

Article

Affordability, Health Perceptions, and Fatty Acid Composition: An Integrated Analysis of Nut Consumption Among University Students in Türkiye

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Abstract

Although nuts are widely recognized as healthy, whether that recognition translates into regular consumption among budget-constrained young adults remains unclear. This study integrated a health-perception survey of 666 university students (aged 18–28) in Türkiye with product-level fatty acid profiling of five commercial nut varieties to address this question. The attitude scale was validated using principal component analysis (PCA), with acceptable sampling adequacy and reliability (KMO = 0.772; Bartlett's test, $p < 0.001$; 57.071% total variance explained; Cronbach's $\alpha = 0.785$). Gas chromatography confirmed high unsaturated fatty acid contents (80.05–87.72% of total fatty acids), consistent with the nutrient density of nuts. Despite consistently positive health perceptions, only 9.3% of students consumed nuts daily. Consumption frequency was significantly associated with monthly expenditure, which remained the strongest predictor in a multinomial logistic model (likelihood-ratio $\chi^2(12) = 91.88$, $p < 0.001$); health-related attitudes also contributed, whereas measured fatty-acid quality did not. The correspondence between health perceptions and lipid quality was weak and non-significant. Overall, affordability, rather than awareness, emerges as the key barrier to regular nut consumption, positioning affordable nutrient-dense foods as a practical entry point for sustainable healthy diets.

Keywords: university students; sustainable healthy diets; nut consumption; health perception; consumer behavior; food affordability; fatty acid profile; Türkiye

1. Introduction

Nuts are an important part of diets worldwide because of their health benefits. Their macronutrient composition, particularly the high levels of unsaturated fatty acids, makes them nutrient dense [1]. Monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) are the predominant fatty acids in these products. This compositional dominance is consistently associated with improved metabolic regulation and a reduced risk of cardiovascular disease [2]. Furthermore, these products are rich in bioactive compounds, such as phenolic compounds and dietary fibers [3].

Nuts are increasingly positioned as nutrient-dense foods within the broader consumer interest in plant-based, minimally processed, and health-oriented dietary choices [4]. These choices increasingly intersect with debates on sustainable food systems, in which dietary patterns that are nutritionally adequate, lower in environmental impact, and economically accessible are recognized as central to sustainable healthy diets [5]. Türkiye is a major



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producer of nuts and dried fruits. Hazelnut exports are particularly important in this sector [6]. However, strong production capacity does not imply homogeneous domestic consumption. In Türkiye, consumer attitudes are heterogeneous and systematically influenced by demographic variables, including education and age, which, in turn, inform perceptions of food quality and safety [7].

Biochemically, nuts are often considered a healthy lipid group because their unsaturated fat profiles remain stable across different cultivars and growing conditions [8–10]. However, for young adults, purchase decisions are rarely driven by such technical compositional knowledge [11]. These young consumers actively pursue a ‘healthy lifestyle’ [12]. Their food choices reflect an evaluation of both internal factors such as nutrition and external factors such as brand image and social media influence [13,14]. Recent evidence from university populations further indicates that healthier dietary patterns are shaped by socio-demographic and behavioral characteristics rather than by nutritional knowledge alone [15].

However, a critical challenge arises when positive health perceptions meet economic realities. Some research shows that price tends to override nutritional information, especially among budget-constrained consumers [16,17]. Income levels and food prices decisively shape purchase behavior in low-income groups more than access to information or proximity to the market [18]. Young adults in Türkiye are associated with relatively high health consciousness and interest in healthy living [19]. However, under conditions of limited student budgets, economic constraints may restrict the extent to which nutritional knowledge and positive health beliefs translate into regular food consumption patterns. In this context, nuts may be perceived not only as healthy foods but also as relatively costly or discretionary products among university students with constrained financial resources [20].

Although various studies have been conducted in the fields of nut biochemistry [9] and consumer attitudes [21,22], a significant research gap persists.

This study addresses this interdisciplinary gap by integrating consumer behavior analysis with laboratory-based gas chromatography–mass spectrometry (GC–MS) profiling. We examined the attitudes and nut consumption patterns of 666 university students in Türkiye and related these survey-based evaluations to the measured fatty acid profiles of five major nut varieties. Rather than developing a causal model, this study applied an integrated consumer-composition perspective to examine how health perceptions, product-level lipid quality, and affordability-related constraints are associated with nut consumption frequency.

While biochemical studies have established the nutritional value of nuts, little is known about how young consumers’ health perceptions translate into actual eating behavior under economic constraints. Specifically, this study aims to evaluate whether health perceptions, monthly expenditure, and purchasing-related factors (brand trust, social influence, and price sensitivity) are associated with the frequency of nut consumption among university students, while integrating the lipid profile of the main nut varieties available on the market. Framing these relationships within the agenda of sustainable healthy diets, this study further aims to identify affordability-sensitive entry points that may support more sustainable and accessible nut consumption among young adults [5].

1.1. Nutritional Quality of Nuts and Category-Level Health Evaluation

Nuts have long been valued in nutrition and food chemistry because of their notably high content of monounsaturated and polyunsaturated fatty acids [23,24]. Although individual nut types differ—hazelnuts and almonds are usually rich in oleic acid [10], whereas walnuts contain more α -linolenic acid—the overall lipid profile across the nut cat-

egory tends to be dominated by unsaturated fats, presenting a relatively stable nutritional signature [8].

However, consumer evaluations follow a different logic. Consumers rarely assess nuts based on their biochemical composition. More often, they rely on a so-called “health halo,” a generalized positive perception at the product category level [25]. For instance, research focusing on Turkish consumers demonstrates that awareness of food categories generally precedes any in-depth understanding of production details or nutrient profiles [21].

Even when consumers possess accurate nutritional knowledge about a food product, the time-dependent degradation of its sensory and compositional qualities, driven by inadequate storage conditions, can create a fundamental divergence between the product’s healthy image and the actual consumption experience [26].

Nut consumption holds a special place in the dietary habits of Mediterranean societies; it has been associated with lower cardiovascular risk and generally higher dietary quality [27]. However, consumption patterns in this region are far from homogeneous, and cultural traditions, demographic characteristics, and geographical conditions significantly shape the consumption habits.

1.2. Intrinsic and Extrinsic Attributes in Food Quality Perception

The theoretical basis of food preference behavior rests on the interaction between two groups of characteristics: the first consists of intrinsic qualities that reflect the physical and chemical properties of food, such as freshness and nutrient density. The second consists of extrinsic cues, such as packaging, brands, and prices [13,28,29]. In actual purchasing contexts, consumers often cannot directly access the intrinsic characteristics of products. Therefore, people tend to use external signals as indirect indicators when evaluating health and safety. Among young adults, digital information sources and social environmental influences increasingly shape their perceptions of quality products [30,31]. Within this scope, nuts are an instructive example; despite their intrinsically high and stable quality, consumer evaluations are largely shaped by extrinsic indicators that do not always reflect the actual biochemical profiles of the products. Supporting this notion, recent studies have emphasized that packaging elements and brand information significantly influence sensory expectations and perceived product quality (e.g., [32]).

1.3. Young Adults, Economic Constraints, and Food Choice Behavior

University students exhibit a strong awareness of health and a keen interest in adopting a healthy lifestyle; however, they are often constrained by considerable financial limitations [33,34].

From a consumer economics perspective, the extent to which healthy food products are accessible at an affordable price is closely related to the translation of health-related attitudes into purchasing behavior [35]. For price-sensitive individuals, especially those in lower-income groups, food prices and income levels may be more closely associated with food choices than access to information or proximity to points of sale [36]. This finding aligns with research indicating that some young consumers may prioritize external factors such as price and practicality alongside health and environmental considerations [37]. Among Turkish university students, limited disposable income and budget constraints may shape consumer habits, making price an important consideration when accessing relatively costly products such as nuts. Although perceived quality may remain generally high within this demographic, the actual consumption frequency can vary according to individuals’ purchasing power. This reveals a relevant affordability dimension in healthy food choices that requires further research [38].

1.4. Research Gap and Conceptual Framework

Research on the biochemical composition of nuts and consumer attitudes has largely followed separate paths, with little overlap. Compositional analyses rarely consider consumer perceptions, whereas consumer research often lacks product-level compositional data that can provide a nutritional context for consumer evaluations. Given that epidemiological and clinical studies have associated the cardiovascular and metabolic benefits of nuts with their favorable unsaturated fatty acid profiles [39], this study examined how such compositional markers correspond to consumers' health perceptions.

To address this gap across disciplines, this study adopts an integrated consumer-composition perspective. From this perspective, intrinsic product quality is represented by the fatty acid composition, which provides a product-level compositional indicator of the nutritional quality. Simultaneously, extrinsic cues, such as product labeling and marketing signals, and socioeconomic factors, such as spending capacity, may shape how consumers perceive quality and make food choices. This approach was used to examine the correspondence between consumers' health-related perceptions and the measured unsaturated fatty acid content of nuts. This enables an exploratory comparison between consumer evaluations and product-level fatty acid composition when assessing the perceived and compositional aspects of nut quality. This integrated perspective is also relevant to sustainability issues. By jointly considering nutritional quality, consumer perception, and economic accessibility, it links product-level food quality to the broader question of how nutrient-dense foods can be made affordable and accessible to young consumers, which is a core concern of sustainable healthy diets [5,40].

The Theory of Planned Behavior (TPB) offers a well-established theoretical lens for interpreting the behavioral dimensions underpinning this integrated framework [41]. The TPB explains behavior as a function of three key components: attitude toward the behavior, subjective norms, and perceived behavioral control (PBC). Attitude reflects an individual's evaluation of performing a behavior, subjective norm captures perceived social pressures, and PBC denotes perceived ease or difficulty in performing the behavior, including internal and external constraints.

In this study, the measured constructs were interpreted through the lens of the TPB. Factor 1 (Health, Freshness, and Product Protection) reflects the attitudinal dimension, representing students' favorable evaluations of the health- and quality-related aspects of nut consumption. Factor 2 (Information and Social Influence), which captures the influence of social media, online reviews, and expert or scientific information, can be linked to the subjective norm component of the model. Factor 3 (Brand, Packaging, and Environmental Quality Perception) and Factor 4 (Processing, Price Premium, and Nutritional Concern) can be interpreted in relation to perceived behavioral control, because brand-, quality-, and price-related considerations shape whether students feel able to obtain relatively costly nutrient-dense foods; within Factor 4, the price-premium item is most directly linked to affordability, whereas the concern over high fat or calorie content additionally reflects an evaluative (attitudinal) element. In this sense, the TPB provides an interpretive framework rather than a causal model [41].

Using TPB as an interpretive lens, together with the consumer-composition perspective, this study connects product-level fatty acid composition with consumer perceptions, social information cues, and affordability-related constraints. This framing supports a multidisciplinary interpretation of nut consumption among university students in Türkiye without treating the observed relationships as being causal.

2. Materials and Methods

2.1. Study Design

This study adopted a cross-sectional design that integrated psychometric consumer survey data with laboratory-based analysis. Such interdisciplinary approaches are useful for examining how consumer perceptions relate to measurable product-level nutritional characteristics [42]. By bridging agricultural economics, food chemistry, and consumer psychology, this approach enables a multidimensional assessment of the association between health perceptions, affordability-related factors, and fatty acid composition in the context of nut consumption by Turkish university students.

2.2. Population and Sample Size Determination

The study population comprised 30,001 active undergraduate and graduate students enrolled at Tekirdağ Namık Kemal University during the 2025–2026 academic year. The required sample size was calculated using Cochran's formula for large populations [43] and subsequently adjusted using the finite population correction (FPC) factor.

The initial sample size for an infinite population was calculated as follows:

$$n_0 = \frac{Z^2 \cdot p \cdot q}{d^2} \quad (1)$$

where n_0 denotes the initial sample size estimated for an infinite population, n denotes the sample size adjusted for the finite population, p represents the estimated proportion of the population (set to 0.5 for maximum variability).

$q = 1 - p$; Z denotes the Z-score corresponding to the selected confidence level (2.58 for 99% confidence); and d represents the acceptable margin of error (0.05).

Thus, $n_0 = (2.58^2 \times 0.5 \times 0.5) / 0.05^2 = 665.64$.

Given the finite population size ($N = 30,001$), the finite population correction (FPC) formula was applied as follows:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \quad (2)$$

$$n = \frac{665.64}{1 + \frac{665.64 - 1}{30001}} = 651.2$$

This adjustment yielded a minimum required sample size of approximately 651 participants. To compensate for potential non-response and incomplete surveys, the final sample size was increased to 666 participants, thereby supporting adequate statistical power.

2.3. Survey Instrument and Scale Development—Construct Validation

The survey instrument was based on previous studies that examined intrinsic and extrinsic food quality attributes and consumer decision-making behavior [13,29]. The questionnaire covered a range of items designed to measure perceived healthfulness, freshness, packaging quality, environmental sensitivity, brand trust, hygiene perception, social influence, and price-related factors. Items related to freshness, nutritional value, and environmentally friendly packaging were drawn from intrinsic product quality frameworks. In contrast, statements about brand reliability, hygiene signals, online reviews, and social media were used to assess extrinsic quality cues. Variables measuring price sensitivity, responsiveness to promotions, and unit price comparisons were adapted from the consumer behavior and food economics literature.

Participants were recruited using a convenience sampling approach that sought to reach a broad cross-section of students enrolled at Tekirdağ Namık Kemal University. Participation was voluntary, and no incentives were offered. The questionnaire was admin-

istered predominantly face-to-face during class breaks and at various locations across the campus, with approximately two-thirds of the responses collected in person; the remaining responses were collected online, with the questionnaire link distributed via email and student WhatsApp groups. The questionnaire began with an informed consent statement explaining that completing and submitting it constituted voluntary consent to participate, that no personally identifying information was collected, and that all responses were anonymous and reported only in aggregate. Each student completed the questionnaire only once: the face-to-face questionnaire was distributed on a single occasion, precluding repeated participation, and the online form was configured to accept only one response per respondent. The study was approved by the Scientific Research and Publication Ethics Committee of Tekirdağ Namık Kemal University (TNKÜ BAYEK). For the 15-item attitude scale, construct validity was examined using principal component analysis (PCA). Internal consistency was evaluated using Cronbach's alpha coefficient.

2.4. Nut Sample Selection and Preparation

To make sure the biochemical data reflected actual market conditions, five major nut varieties were purchased from retail outlets in Tekirdağ Province: Giresun Tombul hazelnut, Chandler walnut, Nonpareil almond, Siirt pistachio, and Osmaniye peanut. For each variety, three separate batches ($n = 3$) were obtained from different retail points. This was performed to account for the natural batch-to-batch variability. All samples were collected during the 2025 harvest season and selected while still in their original packages. To protect the lipid profiles from oxidation, the samples were kept in a dark environment at +4 °C and analyzed within 24 h of opening the containers. This procedure allowed the obtained fatty acid profiles to reflect the intrinsic properties of each variety, rather than any changes caused by storage conditions.

2.5. Fatty Acid Analysis (GC–MS)

The fatty acid compositions of the five commercial nut varieties were determined using gas chromatography–mass spectrometry (GC–MS), with three independent retail batches (lots) ($n = 3$) analyzed per variety. Total lipids were extracted using a chloroform–methanol procedure [44,45]. Briefly, 10 g of finely ground nut sample was shaken with 20 mL of methanol and 10 mL of chloroform for 3 min; a further 10 mL of chloroform was then added, and the mixture was shaken for 30 s, after which 10 mL of distilled water was added, and the mixture was shaken for an additional 30 s. The homogenate was filtered through Whatman No. 1 filter paper, the upper aqueous–methanolic phase was discarded, and the lower chloroform phase containing the lipids was dried over anhydrous sodium sulfate.

Fatty acid methyl esters (FAMES) were prepared from the extracted lipids by cold base-catalyzed transesterification according to the ISO 12966-2:2017 standard [46]. The lipid was treated with 0.2 mL of 2 M methanolic potassium hydroxide (KOH), and the resulting methyl esters were partitioned into the hexane phase and diluted 100-fold with *n*-hexane before injection. GC–MS analysis was performed on a Shimadzu QP-2010 system (Shimadzu Corp., Kyoto, Japan) equipped with an Rt-2560 (Restek Corp., Bellefonte, PA, USA) fused-silica capillary column (100 m × 0.25 mm i.d., 0.20 µm film thickness). The oven temperature was initially held at 60 °C for 2 min, then increased to 220 °C at 3 °C/min and held for 12 min (total run time, 67.33 min), and helium ($\geq 99.999\%$) was used as the carrier gas at a constant flow rate of 1.0 mL/min. Samples (1 µL) were injected in split mode (split ratio 20:1) at an injector temperature of 240 °C. The mass spectrometer was operated in electron-ionization (EI) mode at 70 eV, with the ion source and interface maintained at 240 °C and a scan range of m/z 46–500.

Individual fatty acids were identified by comparing their mass spectra with those in the NIST and Wiley spectral libraries (match quality > 90%). The retention indices of the identified FAMES are provided in Table S3. Because the fatty acid methyl esters were prepared under methanolic conditions, peaks returned by the spectral library as ethyl esters were reassigned to the corresponding fatty acids; in particular, the peak eluting shortly after methyl linoleate in walnut was assigned to α -linolenic acid (C18:3 n-3) on the basis of its retention behavior, and was therefore considered tentative, as authentic FAME standards were not available for confirmation. The relative amount of each fatty acid was calculated by peak area normalization and expressed as a percentage of the total fatty acids. The fatty acid compositions of the five varieties are presented in Section 3.5.

2.6. Statistical Analysis

All statistical analyses were performed using the SPSS software (version 25.0; IBM Corp., Armonk, NY, USA). As a preliminary diagnostic step for the continuous scale-based variables and group-level descriptive comparisons, normality and homogeneity of variance were examined using the Kolmogorov–Smirnov and Levene’s tests, respectively. These diagnostic checks were not used as assumptions for the cross-tabulation or Spearman correlation, which were selected according to the categorical, ordinal, and product-level structures of the study variables. Differences in fatty acid composition among the five nut varieties were assessed by one-way analysis of variance (ANOVA) followed by Tukey’s HSD post hoc test; where Levene’s test indicated unequal variances, the overall significance was confirmed by Welch’s robust test. A p -value < 0.05 was considered statistically significant.

Principal component analysis (PCA) with varimax rotation was applied to determine the underlying dimensions of the nut-consumption attitude scale. For interpretive clarity, the rotated principal components are hereafter referred to as factors. Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) statistic and Bartlett’s test of sphericity [47].

The correspondence between perceived and measured nut quality was examined by relating subjective health-perception data to objective compositional data, calculating the correlation between the mean health perception scores and the laboratory-measured total unsaturated fatty acid (UFA) ratios of the samples. To assess the independent contribution of affordability, a multinomial logistic regression was estimated with nut consumption frequency as the dependent variable (four categories, with low/occasional consumption as the reference). An ordinal (proportional-odds) model was tested first, but because the test of parallel lines rejected the proportional-odds assumption, a multinomial model was adopted. Monthly expenditure was the main affordability-related predictor; gender, age group, accommodation type, budget source, and the four PCA-derived attitude factor scores were entered as covariates. Gender was self-reported, with the response options female, male, or ‘other or prefer not to say’; the small ‘other or prefer not to say’ group (0.4%) was not included in the regression. Descriptive and bivariate analyses used the full sample ($n = 666$); the regression was estimated on complete cases ($N = 663$). Associations are reported as odds ratios (ORs) with 95% confidence intervals. For the regression, accommodation type was grouped into three categories (living with family; dormitory, combining state/KYK and private dormitories; and rented or student housing, including other private housing), budget source into three categories (family support only; scholarship-based support; and own income or part-time work, including mixed or other income), and monthly expenditure was entered in its five original brackets; the three-level expenditure grouping was used only for the descriptive cross-tabulation.

Given the cross-sectional design of this study, all statistical findings were interpreted as associations rather than causal effects. All statistical tests were performed at a 95% confidence level ($p < 0.05$).

3. Results

3.1. Demographic Profile and Nut Consumption Patterns

The research sample comprised 666 university students aged 18–28 years in Türkiye. The gender breakdown was balanced, with 52.9% females and 46.7% males. Most participants were younger, with 47.4% falling into the 18–20 age group. As shown in Table 1, the participants' socioeconomic makeup was diverse and varied. A large majority (64.1%) depend on family support as their primary income source. Simultaneously, individuals' monthly personal spending varies significantly across individuals. This variation provides a solid basis for comparing nut consumption habits across different income levels.

Table 1. Demographic Characteristics of Participants ($n = 666$).

Variable	Category	Percentage (%)
Gender	Female	52.9
	Male	46.7
	Other/Prefer not to say	0.4
Age Group	18–20 years	47.4
	21–23 years	38.0
	24 years and above	14.6
Accommodation Type	State dormitory (KYK)	33.9
	Living with family	29.0
	Rented house (alone/with friends)	28.5
	Other (private dormitory/apartment)	8.6
Income Source	Family support	64.1
	Scholarship and family support	12.8
	Own income/employed	10.4
	Mixed/other sources	12.7
Monthly Personal Expenditure (TRY)	≤4000	16.4
	4001–7000	28.1
	7001–10,000	22.1
	10,001–15,000	16.0
	≥15,001	17.4

Note: TRY: Turkish lira; 1 USD $\approx$ 41 TRY over the data-collection period (Fall 2025).

The behavioral analysis summarized in Table 2 reveals that nuts are primarily perceived and utilized as occasional snacks rather than daily staples in the diet of the students surveyed. Snacking was cited as the primary reason for consumption by 48.2% of respondents. Purchasing patterns have shifted toward an omnichannel shopping behavior. Local nut shops were the most common single outlet, accounting for 24.3% of the purchases. However, a substantial 42.3% of students relied on multiple channels, including supermarket chains and specialized online retailers for their purchases. The consumption frequency was stratified into four groups, and only 9.3% of the participants reported eating nuts daily. The largest proportion (34.5%) consumed them 1–2 times per week.

Table 2. Nut Consumption Habits, Purchasing Channels, and Consumption Frequency ($n = 666$).

Variable	Category	Percentage (%)
Consumption Purpose *	As a snack	48.2
	As a snack and between meals	16.2
	In desserts and between meals	13.5
	Only between meals	5.6
Purchasing Channels *	Local nut shops	24.3
	Discount markets	12.5
	Supermarket chains	11.3
	Supermarkets and discount markets	9.6
	Using multiple channels (local nut shops, supermarkets/discount markets, and online sources including producer brand websites and specialized online nut retailers)	42.3
Consumption Frequency	1–2 times per week	34.5
	1–2 times per month	26.1
	3–4 times per week	18.0
	Almost every day	9.3
	Rarely	12.0

* Multiple responses were allowed; therefore, percentages may exceed 100% within these categories.

3.2. Factor Structure of Consumer Attitudes Towards Nut Quality

The 15-item attitude scale was subjected to Principal Component Analysis (PCA) to uncover the cognitive dimensions underlying nut quality assessment. Sampling adequacy was acceptable ($KMO = 0.772$), and Bartlett's test of sphericity was significant ($\chi^2 = 2598.048$, $df = 105$, $p < 0.001$), confirming the data's suitability for factor analysis. As presented in Table 3, the analysis yielded a four-component solution explaining 57.071% of the total variance, with acceptable internal consistency for the overall scale (Cronbach's $\alpha = 0.785$).

Table 3. (A) Principal Component Analysis (PCA) Results for the Nut Consumption Attitude Scale. (B) Component statistics (eigenvalues and variance explained).

(A)	
Factor and Scale Items	Factor Loading
Factor 1. Health, Freshness, and Product Protection (Variance Explained: 16.077%)	
I perceive nuts as generally healthy and nutritious foods	0.719
Experiencing a negative incident (e.g., foreign substances) would affect my brand/product evaluation	0.682
Packaging is important for preserving product freshness and protection	0.604
Freshness is the most important criterion in my purchasing decision	0.604
Flavor enhancement influences my purchasing preference	0.464
Factor 2. Information and Social Influence (Variance Explained: 15.767%)	
I follow scientific publications or expert analyses related to food products	0.731
I consider recommendations from social media influencers	0.716
Product content information influences my evaluation	0.698
Online consumer reviews influence my purchasing decision	0.595
Flavor enhancement influences my purchasing preference	0.486

Table 3. Cont.

(A)				
Factor and Scale Items				Factor Loading
Factor 3. Brand, Packaging, and Environmental Quality Perception (Variance Explained: 13.985%)				
Trust in the brand’s production processes is important to me				0.701
Environmentally friendly packaging influences my purchasing decision				0.629
Packaging is important for preserving product freshness and protection				0.585
I prefer freshly roasted nuts				0.527
Freshness is the most important criterion in my purchasing decision				0.438
Factor 4. Processing, Price Premium, and Nutritional Concern (Variance Explained: 11.242%)				
Roasting affects my evaluation of nuts				0.798
I am willing to pay a higher price for raw nuts				0.693
High fat or calorie content in nuts raises concerns for me				0.616
Total Variance Explained				57.071%
Overall Scale Reliability (Cronbach’s α)				0.785
(B)				
Component	Initial Eigenvalue	Initial Variance (%)	Rotated Variance (%)	Cumulative Rotated Variance (%)
Factor 1	3.942	26.278	16.077	16.077
Factor 2	2.024	13.496	15.767	31.843
Factor 3	1.385	9.231	13.985	45.829
Factor 4	1.210	8.065	11.242	57.071

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. KMO = 0.772; Bartlett's test of sphericity: $\chi^2 = 2598.048$, $df = 105$, $p < 0.001$. Factor loadings below 0.30 were suppressed in this study. Some items showed cross-loadings; in this table, items are presented under the factor on which they showed their highest loading; where items cross-loaded, the highest loading was retained for table presentation. Note: Extraction: principal components; rotation: varimax with Kaiser normalization. Items with primary loadings ≥ 0.40 were retained; cross-loading was flagged when an item loaded ≥ 0.30 on more than one component, and each item was assigned to its highest-loading component while cross-loadings informed factor interpretation. Four components with eigenvalues > 1 were retained, explaining 57.071% of total variance (KMO = 0.772; Bartlett $\chi^2(105) = 2598.048$, $p < 0.001$; Cronbach $\alpha = 0.785$).

3.3. Economic Constraints and Consumption Frequency

A central finding of this study was the association between monthly expenditure and nut consumption frequency. As shown in Table 4, respondents in the low-expenditure group predominantly reported rare or monthly consumption. In contrast, near-daily intake was more common in the high-expenditure group. This descriptive pattern was formally tested in the multinomial logistic model reported in Section 3.4, in which monthly expenditure was the strongest predictor of consumption frequency (likelihood-ratio $\chi^2(12) = 91.88$, $p < 0.001$) after adjustment for demographic and attitudinal covariates.

3.4. Multivariable Predictors of Nut Consumption Frequency

Because the two lowest consumption categories were sparse, nut consumption frequency was modelled as four ordered categories (low/occasional, 1–2 times per week, 3–4 times per week, and daily/near-daily). An ordinal (proportional-odds) model was tested first, but the test of parallel lines indicated that the proportional-odds assumption was not met; a multinomial logistic regression was therefore used, with low/occasional consumption as the reference category ($N = 663$; Table 5). The overall model was significant ($\chi^2(45) = 218.77$, $p < 0.001$; Nagelkerke $R^2 = 0.306$). Likelihood-ratio tests (Table 5) showed that monthly expenditure had by far the strongest association with consumption frequency ($\chi^2(12) = 91.88$, $p < 0.001$), followed by accommodation type, budget source, and gender; among the attitudinal components, only Factor 1 (Health, Freshness, and Product Protection) was significant. The odds-ratio estimates (Table 5) show that, relative

to the highest-expenditure group ($\geq 15,001$ TRY), students in every lower-expenditure bracket had markedly and significantly lower odds of more frequent consumption (odds ratios of roughly 0.02–0.14 for the daily-versus-occasional contrast). Although the ordering across the intermediate brackets was not strictly monotonic—as expected given sampling variability in a cross-sectional design—the central contrast between all lower brackets and the highest-expenditure group was consistent across every consumption category, indicating a strong affordability-related pattern after adjustment. Health orientation (Factor 1) independently increased the odds of frequent consumption (daily-versus-occasional OR = 2.81), indicating that health attitudes also contribute, although expenditure remained the dominant predictor. Overall classification accuracy was 49.9% (Table 5). These results reinforce the central conclusion that economic accessibility is the principal driver of regular nut consumption.

Table 4. Descriptive cross-tabulation of monthly expenditure level (TRY) and nut consumption frequency (row percentages within each expenditure level).

Expenditure Level	Rarely	1–2/Month	1–2/Week	3–4/Week	Daily
Low (0–5000 TRY; $\approx$ \$0–122)	30.0%	41.4%	17.1%	8.6%	2.9%
Moderate (5001–10,000 TRY; $\approx$ \$122–244)	8.0%	37.5%	41.1%	9.8%	3.6%
High ($\geq 10,001$ TRY; $\approx$ $\geq$ \$244)	2.1%	11.1%	39.6%	29.9%	17.4%

Note: Values are row percentages (% within each monthly expenditure level); rows sum to 100% ($\pm$ rounding). The monthly expenditure level serves as a proxy for students' budget constraints. USD equivalents were converted at the mid-market rate for the data-collection period (Fall 2025; 1 USD $\approx$ 41 TRY; Central Bank of the Republic of Türkiye) and are indicative given lira depreciation during the study period. This cross-tabulation is descriptive; the association between monthly expenditure and consumption frequency was formally tested in the multinomial logistic model (Section 3.4; likelihood-ratio $\chi^2(12) = 91.88$, $p < 0.001$).

3.5. Fatty Acid Composition of Analysed Nuts (GC–MS)

The fatty acid profiles of the five nut varieties (hazelnuts, almonds, pistachios, walnuts, and peanuts) are listed in Table 6. For each variety, three independent retail batches ($n = 3$ per variety) were analyzed. Across all varieties, unsaturated fatty acids (UFAs) constituted the majority of total fatty acids, ranging from 80.05% (peanuts) to 87.72% (almonds). Representative GC–MS total-ion chromatograms for each variety (three retail batches each) are provided in Figures S1–S5.

Hazelnuts and almonds were characterized by high oleic acid content (C18:1 *cis*-9, 68.36% and 57.89%, respectively). Walnuts are rich in polyunsaturated fatty acids (PUFA: 67.77%), mainly linoleic acid (C18:2 *cis*-9,12, 51.80%) and α -linolenic acid (C18:3 *cis*-9,12,15, 15.89%). Peanuts contained the highest level of saturated fatty acids (19.96%), largely owing to palmitic (C16:0, 10.04%) and stearic (C18:0, 4.74%) acids, together with characteristic long-chain saturates (behenic and lignoceric acids).

The 'Other MUFA' fraction (1.78–4.66%) comprised palmitoleic, *cis*-vaccenic, and gondoic acids.

One-way ANOVA confirmed significant varietal differences in all major fatty acids except palmitic acid; walnut showed the highest polyunsaturated and α -linolenic acid contents, hazelnut the highest oleic acid and total MUFA, and peanut the highest arachidic acid and total saturated fatty acids (Tukey's HSD, $p < 0.05$). The analysis identified distinct varietal signatures: hazelnuts and almonds displayed MUFA-dominant profiles driven by oleic acid, whereas walnuts exhibited a PUFA-rich profile with significant linoleic and α -linolenic acid concentrations (Figure 1).

Table 5. (A) Multinomial logistic regression—model summary. (B) Likelihood-ratio tests for the multinomial model. (C) Multinomial logistic regression—odds ratios by consumption category.

(A)			
Model Statistic		Value	
Valid N		663	
Reference category of outcome		Low/occasional consumption	
Final −2 Log Likelihood		1435.939	
Model χ^2 (df)		218.768 (45)	
<i>p</i> -value		<0.001	
Cox & Snell R^2		0.281	
Nagelkerke R^2		0.306	
McFadden R^2		0.132	
Overall classification accuracy		49.9%	
(B)			
Predictor	χ^2	df	<i>p</i>
F1 Health, Freshness & Protection	34.664	3	<0.001
F2 Information & Social Influence	5.020	3	0.170
F3 Brand, Packaging & Environmental	3.551	3	0.314
F4 Processing, Price Premium & Nutritional	7.395	3	0.060
Monthly expenditure level	91.881	12	<0.001
Gender	24.620	3	<0.001
Age group	12.010	6	0.062
Budget source	27.001	6	<0.001
Accommodation type	32.127	6	<0.001
(C)			
Predictor	1–2/wk vs. occ. OR (95% CI)	3–4/wk vs. occ. OR (95% CI)	Daily vs. occ. OR (95% CI)
Attitude factors (PCA scores)			
F1 Health/Freshness	1.154 (0.946–1.408)	1.687 (1.280–2.222) ***	2.814 (1.785–4.435) ***
F2 Info/Social	1.015 (0.828–1.244)	1.274 (0.984–1.651)	0.939 (0.672–1.312)
F3 Brand/Packaging	1.027 (0.847–1.245)	1.235 (0.954–1.598)	1.224 (0.850–1.762)
F4 Processing/Price	0.869 (0.711–1.062)	1.143 (0.875–1.495)	1.181 (0.842–1.656)
Monthly expenditure (ref. ≥15,001 TRY)			
≤4000 TRY	0.099 (0.038–0.257) ***	0.042 (0.013–0.133) ***	0.064 (0.019–0.223) ***
4001–7000 TRY	0.147 (0.058–0.369) ***	0.093 (0.032–0.267) ***	0.051 (0.015–0.174) ***
7001–10,000 TRY	0.055 (0.022–0.139) ***	0.096 (0.035–0.265) ***	0.016 (0.004–0.060) ***
10,001–15,000 TRY	0.170 (0.066–0.433) ***	0.095 (0.031–0.292) ***	0.144 (0.046–0.451) **
Gender (ref. Male)			
Female	0.522 (0.339–0.801) **	0.326 (0.189–0.562) ***	0.239 (0.116–0.492) ***
Age group (ref. 24 years and above)			
18–20 years	0.525 (0.268–1.032)	0.831 (0.349–1.982)	0.202 (0.072–0.562) **
21–23 years	0.725 (0.370–1.419)	1.123 (0.491–2.567)	0.441 (0.172–1.132)
Budget source (ref. Own income/part-time)			
Family support only	2.648 (1.297–5.407) **	0.538 (0.252–1.148)	4.190 (1.378–12.744) *
Scholarship-based	2.581 (1.187–5.615) *	0.583 (0.242–1.402)	4.837 (1.398–16.733) *
Accommodation (ref. Rented/student house)			
Living with family	2.064 (1.152–3.700) *	7.605 (3.597–16.077) ***	2.478 (1.013–6.060) *
Dormitory	1.332 (0.798–2.222)	3.217 (1.540–6.721) **	1.066 (0.428–2.651)

Dependent variable: nut consumption frequency (four categories), reference = low/occasional consumption. Estimated on complete cases (N = 663 of 666). Each test compares the full model with a reduced model omitting the predictor. Monthly expenditure showed the strongest association with consumption frequency. Note: Reference outcome: low/occasional consumption. The small 'Other/Prefer not to say' gender group was excluded from the regression. Expenditure brackets are in TRY (1 USD $\approx$ 41 TRY, Fall 2025). Attitude factors entered as standardized PCA regression scores (per 1 SD). *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. OR > 1 indicates higher odds of the stated category versus low/occasional consumption.

Table 6. Fatty acid composition of five nut varieties (% of total fatty acids, mean $\pm$ SD, $n = 3$). SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; UFA, unsaturated fatty acids; SD, standard deviation.

Fatty Acid	Hazelnut	Almond	Pistachio	Walnut	Peanut
Saturated Fatty Acids (SFA)					
Palmitic acid (C16:0)	9.62 $\pm$ 0.98	9.45 $\pm$ 0.96	11.41 $\pm$ 0.80	8.94 $\pm$ 0.86	10.04 $\pm$ 1.07
Stearic acid (C18:0)	5.57 $\pm$ 1.45 ^a	2.59 $\pm$ 0.29 ^b	4.06 $\pm$ 0.21 ^{ab}	4.47 $\pm$ 0.53 ^{ab}	4.74 $\pm$ 1.18 ^{ab}
Arachidic acid (C20:0)	0.27 $\pm$ 0.11 ^b	0.13 $\pm$ 0.02 ^b	0.32 $\pm$ 0.04 ^b	0.13 $\pm$ 0.03 ^b	1.91 $\pm$ 0.62 ^a
Total SFA	15.51 ^{ab}	12.17 ^b	16.16 ^{ab}	13.54 ^b	19.96 ^a
Monounsaturated Fatty Acids (MUFA)					
Oleic acid (C18:1)	68.36 $\pm$ 1.58 ^a	57.89 $\pm$ 1.59 ^b	58.04 $\pm$ 2.47 ^b	16.77 $\pm$ 1.11 ^c	63.81 $\pm$ 5.09 ^{ab}
Other MUFAs [†]	1.78 $\pm$ 1.49 ^b	3.58 $\pm$ 0.20 ^{ab}	4.66 $\pm$ 0.39 ^a	1.94 $\pm$ 0.31 ^b	2.93 $\pm$ 0.36 ^{ab}
Total MUFA	70.13 ^a	61.46 ^b	62.70 ^{ab}	18.71 ^c	66.74 ^{ab}
Polyunsaturated Fatty Acids (PUFA)					
Linoleic acid (C18:2)	14.06 $\pm$ 1.05 ^c	26.26 $\pm$ 0.23 ^b	20.56 $\pm$ 1.16 ^{bc}	51.80 $\pm$ 1.72 ^a	13.20 $\pm$ 6.83 ^c
Linolenic acid (C18:3)	0.13 $\pm$ 0.12 ^b	n.d.	0.49 $\pm$ 0.05 ^b	15.89 $\pm$ 1.30 ^a	0.11 $\pm$ 0.03 ^b
Total PUFA	14.29 ^c	26.26 ^b	21.05 ^{bc}	67.77 ^a	13.31 ^c
Total UFA	84.43	87.72	83.75	86.48	80.05

Note: [†] Other MUFAs include palmitoleic acid (C16:1 cis-9), cis-vaccenic acid (C18:1 cis-11) and gondoic acid (C20:1). The complete fatty acid composition, including trace fatty acids, is shown in the Supplementary Materials (Tables S1 and S2). Values are means $\pm$ SD ($n = 3$); n.d., not detected. Different superscript letters within a row indicate significant differences among nut varieties (one-way ANOVA followed by Tukey's HSD test, $p < 0.05$); rows without letters (palmitic acid) did not differ significantly. Where Levene's test indicated unequal variances, the overall difference was confirmed by Welch's robust test. Total SFA also includes minor saturated fatty acids not listed separately (myristic, behenic and lignoceric acids).

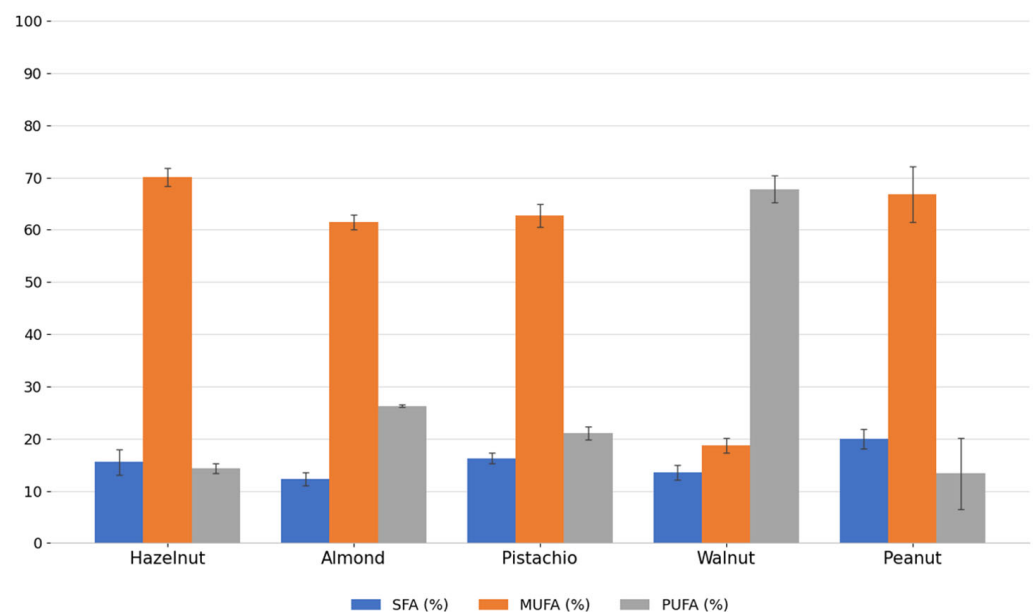


Figure 1. Proportional distribution of SFA, MUFA, and PUFA in the analyzed nut samples (mean values $\pm$ SD, $n = 3$). Error bars represent the standard deviation.

3.6. Exploratory Comparison Between Health Perception and Fatty Acid Composition

To explore the product-level correspondence between perceived healthfulness and fatty acid composition, Spearman's correlation analysis was conducted between Factor 1 (Health Orientation) scores for each nut type (Table A1) and their corresponding total UFA ratios (Table 6). The analysis revealed a weak positive correlation that was not statistically significant ($\rho = 0.300$, $p = 0.624$, $n = 5$), suggesting that the relationship between students' health perceptions and the measured fatty acid profiles of these nut varieties should be interpreted as exploratory and inconclusive.

4. Discussion

The main individual-level findings were derived from the survey-based analyses, which showed that the monthly expenditure level was significantly associated with consumption frequency (multinomial logistic model; likelihood-ratio $\chi^2(12) = 91.88$, $p < 0.001$); affordability-related constraints thus emerged as a key correlate of regular consumption. These findings are consistent with previous studies, indicating that food prices and income-related constraints are closely related to healthy food choices and diet quality among budget-constrained consumers [38].

These findings can be situated within the broader framework of sustainable and healthy diets. The FAO and WHO define sustainable healthy diets as dietary patterns that are not only nutritionally adequate and environmentally sustainable, but also economically accessible and affordable for all [5]. Within this framework, economic access is a key pillar of food security. Our observation that the frequency of nut consumption was more closely associated with monthly expenditure than with health perception suggests that, for budget-constrained university students, affordability may operate as a binding constraint on the adoption of nutrient-dense foods consistent with sustainable dietary patterns.

The observed affordability-related patterns do not reflect a lack of nutritional awareness. As shown in Table A1, the health perception scores remained relatively high across all nut types (ranging from 3.50 to 4.65 on a 5-point scale), suggesting that nuts are generally perceived as healthy foods at the category level rather than evaluated solely through variety-specific compositional knowledge.

This study combined survey data from 666 students with GC–MS fatty acid profiles of five nut varieties. Health-related considerations were prominent in how students evaluated nuts, and in the multinomial model a health orientation (Factor 1) was independently associated with more frequent consumption; nonetheless, health attitudes alone did not translate into the level of regular consumption suggested by the consistently positive perceptions, with monthly expenditure remaining the dominant predictor. This finding is consistent with earlier work suggesting that healthy eating considerations are relevant for young consumer segments [37].

Walnuts received the highest health perception score (4.65 out of 5), yet this favourable perception did not translate into more frequent consumption, mirroring the weak perception–composition correspondence reported above. Across the sample, affordability-related constraints rather than perceived nutritional quality appeared to shape regular consumption, consistent with the strong association between monthly expenditure and consumption frequency.

Digital information sources, such as social media and online reviews, did not appear to be strongly related to reported consumption frequency. This is consistent with recent evidence showing that social media ads and word-of-mouth may have complex and limited associations with health supplement purchases [31].

In summary, the findings suggest that the surveyed students generally held positive health perceptions of nuts, while regular consumption appeared to be closely related to

affordability and accessibility. Practical educational initiatives may support nutritional awareness, but health communication alone may be insufficient when consumers face budget-related constraints [36]. Therefore, strategies aimed at encouraging regular nut consumption should consider affordability-sensitive approaches, such as accessible package sizes, value-based retail options, and communication that connects nutritional quality with economic accessibility. Beyond price and access, regular consumption is likely embedded in broader behavioral determinants and food-literacy practices. In university populations, adherence to healthier dietary patterns has been associated with socio-demographic and behavioral characteristics rather than with nutritional awareness in isolation [15], while food-preparation competencies have been linked to more sustainable dietary behaviors [48]. Strengthening food literacy alongside affordability-oriented measures may therefore help translate favorable perceptions of nutrient-dense foods such as nuts into habitual consumption, in line with the sustainable healthy-diet framing of the present study.

Overall, these results suggest that affordability-related factors, rather than perceived nutritional quality, should be considered when interpreting the regular nut consumption of university students in Türkiye; positive category-level health perceptions did not correspond closely to the measured compositional differences between varieties.

4.1. Interpretation and Integration

Our findings contribute to the literature by showing that the surveyed students generally held positive health perceptions of nuts, whereas the product-level comparison with the total unsaturated fatty acid ratios remained weak and non-significant ($\rho = 0.300$, $p = 0.624$). This suggests that students' perceptions may reflect a broad category-level health image rather than detailed knowledge of the biochemical composition of specific nut varieties. This interpretation is consistent with existing theories of category health halos [24] and provides a product-level compositional context for future research on consumers.

The findings also suggest that affordability-related constraints may be more closely associated with regular nut consumption than limited health awareness in this study's sample. Among Turkish university students with limited disposable income [19], nuts may be perceived as relatively costly or discretionary products rather than daily staples by budget-conscious consumers.

This interpretation is consistent with agricultural economics perspectives, suggesting that, particularly among lower-income groups, price and income constraints may be closely related to food choice patterns [49]. This is consistent with evidence showing that nutrient-dense, health-promoting foods tend to carry higher costs per calorie and are less affordable for lower-income groups [40,50] and that the cost of healthy and sustainable reference diets can exceed the means of a substantial share of the population [51]. Nuts, as relatively expensive nutrient-dense foods, illustrate this tension at the product level: their favorable lipid profile aligns with healthy and sustainable dietary patterns, yet their cost may limit regular consumption among economically constrained young consumers.

This affordability-related pattern does not appear to reflect poor nutritional knowledge alone; rather, it may also be linked to structural and economic barriers to accessing healthy foods. Consistent with the strong association observed between monthly expenditure and consumption frequency in the multinomial model (Section 3.4), regular access to nutrient-dense foods may be perceived as costly by budget-constrained young consumers.

Combining food chemistry and consumer economic perspectives may help provide a more comprehensive understanding of these behaviors.

Unlike processed snacks, the lipid quality of nuts remains intact without industrial frying oil [52]. Studies have also shown that labels and nutritional claims positively affect consumer attitudes and purchase intentions for nut products such as cashew nut

beverages [53]. Walnuts may benefit from a “functional food” reputation, partly related to omega-3 messaging. However, their higher prices, susceptibility to oxidation, freshness concerns, and taste preferences may be associated with lower consumption. This suggests that scientific communication alone may be insufficient, and that economic accessibility and product stability should also be considered.

4.2. Practical Implications

From a sustainability standpoint, improving the affordability and accessibility of nuts is not only a marketing consideration but also a means of supporting more sustainable and healthy food consumption among young adults, in line with Sustainable Development Goals 2 (Zero Hunger), 3 (Good Health and Well-being), and 12 (Responsible Consumption and Production) [5]. These findings offer practical considerations for nut producers, retailers, university food services, policymakers and nutrition educators. For nut producers and retailers, pricing strategies should consider the price sensitivity of young consumers. Student-oriented discounts, smaller package sizes that reduce upfront costs, and communication of value per serving rather than just price per kilogram may help lower perceived entry barriers.

Tailored product messaging may also be considered.

Walnuts (high PUFA): Communication may emphasize freshness, oxidation control through appropriate packaging, and general omega-3-related nutritional attributes.

Hazelnuts and pistachios (high MUFA): Communication may refer to their MUFA-rich profiles and relevance to Mediterranean-style dietary patterns.

For university food services, subsidized nut options in cafeterias or vending machines and the inclusion of modest nut portions in student meal plans may help improve affordability and accessibility.

Regarding public health and nutrition education initiatives, simply stating that “nuts are healthy” may be insufficient to encourage regular consumption among budget-constrained student populations. Campaigns could provide practical guidance on how young consumers can incorporate nuts into their diets more cost-effectively, for example, through portion control, combining nuts with lower-cost foods, or comparing value across package sizes.

4.3. Limitations and Future Directions

The study sample consisted exclusively of students from Tekirdağ Namık Kemal University, which limits the applicability of the findings to the broader population of young adults in Türkiye. Because the study relied on a single-institution student sample, it may not adequately represent the geographic, socioeconomic, and cultural diversity of the country’s youth population. Therefore, the findings should be interpreted as reflecting the patterns observed in this sample, and caution is warranted when generalizing the results beyond the specific study population to the general population. Future research should include a more diverse and representative sample drawn from multiple universities and regions to improve external validity and provide a broader understanding of young adults’ health perceptions and nut consumption behaviors across different socioeconomic and regional contexts.

Several directions have emerged for further research in this area. Longitudinal studies tracking students after graduation could examine whether changes in income are associated with changes in the frequency of the consumption of nuts. Price experiments may help identify budget thresholds related to healthy food purchasing behavior. Replicating this study in other affordability-constrained food environments would allow for an assessment of whether similar patterns are observed under different economic conditions. Additionally,

sensory studies investigating how taste, freshness, texture, and product stability interact with fatty acid profiles could provide further insights into consumption patterns, particularly for PUFA-rich nuts, such as walnuts, and MUFA-rich nuts, such as hazelnuts and pistachios.

Several limitations should also be acknowledged. Participants were recruited through convenience sampling, which may limit the generalizability of the findings to the broader university student population. Fatty acid identification relied on spectral-library matching (NIST and Wiley) together with retention behavior rather than on authentic FAME standards, which were not available; consequently, the assignments—particularly the walnut α -linolenic acid (C18:3 n-3) peak—should be regarded as tentative, and future work should confirm them using certified FAME reference standards. In addition, the daily/near-daily consumption category was relatively small; consequently, several odds ratios for that contrast are estimated with wide confidence intervals and should be interpreted with caution, although the direction and statistical significance of the monthly expenditure association were consistent across all higher-frequency contrasts, supporting the robustness of the affordability-related finding. Finally, the correlation analysis between students' health perceptions and unsaturated fatty acid content was limited by the small number of nut varieties included in the product-level comparison. This limited sample size reduced the statistical power and increased the risk of Type II error; therefore, the observed non-significant correlation ($\rho = 0.300$, $p = 0.624$) should not be interpreted as evidence of no association between the two variables. These findings should be viewed as exploratory. Because this comparison is based on only five product-level observations, it cannot establish whether students' perceptions are aligned with, or decoupled from, the actual lipid quality of nuts, and no such biological inference is drawn here. Future studies would benefit from incorporating a wider range of nut varieties, such as macadamia and cashew nuts, to evaluate the relationship between consumer perception and product-level fatty acid composition in larger and more diverse sample populations.

In addition, MUFA and PUFA values were assigned according to the respondents' reported primary nut preference and should be interpreted as product-level compositional indicators, rather than individual dietary intake estimates.

5. Conclusions

This study provides an integrated consumer–composition perspective on nut consumption among university students in Türkiye by combining survey-based consumer data with product-level fatty acid composition. The findings suggest that students generally perceive nuts as healthy foods; however, regular consumption appears to be more closely related to affordability-related factors, particularly the monthly expenditure level, than to health perception; in the multinomial logistic model, monthly expenditure was the strongest predictor of consumption frequency (likelihood-ratio $\chi^2(12) = 91.88$, $p < 0.001$). The product-level comparison between the health perception scores and total unsaturated fatty acid ratios was weak and non-significant, indicating that this relationship should be interpreted as exploratory and not conclusive. From the perspectives of consumer behavior and agricultural economics, nutritional awareness alone may be insufficient to support regular nut consumption when healthy foods are perceived as costly. Strategies such as student-oriented pricing, smaller package sizes, and value-based retail options may help improve access to nutrient-dense foods among budget-constrained young consumers. By linking product-level compositional quality with consumer affordability, this study underscores that promoting sustainable healthy diets among young adults requires addressing economic accessibility as much as nutritional awareness.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su18157662/s1>. Figures S1–S5: GC–MS total ion chromatograms (TIC) of the FAME profiles of the five nut varieties, each shown for three independent retail batches (R1–R3); Table S1: Full fatty acid composition across three independent retail batches (R1–R3, relative area %); Table S2: Mean $\pm$ SD fatty acid composition per nut variety ($n = 3$); Table S3: Retention indices of the identified fatty acid methyl esters (FAMES).

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Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Data Availability Statement: The raw GC–MS chromatograms and peak-area reports supporting the reported fatty acid profiles are provided as Supplementary Materials (Figures S1–S5). The survey dataset is not publicly available owing to participant privacy and ethical restrictions but is available from the corresponding author on reasonable request.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Health orientation scores (Factor 1) and fatty acid compositions of the nut varieties (mean $\pm$ SD).

Nut Type	Oleic Acid (C18:1 cis-9, %)	PUFA(C18:2 + C18:3, %)	Total SFA (%)	Factor 1 (Health Orientation Score)
Hazelnut	68.36 $\pm$ 1.58	14.29 $\pm$ 0.98	15.51 $\pm$ 2.42	4.12 $\pm$ 0.45
Almond	57.89 $\pm$ 1.59	26.26 $\pm$ 0.23	12.17 $\pm$ 1.24	3.85 $\pm$ 0.52
Pistachio	58.04 $\pm$ 2.47	21.05 $\pm$ 1.20	16.16 $\pm$ 0.96	4.30 $\pm$ 0.38
Walnut	16.77 $\pm$ 1.11	67.77 $\pm$ 2.61	13.54 $\pm$ 1.36	4.65 $\pm$ 0.29
Peanut	63.81 $\pm$ 5.09	13.31 $\pm$ 6.80	19.96 $\pm$ 1.91	3.50 $\pm$ 0.61

Note: PUFA, polyunsaturated fatty acids (linoleic + α -linolenic acid); SFA, saturated fatty acids (palmitic + stearic + arachidic acid); SD, standard deviation. Factor 1 (Health Orientation) denotes the mean PCA-derived health-orientation attitude score of respondents whose primary preference was the respective variety; this table presents the exploratory five-variety ($n = 5$) data underlying the perception–composition correlation ($\rho = 0.300$, $p = 0.624$). The total MUFA values are listed in Table 6.

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