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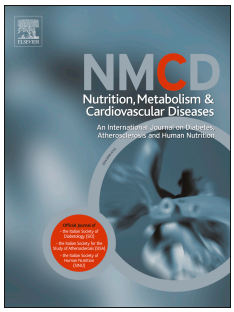

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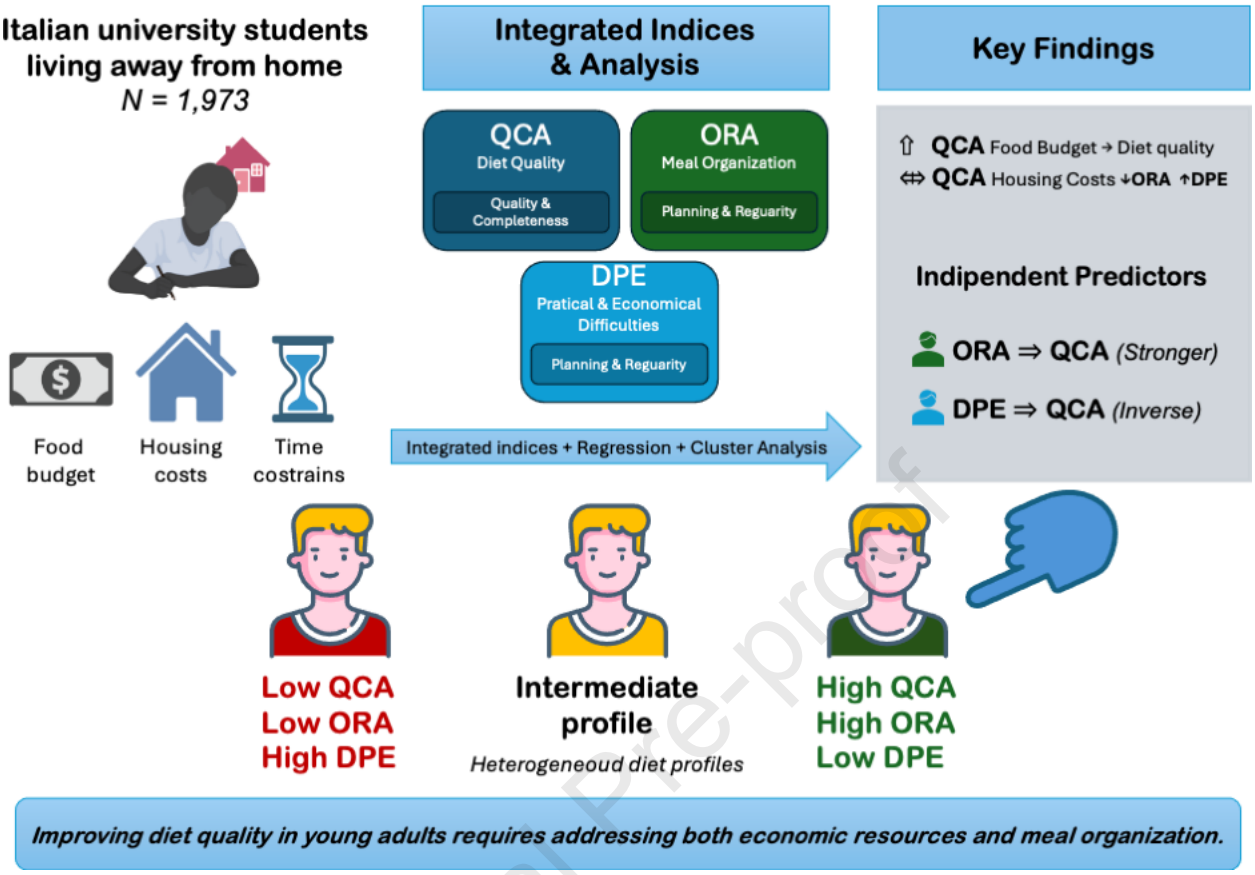

Improving diet quality in young adults requires addressing both economic resources and meal organization.

Economic and organizational determinants of diet quality in university students living away from home.

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Abstract.

Background and Aims: Dietary behaviors established during early adulthood are important for long-term health and may influence the risk of non-communicable diseases later in life. University students living away from home are a vulnerable group, as the transition to independent living is often accompanied by economic constraints, changes in meal organization, and suboptimal dietary habits. This study examined diet quality among Italian university students living away from home using an integrated approach.

Methods and Results: A cross-sectional online survey was conducted among 1973 university students. Dietary behaviors were assessed using three indices: Quality and Completeness of Diet (QCA), Organization and Regularity of Meals (ORA), and Practical and Economic Difficulties (DPE). Associations with monthly food and housing budgets were examined using descriptive analyses, multivariable linear regression, and exploratory cluster analysis.

A gradient was observed between monthly food budget and dietary quality, with higher QCA scores in higher food budget categories. In contrast, housing-related expenditures were not associated with QCA but were linked to poorer meal organization and greater perceived difficulties. In multivariable analysis, both ORA and DPE were independently associated with dietary quality. Cluster analysis identified three distinct profiles characterized by different combinations of diet quality, meal organization, and economic and organizational constraints.

Conclusion: Diet quality among university students living away from home reflects the combined and partially independent effects of economic resources, meal organization, and organizational constraints. These findings highlight early-life determinants of dietary behaviors with potential implications for future health and support integrated preventive strategies for young adults.

Introduction

A balanced diet is a key modifiable determinant of health and plays an important role in preventing non-communicable diseases throughout life [1]. Dietary habits established during early adulthood often persist, shaping long-term behaviors and influencing future health outcomes [2].

The university period is a critical transitional phase marked by increased autonomy, lifestyle changes, and exposure to new organizational and economic constraints [3, 4]. During this stage, students are especially vulnerable to adopting suboptimal dietary behaviors, such as irregular meal patterns, greater reliance on energy-dense foods, and reduced consumption of protective foods [5-8]. The university food environment, academic schedules, and widespread availability of fast food may further encourage choices that prioritize convenience over nutritional quality [4, 9].

Living away from home is an additional vulnerability factor. The transition to independent living requires students to manage food budgeting, shopping, and meal preparation on their own, often with limited economic resources and time. Several studies report that students living away from home have poorer diet quality and lower adherence to healthy dietary patterns compared with peers residing with their families [7, 10]. Economic constraints may further promote the selection of low-cost, energy-dense foods, negatively affecting diet quality [11, 12].

Although suboptimal adherence to dietary recommendations among university students is well documented [13, 14], most studies focus on isolated aspects of dietary behavior. Fewer investigations integrate diet quality with meal organization and perceived practical and economic difficulties, particularly in the Italian context, where updated data remain limited [10, 15]. Notably, intervention studies suggest that nutrition education and health promotion initiatives in university settings may improve dietary behaviors, especially when organizational and economic barriers are explicitly addressed [16, 17].

Therefore, university students living away from home represent a relevant target population for public health nutrition. This study adopts an integrated approach to examine dietary quality and completeness, meal organization and regularity, and perceived practical and economic difficulties among Italian university students living away from home, with the aim of informing realistic and sustainable health promotion strategies.

Materials and Methods

Study Design and Participants

A cross-sectional observational study was conducted among Italian university students living away from home, defined as students residing in a city different from their usual place of residence for study-related reasons. Data were collected using a structured online questionnaire. Of the respondents, 1973 students who completed all main sections were included in the final analysis.

Participants were recruited through social media platforms, primarily TikTok, using targeted posts and short-form videos directed at university students living away from home.

This recruitment strategy uses a non-probabilistic convenience sampling approach, as participants self-selected into the study after online dissemination. No random sampling framework or predefined sampling frame was used. Consequently, the study sample cannot be considered statistically representative of all Italian university students living away from home.

Data collection and questionnaire

The self-administered questionnaire assessed socio-demographic characteristics, economic resources (monthly food and housing budget), dietary habits, meal organization and regularity, and perceived practical and economic difficulties related to food management. Most items were measured using 5-point Likert scales or ordinal frequency scales commonly used in nutrition and

behavioral research. The questionnaire was developed specifically for this study, drawing on previously published surveys assessing dietary behaviors and food-related practices among young adults, as well as established nutritional recommendations for the Italian population. Although it was not based on a previously validated standardized instrument, item formulation was informed by existing literature and commonly used constructs in nutritional epidemiology.

Data preparation

Data were anonymized before analysis. Likert scale responses were recorded on a numerical scale from 1 to 5, with higher values indicating greater intensity of the construct under investigation. Negatively worded items were reverse-coded to ensure consistency in score direction, following standard procedures for scale development [18].

Construction of composite indices and internal consistency

Three composite indices were developed to capture complementary dimensions of eating behavior: Quality and Completeness of Diet (QCA), Organization and Regularity of Meals (ORA), and Practical and Economic Difficulties (DPE), reflecting perceived constraints related to food management. The use of composite indices to describe overall dietary patterns and related behaviors is widely adopted in nutritional epidemiology, as it allows integration of multiple dietary and contextual components into interpretable summary measures [19, 20]. Each index was constructed by aggregating conceptually homogeneous items that reflect distinct but interrelated dimensions of food-related behavior and context.

For each index, item scores were harmonized to ensure consistent directionality, with higher values indicating better dietary quality or meal organization (QCA and ORA) and greater perceived constraints (DPE). Final index scores were calculated as the arithmetic mean of the included items,

preserving the original 1–5 scale and facilitating interpretation and comparison across dimensions. Detailed item composition, scoring criteria, and recoding procedures for each index are provided in the Supplementary Material (Appendices A–C). This approach was chosen to reflect overall patterns rather than unidimensional latent constructs.

The composite indices were constructed as descriptive summary measures to capture the multidimensional aspects of eating behavior and related constraints, rather than to operationalize formally validated psychometric scales. Internal consistency was assessed using Cronbach's alpha coefficients for each index to evaluate the coherence of the included items [21]. Given the composite and multidimensional nature of the indices, alpha values were interpreted cautiously, in line with psychometric theory [22]. Moderate alpha coefficients were considered acceptable, as very high coefficients are not expected for indices designed to capture multiple related aspects of complex behaviors rather than a single underlying trait [23]. No formal external validation or test–retest reliability assessment was conducted.

Assessment of dietary habits and QCA index

Dietary habits were assessed using questions about the frequency of consumption of major food groups, including fruits, vegetables, legumes, cereals, meat, fish, eggs, dairy products, processed meats, and ultra-processed foods.

Based on these data, the Quality and Completeness of Diet (QCA) index was developed as a composite measure to capture overall dietary balance and completeness, rather than formal adherence to a specific dietary guideline.

Scoring criteria were based on widely accepted nutritional principles, integrating both quantitative aspects (frequency of consumption) and qualitative dimensions of diet, and were informed by selected elements of the national dietary recommendations for the Italian population (LARN) [24],

without aiming to operationalize or quantify formal adherence to these guidelines. Separate items were included for total meat consumption and for fish consumption, distinguishing fresh or frozen fish from canned or smoked products to better reflect different dietary patterns. Foods generally considered nutritionally protective were scored positively with increasing consumption frequency, while foods high in salt, saturated fat, or highly processed products were scored inversely. For selected food groups, such as eggs, a simplified non-linear (bell-shaped) scoring approach was applied to reflect moderation.

In addition to food group frequencies, the QCA index included perceptual items related to meal completeness, allowing a broader assessment of dietary adequacy. The final QCA score was calculated as the arithmetic mean of item scores, maintaining the original 1–5 scale, with higher values indicating better dietary quality and completeness. Detailed item composition and scoring criteria are provided in Supplementary Appendix A.

Assessment of meal organization and ORA index

The Organization and Regularity of Meals (ORA) index was developed to assess the organizational and management aspects of eating behaviors, independent of dietary quality or food group consumption. The index emphasizes meal planning, regularity, and daily food management.

Items evaluated the regularity of meal times, meal planning, frequency of meal skipping, time-related constraints due to study or work schedules, and practical barriers to food preparation, such as lack of time or motivation to cook, limited cooking facilities, and the influence of roommates on eating habits. Use of the university canteen was included as an indicator of greater meal structure and access to organized food services.

Negatively worded items were reverse-coded so that higher scores consistently indicated better organization and regularity of eating behaviors. The ORA index score was calculated as the

arithmetic mean of the included items, maintaining the original 1–5 scale. Detailed scoring procedures are provided in Supplementary Appendix B.

Assessment of practical and economic difficulties and DPE index

Perceived practical and economic difficulties related to food management were assessed using items addressing economic constraints, housing-related barriers, time limitations, and compensatory behaviors such as reliance on takeaway food; all items captured self-reported perceptions of these difficulties. All items were coded so that higher scores indicated greater perceived difficulty. The Practical and Economic Difficulties (DPE) index was calculated as the arithmetic mean of item scores on the original 1–5 scale. Detailed item descriptions and scoring procedures are provided in Supplementary Appendix C.

Statistical analysis

Statistical analyses were conducted using GraphPad Prism (version 9.0.0 for macOS). Continuous variables are presented as means and standard deviations, and categorical variables as frequencies and percentages. Group comparisons were performed using one-way analysis of variance (ANOVA), with appropriate post hoc tests when applicable. Multivariable linear regression analysis assessed associations between dietary quality (QCA, dependent variable) and meal organization (ORA) and practical and economic difficulties (DPE), which were included simultaneously as independent variables. Collinearity among independent variables was evaluated before model interpretation [25, 26]. Indices were analyzed as continuous variables, consistent with previous dietary pattern research [27-29]. For graphical representation only, ORA and DPE were categorized into tertiles. Results are reported as standardized regression coefficients (β), with corresponding standard errors,

95% confidence intervals, p-values, and coefficients of determination (R^2). A p-value less than 0.05 was considered statistically significant.

Results

Sample characteristics

A total of 1973 university students living away from home were included in the analysis. Descriptive characteristics of the study sample are presented in **Table 1**. The distributions of the Quality and Completeness of Diet (QCA), Organization and Regularity of Meals (ORA), and Practical and Economic Difficulties (DPE) indices covered the full 1–5 scale, indicating substantial inter-individual variability in dietary behaviors, meal organization, and perceived constraints.

Dietary indices according to geographic area of residence

When stratified by geographic area, using students' current place of residence during university attendance rather than their region of origin, no relevant differences were observed in ORA and DPE scores. Mean QCA values differed slightly across geographic areas, ranging from 2.96 ± 0.51 for students residing in Central Italy to 3.03 ± 0.52 for those residing in Northern Italy. Although this difference reached statistical significance ($p = 0.021$), its magnitude was small and of limited practical relevance. Detailed mean values (± SD) of QCA, ORA, and DPE across geographic areas are provided in Supplementary Table S1.

Dietary habits and meal organization according to economic resources

Associations between monthly food and housing expenditures and dietary quality, meal organization, and practical and economic difficulties are summarized in **Figure 1** (panels A–F). A clear gradient was observed between monthly food budget and dietary quality (**Figure 1A**). QCA

scores increased progressively with higher food budget categories, with the lowest scores among students reporting a food budget of ≤ €100 and the highest among those with a budget of > €500. In contrast, housing-related expenditures were not associated with dietary quality (**Figure 1D**). However, housing costs were significantly associated with meal organization and practical and economic difficulties. Higher housing expenditures were linked to lower ORA scores (**Figure 1E**) and higher DPE values (**Figure 1F**), indicating poorer meal organization and greater constraints. Notably, DPE values peaked in the intermediate housing expenditure categories.

Multivariable regression analysis

In multivariable linear regression analysis with QCA as the dependent variable (**Table 2**), both meal organization and practical and economic difficulties were independently associated with dietary quality. ORA was positively associated with QCA (standardized $\beta = 0.212$, $p < 0.001$), while DPE was inversely associated with dietary quality (standardized $\beta = -0.099$, $p = 0.001$). The overall model was statistically significant ($F = 157.8$, $p < 0.001$) and explained 13.8% of the variance in QCA ($R^2 = 0.138$). These associations are visually summarized in **Figure 2** using a coefficient plot.

For graphical purposes, ORA and DPE were categorized into tertiles. Mean QCA values increased across higher ORA tertiles, while progressively lower QCA values were observed across increasing DPE tertiles (**Figure 3**).

Cluster analysis

An exploratory cluster analysis was conducted to identify homogeneous profiles of university students living away from home based on dietary-related dimensions. The analysis, using standardized QCA, ORA, and DPE indices and a k-means clustering algorithm, identified a three-cluster solution as the most interpretable from a descriptive perspective. The clusters showed

marked heterogeneity within the study population and differed across all three indices (**Table 3**). Specifically, Cluster 1 (n = 633) was characterized by lower dietary quality (QCA = 2.54 ± 0.38), poorer meal organization (ORA = 2.38 ± 0.38), and higher perceived practical and economic difficulties (DPE = 4.13 ± 0.38). Cluster 2 (n = 787) showed intermediate values across all indices, while Cluster 3 (n = 553) was characterized by the highest levels of dietary quality (QCA = 3.24 ± 0.50) and meal organization (ORA = 3.70 ± 0.29), along with the lowest perceived difficulties (DPE = 2.65 ± 0.43). These findings highlight the coexistence of distinct behavioral and structural profiles among university students living away from home.

Discussion

This study offers a comprehensive overview of the dietary habits of Italian university students living away from home, highlighting the interplay among economic resources, meal organization, and perceived practical difficulties as key factors influencing diet quality during a critical life stage. By examining dietary quality and completeness, meal organization, and structural constraints together, this work strengthens existing evidence by moving beyond isolated dietary indicators and adopting a multidimensional approach.

Overall, the findings confirm suboptimal dietary behaviors, consistent with previous international [13, 14] and Italian [7, 10, 15] studies.

A key finding is the positive association between food-specific economic resources and dietary quality. Students with higher monthly food budgets reported better QCA scores, supporting evidence that food affordability is a major determinant of diet quality among young adults [11, 12]. Although causal inference is not possible due to the cross-sectional design, the consistent pattern observed across budget categories suggests that economic constraints are a structural barrier to healthy eating.

In contrast, housing-related expenditures were not associated with dietary quality but were linked to poorer meal organization and greater perceived practical and economic difficulties. This dissociation suggests that different economic pressures affect distinct components of eating behavior: food budgets primarily influence food choices, while housing-related costs shape how meals are organized and managed in daily life. These findings highlight the importance of distinguishing between food-specific and non-food economic constraints when assessing dietary behavior.

Meal organization emerged as a key factor associated with dietary quality, independent of economic resources, consistent with previous evidence highlighting the role of structured eating patterns, time availability, and organizational skills in university settings [6, 9]. Greater meal regularity and planning were associated with better diet quality, while higher perceived practical and economic difficulties were linked to poorer dietary outcomes. In the present analysis, meal organization showed a moderate positive association with dietary quality (standardized $\beta = 0.212$), whereas these difficulties were inversely associated with QCA (standardized $\beta = -0.099$), together explaining 13.8% of the variance in dietary quality. Although the proportion of explained variance was modest, this magnitude is consistent with previous research on complex health-related behaviors, which are influenced by multiple individual, social, and environmental factors not fully captured within a single analytical model. These findings highlight the importance of organizational and structural determinants beyond food-specific economic resources.

No substantial differences in dietary quality, meal organization, or perceived difficulties were observed by geographic area of residence. The narrow range of mean QCA values suggests that, among students living away from home, shared living conditions and academic constraints may outweigh regional or cultural dietary backgrounds. However, this interpretation should be considered with caution, as geographic origin was not assessed in detail. A more precise assessment

of geographic background could have provided further insight into potential influences on dietary quality.

The exploratory cluster analysis revealed significant heterogeneity within the study population, identifying three distinct profiles based on different combinations of dietary quality, meal organization, and perceived difficulties. The most vulnerable cluster was characterized by low dietary quality, poor meal organization, and high perceived constraints, while the most favorable profile combined higher dietary quality with better organization and fewer difficulties. Although descriptive, these findings support the idea that students living away from home are not a homogeneous group. Beyond their descriptive value, these clusters can be interpreted as integrated vulnerability profiles that reflect the coexistence of behavioral and structural determinants of diet quality. However, this analysis was exploratory and not intended to define stable typologies or predictive profiles, nor to support causal inference. Rather, it should be considered hypothesis-generating, illustrating how different dimensions of diet-related vulnerability may co-occur within the same individuals. If confirmed in longitudinal studies, this approach could help identify subgroups at higher long-term dietary risk. From an applied perspective, students in the most vulnerable cluster may benefit from interventions that combine economic support with organizational and environmental strategies, while those with adequate dietary quality but persistent organizational barriers may respond better to initiatives focused on meal planning and access to structured food services. Dietary habits established in early adulthood often persist over time [2], making university students a strategic target for preventive interventions. Therefore, approaches that focus solely on individual nutrition education may be insufficient if structural and organizational barriers are not addressed. Integrated strategies that combine nutrition education with actions targeting economic and organizational constraints align more closely with a public health nutrition perspective based on the social determinants of health. [16, 17, 30].

Despite its strengths, including a large sample size, this study has some limitations. Its cross-sectional design precludes causal inference, and the use of a self-administered online questionnaire distributed via social media resulted in a self-selected sample [31, 32], which may limit the generalizability of prevalence estimates [33, 34]. Recruitment through social media platforms, primarily TikTok, may have influenced the study sample composition, possibly leading to an overrepresentation of students more engaged with social media or more interested in health-related topics. While this recruitment strategy enabled rapid and broad dissemination of the survey, it may have introduced selection bias. However, such bias is more likely to affect absolute levels of dietary quality and meal organization rather than the direction of the observed associations, whose internal validity is less likely to be substantially compromised [33, 34]. Given the non-random recruitment strategy, the findings cannot be considered representative of the broader population of Italian university students living away from home; therefore, caution is warranted when generalizing the results.

Additionally, self-reported data may be subject to recall and social desirability biases [35], although this methodology is widely used and accepted in studies investigating health behaviors among university students [31, 33, 34]. The questionnaire was developed specifically for this study and did not undergo formal external validation. Although internal consistency analyses supported the coherence of the composite indices, measurement error and potential misclassification cannot be excluded. Future research would benefit from validating standardized instruments designed to assess the combined economic and organizational determinants of diet quality among university students.

Italy is characterized by substantial regional variability in cost of living and food prices, particularly between Northern and Southern areas. Although stratified analyses by geographic area of current residence showed only modest differences in dietary quality scores across macro-regions

(Supplementary Table S1), and these differences were small in magnitude, residual confounding related to local economic conditions cannot be entirely excluded. The study did not include objective indicators of regional purchasing power or cost-of-living indices, which may further explain contextual variability in food-related behaviors. Future research incorporating more detailed territorial economic indicators would help clarify the extent to which geographic heterogeneity contributes to dietary differences among students living away from home.

Finally, the QCA index reflects a general dietary framework based on mainstream recommendations [36] and may not fully capture alternative, yet nutritionally adequate, dietary patterns. However, it was designed as a comparative measure within the study population and remains appropriate for examining relative differences in dietary quality and their associations with economic and organizational factors. The internal coherence of the composite indices and the consistency of the findings with existing literature further support the robustness of the results.

Despite these limitations, the large sample size, internally coherent indices, and alignment with existing literature reinforce the robustness and the relevance of the results to nutritional public health and dietetic practice.

In conclusion, dietary behaviors among university students living away from home reflect a complex interplay between individual resources and structural constraints. In this population, dietary quality is influenced not only by food-related economic resources but also by meal organization and practical challenges in daily food management. These findings highlight that diet quality during early adulthood is shaped by both economic and organizational factors, not by food choices alone.

Living away from home creates a condition of nutritional vulnerability during early adulthood. Public health nutrition strategies in university settings should prioritize integrated approaches that address

economic, organizational, and environmental barriers to healthy eating, rather than focusing solely on individual nutrition education. Such strategies may help promote more sustainable dietary behaviors with potential long-term health benefits.

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Conflict of Interest

The authors declare that they have no conflicts of interest to disclose.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used a generative AI tool (ChatGPT, OpenAI) to support exploratory data analysis and qualitative clustering of open-ended questionnaire responses. The AI tool assisted in organizing, summarizing, and identifying recurring themes in non-closed responses, as well as supporting the interpretation of analytical outputs. All analyses, interpretations, and methodological decisions were made under full human supervision. The authors critically reviewed, verified, and edited all AI-assisted outputs and take full responsibility for the content, accuracy, and integrity of the published article.

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Figure legend

Figure 1. Mean (± SD) values of dietary quality and completeness (QCA), meal organization and regularity (ORA), and practical and economic difficulties (DPE) across categories of monthly food and housing expenditures. Panels A–C show mean values (± standard deviation) of QCA (panel A), ORA (panel B), and DPE (panel C) by monthly food budget categories, while panels D–F show mean values (± standard deviation) of QCA (panel D), ORA (panel E), and DPE (panel F) by monthly housing budget categories. Bars represent mean scores, and error bars indicate standard deviation. Differences in QCA across food budget categories were statistically significant, while no statistically significant differences were found for ORA and DPE. In contrast, differences across housing budget categories were not statistically significant for QCA, but statistically significant differences were observed for ORA and DPE (see Results). The "Don't know / No response" category for monthly food budget, accounting for approximately 3% of the sample, was excluded from the figure as it was not classifiable for analytical purposes.

Figure 2. Coefficient plot of standardized regression coefficients from the multivariable linear regression model with dietary quality (QCA) as the dependent variable. Points represent standardized β coefficients and horizontal lines indicate 95% confidence intervals. The vertical line corresponds to the null value (β = 0). ORA: Organization and Regularity of Meals; DPE: Practical and Economic Difficulties.

Figure 3. Mean (± standard deviation) values of dietary quality and completeness (QCA) across tertiles of meal organization and regularity (ORA) and practical and economic difficulties (DPE). Panel A shows mean QCA values across increasing tertiles of the Organization and Regularity of

Meals index (ORA), while Panel B shows mean QCA values across increasing tertiles of the Practical and Economic Difficulties index (DPE). Bars represent mean values and error bars indicate standard deviation. The number of participants in each tertile is reported below the x-axis. Statistical significance of differences across tertiles is reported in the text.

Table 1. Socio-demographic characteristics of the study sample (N = 1973)

Variable	Category	N	%
Geographic area of residence	Northern Italy	876	44.4
	Central Italy	621	31.5
	Southern Italy and Islands	476	24.1
	Total	**1973**	**100.0**
Field of study	Medical and Health Sciences	319	16.2
	Engineering and Technology	242	12.3
	Law and Economics	240	12.2
	Language and Communication Studies	176	8.9
	Humanities	143	7.2
	Psychology	140	7.1
	Mathematical, Physical and Natural Sciences	113	5.7
	Architecture and Design	65	3.3
	Human and Social Sciences	53	2.7
	Arts and Performing Arts	34	1.7
	Agricultural and Veterinary Sciences	6	0.3
	Other / Not classifiable	442	22.4
	Total	**1973**	**100.0**
Monthly budget for rent and utilities	< 400 €	881	44.7
	400–500 €	658	33.4
	500–600 €	269	13.6
	600–800 €	126	6.4
	> 800 €	39	2.0
	Total	**1973**	**100.0**
Monthly food budget	< 100 €	476	24.1
	100–200 €	1.084	54.9
	200–300 €	296	15.0
	300–400 €	47	2.4
	400–500 €	8	0.4
	> 500 €	2	0.1
	Don’t know / No response	60	3.0
	Total	**1973**	**100.0**

Values are reported as absolute frequencies (N) and percentages (%). Geographic area of residence, field of study, monthly budget for rent and utilities, and monthly food budget were collected through a self-administered questionnaire and are presented for descriptive purposes only.

Table 2. Multivariable linear regression analysis with QCA as the dependent variable (N = 1973).

Independent variable	Standardized β	95% CI	Standard error	p-value
ORA	0.212	0.145 to 0.279	0.034	< 0.001
DPE	−0.099	−0.158 to −0.040	0.030	0.001
Model R^2	**0.138**			

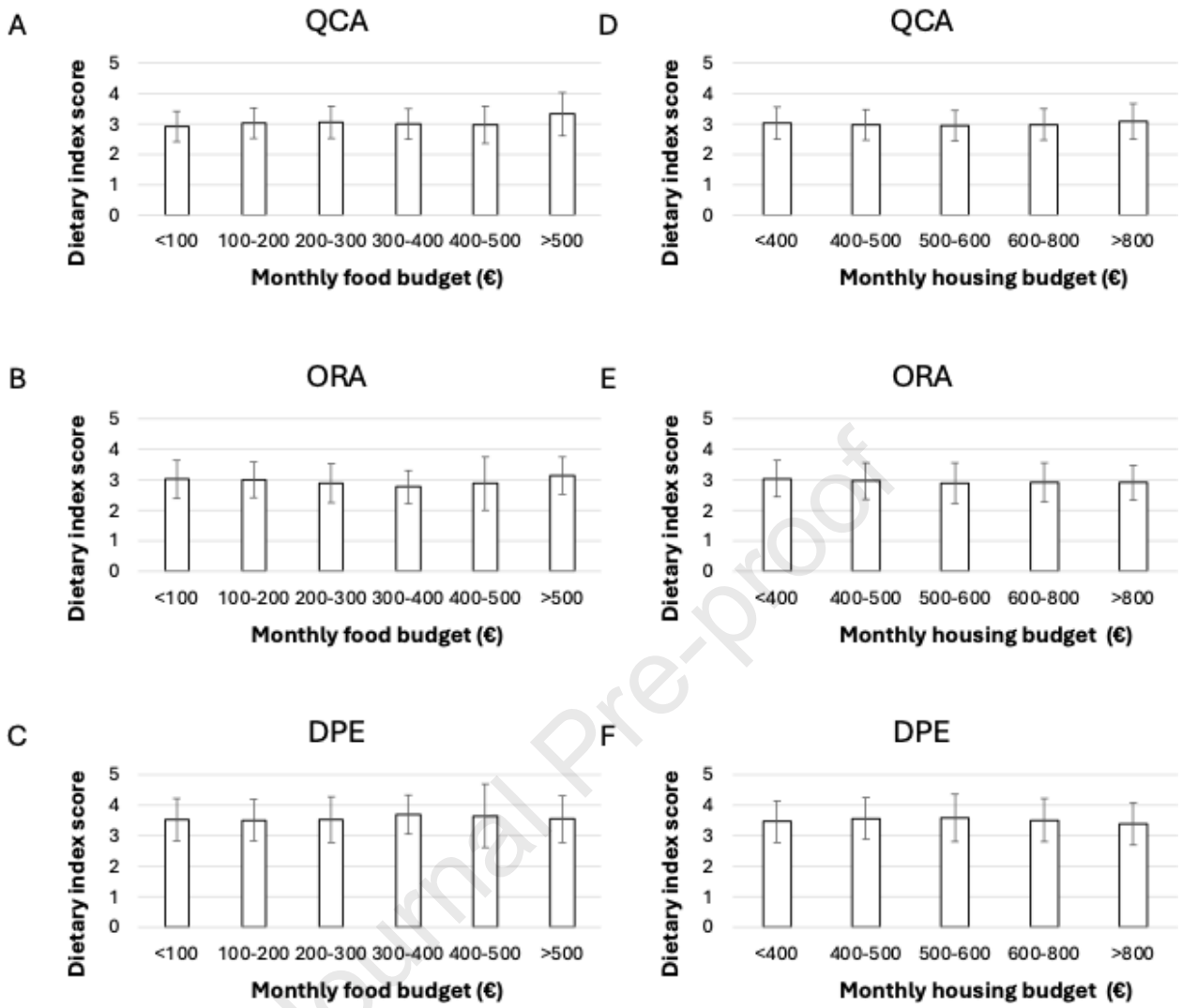
Standardized regression coefficients (β), standard errors, and p-values are reported for the independent variables included in the model. The model included the Organization and Regularity of Meals Index (ORA) and the Practical and Economic Difficulties Index (DPE) simultaneously. The overall model was statistically significant (F = 157.8; p < 0.001) and explained 13.8% of the variance in QCA (R^2 = 0.138).

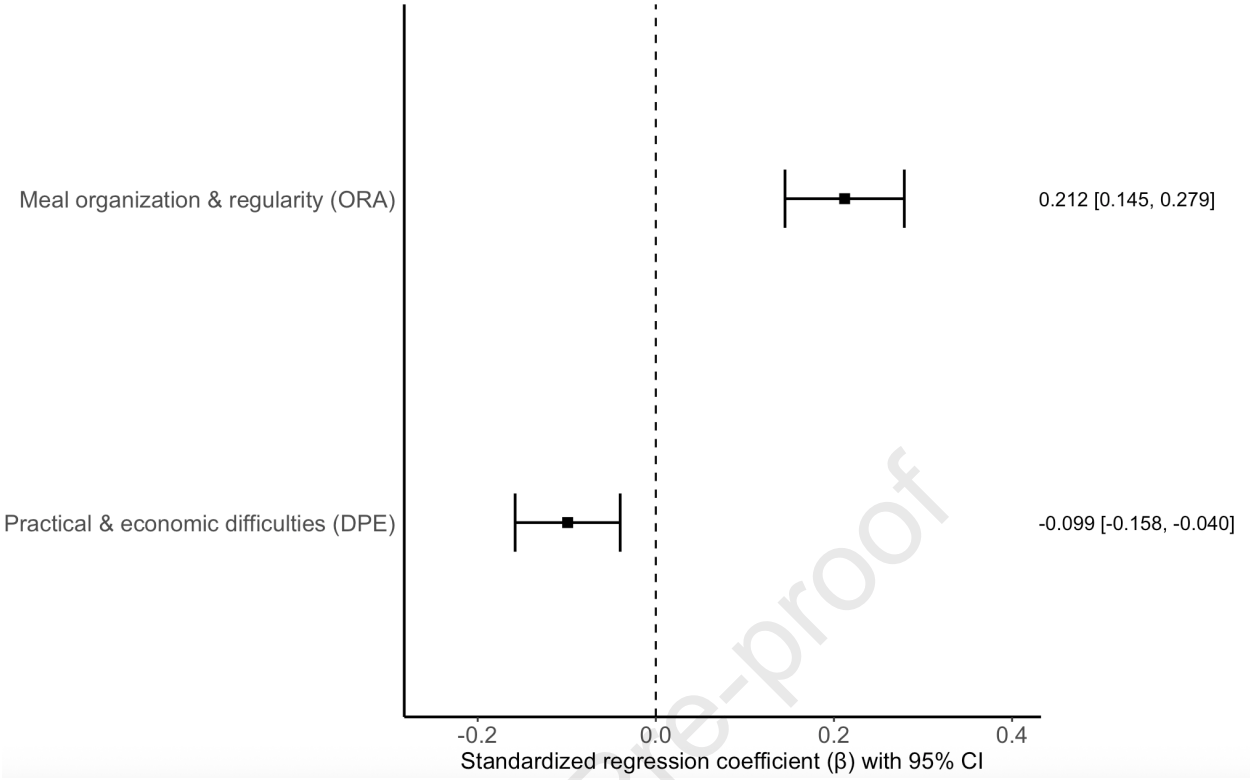
in the text.

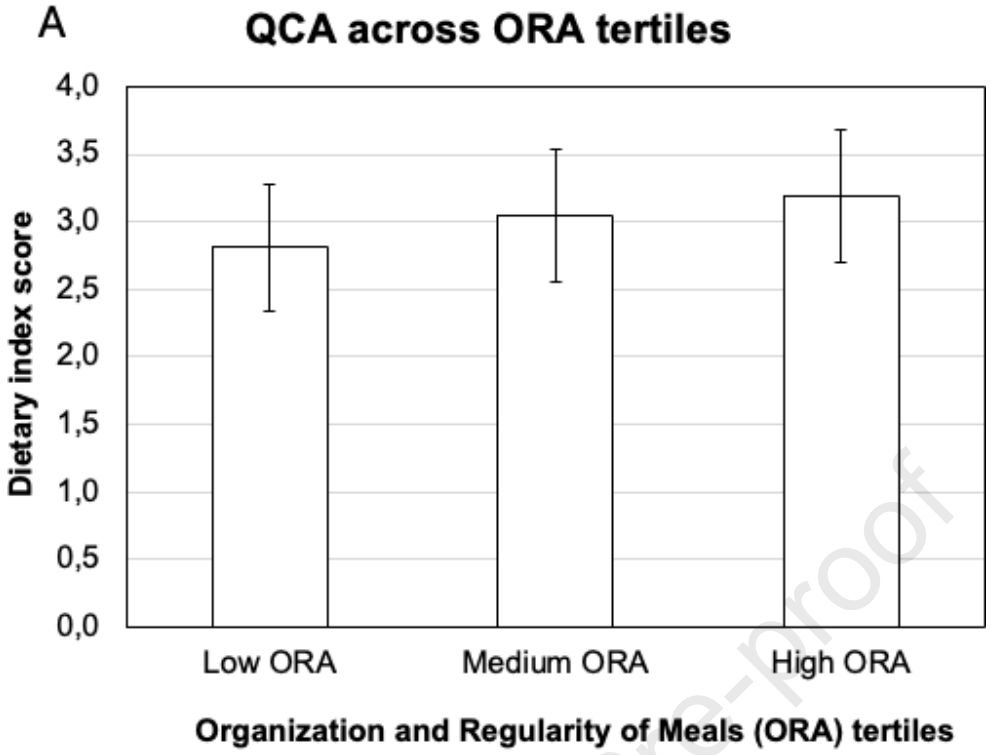
Table 3. Mean (± SD) values of dietary quality and completeness (QCA), meal organization and regularity (ORA), and practical and economic difficulties (DPE) across the identified clusters.

Cluster	QCA (mean ± SD)	ORA (mean ± SD)	DPE (mean ± SD)	N
Cluster 1	2.54 ± 0.38	2.38 ± 0.38	4.13 ± 0.38	633
Cluster 2	3.19 ± 0.36	2.96 ± 0.32	3.62 ± 0.34	787
Cluster 3	3.24 ± 0.50	3.70 ± 0.29	2.65 ± 0.43	553

Values are reported as mean ± standard deviation (SD). Clusters were identified using k-means cluster analysis based on standardized QCA, ORA, and DPE indices. N indicates the number of participants in each cluster. No inferential statistical comparisons are reported, as the cluster analysis is exploratory in nature.







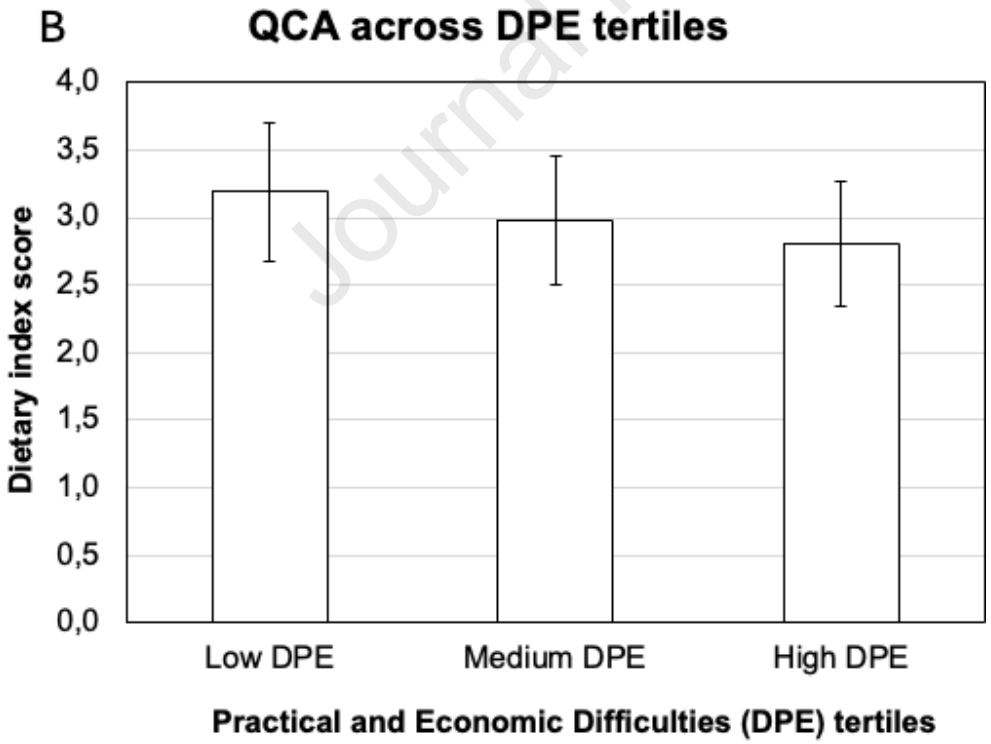


Figure 3

Highlights

- Diet quality in students is strongly associated with food budget, but not with housing costs.
- Meal organization independently predicts diet quality beyond economic resources.
- Housing-related expenses mainly affect meal organization and perceived difficulties.
- Integrated indices captured structural and behavioral determinants of diet quality.
- Cluster analysis revealed heterogeneous diet-related profiles among students.