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The Relationship of the Nutritional Literacy Level of Individuals with Diabetes on Nutrition, Quality of Life, and Metabolic Control

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Abstract

Background Nutritional literacy is essential to improve the quality of life and metabolic control of individuals with diabetes. The aim is to evaluate the relationship between the Nutrition Literacy Level of Diabetic Individuals on Nutrition, Quality of Life, and Metabolic Control.

Methods This study evaluated the relationship between the nutritional literacy level of 179 individuals diagnosed with diabetes aged 18-65 years with nutrition, quality of life, and metabolic control. The data of the study were obtained through a 5-part face-to-face survey method. Self-Perceived Food Literacy Scale (SPFLS) was used to measure the nutritional literacy of the participants, and the Quality-of-Life Short Form 36 (SF-36) was used to assess the health-related quality of life.

Results Of the participants, 55.3% (n=99) had type-2 diabetes, and 44.7% (n=80) had type-1 diabetes. Their mean BMI was 27.83 ± 6.38 kg/m^2 and an HbA1c value of 7.88 ± 2.13%. The mean age of individuals with type-1 diabetes participating in the study was 36.69±13.77, and those with type-2 diabetes as 55.60±9.91. In addition, when evaluated in terms of diabetes duration, the mean age was 13.17±9.74 years in those with type-1 diabetes and 11.80±8.13 years in those with type-2 diabetes. A statistically significant difference ($p<0.05$; $p<0.001$) was found in the SPFLS sub-factor scores for 'Social and Conscious Eating' and 'Food Label Analysis' among diabetic individuals based on their diabetes type. However, no statistically significant difference was found in the SF-36 sub-factor scores ($p>0.05$). The study found a weak negative correlation between the BMI of individuals with type 1 diabetes and the SPFLS sub-factors 'Resilience and Resistance' and 'Examining Food Labels'($p<0.05$). In type-2 diabetics, BMI showed a weak positive correlation with 'Food Preparation Skills' and a weak negative correlation with 'Resilience and Resistance,' 'Examining Food Labels,' and 'Physical Function' ($p<0.05$). Additionally, in type-2 diabetics, BMI was weakly positively correlated with 'Healthy Food Stockpiling,' while the SF-36 sub-factors 'Physical Function,' 'Role Physical,' and 'Vitality' showed weak negative correlations" ($p<0.05$). While no significant statistical difference was found between the SPFLS sub-factors and HbA1c values in type-1 diabetic individuals ($p>0.05$), only the "Healthy Food Availability" sub-factor and HbA1c were found to be statistically significant in type-2 diabetic individuals ($p<0.05$).The subscales of SPFLS and SF-36 show significant relationships with the physical activity level, nutritional habits, body functions, mental health, social life, and general quality of life of individuals with diabetes, comprehensively revealing the disease's physical, psychosocial, and lifestyle effects on the individual. These findings support the significant associations of BMI and HbA1c with various lifestyle and health factors.

Conclusions This study found that in type-1 diabetics, age and diabetes duration were positively correlated with food literacy and quality of life, while no such correlations were found in type-2 diabetics. Increasing food literacy in diabetes management may be an important component that can positively influence metabolic control, improve physical and mental health, and give individuals the option to manage their health and improve quality of life and well-being.

Keywords: Diabetes mellitus, Nutritional literacy, Quality of life; Self-management, Self-perceived food literacy scale

Introduction

Diabetes Mellitus (DM) is a chronic disease that causes microvascular complications such as neuropathy, nephropathy, and retinopathy, as well as macrovascular complications that can result in cardiovascular and cerebrovascular events [1]. DM is divided into type-1 and type-2 diabetes. Type-1 diabetes is an autoimmune disease that usually begins in childhood or young adulthood. Due to the complete cessation of insulin production, these individuals are dependent on insulin therapy for life. Type-2 diabetes is usually characterized by insulin resistance and insufficient insulin production by the pancreas. Lifestyle changes, oral antidiabetic drugs, and, when necessary, insulin therapy are used in the management of type-2 diabetes [2]. The main goal of treatment is to prevent the development of acute and chronic complications and to reduce the financial burden of these diseases on society [3]. Self-management in DM management is critical in providing metabolic control, improving quality of life, and reducing complications, risks, and healthcare costs. In this context, developing evidence-based interventions that support self-management behaviors requires understanding the needs of patients and identifying risk factors. Effective diabetes control prevents complications and improves quality of life by reducing hospitalizations [4,5]. In this context, nutritional literacy is very important for individuals with diabetes. Nutritional literacy is critical in managing blood sugar levels in patients with Type 1 diabetes. Knowing carbohydrate counting and insulin dose adjustments facilitates glycemic control. Nutrition plays a critical role in the management of Type 2 diabetes. Individualized medical nutrition treatments will contribute to glycemic control by reducing oxidative stress and inflammation. It shows that nutritional literacy supports individuals with type 2 diabetes take a more active role in disease management and improve their quality of life [6,7]. Olesen et al. [8], in a study of 1,399 participants with type-1 diabetes, determined that high nutrition and health literacy levels were associated with lower HbA1c levels. Again, Doubova et al. [9] study of 778 patients with type-2 diabetes showed that adequate nutrition and health literacy levels were associated with an increase in participants' good self-rated health. In this case, Healthy eating behaviors are essential in DM management and reflect individuals' knowledge, attitudes, skills, and behaviors. Sustainable interventions targeting risk factors to prevent and control diseases such as diabetes should include efforts to improve nutrition education and food literacy [10]. Nutritional literacy: It combines the knowledge, skills, and behaviors required for individuals to develop healthy eating habits, make conscious food choices, and understand the effects of nutrition on health [11]. In this context, nutritional literacy is addressed in three dimensions: functional, interactive, and critical. The functional dimension includes understanding basic information; the interactive dimension includes making healthy choices and conscious purchases; and the critical dimension includes the ability to identify nutritional barriers and make mindful decisions [12].

Individuals with low health literacy may need help translating information from traditional educational programs and materials into effective self-care. DM with poor literacy may have difficulty interpreting glucose readings, calculating carbohydrate intake, adjusting medications, and performing other daily self-management tasks. Low health literacy has been associated with less diabetes knowledge and poor glycemic control [13]. The American Association of Diabetes Educators (AADE) and the American Diabetes Association (ADA) recommend that all people with diabetes participate in a DM self-management education program at the time of diagnosis and as needed thereafter [14,15]. Many people with DM may not receive the maximum benefit from available diabetes education materials. Recent studies suggest that a comprehensive DM management program using a multidisciplinary approach that addresses health literacy may be particularly beneficial for improving glycemic control in patients with low literacy [16].

According to 2023 data, the number of people with diabetes worldwide is calculated as 529 million, and this number is expected to reach 1.3 billion by 2050. Diabetes affects 6.1% of the population worldwide. Type-2 diabetes accounts for 96% of all instances of diabetes globally and is linked to a high body mass index and other risk factors [17]. In our country, it is estimated that over 9 million people have diabetes, and 42.4% of the population aged 20 and above is affected by either diabetes or prediabetes [18]. Effective diabetes management prevents complications and improves quality of life; nutritional literacy is critical in this process. Nutrition literacy encompasses functional, interactive, and essential dimensions that guide individuals from food selection to consumption by improving their ability to access, evaluate, and apply information for healthy nutrition. Although existing research has examined the link between nutritional literacy, eating habits, and health outcomes, a gap remains in understanding the specific impact of nutritional literacy on glycemic control and quality of life in individuals with diabetes. Existing research primarily focuses on general health literacy, yet the role of nutrition-specific literacy in diabetes self-management remains underexplored. Additionally, there is limited evidence on how different dimensions of nutritional literacy—functional, interactive, and critical—impact treatment adherence, metabolic outcomes, and long-term diabetes management. Addressing these gaps is essential for developing targeted educational interventions and improving self-management strategies for diabetic individuals. While previous studies have generally focused on the relationship between food literacy, this study evaluates the effects of food literacy and quality of life on glycemic control in individuals with diabetes through HbA1c values. The level of nutritional literacy in individuals with diabetes can directly affect their nutritional status, compliance with treatment, and continuity in nutritional therapy. In this context, the study aims to evaluate the effect of the nutritional literacy level of individuals with diabetes on dietary habits, quality of life, and metabolic control. This study is one of the first to assess the relationship between nutritional literacy and quality of life in individuals with type 1 and type 2 diabetes separately, and it represents the first application of the Self-Perceived Food Literacy Scale (SPFLS) among diabetic individuals in Türkiye. This distinction provides a more individualized understanding of the impact of nutritional literacy on diabetes self-management in different patient groups.

Research design and methods

Description of sample

The study was conducted between February 2022 and February 2023 with individuals aged 18–65 residing in İzmir and İstanbul, Turkey. The sample consisted of 179 adults diagnosed with diabetes who applied to the Endocrinology Outpatient Clinic of Ege University Hospital and the Department of Internal Medicine at Istanbul Faculty of Medicine. Data were obtained through face-to-face interviews with a questionnaire, selected by simple random sampling among adults. All participants were informed about the purpose, scope, and procedures of the study before participation, and provided their voluntary consent. The study inclusion criteria were accepting participation in the study, being diagnosed with diabetes, and being between the ages of 18 and 65, representing the young population in the WHO age scale. The study did not include individuals following a unique diet program, pregnant or breastfeeding, under the age of 18, and over the age of 65. G-Power 3.9.1.4 software (G-Power, Universität Düsseldorf, Germany) was used for the post-hoc sample size analysis. The power ($1-\beta$) is the probability of reaching a significant difference. Finding the power $1-\beta=0.95$ is sufficient. Correlations and group differences will be calculated, and the results will be obtained [19]. G-Power analysis determined that at least 176 samples were needed with a confidence level of 95% and an acceptable error rate of 5% in two independent groups. In the current study, enough was provided with 179 samples.

Measures

No interventional procedure was applied to the subjects. The protocol required the completion of all questionnaires through interviews with the subjects who needed help with reading, writing, and understanding to determine their anthropometric characteristics. The questionnaire consists of 31 questions that researchers created as a result of a literature review, including socio-demographic factors (age, gender, education level, marital status, type of diabetes, additional diseases of diabetes, medical treatment used, type of insulin used, etc.) and anthropometric and biochemical measurement information such as height, weight, waist circumference, and HbA1c. HbA1c values obtained from blood test results of patients diagnosed with diabetes who applied to Ege University Hospital Endocrinology Polyclinic and Istanbul Faculty of Medicine Department of Internal Medicine were used.

Self-Perceived Food Literacy Scale (SPFLS)

The third part of the survey consists of the "Self-Perceived Food Literacy Scale (SPFLS)," which consists of eight sections and 29 questions and is intended to measure the nutritional literacy of the participants. Poelman et al. [20] developed the self-perceived food literacy scale in 2018. The Turkish scale's reliability and validity were conducted by Tarı Selçuk et al. [21] in a study involving 391 adults aged ≥18 living in a neighborhood in the city center of Balıkesir in 2020. The Perceived Food Literacy Scale is eight sections (Food Preparation Skills (FPS), Resilience and Resistance (RR), Types of Healthy Snack (HSS), Social and Conscious Eating (SCE), Examining Food Labels (EFL), Daily Food Planning (DFP), Expenditure on Healthy Foods (EHF), and Healthy Food Stockpiling (HFS)). Each sub-factors measures a different aspect of food literacy. "FPS" evaluates individuals' abilities to plan meals, modify recipes, and prepare food independently. "RR" assesses the capacity to maintain healthy eating habits under stressful or emotionally challenging conditions. "HSS" measure the tendency to choose nutritious snacks, such as fruits, instead of energy-dense and nutrient-poor foods. "SCE" reflects awareness of the social context and mindful eating behaviors during meals. "EFL" evaluates the level of attention individuals pay to calorie, fat, sugar, and salt content when making food choices. "DFP" measures the extent to which individuals organize their meals in advance and make conscious decisions about what and when to eat. "EHF" assesses the tendency to purchase healthy foods even when they are more expensive, while "HFS" reflects the presence or absence of healthy or unhealthy foods at home, indicating the individual's long-term food environment. Collectively, these sub-factors provide a comprehensive perspective on how consciously, knowledgeably, and sustainably individuals make decisions regarding food selection, planning, and consumption. The scale was scored on a 5-point Likert type (never," "rarely," "sometimes," "yes, usually," and "yes, always"). The scale has "2, 10, 12, 19, 26, 27, 28, 29" reverse-scored questions while the remaining questions were straight-scored. The minimum score in SPFLS is 29 and the maximum score is 145. After calculating the perceived food literacy scores, the average score was determined. Those below average were considered to have low food literacy, and those above average were considered to have high food literacy. Higher food literacy levels have been associated with greater self-control, less impulsivity, and healthier food consumption [21].

Quality of Life Short Form (SF-36)

The 8-section 36-question quality of life short form (SF-36), a popular tool for assessing health-related quality of life. SF-36 is one of the most common generic measures to measure quality of life. The reliability and validity of the Turkish version of the Short Form-36 Quality-of-Life was conducted by Koçyiğit et al. [22] on 100 patients, 50 with osteoarthritis and 50 with chronic low back pain in 1999. The SF-36 scale consists of 8 sub-factors: 10 items for physical functioning, 4 items for role limitations due to physical health, 2 items for pain, 5 items for general health, 4 items for energy, 2 items for Social Function, 3 items for role limitations due to emotional problems, and 5 items for emotional well-being. These sub-factors are Physical Functioning (PF), Role Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Function (SF), Role Emotional (RE), and Mental Health (MH). Component analyses showed that there were two distinct concepts measured by the SF-36: a physical dimension represented by the Physical Component Score (PCS) and a mental dimension represented by the Mental Component Score (MCS) [23]. Each domain is converted to a range from 0 to 100, assuming each question carries equal weight. A lower score indicates a more significant disability, while a higher score indicates a more favorable health status; for example, a score of zero is equivalent to a maximum disability, and a score of 100 is equivalent to no disability [24].

Anthropometrics measurements

Participants' body weight (in kilograms), height (in centimeters), waist circumference (in centimeters), and hip circumference (in centimeters) were evaluated and documented. The measurements were taken using standard equipment, including a SECA stadiometer, Tanita BC-480 and rigid measuring tape. Waist and hip circumferences were measured by a nutritionist using a rigid tape measure, and weight was measured with a scale (Tanita BC-480). Participants' body mass index (BMI) was calculated by dividing body weight in kilograms (kg) by the square of height in meters (m^2), and the World Health Organization (WHO) classification was used. Below 18.5 kg/m^2 is considered thin, between 18.5 kg/m^2 and 24.9 kg/m^2 is normal, 25.0-29.9 kg/m^2 is pre-obese, and 30 kg/m^2 and above is obese [25].

Ethical consideration

All procedures followed were by the ethical standards of the Human Experimentation Responsible Committee (institutional and national) and the 1975 Declaration of

Helsinki, revised in 2008. Acıbadem Mehmet Ali Aydınlar University and Acıbadem Healthcare Institutions Medical Ethics Committee (ATADEK) approved the study on 28/01/2022, with IRB protocol number 2022-02/24

Statistical analysis

Patient data collected within the study were analysed using the IBM Statistical Package for the Social Sciences (SPSS) for Windows 26.0 (IBM Corp., Armonk, NY) package program. Descriptive statistics for categorical variables (demographic characteristics) were presented as frequencies and percentages. The conformity of numerical variables to normal distribution was performed with the "Shapiro-Wilk Test". Descriptive statistics of numerical variables were given as standard deviation ($\bar{X}$±SD) for normally distributed data and median (min-max) values for non-normally distributed data. The "Independent Sample T Test" was used to compare two independent groups with normal distribution, and the "Mann-Whitney U Test" was used to compare two independent groups with non-normal distribution.

An examination of the relationships between the scales was performed using "Spearman's Rank Difference Correlation Coefficient" for data that did not show normal distribution. In the interpretation of the correlation coefficient, "very weak correlation if <0.2", "weak correlation if 0.2-0.4", "moderate correlation if 0.4-0.6", "0.6-0.8" The criteria of "high correlation between 0.8 and very high correlation" were used. "Multiple Regression Analysis" was performed to test the effect between independent variables [26]. The results were considered statistically significant when the p-value was less than 0.05. While descriptive statistics were presented for the entire sample of individuals with diabetes, all inferential statistical analyses, including correlation and regression, were conducted separately for individuals with type-1 and type-2 diabetes to account for clinical and demographic differences between the two groups.

Results

As seen in Table 1, a total of 179 people participated in the study; 44.7% (n=80) of the patients participating in the study had type-1 diabetes, and 55.3% (n=99) had type-2 diabetes. The mean age of the type-1 diabetic patients participating in the survey was 36.69 ± 13.77 years, while the mean age of the type-2 diabetic patients was 55.60 ± 9.91 years. Of the participants with type 1 diabetes, 66.3% (n = 53) were female and 56.3% (n = 45) held a bachelor's degree. While 62.6% (n=62) of the patients with type-2 diabetes were female, 35.4% (n=35) had primary school degrees. The mean duration of diabetes in type-1 people with diabetes was determined as 13.17 ± 9.74 years. Insulin treatment was administered to 88.8% (n=71) of patients with type-1 diabetes.

The mean duration of diabetes in type-2 people with diabetes was determined as 11.80 ± 8.13 years, while 40.4% (n=40) were receiving oral antidiabetic drug treatment. The mean body mass index (BMI) of type-1 diabetics was determined as 25.66 ± 6.18 kg/m^2, mean waist circumference as 87.74 ± 16.25 cm, and mean HbA1c value as 8.07 ± 2.07%. The mean BMI of participants with type-2 diabetes was 29.59 ± 6.02 kg/m^2 (40.4% were obese), the mean waist circumference was 100.85 ± 13.86 cm, and the mean HbA1c value was 7.72 ± 2.17% (Table 1).

Table 1 Descriptive assessment of patients' according to diabetes types.

	Type-1 Diabetes		Type-2 Diabetes		Total	
Gender	**n**	**%**	**n**	**%**	**n**	**%**

Male	27	33.8	37	37.4	64	35.8
Female	53	66.3	62	62.6	115	64.2
Age *(years)* ($\bar{X}$ ± SD)	36.69 ± 13.77		55.60 ± 9.91		47.15 ± 15.07	
Age *(years)* *Median(min-max)*	36 (18-65)		56 (23-65)		47 (18-65)	
Educational Status						
Illiterate	3	3.8	8	8.1	11	6.1
Primary school	11	13.8	35	35.4	46	25.7
Middle school	5	6.3	12	12.1	17	9.5
High school	12	15.0	21	21.2	33	18.4
Associate degree	1	1.3	3	3.0	4	2.2
Bachelor's degree	45	56.3	19	19.2	64	35.8
Postgraduate	3	3.8	1	1.0	4	2.2
Marital status						
Single	40	50.0	26	26.3	66	36.9
Married	40	50.0	73	73.7	113	63.1
Occupational Status						
Housewife	14	17.5	42	42.4	56	31.3
Officer	6	7.5	4	4.0	10	5.6
Employee	6	7.5	7	7.1	13	7.3
Retired	8	10.0	35	35.4	43	24.0
Not working	6	7.5	2	2.0	8	4.5
Other	40	50.0	9	9.1	49	27.4
Diabetes Duration *(years)* *($\bar{X}$±SD)*	13.17 ± 9.74		11.80 ± 8.13		12.41 ± 8.89	
Diabetes Duration *(years)* *Median(min-max)*	12.5 (0.13-42)		11 (0.08-35)		12 (0.08-42)	
Medical Treatment						
Insulin	71	88.8	27	27.3	92	51.4
Oral Antidiabetic Drug	0	0.0	40	40.4	46	25.7
Insulin and Oral Antidiabetic Medication	9	11.2	32	32.3	41	22.9
Type of Insulin						
Basal Insulin	1	1.3	4	4.0	5	2.8
Basal+Bolus Insulin	79	98.8	95	96.0	174	97.2
Supplementary Vitamin/Mineral Use						
Regularly	26	32.5	28	28.3	54	30.2
Irregularly	23	28.7	22	22.2	45	25.1
No	31	38.8	49	49.5	80	44.7
Smoking Status						
Yes	22	27.5	13	13.1	35	19.6
No	53	66.3	67	67.7	120	67.0
Quit	5	6.3	19	19.2	24	13.4
Alcohol Consumption Status						
Yes	19	23.8	9	9.1	28	15.6
No	61	76.2	90	89.9	151	84.4
Main Meal Consumption						

2 main meals	13	16.3	26	26.3	39	21.8
3 main meals	67	83.8	73	73.7	140	78.2
Snack Consumption						
I do not consume	14	17.5	14	14.1	28	15.6
1 snack	21	26.3	23	23.2	44	24.6
2 snacks	24	30.0	45	45.5	69	38.5
3 snacks	21	26.3	17	17.2	38	21.2
Main Meal Skipping						
Yes	11	13.8	18	18.2	29	16.2
Sometimes	2	2.4	8	8.1	10	5.6
No	67	83.8	73	73.7	140	78.2
Skipped Main Meal*						
Morning	13	100.0	26	100.0	39	100.0
Skipping Snacks						
Yes	50	62.5	58	58.6	108	60.4
Sometimes	9	11.2	24	24.2	33	18.4
No	21	26.3	17	17.2	38	21.2
Skipped Snack*						
Morning	30	50.8	38	46.3	68	48.2
Afternoon	19	32.2	28	34.1	47	33.3
Evening	43	72.9	58	70.7	101	71.6
Consuming Food Outside the Home						
Yes	56	70.0	56	56.6	112	62.6
No	24	30.0	43	43.4	67	37.4
BMI Group						
Thin (□□18.5)	6	7.5	0	0.0	6	3.4
Normal (18.5-24.9)	38	47.5	26	26.3	64	35.7
Pre-obese (25.0-29.9)	19	23.8	33	33.3	52	29.1
Obese (□ 30.0)	17	21.2	40	40.4	57	31.8
BMI (kg/m²) ($\bar{X}$±SD)	25.66 ± 6.18		29.59 ± 6.02		27.83 ± 6.38	
Waist Circumference (cm) ($\bar{X}$±SD)	87.74 ± 16.25		100.85 ± 13.86		94.99 ± 16.30	
HbA_{1c} (%) ($\bar{X}$±SD)	8.07 ± 2.07		7.72 ± 2.17		7.88 ± 2.13	

*: More than one answer was given.

The total mean score of the self-perceived food scale of the diabetic patients participating in the study was 104.98 ± 14.24 (min. 59-max. 135). The mean score of the “Food Preparation Skills” sub-factor of the scale was found to be 22.64 ± 5.72, the mean score of the “Resilience and Resistance” sub-factor was found to be 19.77 ± 4.61, the mean score of the “Healthy Snack Styles” sub-factor was found to be 15.12 ± 3.65. The mean score of the “Social and Conscious Eating” sub-factor was 11.73 ± 2.67. The mean score of the “Examining Food Labels” sub-factor was 5.48 ± 2.76, the mean score of the “Daily Food Planning” sub-factor was 6.54 ± 2.38, the mean score of the “Expenditure on Healthy Foods” sub-factor was 8.10 ± 1.97, and the mean score of the “Healthy Food Stockpiling” sub-factor was 15.60 ± 4.22 (Table 2).

Table 2 Evaluation of SPFLS subfactor and total scores and SF-36 subfactor scores of individuals with diabetes.

		Median (min-max)	X̄ ± SD
SPFLS	Food Preparation Skills	24 (6-30)	22.64 ± 5.72
	Resilience and Resistance	20 (7-30)	19.77 ± 4.61
	Healthy Snack Styles	16 (4-20)	15.12 ± 3.65
	Social and Conscious Eating	12 (3-15)	11.73 ± 2.67
	Examining Food Labels	6 (2-10)	5.48 ± 2.76
	Daily Food Planning	7 (2-10)	6.54 ± 2.38
	Expenditure on Healthy Foods	8 (2-10)	8.10 ± 1.97
	Healthy Food Stockpiling	17 (4-20)	15.60 ± 4.22
	SPFLS Total	105 (59-135)	104.98 ± 14.24
SF-36	Physical Function	75 (0-100)	72.63 ± 23.39
	Role Physical	75 (0-100)	54.33 ± 41.97
	Bodily Pain	66.7 (0-100)	52.14 ± 34.98
	General Health	60 (30-90)	58.30 ± 12.13
	Vitality	52 (20-84)	50.01 ± 15.00
	Social Function	75 (0-100)	68.02 ± 26.17
	Role Emotional	67.5 (0-100)	65.91 ± 30.60
	Mental Health	45 (10-80)	42.93 ± 14.12
	Physical Component Score	61.3 (16.3-95)	59.35 ± 20.66
	Mental Component Score	58.4 (14.4-84.9)	56.72 ± 16.23

Again, the SF-36 scale sub-factors of diabetic individuals were evaluated in Table 2. The mean score of the “Physical Function” sub-factor was determined as 72.63 ± 23.39, the mean score of the “Role Physical” sub-factor was determined as 54.33 ± 41.97, the mean score of the “Bodily Pain” sub-factor was determined as 52.14 ± 34.98, the mean score of the “General Health” sub-factor was determined as 58.30 ± 12.13, the mean score of the “Vitality” sub-factor was determined as 50.01 ± 15.00, the mean score of the “Social Functions” sub-factor was determined as 68.02 ± 26.17, the mean score of the “Role Emotional” sub-factor was determined as 65.91 ± 30.60, and the mean score of the “Mental Health” sub-factor was determined as 42.93 ± 14.2. The mean score of the “Physical Component Score,” two separate concepts measured by SF-36, was determined as 59.35 ± 20.66, and the mean score of the “Mental Component Score” was determined as 56.72 ± 16.23.

A statistically significant difference was achieved between the "Social and Conscious Eating" and "Examining Food Labels" sub-factor scores of SPFLS according to the diabetes type of the diabetic individuals participating in the study. When the results are examined, in the "Social and Conscious Eating" sub-factor scores of SPFLS, the median of individuals with type-2 diabetes (16; range 4-20) was lower than the median of individuals with type-1 diabetes (11; range 3-15). The median of "Examining Food Labels" sub-factor scores with type-2 diabetes (13; range 3-15) was statistically higher than the median of individuals with type-1 diabetes (6; range 2-10) (Table 3).

Table 3 Comparison of SPFLS sub-factor and total scores and SF-36 sub-factor scores according to diabetes type.

Self-Perceived Food Literacy Scale (SPFLS)	X̄ ± SD	Median (min-max)	t-U	p-value
Food Preparation Skills	23 (9-30)	25 (6-30)	U=3416.5	0.114
Resilience and Resistance	19.54 ± 4.30	19.96 ± 4.86	t=-0.608	0.544
Healthy Snack Styles	15 (4-20)	20 (7-30)	U=3690	0.430
Social and Conscious Eating	11 (3-15)	16 (4-20)	**U=3171**	**0.021***
Examining Food Labels	6 (2-10)	13 (3-15)	**U=2806**	**<0.001*****
Daily Food Planning	7 (2-10)	4 (2-10)	U=3676	0.404
Expenditure on Healthy Foods	8 (2-10)	6 (2-10)	U=3671.5	0.384
Healthy Food Stockpiling	16 (4-20)	8 (2-10)	U=3537	0.216
SPFLS Total Score	103.78 ± 13.91	105.96 ± 14.50	t=-1.020	0.309
Quality of Life Scale (SF-36)	X̄ ± SD	**Median (min-max)**	**t-U**	**p-value**
Physical Function	80 (0-100)	75 (5-100)	U=3642	0.354
Role Physical	62.5 (0-100)	75 (0-100)	U=3785	0.598
Bodily Pain	66.67 (0-100)	66.67 (0-100)	U=3686	0.410
General Health	55 (30-90)	60 (30-90)	U=3565.5	0.248
Vitality	50 (20-80)	52 (20-84)	U=3931	0.933
Social Function	75 (0-100)	75 (0-100)	U=3858	0.794
Role Emotional	65 (0-100)	70 (0-100)	U=3902	0.865
Mental Health	45 (15-70)	45 (10-80)	U=3895	0.850
Physical Component Score	62.3 (16.3-95)	59.6 (16.3-93.8)	U=3810	0.663
Mental Component Score	58.1 (20.6-81.5)	58.4 (14.4-84.9)	U=3769.5	0.580

t: Independent Sample T Test; U: Mann-Whitney U Test. *p<0.05; ***p<0.001.

As shown in Table 4, in individuals with type 1 diabetes, age showed positive correlations with several SPFLS subfactors, including *Food Preparation Skills* (r = 0.282, p = 0.011), *Social and Conscious Eating* (r = 0.325, p = 0.003), and *Healthy Food Stockpiling* (r = 0.238, p = 0.034). Moreover, diabetes duration was positively correlated with the SPFLS total score (r = 0.444, p < 0.001) and the SF-36 subfactors *General Health* (r = 0.304, p = 0.006) and *Vitality* (r = 0.241, p = 0.031), confirming that longer disease duration and older age were associated with higher food literacy and better quality-of-life indicators.

A significant weak positive correlation was found between the ages of individuals with type-1 diabetes and the SPFLS "Food Preparation Skills," "Social and Conscious Eating," and "Healthy Food Stockpiling" subfactor scores, a significant negative weak correlation was found between the SPFLS "Examining Food Labels" subfactor scores, and a significant negative moderate correlation was found between the SF-36 "Physical Function" subfactor scores ($p<0.05$; $p<0.01$; $p<0.001$). A significant negative, very weak correlation was found between the ages of individuals with type-2 diabetes and the SPFLS "Social and Conscious Eating" subfactor scores, and a significant positive weak correlation was found between the SF-36 "Vitality" subfactor scores ($p<0.05$) (Table 4).

As seen in Table 4, a significant positive weak correlation was found between the duration of diabetes and SPFLS "Food Preparation Skills," "Resilience and Resistance," "Social and Conscious Eating," SF-36's "General Health" and "Vitality" sub-factor scores of individuals with type-1 diabetes, and a significant positive moderate correlation was found between SPFLS "Expenditure on Healthy Foods" sub-factor and "SPFLS Total" scores ($p<0.05$; $p<0.01$; $p<0.001$). However, no statistically significant correlation was found between the duration of diabetes and SPFLS sub-factor scores and total score and SF-36 sub-factor scores of individuals with type-2 diabetes ($p>0.05$). Again, a significant negative, weak correlation was found between the BMI values of individuals with type-1 diabetes and the scores of the sub-factors of SPFLS "Resilience and Resistance" and "Examining Food Labels" ($p<0.05$). In individuals with type-2 diabetes, a significant positive weak correlation was found between BMI values and SPFLS "Food Preparation Skills" sub-factor scores, and a significant negative, weak correlation was found between SPFLS "Resilience and Resistance," "Examining Food Labels" and SF-36 "Physical Function" sub-factor scores ($p<0.05$; $p<0.001$).

Table 4 shows no statistically significant correlation between the HbA1C values of individuals with type-1 diabetes and SPFLS and SF-36 ($p>0.05$). In individuals with type-2 diabetes, there was a significant negative, weak correlation between the HbA1c values and SPFLS "Healthy Food Stockpiling," SF-36's "Physical Function," "Role Physical" and "Vitality" subfactor scores ($p<0.05$). As the HbA1c values of individuals with type-2 diabetes increased, a decrease was observed in the subfactor scores of "Healthy Food Stockpiling" (23.3%), "Physical Function" (21.3%), "Role Physical" (20.1%) and "Vitality" (21.2%) of SF-36. The weak correlation coefficients in the table indicate that the relationship between the variables is minimal. This suggests that the relationship between age, duration of diabetes, HbA1c values and SFLS and SF-36 subfactor scores has a limited effect on diabetes management. Therefore, these weak correlations do not significantly affect the main findings and conclusions of our study.

Table 4 Correlation between age, anthropometric and biochemical values and SPFLS subfactor and total scores and SF-36 subfactor scores according to diabetes types.

		Type-1 Diabetes			
		Age (years)	**Diabetes Duration *(years)***	**BMI (kg/m²)**	**HbA1c (%)**
FPS	**r**	**0.282**	**0.229**	0.102	-0.108
	p	**0.011***	**0.041***	0.370	0.340
RR	**r**	-0.045	**0.323**	**-0.223**	-0.090
	p	0.692	**0.003****	**0.047***	0.430
HSS	**r**	-0.065	0.142	-0.130	-0.021
	p	0.564	0.209	0.252	0.852
SCE	**r**	**0.325**	**0.365**	-0.086	0.018
	p	**0.003****	**0.001****	0.446	0.877
EFL	**r**	**-0.243**	0.171	**-0.253**	-0.032
	p	**0.030***	0.130	**0.024***	0.777
DFP	**r**	-0.135	0.031	-0.131	-0.065
	p	0.233	0.782	0.246	0.569
EHF	**r**	0.045	**0.419**	-0.064	-0.132
	p	0.691	**<0.001*****	0.572	0.244
HFS	**r**	**0.238**	0.067	0.092	0.050
	p	**0.034***	0.556	0.419	0.663
SPFLS	**r**	0.172	**0.444**	-0.138	-0.108
	p	0.128	**<0.001*****	0.221	0.340
PF	**r**	**-0.428**	0.214	-0.173	0.017
	p	**<0.001*****	0.056	0.126	0.883
RP	**r**	-0.080	0.060	-0.067	-0.018
	p	0.479	0.596	0.552	0.875
BP	**r**	-0.095	0.064	0.011	-0.202
	p	0.402	0.574	0.924	0.072
GH	**r**	-0.019	**0.304**	-0.041	-0.076
	p	0.867	**0.006****	0.716	0.503
VT	**r**	0.096	**0.241**	0.055	-0.091
	p	0.398	**0.031***	0.627	0.423
SF	**r**	-0.018	0.166	0.050	0.006
	p	0.873	0.140	0.657	0.960
RE	**r**	-0.184	0.075	-0.038	-0.074
	p	0.102	0.510	0.740	0.513
MH	**r**	-0.175	0.032	-0.101	-0.060
	p	0.120	0.777	0.374	0.595
PCS	**r**	-0.187	0.127	-0.087	-0.103
	p	0.096	0.262	0.442	0.363
MCS	**r**	-0.107	0.153	-0.005	-0.070
	p	0.343	0.175	0.966	0.539

FPS: Food Preparation Skills; RR: Resilience and Resistance; HSS: Healthy Snack Styles; SCE: Social and Conscious Eating; EFL: Examining Food Labels; DFP: Daily Food Planning; EHF: Expenditure on Healthy Foods; HFS: Healthy Food Stockpiling; SPFLS: Self-Perceived Food Literacy Scale; PF: Physical Function; RP: Role Physical;

BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Function; RE: Role Emotional; MH: Mental Health; PCS: Physical Component Score; MCS: Mental Component Score. r: Spearman Rank Difference Correlation Coefficient. *p<0.05; **p<0.01; ***p<0.001.

Table 4 (Continued) Correlation between age, anthropometric and biochemical values and SPFLS subfactor and total scores and SF-36 subfactor scores according to diabetes types.

		Type-2 Diabetes			
		Age (years)	**Diabetes Duration *(years)***	**BMI (kg/m²)**	**HbA1c (%)**
FPS	**r**	0.025	-0.066	**0.399**	0.100
	p	0.807	0.517	**<0.001*****	0.325
RR	**r**	0.152	0.171	**-0.219**	-0.195
	p	0.133	0.091	**0.030***	0.053
HSS	**r**	0.060	0.012	-0.064	-0.006
	p	0.556	0.903	0.527	0.956
SCE	**r**	**-0.199**	-0.140	-0.005	-0.086
	p	**0.049***	0.166	0.962	0.400
EFL	**r**	0.067	0.121	**-0.235**	-0.106
	p	0.511	0.233	**0.019***	0.298
DFP	**r**	0.116	0.008	0.013	-0.066
	p	0.254	0.936	0.898	0.516
EHF	**r**	-0.074	-0.039	0.048	-0.077
	p	0.469	0.704	0.639	0.450
HFS	**r**	0.155	0.011	-0.085	**-0.233**
	p	0.125	0.911	0.400	**0.020***
SPFLS	**r**	0.063	0.020	0.008	-0.127
	p	0.538	0.842	0.941	0.209
PF	**r**	-0.134	-0.102	**-0.215**	**-0.213**
	p	0.187	0.313	**0.033***	**0.035***
RP	**r**	0.017	-0.017	0.009	**-0.201**
	p	0.866	0.865	0.932	**0.046***
BP	**r**	0.042	0.050	-0.018	-0.093
	p	0.682	0.620	0.861	0.358
GH	**r**	-0.021	0.090	0.060	-0.019
	p	0.833	0.373	0.554	0.850
VT	**r**	**0.206**	0.061	-0.004	**-0.212**
	p	**0.041***	0.547	0.969	**0.035***
SF	**r**	0.047	0.089	-0.145	-0.177
	p	0.641	0.380	0.153	0.079
RE	**r**	0.074	0.030	-0.122	-0.163
	p	0.464	0.772	0.229	0.108
MH	**r**	-0.033	0.002	-0.075	-0.113
	p	0.746	0.982	0.458	0.266
PCS	**r**	0.007	0.013	-0.056	-0.186
	p	0.949	0.901	0.584	0.065
	r	0.114	0.080	-0.131	-0.197

MCS	**p**	0.262	0.432	0.197	0.051

FPS: Food Preparation Skills; RR: Resilience and Resistance; HSS: Healthy Snack Styles; SCE: Social and Conscious Eating; EFL: Examining Food Labels; DFP: Daily Food Planning; EHF: Expenditure on Healthy Foods; HFS: Healthy Food Stockpiling; SPFLS: Self-Perceived Food Literacy Scale; PF: Physical Function; RP: Role Physical; BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Function; RE: Role Emotional; MH: Mental Health; PCS: Physical Component Score; MCS: Mental Component Score. r: Spearman Rank Difference Correlation Coefficient. *p<0.05; **p<0.01; ***p<0.001.

When Table 5 is examined, it is seen that there are significant, weak positive correlations between the SPFLS subfactor scores of individuals with type-1 diabetes and various subfactor scores of SF-36 ($p<0.05$; $p<0.01$). This indicates that the relationship between these variables is limited, and that food literacy has a minimal effect on quality of life. In particular, the "Food Preparation Skills" subfactor is related to the "Role Physical," "Bodily Pain," "Social Function," "Role Emotional," "Physical Component Score," and "Mental Component Score" of SF-36. The "Resilience and Resistance" subfactor is positively correlated with "Bodily Pain," "Vitaliy," "Social Function," and "Mental Component Score." The "Healthy Snack Styles," "Examining Food Labels," "Daily Food Planning," "Social and Conscious Eating," and "Expenditure on Healthy Foods" subfactors also have significant positive relationships with different components of SF-36. However, it is negatively correlated with "Healthy Food Stockpiling," "Bodily Pain," and "Physical Component Score." In general, as the SPFLS total score increases, significant increases are observed in the "Physical Function," "Vitality," "Social Function," "Physical Component," and "Mental Component" scores of SF-36. Similarly, in individuals with type-2 diabetes, significant positive relationships were found between the sub-factors "Resilience and Resistance," "Social and Conscious Eating," "Examining Food Labels," "Daily Food Planning," and "Healthy Food Stockpiling," and various sub-factors of SF-36 ($p<0.05$; $p<0.01$; $p<0.001$). In particular, the "Healthy Food Stockpiling" sub-factor is associated with significant increases in the "Physical Function," "Role Physical," "Role Emotional," "Physical Component," and "Mental Component" scores. These results show that nutritional awareness and management positively affect quality of life.

The SF-36 "Physical Component score" was found to be statistically significantly impacted by the SPFLS "Food Preparation Skills" and "Healthy Food Stockpiling" subfactor scores for individuals with type-1 diabetes. When the results were examined, it was seen that when there was a one-unit increase in the “Food Preparation Skills” subfactor scores of individuals with type-1 diabetes, there was a 0.951-fold increase in their SF-36 “Physical Component” scores. In individuals with type-2 diabetes, it was found that the SFLS “Expenditure on Healthy Foods” subfactor scores had a statistically significant effect on the SF-36 “Physical Component” scores ($p <0.05$). When the results were examined, it was found that when there was a one-unit increase in the SFLS “Expenditure on Healthy Foods” subfactor scores of individuals with type-2 diabetes, there was a 2.971-fold increase in their SF-36 “Physical Component” scores (Table 6).

The SF-36 "Mental Component score" was found to be statistically significantly affected by the SPFLS "Healthy Food Stockpiling" sub-factor score of individuals with type-1 diabetes ($p <0.05$). It was observed that when there was a one-unit increase, there was a 1.055-fold decrease in the SF-36 “Mental Component scores”. It was found that the SFLS “Daily Food Planning,” “Expenditure on Healthy Food,” and “Healthy Food Stockpiling” sub-factor scores of type-2 diabetic participants had a statistically significant effect on the SF-36 “Mental Component scores” ($p <0.05$). When the results were examined, it was seen that when there was a one-unit increase in the SPFLS “Daily Food Planning,” “Expenditure on Healthy Food,” and “Healthy Food Stockpiling” sub-factor scores of individuals with type-2 diabetes, the SF-36 “Mental Component scores” increased by 1.875, 2.253 and 0.926 times, respectively (Table 6).

Discussion

According to the International Diabetes Federation (IDF), 77% of people with diabetes experience anxiety, depression, or other mental health issues. However, diabetes management often emphasizes blood glucose control alone, overwhelming many [27]

Specifically, it aimed to evaluate their self-perceived food literacy and its relationship with quality of life, particularly regarding HbA1c levels and glycemic control. Nutritional knowledge and skills of individuals diagnosed with diabetes help them improve their quality of life and make the right food choices by supporting their metabolic self-management. The study observed that 60.1% (n=47) of patients with type-1 diabetes had undergraduate or graduate education, while 38.0% (n=68) of patients with type-2 diabetes had the same level of education. The total SPFLS score was determined as 104.98 ± 14.24. In their study, Baş and Kavak [28] determined the total SPFLS score of university students as 91.14 ± 13.72. In the survey conducted by Griebler et al. [28] in Austria, this score was 62.4± 10.8, and the distribution was slightly skewed to the left. In another study conducted on the Japanese population, Murakami et al. (2024) reported the mean SPFLS score as 3.18 ± 0.43 in their study on Japanese people [30]. In the study conducted

Table 5 Correlation between SPFLS subfactor and total scores and SF-36 subfactor scores according to diabetes types.

		Type-1 Diabetes									
		PF	**RP**	**BP**	**GH**	**VT**	**SF**	**RE**	**MH**	**PCS**	**MCS**
FPS	**r**	0.167	**0.339**	**0.269**	0.102	0.107	**0.248**	**0.220**	0.046	**0.355**	**0.232**
	p	0.139	**0.002****	**0.016***	0.367	0.346	**0.026***	**0.049***	0.686	**0.001****	**0.038***
RR	**r**	0.219	0.061	**0.223**	0.079	**0.295**	**0.285**	0.065	0.115	0.157	**0.240**
	p	0.051	0.592	**0.046***	0.484	**0.008****	**0.010***	0.568	0.308	0.165	**0.032***
HSS	**r**	0.130	0.158	0.100	-0.114	**0.271**	0.100	0.034	0.173	0.119	0.160
	p	0.252	0.161	0.376	0.313	**0.015***	0.376	0.762	0.124	0.293	0.156
SCE	**r**	-0.070	0.076	0.202	0.183	**0.313**	0.184	0.043	0.173	0.136	0.197
	p	0.538	0.501	0.073	0.104	**0.005****	0.102	0.707	0.125	0.228	0.080
EFL	**r**	**0.362**	0.121	0.205	0.133	0.183	0.129	0.193	**0.248**	**0.241**	**0.228**
	p	**0.001***	0.287	0.068	0.240	0.104	0.256	0.087	**0.026***	**0.031***	**0.042***
DFP	**r**	**0.223**	0.098	0.110	0.121	0.151	0.123	0.057	0.199	0.133	0.124
	p	**0.047***	0.385	0.333	0.285	0.181	0.277	0.617	0.076	0.239	0.273
EHF	**r**	0.159	0.003	0.169	0.212	**0.302**	0.124	0.022	0.170	0.129	0.167
	p	0.159	0.977	0.133	0.060	**0.006****	0.274	0.845	0.132	0.255	0.140
HFS	**r**	-0.210	-0.110	**-0.288**	-0.120	-0.043	0.027	-0.066	-0.047	**-0.255**	-0.049
	p	0.062	0.331	**0.010***	0.290	0.704	0.809	0.560	0.676	**0.023***	0.665
SPFLS	**r**	**0.256**	0.187	0.203	0.127	**0.334**	**0.276**	0.153	0.194	**0.238**	**0.288**
	p	**0.022***	0.097	0.071	0.263	**0.002****	**0.013***	0.174	0.085	**0.033***	**0.010***

FPS: Food Preparation Skills; RR: Resilience and Resistance; HSS: Healthy Snack Styles; SCE: Social and Conscious Eating; EFL: Examining Food Labels; DFP: Daily Food Planning; EHF: Expenditure on Healthy Foods; HFS: Healthy Food Stockpiling; SPFLS: Self-Perceived Food Literacy Scale; PF: Physical Function; RP: Role Physical; BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Function; RE: Role Emotional; MH: Mental Health; PCS: Physical Component Score; MCS: Mental Component Score. r: Spearman Rank Difference Correlation Coefficient. *p<0.05; **p<0.01; ***p<0.001.

Table 5 (Continued) Correlation between SPFLS subfactor and total scores and SF-36 subfactor scores according to diabetes types.

		Type-2 Diabetes									
		PF	**RP**	**BP**	**GH**	**VT**	**SF**	**RE**	**MH**	**PCS**	**MCS**
FPS	**r**	-0.013	0.056	-0.082	0.003	0.069	-0.032	-0.041	0.016	0.006	0.000
	p	0.901	0.579	0.422	0.979	0.499	0.756	0.685	0.873	0.956	0.999
RR	**r**	0.123	0.029	0.024	0.064	0.152	**0.230**	0.126	0.120	0.072	**0.201**
	p	0.224	0.777	0.816	0.532	0.132	**0.022***	0.213	0.238	0.476	**0.046***
HSS	**r**	0.187	0.128	0.087	0.043	0.018	0.092	0.028	0.055	0.145	0.068
	p	0.064	0.206	0.390	0.674	0.858	0.365	0.785	0.588	0.151	0.504
SCE	**r**	**0.216**	-0.042	0.068	0.194	0.026	0.151	0.093	0.092	0.099	0.122
	p	**0.031***	0.678	0.501	0.055	0.799	0.135	0.362	0.366	0.329	0.227
EFL	**r**	0.140	0.070	0.111	0.009	0.087	0.186	0.125	**0.223**	0.121	0.192
	p	0.168	0.493	0.272	0.929	0.390	0.065	0.216	**0.026***	0.232	0.057
DFP	**r**	0.109	**0.211**	**0.218**	-0.051	**0.253**	**0.278**	**0.262**	0.125	**0.228**	**0.324**
	p	0.285	**0.036***	**0.030***	0.613	**0.011***	**0.005****	**0.009****	0.219	**0.023***	**0.001****
EHF	**r**	**0.373**	**0.239**	0.044	0.012	0.142	0.178	**0.295**	0.016	**0.226**	**0.233**
	p	**<0.001*****	**0.017***	0.664	0.908	0.160	0.077	**0.003****	0.876	**0.025***	**0.020***
HFS	**r**	0.121	0.055	0.005	**0.207**	0.195	0.195	0.139	**0.246**	0.065	**0.226**
	p	0.232	0.589	0.962	**0.040***	0.053	0.053	0.172	**0.014***	0.525	**0.025***
SPFLS	**r**	**0.221**	0.169	0.083	0.086	**0.223**	**0.289**	0.154	**0.238**	**0.200**	**0.283**
	p	**0.028***	0.094	0.414	0.400	**0.027***	**0.004****	0.129	**0.018***	**0.047***	**0.005****

FPS: Food Preparation Skills; RR: Resilience and Resistance; HSS: Healthy Snack Styles; SCE: Social and Conscious Eating; EFL: Examining Food Labels; DFP: Daily Food Planning; EHF: Expenditure on Healthy Foods; HFS: Healthy Food Stockpiling; SPFLS: Self-Perceived Food Literacy Scale; PF: Physical Function; RP: Role Physical; BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Function; RE: Role Emotional; MH: Mental Health; PCS: Physical Component Score; MCS: Mental Component Score. r: Spearman Rank Difference Correlation Coefficient. *p<0.05; **p<0.01; ***p<0.001.

Table 6 Regression analysis of SPFLS sub-factor and SF-36 "Physical Component Score" and "Mental Component Score" according to diabetes types.

		Type-1 Diabetes						**Type-2 Diabetes**					
		Unstandardized Coefficients			**95% Confidence Interval for β**			**Unstandardized Coefficients**			**95% Confidence Interval for β**		
		β	**SE**	**t**	**p-value**	**Lower Limit**	**Upper Limit**	**β**	**SE**	**t**	**p-value**	**Lower Limit**	**Upper Limit**
PCS	(Constant)	30.734	16.444	1.869	0.066	-2.054	63.522	18.790	17.213	1.092	0.278	-15.406	52.986
	FPS	0.951	0.405	**2.350**	**0.022***	0.144	1.758	-0.266	0.372	-0.715	0.477	-1.005	0.473
	RR	0.284	0.597	4.75	0.636	-0.907	1.475	-0.348	0.498	-0.698	0.487	-1.337	0.642
	HSS	0.034	0.649	0.053	0.958	-1.260	1.329	0.411	0.666	0.617	0.539	-0.913	1.735
	SCE	0.471	0.758	0.621	0.537	-1.040	1.981	-0.147	0.968	-0.152	0.880	-2.069	1.776
	EFL	0.769	1.064	0.722	0.472	-1.353	2.891	0.350	0.829	0.422	0.674	-1.297	1.997
	DFP	0.291	1.042	0.279	0.781	-1.788	2.370	1.865	0.977	1.910	0.059	-0.075	3.805
	EHF	0.847	1.231	0.688	0.494	-1.607	3.302	2.971	1.294	**2.296**	**0.024***	0.400	5.541
	HFS	-1.055	0.517	**-2.041**	**0.045***	-2.086	-0.024	0.637	0.549	1.161	0.249	-0.453	1.727
MCS	(Constant)	26.477	12.873	**2.057**	**0.043***	0.808	52.145	16.582	13.115	1.264	0.209	-9.473	42.637
	FPS	0.364	0.317	1.149	0.254	-0.268	0.996	-0.221	0.284	-0.779	0.438	-0.784	0.342
	RR	0.744	0.468	1.590	0.116	-0.189	1.676	0.142	0.380	0.374	0.709	-0.612	0.896
	HSS	-0.272	0.508	-0.535	0.594	-1.286	0.741	-0.376	0.508	-0.741	0.461	-1.385	0.633
	SCE	0.745	0.593	1.256	0.213	-0.438	1.928	-0.012	0.737	-0.017	0.987	-1.477	1.452
	EFL	0.958	0.833	1.150	0.254	-0.703	2.619	0.671	0.632	1.062	0.291	-0.584	1.926
	DFP	0.096	0.816	0.118	0.906	-1.531	1.724	1.875	0.744	**2.520**	**0.013***	0.397	3.354
	EHF	0.187	0.964	0.194	0.847	-1.735	2.108	2.253	0.986	**2.286**	**0.025***	0.295	4.212
	HFS	-0.333	0.405	-0.822	0.414	-1.140	0.474	0.926	0.418	**2.214**	**0.029***	0.095	1.757

FPS: Food Preparation Skills; RR: Resilience and Resistance; HSS: Healthy Snack Styles; SCE: Social and Conscious Eating; EFL: Examining Food Labels; DFP: Daily Food Planning; EHF: Expenditure on Healthy Foods; HFS: Healthy Food Stockpiling; PCS: Physical Component Score; MCS: Mental Component Score. β: Beta Coefficient: SE: Standard Error. *$p<0.05$.

by Poelman et al. [20] on the Dutch population, the mean score was determined as 3.83 ± 0.41. In the Luque et al. [31] study on adult Italians, this score was 3.50 ± 0.55. The mean SPFLS score obtained in this study was 3.62 ± 0.49. These results show a similar trend to those found in the Netherlands and Italy studies. The high level of food literacy observed due to the studies is expected to encourage more self-control and healthy food consumption in individuals. The study evaluating the food literacy of university students studying in different departments determined that the food label reading attitudes of students whose source of nutritional information was textbooks were statistically significantly higher ($p<0.05$) [28]. Similarly, Silva [32] reported in his study that most participants had sufficient nutritional literacy levels, but one in every five individuals had limited nutritional literacy. Abrams et al. [33] revealed that 79.8% of individuals had sufficient nutritional literacy levels. Aihara et al. [34] reported that 30.7% of individuals were adequate and 66.3% were borderline, while Zoellner et al. [35] reported that 24.0% of individuals had inadequate, 28.0% limited, and 48.0% adequate nutritional literacy. A systematic review by Abdullah et al. [36] revealed that the level of health literacy in individuals with diabetes varied across countries and ranged from 7.3% (Switzerland) to 82.0% (Taiwan), emphasizing that overall health literacy was limited. These findings demonstrate that strategies to increase individuals' nutritional literacy in diabetes management are a powerful tool that can transform both individual and public health.

Individuals with diabetes can effectively manage their condition by adopting self-care behaviors such as maintaining an appropriate diet, exercising regularly, controlling blood sugar levels, and using oral antidiabetic agents or insulin therapy correctly. Self-management is the ability of a person to perform a behavior to achieve specific results in diet and medication, highlighting the importance of nutritional literacy in managing diabetes. Hashim et al. [37] showed a relationship between self-management, self-efficacy, and health literacy in individuals with diabetes in their study on type-2 diabetes, and diabetes self-management programs contribute to effective diabetes control by increasing the level of health literacy. Again, in a study conducted on individuals with diabetes, A high and negative significant correlation was found between nutritional literacy and HbA1c. This shows that individuals with high nutrition literacy have better glycemic control [38]. Another study conducted on elderly individuals with type 2 diabetes determined that increasing health literacy levels reduced the burden of diabetes. This finding suggests that increasing health literacy can play an important role in diabetes management and contribute positively to patients' quality of life [39]. Inadequate/low health literacy prevents the individual from using health services effectively, causes a decrease in the quality of life at the social level, and increases morbidity and mortality [37, 40]. In individuals with diabetes who have low self-management skills, emergency room use, and hospital readmission rates increase, and the risk of developing diabetes complications and severe hypoglycemia increases. It is also reported that these individuals consume more carbohydrates than other food groups. Illiterate patients use health services more frequently, misunderstand food labels, have difficulty estimating portion sizes, and have higher HbA1c levels due to poor self-management [41]. Van der Heide et al. (2014) showed that low health literacy causes higher HbA1c and glucose values and decreased physical activity levels [42]. Olesen et al. [8] found that in individuals with type-1 diabetes, lower HbA1c levels were associated with nutrition and health literacy. The relationship between literacy and HbA1c remained significant when education level was considered. In other words, individuals with higher nutrition and health literacy exhibited better glycemic control regardless of their education level. Unlike other studies, Abrams et al. [33] did not find a strong direct relationship between nutritional literacy and HbA1c levels. However, they suggested that nutritional literacy may indirectly influence HbA1c levels by shaping individuals' approaches to diabetes management. In this context, nutritional literacy is an indispensable component of individual self-management in diabetes care, albeit indirectly. According to the study by Gutierrez and Long [43], 23% of individuals with diabetes do not comply with treatment, while this rate was determined as 28.3% in the study by Fedrick and Justin [44]. Regional differences are also striking. In a study conducted in Korea, the non-adherence rate to treatment was found to be 60% and 71.3% in Egypt [45,46]. While there was no significant relationship between HbA1c levels and SPFLS and SF-36 in individuals with type-1 diabetes ($p>0.05$), HbA1c levels in individuals with type-2 diabetes showed a significant, weak, and negative correlation with the sub-factors "Storing Healthy Food" of SPFLS and "Physical Function", "Role Physical" and "Vitality" of SF-36 ($p<0.05$). This finding emphasizes that improving metabolic control in individuals with type-2 diabetes is critical in glycemic control and improving quality of life. More comprehensive studies are needed to determine other factors affecting the quality of life for individuals with type-1 diabetes. These results again reveal the importance of individualizing diabetes management and increasing health literacy. Given the clinical heterogeneity of type-1 and type-2 diabetes, statistical analyses were conducted separately for each group to ensure the validity of the results.

In individuals with type-1 diabetes, increasing age was associated with higher scores in "Food Preparation Skills", "Social and Conscious Eating", and "Healthy Food Stockpiling", but lower scores in "Examining Food Labels" and "Physical Function". Among those with type-2 diabetes, aging was linked to higher "Vitality scores" but lower "Social and Conscious Eating" scores. Similarly, Baş et al. [47] reported that age was positively correlated with “Food Preparation Skills” and "Expenditure on Healthy Foods", but negatively correlated with "Healthy Food Stockpiling" among women, highlighting the complex effects of aging on dietary behaviors. Type-2 diabetes, which is usually diagnosed later in life and is often accompanied by comorbidities such as hypertension and obesity, may limit participation in structured education and negatively influence both metabolic control and quality of life [8, 42]. These differences may explain why the correlations between age, diabetes duration, food literacy, and quality of life were stronger among individuals with type-1 diabetes. Overall, these findings emphasize the nuanced effects of age on dietary behavior and quality of life, underscoring the importance of targeted interventions that address the specific challenges associated with aging and chronic disease management.

In addition, BMI demonstrated differing associations with health-related behaviors across diabetes types. Among type-1 diabetics, higher BMI was associated with lower scores in "Resilience and Resistance" and "Examining Food Labels". In contrast, in type-2 diabetics, increasing BMI was linked to improved "Food Preparation Skills" but lower "Resilience and Resistance", "Examining Food Labels", and "Physical Function" scores. These findings indicate that the influence of BMI, age, and disease duration on food literacy and health-related quality of life may vary by diabetes type. Therefore, developing individualized nutritional literacy interventions that consider demographic and clinical factors such as age, BMI, and disease duration is essential for optimizing self-management and improving quality of life in both groups.

Additionally, BMI exhibited varying associations with health-related behaviors across different types of diabetes. Among individuals with type-1 diabetes, a higher BMI was associated with lower scores in "Resilience and Resistance", as well as "Examining Food Labels". Conversely, in those with type-2 diabetes, an increasing BMI was linked to higher "Food Preparation Skills" but lower "Resilience and Resistance", as well as lower scores in "Examining Food Labels" and "Physical Function". These findings are consistent with Baş et al. [47], who reported a positive association between age and "Healthy Snack Types" among individuals with SPFLS scores above the median, as well as a weak positive relationship between BMI and "Food Preparation Skills". In another study examining the effects of nutritional literacy on quality of life by the same researchers, it was found that physical component scores (PCS) decreased as age and BMI increased. In contrast, mental component scores (MCS) improved with higher nutritional literacy and advancing age [48].

Clinically, these correlation patterns highlight that nutritional literacy has potential implications for diabetes management beyond behavioral outcomes. For instance, the weak negative correlation observed between BMI and the "Examining Food Labels" subscale suggests that individuals who pay greater attention to nutritional information on food packaging tend to maintain slightly lower body weights, reflecting more conscious food choices. Similarly, higher "Food Preparation Skills" among individuals with type-2 diabetes may indicate a better ability to plan and prepare balanced meals at home, supporting healthier dietary patterns and glycemic stability. In individuals with type-1 diabetes, the positive associations between age, diabetes duration, and nutritional literacy may reflect the accumulation of disease management experience over time, which in turn enhances self-efficacy and self-regulation. These findings underscore the importance of integrating individualized nutritional literacy–focused education into diabetes care to reinforce self-management skills and improve metabolic and quality-of-life outcomes.

These results suggest that the effects of BMI, age, and disease duration on food literacy and health-related quality of life differ between individuals with type-1 and type-2 diabetes. Therefore, developing individualized nutritional literacy interventions that consider demographic and clinical characteristics—such as age, BMI, and disease duration—represents a critical strategy to enhance self-management, improve quality of life, and achieve more effective outcomes in diabetes care.

Moreover, SPLFS subfactor scores, such as "Food Preparation Skills," "Resilience and Resistance," "Daily Food Planning," "Expenditure on Healthy Food," and "Examining Food Labels," significantly improved various SF-36 quality-of-life dimensions, including physical and mental component scores, Social Function, Mental Health, and Vitality. However, an increase in "Healthy Food Stockpiling" scores was associated with decreased Bodily Pain and physical component scores, highlighting the complex relationship between subfactors and quality of life. These findings underscore the strong positive impact of nutritional awareness and planning on the overall quality of life in individuals with type-1 and type-2 diabetes.

Effective individual monitoring is necessary for the control and treatment of diabetes and the prevention or delay of possible complications. In this process, the most important individual precaution patients can take, and one of the most critical factors in diabetes management, is adequate nutritional literacy. However, the findings obtained in the study show that simply being able to read food labels is not enough to improve the quality of life in diabetes management directly and that a more comprehensive education and support system is needed. In daily clinical practice, health professionals should guide how to interpret and integrate this information into individual nutritional habits rather than just teaching how to read food labels. In addition, developing behavioral change strategies in diabetes management may offer more effective approaches to improving quality of life. The findings of this study suggest that integrating food literacy assessment, mainly including sub-factors such as reading food labels, daily nutrition planning, and meal preparation skills, into diabetes education programs can strengthen individualized care approaches. Adapting educational strategies according to individuals' diabetes type and nutritional literacy profile can improve self-management and quality of life. Furthermore, the individual-level data used in this study are subject to ethical restrictions and cannot be shared, even in anonymized form. This limitation may hinder the inclusion of our findings in future meta-analyses. We acknowledge this as a constraint regarding the reusability and reproducibility of our results.

Limitations of the study

This study has some limitations regarding the generalizability of the results due to the limited sample obtained from two hospitals in Turkey. In addition, although it presents original findings on the relationship between nutritional literacy and quality of life by evaluating type-1 and type-2 diabetes groups separately, the data collection methods on metabolic control of diabetes have some limitations. Although monitoring glycemic variability is an essential parameter in diabetes management, in this study, due to high cost and limited access to patient data, only HbA1c measurements were used. However, more frequent measurement of HbA1c values, inclusion of additional data such as food consumption records, and widespread use of sensors in the future will enable a more comprehensive analysis of glycemic control. Therefore, designing future studies with larger samples and including sensor data will contribute to a more in-depth understanding of the relationship between metabolic control of diabetes and nutrition. Despite these limitations, the findings provide preliminary yet meaningful insights into how nutritional literacy subdomains influence self-management behaviors and quality of life in individuals with diabetes, laying the groundwork for future interventions.

Conclusions

Diabetes is a chronic disease that directly affects individuals' quality of life. In managing this condition, nutritional literacy—defined as the knowledge and practical ability to make informed dietary choices—plays a critical role. This study demonstrated that higher nutritional literacy was positively associated with quality of life and metabolic control among individuals with diabetes. In patients with type 1 diabetes, nutritional literacy showed positive correlations with age and diabetes duration, and significant associations with quality-of-life domains such as physical function and vitality ($p < 0.05$). In patients with type 2 diabetes, higher nutritional literacy was weakly but significantly related to lower HbA1c values ($p < 0.05$) and higher scores in the physical and mental health components of the SF-36. These findings indicate that individuals who can interpret food labels, plan meals, and make conscious dietary choices achieve better glycemic control and overall well-being.

When planning diabetes treatment, assessing patients' nutritional literacy and designing individualized interventions accordingly can have meaningful positive effects on metabolic control. Enhancing nutritional literacy facilitates the adoption of healthy eating habits and supports self-management behaviors that improve treatment outcomes. The results of this study highlight the importance of developing health policies and educational strategies that strengthen nutrition literacy both at the community level and in chronic disease management. In line with the International Diabetes Federation's 2024–2026 theme emphasizing well-being, efforts to improve nutritional literacy may enhance patients' confidence, self-efficacy, and holistic well-being while contributing to a more sustainable and cost-effective healthcare system. Future research should focus on designing and validating comprehensive, literacy-based diabetes education programs to improve metabolic outcomes and overall quality of life.

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Declarations

Ethics approval and consent to participate
Before study initiation, ethical approval was obtained from Acıbadem Healthcare Institutions Medical Ethics Committee (ATADEK) of Acıbadem Mehmet Ali Aydınlar University (Dated 28.01.2022 and No. 2022-02/24). Participants were also asked to approve the informed consent form.

Consent for publication
Not applicable.

Availability of data and materials
Data is provided within the manuscript or supplementary information files

Competing interests
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