



Article

Adherence to the Mediterranean Diet and Sustainable Nutrition: The Role of Nutrition Literacy Across Generations

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Abstract

Background: Sustainable diets, particularly the Mediterranean diet, are associated with improved human and planetary health. Nutrition literacy influences food choices, yet intergenerational differences in literacy and adherence to sustainable diets remain under-explored. This study examined the relationship between nutrition literacy, adherence to the Mediterranean diet, and sustainable nutrition behaviors among Generation X, Y, and Z adults living in Istanbul. **Methods:** A cross-sectional online survey was conducted among adults aged 18–60 years. Data were collected through a demographic questionnaire, the E-Healthy Nutrition Literacy Scale, and the Short Questionnaire for Mediterranean Diet Adherence and Sustainable Nutrition. Parametric statistical analyses were performed. **Results:** Among 1395 participants, adherence to the Mediterranean diet did not significantly differ by generation or gender ($p > 0.05$). Participants with prior nutrition education were significantly more likely to achieve high nutrition literacy scores and adhere to sustainable eating practices. Adherence to sustainable nutrition increased across generations, with Generation Z exhibiting the highest proportion of low adherence (53%), while Generations Y and X demonstrated progressively higher rates of moderate (39%) and high adherence (31.6%) ($p < 0.05$). Correlation analyses indicated that adherence to sustainable nutrition was positively associated with the application dimension of nutrition literacy, suggesting that both knowledge and practical skills may influence sustainable nutrition behaviors. **Conclusion:** Older and more educated participants achieved higher nutrition literacy and sustainable nutrition adherence scores. Knowledge alone is insufficient to ensure healthy or sustainable eating. Enhancing practical skills and providing sustainability-focused nutrition education may improve diet quality and public health.

Keywords: nutrition literacy; sustainability; generations; Mediterranean diet; sustainable nutrition behaviors



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1. Introduction

Nutrition is the intake of nutrients required by individuals in sufficient amounts and at appropriate times to protect and improve health and increase quality of life. Adequate and balanced nutrition of individuals plays an important role in reducing the prevalence of non-communicable chronic diseases and minimizing nutrition-related health problems such as protein-energy malnutrition and vitamin–mineral deficiencies [1]. Recently, the effects of nutrition on human health and the environment have also been revealed [2].

One indicator of the environmental impact of food production is the food carbon footprint (CFP), expressed as greenhouse gas emissions. Many stages, especially food production, transportation, storage, cooking, and waste management, contribute significantly to greenhouse gas emissions and, therefore, to the formation of CFP. A large share of greenhouse gas emissions occurs during the agricultural stage; to achieve a significant reduction, it is necessary to change food choices and reduce food waste and loss [3–5]. The food system is responsible for approximately 21 to 37 percent of global anthropogenic greenhouse gas emissions. Without targeted interventions, emissions are projected to increase by 30 to 40 percent by 2050 [6]. Greenhouse gas emissions have an important place in global warming and, in this context, negatively affect planetary well-being [7]. The European Commission's report "A Clean Planet for All" emphasizes that shifting consumers' food choices toward diets lower in animal products is important for improving health and achieving climate neutrality by 2050. It has also been observed that high amounts of greenhouse gas emissions reduce the levels of zinc, iron, B vitamins, and protein in foods [8].

Food production is also known to have an important place in the use of water resources. Globally, 92% of water use is for food production. Twenty-nine percent of the water used in agriculture is used directly or indirectly to produce animal-based foods. Compared to plant-based foods, animal-derived foods require more water use per unit of energy [9]. Reducing the consumption of animal-based foods has significant benefits in the proper use of water resources [10]. Mekonnen and Hoekstra, among the first researchers to examine the effect of diet on the water footprint (WFP), found that animal-based foods have much higher WFP values than plant-based foods with the same calorie content. The average WFP value of beef per calorie is approximately 20 times greater than that of cereals and starchy vegetables. When assessed per unit of protein, the WFP of beef is six times higher than that of legumes [11].

Current projections indicate that the global population will reach approximately 10 billion by 2050. Providing nutritionally adequate diets for all individuals while safeguarding planetary health represents a significant global challenge. The concept of sustainable nutrition emerges as a central consideration [12,13]. Sustainable diets are defined by the Food and Agriculture Organization of the United Nations and the World Health Organization as "diets that have low environmental impact, are accessible, affordable, safe, fair, culturally acceptable, and support the health and well-being of individuals in all dimensions" [14]. Sustainable diets, beyond being merely a form of nutrition, are a lifestyle that supports healthy and sustainable living across all its components, including health, biodiversity, equity, cultural heritage, food security, and locality, and they integrate all aspects of sustainability [15]. According to the Lancet Planetary Health Commission, transitioning to a more sustainable dietary pattern can improve both human and planetary health. The Lancet Commission has stated that transitioning to a sustainable diet could prevent 27% of diet-related deaths. Furthermore, it is estimated that transitioning to a sustainable and healthy diet could reduce agricultural greenhouse gas emissions by up to 20% [16].

Among sustainable dietary models, the Mediterranean diet includes high amounts of olive oil, olives, fruits, vegetables, cereals (especially whole grains), legumes, and nuts; moderate-to-high levels of fish; moderate levels of eggs, poultry, and dairy products; and low levels of red meat, processed meats, and sweets. Research shows that adherence to the Mediterranean diet may reduce the risk of cardiovascular disease and cancer and improve cognitive health [17]. In 2010, the Mediterranean diet was recognized as an "Intangible Cultural Heritage of Humanity" by the United Nations Educational, Scientific, and Cultural Organization. From a sustainability perspective, four benefits of the Mediterranean diet

stand out. Key advantages include significant health and nutritional benefits, reduced environmental impacts, enhanced biodiversity, substantial sociocultural food value, and positive economic outcomes at the local level [18]. The Mediterranean diet is of great importance for assessing diet quality and determining sustainable nutrition behaviors. Nutritional knowledge has an important place in individuals' food choices. Knowledge, skills, and behaviors related to nutrition affect food selection, consumption, and dietary patterns [19].

Nutrition literacy, a new concept emerging in the developing world, is the capacity to access, understand, interpret, and apply basic nutrition information to improve individual health. Healthy nutrition literacy, also referred to as nutrition literacy, has been identified as a sub-dimension of health literacy [20]. It is recognized as a critical component in strategic efforts to promote healthy eating habits and improve health outcomes. Research shows that individuals across generations have distinct food-choice habits [21,22]. One study showed that younger generations (Y and Z) prioritize price in food choices, while older generations (X) place greater importance on food quality and the environmental impact of food [23]. Although the current literature includes many studies on nutrition literacy, adherence to the Mediterranean diet, and sustainable nutrition behaviors, research that considers these variables together in the context of intergenerational differences is limited [24,25]. However, food preferences, environmental sensitivity, and dietary habits differ significantly among generations. This research addresses a gap in the literature by examining the relationships among nutrition literacy, adherence to the Mediterranean diet, and sustainable eating behaviors across the X, Y, and Z generations. The study evaluates how intergenerational differences in nutrition literacy influence adherence to the Mediterranean diet and sustainable eating behaviors. Furthermore, it investigates the effects of demographic variables and prior nutrition education on these outcomes and identifies the components of nutrition literacy most strongly associated with healthy and sustainable nutrition practices. The findings are anticipated to inform the identification of predictors of sustainable nutrition behaviors and to support progress toward sustainable development goals.

2. Materials and Methods

2.1. Study Design

This study was designed as a cross-sectional survey conducted among adults residing in Istanbul. Data were collected online via Google Forms between March–May 2025. Ethical approval was obtained from the Istanbul Gedik University Ethics Committee (February 2025). All participants provided electronic informed consent prior to participation.

2.2. Participants

Participants were eligible for inclusion if they were between 18 and 60 years of age, resided in Istanbul, and belonged to one of the targeted generational cohorts: Generation X (1965–1979), Generation Y (1980–1995), or Generation Z (1996–2007). Additional requirements were voluntary participation, provision of informed consent, and the ability to read and complete an online questionnaire. Individuals were excluded if they were younger than 18 or older than 60 years, lived outside of Istanbul, did not provide informed consent, or submitted incomplete or inconsistent responses. Those with cognitive, visual, or linguistic impairments that could interfere with survey completion were also excluded.

According to the Turkish Statistical Institute, the total population of Istanbul was 15,701,602 as of 31 December 2024 [26]. As age-specific population distributions were not available, sample size calculation was performed using the total population. In the absence of prior data regarding the prevalence of nutrition literacy or related outcomes

in the adult population of Istanbul, the sample size calculation was performed using the most conservative approach by assuming $p = 0.50$, which maximizes the required sample size and ensures sufficient statistical power for the study. The sample size was determined using the formula suggested by Büyüköztürk (2018) with a 95% confidence level, $p = 0.50$, and $d = 0.05$ (margin of error) [27]. According to this calculation, the minimum sample size required to ensure representativeness of the study population was 384 participants.

2.3. Data Collection Tools

Data were collected using an online questionnaire administered via Google Forms. Prior to participation, all individuals were informed about the study and provided informed consent electronically. The questionnaire consisted of the following sections:

2.3.1. General Information Form

Included demographic and health-related items such as age, sex, marital status, education level, place of residence, body weight, height, body mass index (BMI) and prior participation in nutrition-related training.

2.3.2. E-Healthy Nutrition Literacy Scale (E-HNL)

This 11-item scale evaluates nutrition literacy across four subdomains: Access, Understanding, Evaluation, and Application. Responses are rated on different Likert-type formats: Access (1 = never to 5 = daily), Evaluation (1 = strongly disagree to 5 = strongly agree), Application (1 = never to 5 = always), and Understanding (yes = 5; no/don't know = 1). The total score is obtained by summing all items, with higher scores indicating greater nutrition literacy. The validity and reliability of the scale were established in adults aged 18–65 years [28].

2.3.3. Short Questionnaire for the Assessment of Mediterranean Diet Adherence and Sustainable Nutrition

This scale is scored according to the portion sizes consumed from different food groups. The food groups evaluated on this scale are cereals and cereal products, legumes, fresh vegetables, fresh fruits, dairy products, fish and fish products, meat and meat products, and olive oil. A Mediterranean Diet total score and a sustainable nutrition score are obtained based on the consumption frequency and portion sizes of the specified food groups. Mediterranean Diet Total Score: Low adherence = 0.0 to 9.0; Moderate adherence = 9.1 to 11.0; High adherence = 11.1 to 16.0. Sustainable Nutrition Total Score: Low adherence = 0.0 to 3.0; Moderate adherence = 3.1 to 4.0; High adherence = 4.1 to 8.0. The validity and reliability of the Short Questionnaire for the Assessment of Adherence to the Mediterranean Diet and Sustainable Nutrition was conducted on individuals aged between 18 and 64 [29].

2.4. Statistical Analysis

Data were analyzed using SPSS 22.0 (IBM Corp., Armonk, NY, USA). Normality was tested with the Shapiro–Wilk and Kolmogorov–Smirnov tests, as well as skewness–kurtosis values (−1.5 to +1.5). Since assumptions were met, parametric tests were used. Descriptive statistics were presented as frequencies and percentages for categorical variables, and as mean \pm SD (standard deviation), minimum, and maximum for continuous variables. Associations between continuous variables and scale scores were examined with Pearson's correlation. Group comparisons were performed with an independent samples *t*-test (two groups) or one-way ANOVA (≥ 3 groups), followed by Tukey's post hoc test when appropriate. Chi-square test with Bonferroni correction was applied for categorical variables. Multiple linear regression analysis was applied to evaluate the predictive effects

of independent variables on the dependent variable. Statistical significance was accepted at $p < 0.05$.

3. Results

3.1. General Characteristics of Participants

Most of the participants were from Generation Z (51%), female (69.7%), and single (56.3%). In terms of marital status, 56.3% of the participants were single, and regarding educational level, 61.1% were university graduates. Furthermore, 77.2% had not previously received any nutrition-related education. The mean E-HNL score of the participants was 32.486 ± 6.95 . Most participants demonstrated low adherence to the Mediterranean diet (90.2%) and to sustainable nutrition practices (84.5%) (Table 1).

Table 1. General Characteristics of Participants (n = 1395).

	n	%
Generation		
Generation Z	719	51.6
Generation Y	314	22.5
Generation X	362	25.9
Gender		
Female	973	69.7
Male	422	30.3
Marital Status		
Single	785	56.3
Married	610	43.7
Educational Level		
Primary School	142	10.2
High School	325	23.3
University	853	61.1
Master's/Doctorate	75	5.4
Previous Nutrition Education Status		
Yes	318	22.8
No	1077	77.2
	Min–Max	Mean \pm SD
Anthropometric Measurements		
Body Weight (kg)	38–150	70.32 \pm 15.87
Height (cm)	150–200	167.75 \pm 9
BMI (kg/m ²)	15.21–46.3	24.9 \pm 4.83
Score Distributions of E-HNL and Its Sub-dimensions		
Access	3–15	9.66 \pm 3.58
Understanding	4–20	10.45 \pm 4.58
Evaluation	2–10	7.04 \pm 2.36
Application	2–10	5.33 \pm 1.82
Total E-HNL Score	11–53	32.486 \pm 6.95
Mediterranean Diet Adherence Scores		
	0–14	5.7 \pm 2.75
Sustainable Diet Adherence Scores		
	0–7	2.11 \pm 1.38

Table 1. *Cont.*

	n	%
MDAL		
Low Adherence	1259	90.2
Moderate Adherence	114	8.2
High Adherence	22	1.6
SDAL		
Low Adherence	1178	84.5
Moderate Adherence	141	10.1
High Adherence	76	5.4

BMI, Body Mass Index; E-HNL: e-healthy nutrition literacy; SD, standard deviation; Min-Max, minimum–maximum; MDAL, Mediterranean Diet Adherence Level; SDAL, Sustainable Diet Adherence Level.

3.2. Comparison of E-HNL Scores and Sub-Dimensions by Demographic and Educational Variables

When comparing the sub-dimensions and total scores of the E-HNL across generations, statistically significant differences were observed in the access and understanding sub-dimensions as well as in the total score ($p < 0.05$). In contrast, no significant differences were found among generations in the appraisal and applying sub-dimensions ($p > 0.05$). According to gender, significant differences were identified in the appraisal and applying sub-dimensions and in the total score, with women scoring significantly higher than men in all three ($p < 0.05$). Moreover, participants who had previously received nutrition education scored significantly higher in the access and applying sub-dimensions, as well as in the total score ($p < 0.001$). These findings are presented in Table 2.

Table 2. Comparison of E-HNL and Its Sub-Dimensions by Generation, Gender, and Previous Nutrition Education Status.

		Access	Understanding	Evaluation	Application	Total E-HNL Score
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Generations	Generation Z (n = 719)	9.91 ± 3.28	9.28 ± 4.3	7.03 ± 2.25	5.31 ± 1.8	31.53 ± 6.52
	Generation Y (n = 314)	9.35 ± 3.84	11.47 ± 4.73	6.95 ± 2.47	5.36 ± 1.85	33.15 ± 7.53
	Generation X (n = 362)	9.45 ± 3.9	11.87 ± 4.38	7.11 ± 2.48	5.361 ± 1.84	33.8 ± 6.98
	F	3558	52.63	0.363	0.144	15.002
	p-value	0.029 *	<0.001 *	0.696	0.866	<0.001 *
Gender	Female (n = 973)	9.8 ± 3.3	10.45 ± 4.48	7.18 ± 2.31	5.48 ± 1.81	32.92 ± 6.58
	Male (n = 422)	9.37 ± 4.15	10.44 ± 4.8	6.68 ± 2.44	4.98 ± 1.78	31.5 ± 7.64
	t	1851	0.017	3.55	4.72	3322
	p-value	0.065	0.986	<0.001 *	<0.001 *	0.001 *
Previous Nutrition Education Status	Yes (n = 318)	10.07 ± 2.82	10.32 ± 4.61	7.2 ± 2.41	6.22 ± 1.84	33.82 ± 6.36
	No (n = 1077)	9.54 ± 3.77	10.48 ± 4.57	6.98 ± 2.34	5.1 ± 1.72	32.1 ± 7.06
	t	2667	−0.539	1415	10.265	4.138
	p-value	0.008 *	0.59	0.157	<0.001 *	<0.001 *

E-HNL, e-healthy nutrition literacy; SD, standard deviation; One-Way ANOVA; *t*-test; * $p < 0.05$.

3.3. Comparison of Mediterranean and Sustainable Diet Adherence Across Demographic and Educational Variables

As shown in Table 3, Mediterranean Diet Adherence levels did not differ significantly by generation, gender, or previous nutrition education status ($p > 0.05$). In contrast, Sustainable Diet Adherence levels were found to vary significantly according to generation and nutrition education status ($p < 0.05$). When examined in terms of marital status, 52.6% of those with high adherence to sustainable nutrition were married, while those with low

adherence were single (57.7%) ($X^2 = 6.543$; $p = 0.038$). No difference was found in adherence to the Mediterranean diet based on marital status ($p > 0.05$).

Table 3. Comparison of Mediterranean Diet Adherence and Sustainable Diet Adherence Levels by Generation, Gender, and Previous Nutrition Education Status.

	MDAL			SDAL			X^2	p -Value	X^2	p -Value
	Low Adherence	Moderate Adherence	High Adherence	Low Adherence	Moderate Adherence	High Adherence				
	n (%)			n (%)						
Generations										
Generation Z	657 (52.2%)	53 (46.5%)	9 (40.9%)	6.105	0.191	624 (53%)	59 (41.8%)	36 (47.4%)	16.08	0.003 *
Generation Y	284 (22.6%)	27 (23.7%)	3 (13.6%)			271 (23%)	27 (19.1%)	16 (21.1%)		
Generation X	318 (25.3%)	34 (29.8%)	10 (45.5%)			283 (24%)	55 (39%)	24 (31.6%)		
Gender										
Female	887 (70.5%)	74 (64.9%)	12 (54.5%)	3.97	0.137	835 (70.9%)	89 (63.1%)	49 (64.5%)	4.656	0.097
Male	372 (29.5%)	40 (35.1%)	10 (45.5%)			343 (29.1%)	52 (36.9%)	27 (35.5%)		
Previous Nutrition Education Status										
Yes	281 (22.3%)	31 (27.2%)	6 (27.3%)	1.665	0.435	256 (21.7%)	35 (24.8%)	49 (64.5%)	70.89	<0.001 *
No	978 (77.7%)	83 (72.8%)	16 (72.7%)			922 (78.3%)	106 (75.2%)	27 (35.5%)		

MDAL, Mediterranean Diet Adherence Level; SDAL, Sustainable Diet Adherence Level; Chi-square test; * $p < 0.05$.

3.4. Predictors of Adherence to the Mediterranean Diet

According to the results of multiple linear regression analysis, the variables included in the model explained only a very small portion of the total variance in the Mediterranean diet adherence score ($R^2 = 0.012$). While the model appeared statistically significant, the majority of the independent variables did not have a significant effect on adherence to the Mediterranean diet, with only gender appearing as a low-level significant predictor ($B = 0.387$; $p = 0.001$).

3.5. Correlation Analysis of Different Parameters

Positive but weak yet statistically significant correlations were observed between MDAL and the access sub-dimension of the E-HNL, the total E-HNL score, and BMI ($p < 0.05$). In contrast, a negative significant correlation was found between MDAL and the understanding sub-dimension of the E-HNL ($p < 0.05$). SDAL was positively and significantly correlated with the applying sub-dimension of the E-HNL and with BMI ($p < 0.05$). Furthermore, BMI showed a negative correlation with the access sub-dimension of the E-HNL, while positive significant correlations were identified with the understanding sub-dimension and the total E-HNL score ($p < 0.05$) (Tables 4 and 5).

Table 4. Multiple Linear Regression Analysis of Factors Predicting Mediterranean Diet Adherence Score.

Variable	F	p	R^2	Adj. R^2	B	t	p
Constant					5.491	16.671	0.00 *
Total E-HNL Score					−0.002	−0.299	0.765
Generations	4.306	0.002 *	0.012	0.009	0.119	1.275	0.202
Gender					0.387	3.257	0.001 *
Marital Status					0.057	0.359	0.719

E-HNL, e-healthy nutrition literacy; Multiple linear regression model; * $p < 0.05$

Table 5. Correlation Analysis of E-HNL and Its Sub-Dimensions, MDAL, SDAL, and BMI.

		MDAL	SDAL	BMI
Access	r	0.068 *	0.051	−0.056 *
	p-value	0.011	0.056	0.035
Understanding	r	−0.056 *	−0.023	0.135 *
	p-value	0.035	0.382	0.000
Evaluation	r	0.008	−0.007	0.003
	p-value	0.759	0.789	0.913
Application	r	0.069 *	0.076 *	−0.014
	p-value	0.010	0.004	0.605
Total E-HNL Score	r	0.019	0.029	0.057 *
	p-value	0.480	0.287	0.033
BMI	r	0.067 *	0.064 *	
	p-value	0.013	0.017	

MDAL, Mediterranean Diet Adherence Level; SDAL, Sustainable Diet Adherence Level; BMI, body mass index; E-HNL, e-healthy nutrition literacy; * $p < 0.05$.

4. Discussion

4.1. Sustainable and Healthy Eating Behaviors

Sustainable and healthy eating behaviors are of great importance as they directly affect food choice and ecological footprint [30]. A related study showed a moderate positive relationship between sustainable and healthy eating behaviors and awareness of reducing ecological footprint [31]. In this study, 84.5% of participants were found to have low adherence to sustainable and healthy eating behaviors. The low SDAL scores indicate limited adherence to sustainable dietary practices in this population. Practically, this suggests that participants are not consistently engaging in behaviors such as choosing plant-based foods, selecting local or seasonal products, or reducing food waste. These gaps may reflect low awareness of sustainability principles or barriers such as cost, accessibility, and time. Overall, the findings highlight the need for public health strategies and educational efforts that support and promote sustainable eating behaviors. Also, this suggests that large-scale educational programs covering a significant part of society are necessary to reduce the ecological footprint.

A study evaluating the scores of the Sustainable and Healthy Eating Behaviors Scale across different generations found that individuals born between 1965 and 1979 scored 4.56 ± 0.78 , those born between 1980 and 1999 scored 4.27 ± 0.83 , and those born in 2000 and later scored 4.02 ± 0.93 [32]. Another related study showed that sustainability awareness was higher among middle-aged adults compared to younger individuals [33]. Consistent with the literature, the results of this study also revealed that younger individuals showed less adherence to sustainable and healthy eating behaviors. It was observed that the factors most influencing Gen Z's food choices were taste, price, and the health effects of foods, while they attached less importance to the relationship between diet and the environment [34]. Therefore, lower adherence to sustainable eating behaviors may be higher among young adults for this reason.

In this study, it was observed that married individuals had higher adherence to sustainable and healthy eating behaviors ($p < 0.05$). Research consistently demonstrates that married individuals exhibit more sustainable and healthy nutrition behaviors compared to their unmarried counterparts. In a large-scale study conducted in Turkey with 3037 adults, married participants were found to have significantly higher Sustainable and Healthy Eating Behaviors Scale scores compared to single participants [35]. Similarly, among highly educated adults, sustainable nutrition behaviors were found to be significantly associated

with marital status [36]. This situation is thought to be mainly related to generations. The fact that married individuals in the study largely belonged to Gen X and Y suggests that the results may be due to the demographic characteristics of these generations.

The most important problem in accessing sustainable and healthy food is thought to be the lack of knowledge and awareness on the subject [37]. A related study showed that an increase in education level resulted in an increase in sustainable and healthy eating behaviors [38]. Another study also found that especially those who received education related to health and nutrition preferred sustainable foods more [33]. In the study, a significant difference was found between having previously participated in any nutrition-related education and sustainable and healthy eating behaviors ($p < 0.05$). This difference shows that nutrition education contributes positively to sustainable nutrition. The higher rates of adherence among individuals who participated in education suggest that the level of awareness is reflected in behaviors.

It has been shown that individuals with high “ecological footprint awareness,” which expresses the extent to which an individual, community, or institution is aware of the impact they create on the environment, had higher health literacy levels and normal BMI levels [39]. Increased adherence to the EAT-Lancet Commission Reference Diet, which has an important place among sustainable diet models, was found to be associated with reductions in anthropometric measurement results, particularly BMI [40]. The results of a systematic review and meta-analysis on the subject showed that sustainable diets can reduce the risk of being overweight/obese, and therefore, they may be an important solution for improving both public health and planetary health [41]. Individuals with higher Planetary Health Diet Index scores, which evaluates adherence to the EAT-Lancet Commission Reference Diet, had a 24.0% lower rate of being overweight and a 27.0% lower rate of abdominal obesity [42]. In this study, a low-level but significant positive relationship was also found between sustainable and healthy eating behaviors and body weight and BMI ($p < 0.05$). The main reason for this result, which contradicts the literature, is thought to be related to the fact that the average BMI values of the participants in this study were already within the normal range.

Examining the relationship between the E-HNL Scale and the Sustainable Eating Behaviors Scale revealed a positive, low-level, statistically significant relationship only with the ‘practice’ sub-dimension ($p < 0.05$). This suggests that the transformation of knowledge into practice is particularly effective in developing sustainable eating behaviors.

4.2. Nutrition Literacy

Nutrition literacy, the ability of individuals to obtain, process, and comprehend essential nutrition information and services needed to make appropriate nutrition decisions, varies significantly across age groups. The result of this study suggests that while access to nutrition information is slightly better in younger adults, the ability to understand information improves with age, and overall nutrition literacy is higher in older adults. Evaluation and application skills appear to be stable across age groups. Similarly to our results, one study concentrated on nutrition literacy for young adults (18–25 years old), emphasizing the importance of having sufficient nutrition literacy to evaluate nutrition information critically because of their extensive media consumption and exposure to conflicting information. Because there is so much conflicting information available online, young individuals (18–25 years old) frequently struggle with nutrition literacy [43]. In one study, a negative correlation was found between age and nutrition literacy, suggesting that nutrition literacy tends to decline with age. Regardless of age, those who received nutrition education in school had the highest nutrition literacy scores. On the other hand, those between the ages of 19 and 64 exhibit a high degree of nutrition literacy, with education

being a key factor; those who had received formal nutrition education scored noticeably better [44]. In another study, it was emphasized that the nutrition literacy of children is low. The family and school settings influence nutrition literacy in children ages 11 to 12, emphasizing the value of reliable sources like instructors [45].

The nutrition literacy scale has subgroups including access, understanding, evaluation, and application. This study showed that younger adults (18–29 years) demonstrated slightly higher scores in accessing nutrition information, which may reflect greater familiarity with digital platforms and online health resources. In contrast, older participants (46–60 years) scored significantly higher in understanding nutrition information and in overall nutrition literacy. This pattern suggests that life experience, accumulated knowledge, and exposure to nutrition education may enhance comprehension and the integration of dietary knowledge into daily practices. Parallel to our results, in one study, the ability of older adults to comprehend and apply nutrition information to make educated dietary decisions is known as nutritional literacy. This is important for maintaining and improving their nutrition and overall health as they age [46].

In addition to age groups, the results of this study demonstrated notable gender differences in nutrition literacy. The overall nutrition literacy score was significantly higher in women. Although no significant differences were observed in access and understanding, women scored significantly higher than men in the evaluation and application subdomains, as well as in overall nutrition literacy. These findings suggest that while men and women may have similar opportunities to access and comprehend nutrition information, women appear more proficient in critically evaluating and applying such information to daily life. In one study, white-collar employees aged 18–65 participated, with an average age of 24.3 years. It found that women's nutrition literacy was much greater than men's, suggesting that nutrition literacy levels may vary by generation [47]. In another study, like our results, women showed significantly higher nutrition literacy scores than men. In Turkey, as women often play a central role in child-rearing and family nutrition, it is reasonable that they engage more actively in research on this topic and utilize contemporary technologies to a greater extent [48].

4.3. Mediterranean Diet Adherence

The Mediterranean diet is one of the most researched nutritional models in terms of both individual health and sustainable nutrition, and the findings obtained in this study provide remarkable data when compared with the results in the literature. In this study, 90% of the participants were found to have low adherence to the Mediterranean diet. Similar results have been reported in studies conducted with university students in Turkey, where adherence rates were also low, ranging between 32% and 60% [49–51]. The fact that more than half of the participants (51%) in this study belonged to Generation Z, and therefore consisted largely of university students, may explain the higher prevalence of low adherence. Additionally, adherence to the Mediterranean diet has been assessed in the literature using different scales and methodological differences may also contribute to the variability observed across studies.

When Mediterranean diet adherence was evaluated by generation, gender, and prior nutrition education status, no statistically significant differences were observed. However, in one study where participants were categorized into four age groups, an increasing trend in Mediterranean diet adherence was reported with advancing age [52]. It should be noted, however, that this particular study included only female participants, which may account for the difference in findings. Although the study aimed to explore potential generational differences in adherence, our findings indicate that adherence levels were largely similar across Gen X, Gen Y, and Gen Z. This lack of significant variation suggests that generational

cohorts, despite differing in digital exposure, technology use, and lifestyle patterns, may not differ substantially in their adherence behaviors within the context of nutrition-related practices. This result challenges common assumptions that younger or older generations would inherently exhibit higher or lower adherence and highlights the possibility that adherence may be influenced more strongly by individual factors (e.g., motivation, health awareness, prior education) rather than generational identity. These findings underscore the potential for broad, age-inclusive intervention strategies, as adherence behaviors appear consistent across generations in our sample.

Although several studies in the literature have reported higher adherence to the Mediterranean diet among women [53,54]. In one study, it was reported that the results consistent with our study, finding no significant gender differences [55]. The absence of differences in our study may be due not only to the relatively homogeneous structure of the sample in terms of education and age but also to the fact that most participants were young adults whose dietary behaviors are shaped by similar sociocultural factors.

In this study, multiple linear regression analysis was performed to predict adherence to the Mediterranean diet revealed relationships at a level that would make the model generally significant, but the relatively low explained variance ($R^2 = 0.012$) suggests that the independent variables have a limited impact on adherence to the Mediterranean diet. Findings indicate that nutritional literacy, generational age, and marital status are not significant predictors of adherence to the Mediterranean diet. The only significant variable in the model is gender, and its low effect size suggests that the variable has limited practical significance. Overall, these results suggest that adherence to the Mediterranean diet is a multidimensional phenomenon and difficult to explain with single demographic or behavioral variables.

Numerous studies have shown that receiving nutrition education enhances adherence to the Mediterranean diet [56–59]. In contrast, our study found no significant difference in adherence between those who had received nutrition education and those who had not. This may be attributed to uncertainties regarding the scope and duration of the education received, as well as variability in the content of the educational programs. Significant correlations were found in the correlation analysis. Higher scores on the “access” subscale of E-HNLs were found to be positively associated with adherence to the Mediterranean diet. This appears consistent with the literature suggesting that greater access to nutritional information and greater use of this information improve adherence to healthy eating [60–62]. On the other hand, a negative relationship was found between the “understanding” sub-dimension and adherence to the Mediterranean diet. It is thought that exposure to excessive or conflicting nutrition information may negatively affect individuals. Conversely, high scores on the subscale were found to be positively associated with adherence to the Mediterranean diet. Similarly, the literature highlights that applying nutrition knowledge to daily life strengthens adherence to healthy eating patterns [63,64].

The results of this study indicate a relationship between BMI and adherence to the Mediterranean diet. Previous studies have shown that greater adherence to the Mediterranean diet is generally associated with lower BMI and reduced obesity risk [65,66]. The conflicting findings in our study may be explained by the fact that most participants already had BMI values within the normal range

4.4. Strengths and Limitations

One of the most significant strengths of this study is that it addresses sustainable nutrition, adherence to the Mediterranean diet, and nutritional literacy together, filling a significant gap in the literature. Furthermore, the comparative evaluation of Generations X, Y, and Z provides a unique contribution by revealing the impact of intergenerational

differences on nutritional behaviors. The use of previously validated and reliable scales enhances the scientific credibility of the findings. Calculating the sample size using statistical methods is another strength in terms of representativeness. However, the study has several limitations. Data collection via a self-reported online survey may have created a risk of bias by allowing participants to misreport information such as height, weight, and dietary habits. Furthermore, the study was conducted only with adults living in Istanbul, limiting the generalizability of the results. The online administration of the survey may have limited the participation of groups with disadvantaged digital access and literacy levels. While the short scales used provide practical application, they are insufficient to assess nutritional behaviors in all their dimensions. Another key limitation of the present study is the overrepresentation of Generation Z participants (51.6%). This age imbalance may introduce bias into the generational comparisons and limits the generalizability of the results to older cohorts. Because digital health literacy and nutrition-related behaviors can vary substantially across age groups, future research should aim to recruit more balanced generational samples. Finally, another limitation of the study is that the data were collected within a specific period.

5. Conclusions

This study found that adults in Istanbul had moderate nutrition literacy but low adherence to the Mediterranean diet and sustainable nutrition. Generational differences were observed in certain literacy domains, with older adults showing stronger understanding and application skills. Women and those with prior nutrition education had higher nutrition literacy scores. While Mediterranean diet adherence did not vary significantly across groups, sustainable nutrition adherence was higher among older participants and the educated. Weak yet significant correlations between nutrition literacy and both diet scores indicate that knowledge alone may not ensure healthy or sustainable eating behaviors. Efforts to improve public nutrition should emphasize practical skills and integrate sustainability concepts into nutrition education. Future studies should use longitudinal or interventional approaches to clarify how nutrition literacy influences diet quality and sustainability over time.

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Abbreviations

The following abbreviations are used in this manuscript:

WFP	Water footprint
CFP	Carbon footprint
MDAL	Mediterranean diet adherence level
SDAL	Sustainable diet adherence level
E-HNL	e-Healthy nutrition literacy
BMI	Body mass index
SD	Standard deviation

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