

The Relationship Between e-Health Literacy and Food and Nutrition Literacy Among University Students: A Cross-Sectional Study in Türkiye

Deniz Dilara ALYAZ

denizdilaraalyaz@gmail.com

Muğla University

Adile TÜMER

Muğla University

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Abstract

Background

E-health literacy and food and nutrition literacy play an important role in promoting healthy behaviors among young adults. This study aimed to examine the relationship between e-health literacy and food and nutrition literacy among university students in Türkiye.

Methods

The cross-sectional and correlational study was conducted with the participation of 345 university students. Data were collected between February and March 2025 using the Descriptive Characteristics Form, the e-Health Literacy Scale (e-HEALS) and the Food and Nutrition Literacy Scale (FNLS). Descriptive statistics, the Mann-Whitney U test, the Kruskal-Wallis test, Spearman correlation analysis and linear regression analysis were used in the analysis of the data.

Results

The mean e-health literacy score of the participants was 40.91 ± 6.54 . The mean scores of the subdimensions of food and nutrition literacy were found to be 10.42 ± 3.80 for knowledge, 47.66 ± 4.85 for attitude, and 30.13 ± 5.74 for behavior, respectively. A statistically significant, weak positive correlation was found between the mean total e-health literacy score and the attitude subdimension score of food and nutrition literacy ($r = 0.170$, $p = 0.002$). In the regression analysis, it was determined that e-health literacy significantly predicted the knowledge ($\beta = 0.178$, $R^2=0.032$, $p < 0.05$) and behavior ($\beta = 0.224$, $R^2=0.050$, $p < 0.05$) subdimensions of food and nutrition literacy.

Conclusions

The findings showed that the participants had scores above the moderate level in e-health literacy and in the knowledge and attitude subdimensions of food and nutrition literacy, while they had moderate-level scores in the behavior subdimension. E-health literacy is a significant predictor of the knowledge and behavior dimensions of food and nutrition literacy. Improving e-health literacy during university education may be considered a potential strategy for promoting healthy nutrition.

Introduction

Health literacy is a fundamental component of public health, encompassing individuals' abilities to access health-related information, understand and evaluate this information and use it in health-related decision-making processes [1, 2]. As health information is increasingly obtained from digital sources, e-health literacy, the digital counterpart of this competency, has become even more prominent [2]. E-health

literacy is defined as individuals' ability to access online health information, evaluate the reliability of this information and use the information obtained in health-related decision-making processes [3]. The high proportion of the young population within the total population in Türkiye and the widespread use of the internet among young people make e-health literacy a particularly critical area of competency for university students [4, 5].

The university period is an important stage of life in which individuals' health behaviors and dietary habits are permanently shaped [6, 7]. During this period, while students are increasingly exposed to online health information, they also experience various difficulties in maintaining healthy eating behaviors [8, 9]. Therefore, it is important for young adults to be able to accurately evaluate nutrition-related information and transform this information into healthy behaviors [9]. In this context, food and nutrition literacy is defined as a multidimensional concept encompassing individuals' abilities to access, evaluate and use information related to food and nutrition [10, 11]. This competency supports individuals in making healthy and sustainable dietary decisions through the components of knowledge, attitude and behavior [11].

E-health literacy and food and nutrition literacy are two concepts that intersect in the processes of individuals acquiring health information, evaluating it and transforming this information into behavior [12, 13]. The increasing influence of digital sources on nutrition-related decisions makes the evaluation of online health information a key area of competency. Therefore, e-health literacy is considered a significant determinant that may affect young adults' knowledge, attitudes and behaviors related to food and nutrition [14].

Although e-health literacy [14, 15, 16, 17] and food and nutrition literacy [18, 19] have been examined separately in young adults, no study investigating the relationship between these two concepts has been identified. Evaluating these two areas of literacy together among university students is important for understanding how digital health competencies are related to nutrition-related knowledge, attitudes and behaviors in young adults. Therefore, this study aimed to examine the relationship between e-health literacy and food and nutrition literacy among university students. It is thought that the findings obtained may contribute to the development of intervention programs that address both e-health literacy and food and nutrition literacy in health promotion practices for university students.

Research Questions

- What are the levels of e-health literacy and food and nutrition literacy among university students?
- Is there a significant relationship between e-health literacy and food and nutrition literacy among university students?
- Does e-health literacy predict food and nutrition literacy?

Methods

This cross-sectional and correlational study was conducted in 2025. The study population consisted of 950 students enrolled in the English Preparatory Program at the School of Foreign Languages, Muğla Sıtkı Koçman University, during the 2024–2025 academic year. The sample size was calculated using G*Power software [20]. With an effect size of 0.20, a significance level of $\alpha = 0.05$ and a statistical power of 0.80, the minimum required sample size was calculated as 270 students. A total of 345 students who were accessible using convenience sampling, one of the non-probability sampling methods, participated in the study.

Data Collection

The data of the study were collected through face-to-face surveys between February 20 and March 1, 2025. The data collection process was conducted at the School of Foreign Languages after obtaining the necessary institutional permissions. The surveys were administered in classroom settings outside class hours and completed by participants using a self-report method. Each survey took approximately 10–15 minutes to complete.

Data Collection Tools

The study data were collected using the Descriptive Characteristics Form, the e-Health Literacy Scale (e-HEALS) and the Food and Nutrition Literacy Scale (FNLS).

Descriptive Characteristics Form

The Descriptive Characteristics Form was developed by the researchers based on the relevant literature in line with the aim of the study [9, 21]. The form consists of a total of 11 questions designed to assess participants' sociodemographic and health-related characteristics. The form includes questions on age, gender, family income status, parental education level, perceived health status, presence of chronic disease, sources of health-related information, receipt of nutrition education and online health information-seeking behavior.

e-Health Literacy Scale (e-HEALS)

The e-Health Literacy Scale (e-HEALS) was developed by Chiang et al. [22] to assess individuals' abilities to search for, find, understand, evaluate and use health information from digital sources in health-related decision-making. The Turkish validity and reliability study of the scale was conducted by Şenyurt and Korkmaz Aslan [23]. The Turkish version of the scale consists of a total of 12 items across three subdimensions: functional literacy (3 items), interactive literacy (4 items) and critical literacy (5 items). The scale items are rated on a 5-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). The total score obtainable from the scale ranges from 12 to 60, with higher scores indicating

a higher level of e-health literacy. In the Turkish validity and reliability study, the Cronbach's alpha coefficient was found to be 0.824 for the overall scale, while the alpha coefficients for the subdimensions ranged from 0.630 to 0.857 [23]. In the present study, the Cronbach's alpha coefficient of the scale was calculated as 0.748.

Food and Nutrition Literacy Scale (FNLS)

The Food and Nutrition Literacy Scale (FNLS) was developed by Demir and Özer [24] to assess the food and nutrition literacy levels of individuals aged 18–21 years. The scale consists of 36 items in total across three subscales: knowledge (13 items), attitude (13 items) and behavior (10 items). In the knowledge subscale, each correct answer is worth 1 point, while incorrect or unknown answers are worth 0 points. Scores for the knowledge subscale range from 0 to 13. Items in the attitude subscale are scored on a 5-point Likert scale, with possible scores ranging from 13 to 65. In the behavior subscale, responses are rated from “Always” to “Never”, with scores ranging from 10 to 50. Higher scores indicate a higher level of food and nutrition literacy. The scale developers classified scores for the knowledge subscale as follows: ≤ 9 points as insufficient, 10–11 points as limited and ≥ 12 points as excellent; scores for the attitude subscale as follows: ≤ 43 points as insufficient, 44–51 points as limited and ≥ 52 points as excellent; and scores for the behavior subscale as follows: ≤ 25 points as insufficient, 26–33 points as limited and ≥ 34 points as excellent [24]. In the scale development study, it was reported that the KR-20 coefficient for the knowledge subscale was above 0.60 and the Cronbach's alpha coefficients for the attitude and behavior subscales were above 0.70. In the present study, the reliability coefficients were calculated as 0.589 (KR-20) for the knowledge subscale, 0.701 for the attitude subscale and 0.689 for the behavior subscale.

Data Analysis

Data were analyzed using the Jamovi version 2.3.26. Descriptive statistics (mean, standard deviation, frequency and percentage) were used to summarize the study variables. Since the data did not meet the assumption of normal distribution, the Mann-Whitney U and Kruskal-Wallis tests were used to compare e-health literacy and food and nutrition literacy scores according to descriptive characteristics, whereas Spearman correlation analysis was used to examine the relationships between these variables. Simple linear regression analysis was performed to evaluate the predictive effect of e-health literacy on food and nutrition literacy. In the regression models, the knowledge, attitude and behavior subscale scores of the FNLS were used as dependent variables, whereas the total e-HEALS score was used as the independent variable. In all analyses, the statistical significance level was accepted as $p < 0.05$.

Results

The descriptive characteristics of the participants are presented in Table 1. The mean age of the participants was 19.18 ± 0.992 years and 56.5% were female. 55.4% of the students had equal income and expenses and 85.8% did not have a chronic disease. Among the participants, 69.0% reported

receiving information from healthcare professionals, while 24.6% stated that they accessed health information through internet search engines.

Table 1
Distribution of descriptive characteristics of participants (n = 345)

Variables		n	%
Age $\bar{X} \pm SD$: 19.18 $\pm$ 0.992 Min.:18 Max.:21			
Gender	Female	195	56.50
	Male	150	43.50
Department	Faculty of Engineering	122	35.40
	Faculty of Economics	99	28.70
	Faculty of Tourism	56	16.20
	*Other	68	19.70
Perceived income level	Income less than expenditure	43	12.50
	Income equals expenditure	190	55.40
	Income more than expenditure	110	32.10
Sources of health information **	Healthcare professionals	238	69.00
	Internet	85	24.60
	Social media	13	3.80
	Family and friends	55	15.90
	Mobile health applications	9	2.60
Presence of chronic disease	Yes	49	14.20
	No	296	85.80
Health information seeking during the past week	Yes	175	51.50
	No	165	48.50
Receiving nutrition education	Yes	47	13.70
	No	297	86.30

* $\bar{X} \pm SD$ = Mean $\pm$ Standard deviation; Min: Minimum; Max: Maximum.

** = Multiple response options have been selected in the relevant item.

In the study, the mean total e-HEALS score of the participants was determined to be 40.91 $\pm$ 6.535, while the mean subscale scores were 8.3 $\pm$ 2.354 for the functional dimension, 15.12 $\pm$ 3.67 for the interactive

dimension and 17.48 ± 3.81 for the critical dimension. In this study, the mean scores of the FNLS subscales were calculated and participants were classified into insufficient, limited and excellent levels for each subdimension. The mean score of the FNLS knowledge subscale was determined to be 10.42 ± 3.80 and 44.10% of the students were found to have a limited level of knowledge. The mean score of the FNLS attitude subscale was determined to be 47.66 ± 4.85 and 43.60% of the students were found to be at a limited level. The mean score of the FNLS behavior subscale was found to be 30.13 ± 5.74 and 49.30% of the students were found to be at a limited level (Table 2).

Table 2
Distribution of mean scores for the eHealth Literacy Scale (e-HEALS) and Food and Nutrition Literacy Scale (FNLS)

Scales/Subscales		n	%	Number of items	Total score $\bar{X} \pm SD$	Min-Max	Item score $\bar{X} \pm SD$
e-HEALS				12	40.91 ± 6.535	12–54	3.40 ± 0.54
Functional subscale				3	8.3 ± 2.354	3–15	2.77 ± 0.78
Interactive subscale				4	15.12 ± 3.67	4–20	3.78 ± 0.91
Critical subscale				5	17.48 ± 3.81	5–25	3.49 ± 0.76
FNLS							
Knowledge subscale	Insufficient	84	24.30	13	10.42 ± 3.80	2–13	0.80 ± 0.15
	Limited	152	44.10				
	Excellent	109	31.60				
Attitude subscale	Insufficient	84	24.40	13	47.66 ± 4.85	17–63	3.66 ± 0.55
	Limited	150	43.60				
	Excellent	110	32.00				
Behavior subscale	Insufficient	77	22.60	10	30.13 ± 5.74	14–46	3.01 ± 0.60
	Limited	168	49.30				
	Excellent	95	27.90				

*Min: Minimum; Max: Maximum; $\bar{X} \pm SD$ = Mean $\pm$ Standard deviation.

The findings of the study revealed that the mean total e-HEALS score differed significantly according to some variables. The mean total e-HEALS score was higher among students who received health information from healthcare professionals than among those who did not ($p = 0.011$), while it was lower

among students who used social media as a source of health information than among those who did not ($p = 0.005$). A significant relationship was found between chronic disease status and the interactive subscale of e-HEALS ($p = 0.046$) and between conducting health-related research within the last week and the critical subscale ($p = 0.009$). Receiving courses or training related to nutrition was significantly associated with the functional ($p = 0.036$) and critical ($p = 0.002$) subscales of e-HEALS. No significant difference was found in the total and subscale e-HEALS scores according to gender (Table 3).

Table 3
Comparison of eHealth Literacy Scale (e-HEALS) mean scores according to descriptive characteristics of participants (n = 345)

Variables	n	e-HEALS1 Mean $\pm$ SD	e-HEALS2 Mean $\pm$ SD	e-HEALS3 Mean $\pm$ SD	Overall e-HEALS Mean $\pm$ SD
Gender					
Female	195	8.42 $\pm$ 2.21	15.08 $\pm$ 3.55	17.41 $\pm$ 3.75	40.9 $\pm$ 6.5
Male	150	8.15 $\pm$ 2.53	15.18 $\pm$ 3.84	17.58 $\pm$ 3.91	40.91 $\pm$ 6.6
Test statistic					
U		13769	14084	14304	14446
p-value		0.347	0.553	0.726	0.846
Presence of chronic disease					
Yes	49	8.14 $\pm$ 2.49	14.06 $\pm$ 4.07	17.18 $\pm$ 4.4	39.39 $\pm$ 8.01
No	296	8.33 $\pm$ 2.33	15.3 $\pm$ 3.58	17.53 $\pm$ 3.71	41.16 $\pm$ 6.24
Test statistic					
U		6748	5970	7088	6526
p-value		0.431	0.046	0.799	0.261
Obtaining health information from healthcare professionals					
Yes	238	8.22 $\pm$ 2.32	15.5 $\pm$ 3.61	17.66 $\pm$ 3.8	41.38 $\pm$ 6.39
No	107	8.48 $\pm$ 2.44	14.29 $\pm$ 3.7	17.08 $\pm$ 3.84	39.85 $\pm$ 6.76
Test statistic					
U		12009	10128	11608	10550
p-value		0.394	0.002	0.188	0.011
Obtaining health information from the internet					
Yes	85	8.56 $\pm$ 2.34	14.84 $\pm$ 3.44	18.22 $\pm$ 3.6	41.62 $\pm$ 6.16
No	260	8.22 $\pm$ 2.36	15.22 $\pm$ 3.75	17.24 $\pm$ 3.86	40.67 $\pm$ 6.65
Test statistic					
U		9955	10214	9332	10261
p-value		0.166	0.292	0.031	0.322
Obtaining health information from social media					

Variables	n	e-HEALS1 Mean ± SD	e-HEALS2 Mean ± SD	e-HEALS3 Mean ± SD	Overall e-HEALS Mean ± SD
Gender					
Yes	13	8.38 ± 1.85	12.15 ± 1.86	16.85 ± 3.83	37.38 ± 3.75
No	332	8.3 ± 2.37	15.24 ± 3.68	17.51 ± 3.82	41.05 ± 6.58
Test statistic					
U		2076	925	1950	1160
p-value		0.815	< .001	0.555	0.005
Obtaining health information from mobile health applications					
Yes	9	7.78 ± 2.68	15.56 ± 2.83	17.78 ± 3.56	37.38 ± 5.16
No	336	8.32 ± 2.35	15.11 ± 3.7	17.48 ± 3.83	41.05 ± 6.57
Test statistic					
U		1427	1473	1468	1428
p-value		0.771	0.0894	0.881	0.777
Obtaining health information from family and friends					
Yes	55	8.53 ± 2.59	15.64 ± 3.41	17.42 ± 3.36	42.34 ± 5.39
No	290	8.26 ± 2.31	15.04 ± 3.73	17.25 ± 3.9	40.88 ± 6.74
Test statistic					
U		7580	7869	7575	7755
p-value		0.557	0.876	0.554	0.746
Status of receiving nutrition education					
Yes	47	7.77 ± 2.09	15.64 ± 3.23	18.94 ± 3.62	42.34 ± 5.12
No	297	8.39 ± 2.39	15.04 ± 3.75	17.25 ± 3.8	40.67 ± 6.72
Test statistic					
U		5660	6380	5029	5823
p-value		0.036	0.341	0.002	0.067
Searched for health information in the past week					
Yes	175	8.05 ± 2.34	15.27 ± 3.76	17.98 ± 3.91	41.29 ± 6.68
No	165	8.55 ± 2.34	14.96 ± 3.63	16.94 ± 3.68	40.44 ± 6.4

Variables	n	e-HEALS1 Mean ± SD	e-HEALS2 Mean ± SD	e-HEALS3 Mean ± SD	Overall e-HEALS Mean ± SD
Gender					
Test statistic					
U		12889	13531	12077	12975
p-value		0.084	0.314	0.009	0.106

*p < 0.05, U=Mann-Whitney U test. E-HEALS1 = e-HEALS functional subscale, e-HEALS2 = e-HEALS interactive subscale, e-HEALS3 = e-HEALS critical subscale. $\bar{X} \pm SD$ = Mean $\pm$ Standard deviation.

The study findings revealed statistically significant differences in the mean scores of the FNLS subscales based on certain variables. Female students had a higher mean score on the FNLS attitude subscale than male students (p < 0.01), while male students had a higher mean score on the behavior subscale (p = 0.004). Students who conducted online health research in the last week had a significantly higher mean FNLS behavior subscale score than students who did not (p < 0.001) (Table 4).

Table 4
Comparison of mean Food and Nutrition Literacy Scale (FNLS) scores according to descriptive characteristics of participants (n = 345)

Variables	n	FNLS1	FNLS2	FNLS3
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Gender				
Female	195	10.4 $\pm$ 2.02	48.9 $\pm$ 6.87	29.4 $\pm$ 5.73
Male	150	10.5 $\pm$ 1.99	46.0 $\pm$ 7.38	31.2 $\pm$ 6.37
Test statistic				
U		14293	10874	11523
p-value		0.713	< 0.01	0.004
Presence of chronic disease				
Yes	49	10.3 $\pm$ 2.2	47.6 $\pm$ 8.02	28.9 $\pm$ 5.82
No	296	10.4 $\pm$ 1.97	47.7 $\pm$ 7.11	30.3 $\pm$ 6.09
Test statistic				
U		7169	6944	6070
p-value		0.896	0.803	0.146
Obtaining health information from healthcare professionals				
Yes	238	10.5 $\pm$ 1.93	48.0 $\pm$ 7.11	30.2 $\pm$ 5.89
No	107	10.2 $\pm$ 2.16	46.8 $\pm$ 7.46	29.9 $\pm$ 6.48
Test statistic				
U		11721	11353	12267
p-value		0.231	0.12	0.983
Obtaining health information from the internet				
Yes	85	10.1 $\pm$ 2.06	47.0 $\pm$ 7.25	29.6 $\pm$ 6.15
No	260	10.5 $\pm$ 1.98	47.9 $\pm$ 7.23	30.5 $\pm$ 6.01
Test statistic				
U		9666	10072	9402
p-value		0.078	0.239	0.093
Obtaining health information from social media				

Variables	n	FNLS1	FNLS2	FNLS3
		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Gender				
Yes	13	11.3 $\pm$ 0.947	49.6 $\pm$ 6.513	29.2 $\pm$ 8.707
No	332	10.4 $\pm$ 2.03	47.6 $\pm$ 7.26	30.2 $\pm$ 5.96
Test statistic				
U		1605	1812	1979
p-value		0.111	0.334	0.687
Obtaining health information from mobile health applications				
Yes	9	9.89 $\pm$ 3.02	48.44 $\pm$ 8.22	30.44 $\pm$ 5.22
No	336	10.4 $\pm$ 1.97	47.6 $\pm$ 7.22	30.1 $\pm$ 6.1
Test statistic				
U		1452	1395	1448
p-value		0.838	0.702	0.9
Obtaining health information from family and friends				
Yes	55	10.3 $\pm$ 1.76	48.7 $\pm$ 6.01	29.3 $\pm$ 6.01
No	290	10.4 $\pm$ 2.05	47.5 $\pm$ 7.44	30.3 $\pm$ 6.08
Test statistic				
U		7493	7337	7117
p-value		0.471	0.366	0.381
Status of receiving nutrition education				
Yes	47	10.5 $\pm$ 2.0	49.4 $\pm$ 7.61	31.8 $\pm$ 6.17
No	297	10.4 $\pm$ 2.01	47.4 $\pm$ 7.16	29.9 $\pm$ 6.03
Test statistic				
U		6661	5719	5532
p-value		0.61	0.075	0.082
Searched for health information in the past week				
Yes	175	10.4 $\pm$ 1.9	47.9 $\pm$ 7.19	31.6 $\pm$ 5.87
No	165	10.4 $\pm$ 2.12	47.4 $\pm$ 7.36	28.5 $\pm$ 5.97

Variables	n	FNLS1	FNLS2	FNLS3
		Mean ± SD	Mean ± SD	Mean ± SD
Gender				
Test statistic				
U		14054	13777	10120
p-value		0.668	0.525	< 0.001

*p < 0.05, U=Mann-Whitney U test. FNLS1 = FNLS knowledge subscale, FNLS2 = FNLS attitude subscale, FNLS3 = FNLS behavior subscale.

According to the Spearman correlation analysis, a weak positive and statistically significant correlation was found between the total e-HEALS score and the FNLS attitude subscale ($r = 0.170$, $p = 0.002$). No significant correlation was found between the total e-HEALS score and the FNLS knowledge and behavior subscales. Detailed findings of the correlation analysis are presented in Table 5.

Table 5

Findings regarding the linear relationship between university students' eHealth Literacy Scale (e-HEALS) and Food and Nutrition Literacy Scale (FNLS) Scores

e-HEALS1		e-HEALS1	e-HEALS2	e-HEALS3	Overall e-HEALS	FNLS1	FNLS2	FNLS3
	r	-	-	-				
	p	-	-	-				
e-HEALS2	r	0.199	-	-				
	p	< .001	-	-				
e-HEALS3	r	-0.149	0.484	-				
	p	0.006	< .001	-				
Overall e-HEALS	r	0.150	0.771	0.806				
	p	0.005	< .001	< .001				
FNLS1	r	-0.104	0.131	0.104	0.102	-		
	p	0.053	0.015	0.054	0.057	-		
FNLS2	r	-0.043	0.127	0.203	0.170	0.209		
	p	0.428	0.018	< .001	0.002	< .001		
FNLS3	r	-0.193	0.112	0.126	0.08	-0.136	0.184	-
	p	< .001	0.04	0.02	0.144	0.012	< .001	-

r: Spearman's rank correlation coefficient.

The predictive effect of the total e-HEALS score on the FNLS subscales was examined using linear regression analysis. The analysis revealed that the total e-HEALS score was a significant predictor of the FNLS knowledge ($\beta = 0.178$, $p < 0.05$; $R^2=0.032$) and behavior ($\beta = 0.224$, $p < 0.05$; $R^2=0.050$) subscales. No significant relationship was found for the attitude subscale ($\beta=-0.061$, $p = 0.261$; $R^2=0.004$). Detailed results of the regression analysis are presented in Table 6.

Table 6

Results of linear regression analysis on the effect of eHealth Literacy Scale (e-HEALS) mean score on Food and Nutrition Literacy Scale (FNLS) subdimension mean scores

Dependent variables	B	SE	β	t	p	R ²	F	p
FNLS Knowledge Dimension								
Constant	20.650	1.359	-	15.197	< 0.05	0.032	11.246	< 0.05
Overall e-HEALS	0.106	0.032	0.178	3.354	< 0.05			
FNLS Attitude Dimension								
Constant	39.253	1.449	-	27.081	< 0.05	0.004	1.270	0.261
Overall e-HEALS	-0.038	0.034	-0.061	-1.127	0.261			
FNLS Behavior Dimension								
Constant	23.034	2.045	-	11.266	< 0.05	0.050	17.763	< 0.05
Overall e-HEALS	0.201	0.048	0.224	4.215	< 0.05			
*B= Unstandardized coefficient. SE= Standard error. β : Standardized coefficient. R ² = Coefficient of determination								

Discussion

Nowadays, the fact that a significant proportion of nutrition-related information is obtained from digital sources has made e-health literacy one of the potential determinants of food and nutrition literacy [25]. This study showed that there were significant relationships between e-health literacy and food and nutrition literacy among university students and that e-health literacy significantly predicted the knowledge and behavior subscales of food and nutrition literacy.

In this study, students' e-health literacy was found to be at a moderate level. When the subdimensions were examined, it was observed that the functional and critical dimensions were at a moderate level, while the interactive dimension was relatively higher. Similarly, a study conducted among students in Taiwan reported that e-health literacy was at a moderate level in all subdimensions [16]. However, some studies have reported lower competencies in the critical dimension, while others have reached different results regarding the interactive and functional dimensions [14, 17]. A study conducted in Türkiye reported that the interactive dimension was at the highest level, while the functional dimension was at the lowest level [26]. These findings are consistent with the limitations observed in the functional dimension in our study. Studies conducted in Iran, China, Jordan, Japan and Greece have reported lower levels of e-health literacy [27, 28, 29, 30, 31]. These differences may be related to socio-cultural

structures, education systems, access to digital health resources and sample characteristics between countries.

Students who obtained health information from healthcare professionals had higher interactive subscale and total e-health literacy scores and these differences were statistically significant. Similarly, among students who obtained health information from the internet, a significant association was found with the critical subscale. Previous studies have reported significant associations between online health information-seeking behavior and e-health literacy [32, 33, 34, 35, 36, 37]. Studies conducted among nursing students have also indicated that the internet is considered an important source of information in health-related decision-making processes [38, 39]. It is noteworthy that significant differences were found in the interactive subscale and total e-health literacy among students who used social media platforms to obtain health information. In contrast, the low preference for social media as a source of health information may suggest that students are selective in evaluating the reliability of digital content. Indeed, social media may increase the risk of exposure to misleading information, particularly among individuals with low health literacy [40]. Accordingly, it is important to support students' skills in critically evaluating digital health information.

A significant difference was found between chronic disease status and e-health literacy and this difference was observed particularly in the interactive subscale. Previous studies have shown that individuals with chronic diseases may have higher levels of health literacy because of their greater need for health information [27, 41, 42]. However, e-health literacy may be associated not only with the presence of chronic disease but also with the type and duration of the disease, the frequency of contact with healthcare services and individual digital skills [43]. Therefore, the lower interactive e-health literacy scores observed among students with a history of chronic disease may be related to differences in disease type and duration, frequency of contact with healthcare services and individual digital skills.

In this study, the students' food and nutrition literacy levels were found to be generally moderate. Similar findings were also reported in a study conducted among university students in Türkiye [18]. Although relatively higher scores were obtained in the knowledge subscale, more limited levels were observed in the attitude and behavior subscales. Another study conducted in Türkiye reported that knowledge, attitude and behavior scores increased together, indicating a more balanced development across all subscales [44]. These differences indicate that nutrition education should not be limited to the transfer of knowledge but should also be structured with practices that support changes in attitudes and behaviors.

Statistically significant differences by gender were found in the attitude and behavior subscales of food and nutrition literacy. Attitude subscale scores were higher among female students. This finding is consistent with previous research findings [44]. In the behavior subscale, the higher scores of male students differ from some findings in the literature. A study conducted among health sciences students in Türkiye reported no significant difference by gender [45]. Another study conducted among university students found statistically significant differences by gender in the knowledge, attitude and behavior

subscales, with male students scoring higher than female students in the behavior subscale [18]. A study conducted among young adults reported that women had higher levels than men in the knowledge, attitude and behavior subscales [19]. Similarly, a large-scale study conducted among adolescents in Tehran showed that although females had higher levels of knowledge, they had more unfavorable dietary habits than males [46]. These differences may be related to gender roles, cultural norms and the way responsibility for health is perceived.

In this study, although students who received nutrition education had higher behavior scores, the difference did not reach statistical significance. However, previous studies have reported statistically significant differences in behavior levels among students who had received nutrition education [18, 44]. A comparative study conducted among university students in Türkiye and the United States also found that individuals who had received nutrition education had higher knowledge and attitude scores [47]. Differences between the findings may be related to the curricular structure of universities, educational content and students' awareness of nutrition.

In this study, students were found to most frequently obtain health information from healthcare professionals and the internet. Consistent with this finding, studies conducted in different samples have reported that the internet is widely used to access health and nutrition information, whereas trust in healthcare professionals is higher [48, 49, 50, 51]. Healthcare professionals have also been identified as reliable sources of information on food safety [52]. In contrast, the presence of misinformation on the internet and in the media may reduce trust in these sources [7]. Therefore, supporting access to reliable sources of information is an important component of improving food and nutrition literacy.

A statistically significant difference was found in the FNLS behavior subscale according to whether students had searched for health information on the internet within the last week. This finding suggests that online health information seeking may be associated with nutrition-related behaviors. Previous studies have reported that individuals with sufficient e-health literacy seek information online more frequently and obtain higher-quality information [53]. However, individuals with insufficient critical evaluation skills may be exposed to misleading content [54]. Therefore, in order for information acquired online to support healthy eating behaviors, it is important to consider both access to reliable information sources and critical evaluation skills.

In this study, a weak positive and statistically significant correlation was identified between the overall e-health literacy score and the FNLS attitude subscale. This finding suggests that e-health literacy may be associated with positive attitudes toward nutrition. Similarly, a study conducted among adolescents identified a weak correlation between health literacy and eating attitudes [55]. Another study conducted among young adults reported a positive correlation between health promotion literacy and healthy eating habits [56]. These findings support the possibility that the ability to obtain, understand and use health-related information may be linked to nutrition-related attitudes and practices. However, the weak correlation suggests that nutrition-related attitudes cannot be explained solely by e-health literacy and

that various factors, such as cultural values, family and peer influence, individual experiences, dietary habits and environmental conditions, may also play a role in this process.

Regression analysis revealed that the overall e-health literacy score was a significant predictor of the FNLS knowledge and behavior subscales, but did not significantly predict the attitude subscale. This finding suggests that e-health literacy may play a role particularly in the processes of acquiring nutrition-related information and translating this information into behavior. A previous study conducted among university students showed that different dimensions of e-health literacy were associated with dietary behaviors such as maintaining a balanced diet, regular meal consumption and avoiding unhealthy foods [21]. Supporting this finding, a study conducted among nursing and medical students reported that digital healthy eating literacy was associated with changes in dietary behaviors [41]. However, the limited explanatory power of e-health literacy for the knowledge and behavior subscales indicates that these dimensions are influenced not only by e-health literacy but also by numerous individual, social, cultural and environmental factors. Therefore, interventions aimed at improving food and nutrition literacy should not only focus on increasing access to digital health information but also on developing skills that enable individuals to evaluate reliable information, apply it to daily life and support sustainable behavior change.

This study is one of the pioneering studies directly examining the relationship between e-health literacy and food and nutrition literacy in a sample of university students in Türkiye. Although studies directly evaluating the relationship between these two concepts are limited in the literature, studies conducted in different age groups have reported that higher levels of health literacy are associated with better diet quality, healthier eating habits and positive behavioral changes [41, 50, 57, 58, 59, 60]. These findings suggest that the results obtained regarding the relationship between e-health literacy and food and nutrition literacy can be supported from a theoretical perspective.

Limitations

Some limitations of this study should be considered. First, the study was conducted with students aged 18–21 years who were enrolled in the English Preparatory Program of the School of Foreign Languages at a single university and agreed to participate in the study. Therefore, the findings of this study cannot be generalized to all university students. In addition, the use of a non-probability sampling method to select participants limits the generalizability of the findings. Second, due to the cross-sectional design, the findings cannot be interpreted causally. Finally, the use of self-reported measures may be subject to response and recall bias which may have affected the accuracy of the reported information.

Conclusion and Recommendations

The findings of this study indicate that university students generally have moderate levels of e-health literacy and food and nutrition literacy. The study identified that various variables, including the presence of chronic disease, preference for healthcare professionals as a source of information, use of social

media and the internet, receiving nutrition education, gender and conducting health-related research within the last week, were associated with either e-health literacy or food and nutrition literacy. The study found a weak, positive and significant correlation between e-health literacy and the attitude subscale of food and nutrition literacy. In addition, e-health literacy was shown to be a significant predictor of the knowledge and behavior subscales of food and nutrition literacy. However, the low variance explained by the regression model indicates that food and nutrition literacy cannot be explained solely by e-health literacy; many individual, social, cultural and environmental factors also play a role in this process.

Based on the findings of the study, the development of intervention programs aimed at improving university students' e-health literacy and food and nutrition literacy levels is recommended. Especially for student groups with low levels in these two areas, training and counseling activities can be organized in collaboration with university health units, public health nurses, dietitians and other healthcare professionals. In addition, it is important to expand institutional practices that facilitate students' access to reliable health and nutrition information and to develop policies that support e-health literacy and food and nutrition literacy. Conducting studies that include students from different universities, faculties and sociodemographic backgrounds will increase the generalizability of the findings. Furthermore, longitudinal, randomized controlled and qualitative research designs may provide a deeper understanding of the mechanisms underlying these relationships and contribute to the development of more targeted and effective interventions.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Muğla Sıtkı Koçman University Health Sciences Ethics Committee (Date: 11.12.2024; Decision No.: 240143-152). The necessary institutional permission to conduct the study was also obtained (E-28677689-302.08.02-876355). Permission to use the e-Health Literacy Scale and the Food and Nutrition Literacy Scale was obtained from the relevant authors via email. Before the data collection process, all participants were informed about the purpose and scope of the study and the principles of voluntary participation and provided written informed consent. The confidentiality and anonymity of the participants' identifying information were protected throughout the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Clinical trial number

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Author Contribution

Conceptualization, DDA, AT; Methodology, DDA, AT; Data collection, DDA; Data analysis, DDA, AT; Writing (Original Draft Preparation), DDA, AT; Writing (Review & Editing), DDA, AT; Supervision, DDA, AT.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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