mediterranean diet score is associated with a lower risk of incident metabolic syndrome over 25 years among young adults: The CARDIA (Coronary Artery Risk Development in Young Adults) study. British Journal of Nutrition. 2014 Nov 28;112(10):1654–61. doi:10.1017/S0007114514002633
39. Li Y, Roswall N, Ström P, Sandin S, Adami HO, Weiderpass E. Mediterranean and Nordic diet scores and long-term changes in body weight and waist circumference: results from a large cohort study. Br J Nutr. 2015 Oct 13;114(12):2093–102. doi:10.1017/S0007114515003840
40. Rosi A, Giopp F, Milioli G, Melegari G, Goldoni M, Parrino L, et al. Weight status, adherence to the mediterranean diet, physical activity level, and sleep behavior of Italian junior high school adolescents. Nutrients. 2020 Feb 1;12(2). doi:10.3390/NU12020478,
41. Ruggiero E, Di Castelnuovo A, Costanzo S, Persichillo M, Bracone F, Cerletti C, et al. Socioeconomic and psychosocial determinants of adherence to the Mediterranean diet in a general adult Italian population. Eur J Public Health. 2019 Apr 1;29(2):328–35. doi:10.1093/eurpub/cky127
42. Pennisi F, Nucci D, Pinto A, Stacchini L, Veronese N, Maggi S, et al. Adherence to the Mediterranean diet and depressive symptoms. A cross-sectional study among Italian university students: The UniFoodWaste study. Nutrition. 2026 Apr 1;144(11):113070. doi:10.1016/j.nut.2025.113070
43. Pennisi F, Nucci D, Pinto A, Stacchini L, Veronese N, Maggi S, et al. Interpreting the Association Between Mediterranean Diet Adherence and Depressive Symptoms: Methodological Reflections and Clarifications. Nutrition. 2026 Mar 4;113181. doi:10.1016/j.nut.2026.113181
44. Barrios-Vicedo R, Navarrete-Muñoz EM, García de la Hera M, González-Palacios S, Valera-Gran D, Checa-Sevilla JF, et al. Una menor adherencia a la dieta mediterránea se asocia a una peor salud auto-percibida en población universitaria. Nutr Hosp. 2015 Nov 30;31(2):785–92. doi:10.3305/NH.2015.31.2.7874
45. Collins CE, Young AF, Hodge A. Diet Quality Is Associated with Higher Nutrient Intake and Self-Rated Health in Mid-Aged Women. J Am Coll Nutr. 2008 Feb 1;27(1):146–57. doi:10.1080/07315724.2008.10719686
46. Zarini GG, Vaccaro JA, Canossa Terris MA, Exebio JC, Tokayer L, Antwi J, et al. Lifestyle behaviors and self-rated health: The living for health program. J Environ Public Health. 2014;2014. doi:10.1155/2014/315042
47. Baska T, Baska T, Lacíková R, Štefanová E, Szabóová V. Changes of eating habits and alcohol drinking among medical students occurring during their undergraduate study. Int J Health Promot Educ [Internet]. 2020 [cited 2025 Aug 7];(Vol. 58 n°1). Available from: https://sites.uclouvain.be/reso/opac_css/index.php?lvl=notice_display&id=997483
48. Lloyd-Richardson EE, Lucero ML, DiBello JR, Jacobson AE, Wing RR. The relationship between alcohol use, eating habits and weight change in college freshmen. Eat Behav. 2008 Dec;9(4):504–8. doi:10.1016/j.eatbeh.2008.06.005
49. Amaral LA, Peixoto A, Godoy F, Colares V, Menezes V, Franca C da. Excesso de peso e consumo de álcool em binge: um estudo com adolescentes. Revista Brasileira de Obesidade, Nutrição e Emagrecimento [Internet]. 2020 Oct 1 [cited 2025 Aug 9];13(83):1091–8. Available from: https://doaj.org/article/db6843b6ef6947d2890b285d01bbe476
50. Brook CA, Willoughby T. Social anxiety and alcohol use across the university years: Adaptive and maladaptive groups. Dev Psychol. 2016 May 1;52(5):835–45. doi:10.1037/DEV0000110
51. Horta PM, Souza JPM, Rocha LL, Mendes LL. Digital food environment of a Brazilian metropolis: food availability and marketing strategies used by delivery apps. Public Health Nutr. 2021 Feb;24(3):544-548. doi: 10.1017/S1368980020003171.
52. Partridge SR, Gibson AA, Roy R, Malloy JA, Raeside R, Jia SS, et al. Junk food on demand: A cross-sectional analysis of the nutritional quality of popular online food delivery outlets in Australia and New Zealand. Nutrients. 2020 Oct 1;12(10):1–16. doi:10.3390/NU12103107,
53. Godos J, Guglielmetti M, Ferraris C, Frias-Toral E, Domínguez Azpíroz I, Lipari V, et al. Mediterranean Diet

and Quality of Life in Adults: A Systematic Review. Nutrients . 2025 Feb 1;17(3). doi:10.3390/NU17030577
54. Qian F, Riddle MC, Wylie-Rosett J, Hu FB. Red and Processed Meats and Health Risks: How Strong Is the Evidence? Diabetes Care. 2020 Feb 1;43(2):265. doi:10.2337/DCI19-0063
55. Daneshzad E, Askari M, Moradi M, Ghorabi S, Rouzitalab T, Heshmati J, et al. Red meat, overweight and obesity: A systematic review and meta-analysis of observational studies. Clin Nutr ESPEN. 2021 Oct 1;45:66–74. doi:10.1016/J.CLNESP.2021.07.028
56. Elmskini FZ, Bouh A, Labyad A, Elghoulam N, Iraqi H, Mehdad S, et al. Increased nutrition knowledge and adherence to the Mediterranean diet are associated with lower body mass index and better self-rated general health among university students. Human Nutrition & Metabolism. 2024 Mar 1;35:200240. doi:10.1016/J.HNM.2024.200240
57. Haruna U, Mohammed AR, Braimah M. Understanding the burden of depression, anxiety and stress among first-year undergraduate students. BMC Psychiatry. 2025 Dec 1;25(1). doi:10.1186/S12888-025-07069-8,
58. Gianfredi V, Nucci D, Tonzani A, Amodeo R, Benvenuti AL, Villarini M, et al. Sleep disorder, Mediterranean Diet and learning performance among nursing students: inSOMNIA, a cross-sectional study. Ann Ig. 2018;30(6):470–81. doi:10.7416/ai.2018.2247
59. Pennisi F, Buzzoni C, Gervasi F, Russo AG, Renzi C. Emergency colon cancer diagnosis in people with mental health conditions: a population-based cohort study in northern Italy. BMJ mental health. 2025 Jul 1;28(1):e301733. doi:10.1136/BMJMENT-2025-301733
60. Pennisi F, Ricciardi GE, von Wagner C, Smith L, Kaushal A, Lyratzopoulos G, et al. Impact of Self-Reported Long-Term Mental Health Morbidity on Help-Seeking and Diagnostic Testing for Bowel-Related Cancer Symptoms: A Vignette Study. Cancer Med. 2024 Dec;13(23):e70426. doi:10.1002/cam4.70426
61. Mengarelli CA, Kirchoff C, Palacios C. College Students' Perception of Snacks Sold in Vending Machines in the US: A Mixed-Methods Study. Front Nutr. 2021;8:742121. doi:10.3389/fnut.2021.742121
62. Nucci D, Stacchini L, Villa M, Passeri C, Romano N, Ferranti R, et al. The role of Mediterranean diet in reducing household food waste: the UniFoodWaste study among italian students. Int J Food Sci Nutr. 2025 May 19;76(4):443–55. doi:10.1080/09637486.2025.2495719
63. Gianfredi V, Stacchini L, Lotti S, Sarno I, Sofi F, Dinu M. Knowledge, attitude and behaviours towards food sustainability in a group of Italian consumers. A cross-sectional study. Int J Food Sci Nutr. 2024 Aug;75(5):463–74. doi:10.1080/09637486.2024.2335524
64. Nucci D, Minelli L, Gianfredi V. MI NUTRO (MIgrants NUTRition knOwledge for integration): a nutrition education intervention among immigrants, Perugia (Italy) - pilot study [MI NUTRO (MIgrants NUTRition knOwledge per l'integrazione): un intervento di educazione alimentare tra gli immigrati, Perugia - uno studio pilota]. Recenti Prog Med. 2020 Sep;111(9):546-552. Italian. doi: 10.1701/3421.34070.
65. Gianfredi V, Bertarelli G, Minelli L, Nucci D. Promoting healthy eating in childhood: results from the Children PrOmOting Nutrition throUgh Theatre (COcONUT) project. Minerva Pediatrics. 2024 Jul;76(4). doi:10.23736/S2724-5276.21.06249-2
66. Pennisi F, Minerva M, Dalla Valle Z, Odone A, Signorelli C. Genesis and prospects of the shortage of specialist physicians in Italy and indicators of the 39 schools of hygiene and preventive medicine. Acta Biomed. 2023 Aug 30;94(S3):e2023159. doi: 10.23750/abm.v94iS3.14512.
67. Gianfredi V, Beran M, Koster A, Eussen SJ, Odone A, Signorelli C, et al. Association between social network characteristics and prevalent and incident depression: The Maastricht Study. J Affect Disord. 2021 Oct 1;293:338–46. doi:10.1016/j.jad.2021.06.046
68. Pinto A, Pennisi F, Pompili C, Minerva M, Veronesi G, Renzi C. The Surgical Glass Ceiling: A Retrospective Observational Study of Gender Representation from Residency Programs to Academic Positions in Italy. J Am Coll Surg. 2026 Mar 13. doi:10.1097/XCS.0000000000001848
69. Tocchioni V, Milone S, Lombardi G. Gender disparities in school-to-university transition in Italy: the role played by the socio-economic condition and the type of high school. Riv Ital Econ Demogr Stat. 2025 Feb 13;67–78. doi:10.71014/SIEDS.V79I1.351v