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Effect of food literacy on adherence to mediterranean diet and anthropometric measurements in adults

Efeito da alfabetização alimentar na adesão à dieta mediterrânea e nas medidas antropométricas em adultos

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ABSTRACT

Objective
This study aimed to evaluate the relationship between food literacy, adherence to the Mediterranean diet (MetDiet), and anthropometric measurements.

Method
In this study, 551 adults were evaluated. The defining features were questioned with the questionnaire form, Short Food Literacy Questionnaire (SFLQ), and Mediterranean Diet Adherence Screener (MEDAS). Neck circumference, waist circumference (WC) measurements, waist to height ratio (WHtR), waist to hip ratio (WHR), and body mass index (BMI) were evaluated. The effect of the SFLQ scores on the anthropometric measurements and MEDAS scores was evaluated with linear and binary logistic regression analysis.

Results
The food literacy scores were low in individuals with overweight and obesity and have risk according to the waist circumference and waist to height ratio. Individuals with high adherence to the MetDiet had high food literacy. The food literacy had the most effect on waist circumference. There was a positive relationship between the food literacy and MetDiet scores when the crude and adjusted models were compared according to age, gender, education level, marital status, and BMI. According to crude and adjusted models, food literacy was effective on strict adherence to the diet (Wald=13.446), and a 1-unit increase in the food literacy increased strict adherence to MetDiet by 1.05 times (95% CI=1.03–1.09).

Conclusion
The results showed positive effect of food literacy on obesity-related anthropometric measurements and MetDiet.

Keywords: Food literacy. Nutrition. Mediterranean diet. Obesity. Waist circumference.

RESUMO

Objetivo

Este estudo teve como objetivo avaliar a relação entre alfabetização alimentar, adesão à dieta mediterrânea (MetDiet) e medidas antropométricas.

Método

Neste estudo foram avaliados 551 adultos. As características definidoras foram questionadas com o formulário do questionário Short Food Literacy Questionnaire (SFLQ) e Mediterranean Diet Adherence Screener (MEDAS). Medidas de circunferência do pescoço, circunferência da cintura (CC), relação cintura/altura (RCEst), relação cintura/quadril (RCQ) e índice de massa corporal (IMC) foram avaliados. O efeito dos escores SFLQ nas medidas antropométricas e escores MEDAS foi avaliado com análise de regressão logística linear e binária.

Resultados

Os escores de alfabetização alimentar foram baixos em pacientes com sobrepeso e obesidade e apresentam risco de acordo com a circunferência da cintura e relação cintura/altura. Indivíduos com alta adesão ao MetDiet tiveram alta alfabetização alimentar. A alfabetização alimentar teve o maior efeito sobre a circunferência da cintura. Houve uma relação positiva entre a alfabetização alimentar e os escores do MetDiet quando os modelos brutos e ajustados foram comparados de acordo com idade, sexo, escolaridade, estado civil e IMC. De acordo com modelos brutos e ajustados, a alfabetização alimentar foi eficaz na adesão estrita à dieta (Wald=13,446), e um aumento de 1 unidade na alfabetização alimentar aumentou a adesão estrita à MetDiet em 1,05 vezes (95% CI=1,03–1,09).

Conclusão

Os resultados mostraram efeito positivo da alfabetização alimentar sobre medidas antropométricas relacionadas à obesidade e MetDiet.

***Palavras-chave*:** *Literacia alimentar. Nutrição. Dieta mediterrânica. Obesidade. Circunferência da cintura.*

INTRODUCTION

The healthy food preferences of individuals are related to the adequacy of nutritional information, and healthy nutrition is also essential for a healthy life [1]. Food literacy is described as the adequacy of food-related skills and knowledge. The concept of food literacy, which is known to have emerged for the first time in the early 1990s, is the sum of the processes that concern the stages of food selection, preparation, and consumption. These developed skills of individuals allow them to make healthy diet choices [2]. Moreover, it determines the foods be consumed, have knowledge, skills, and behaviors that will require preparation and eating to meet the needs of the body [3]. Food literacy is also associated with health literacy and shows that the right health choices [2]. Given nutrition interventions to the society are essential to develop healthy eating habits and increase the food literate of individuals [4]. In a cross sectional study, health literacy was associated with healthy food consumptions [5]. Intervention for food advertising literacy has been shown to affect food preferences in children positively [6].

Overweight and obesity are rapidly growing public health problems worldwide, and according to the World Health Organization, in 2016, there were 1.9 billion overweight and 650 million obese adults worldwide [7]. Food literacy has been important in research about food and nutrition because of its impact on many public health problems, from obesity to sustainable nutrition [3]. It has been determined that low food literacy has a negative effect on body weight loss [8].

The Mediterranean diet (MetDiet) is a diet that is rich in plant-based foods (including grains, fruits, vegetables, legumes, nuts, oilseeds, and olives), high and moderate in fish and seafood, moderate in eggs, poultry, and dairy products (yogurt and cheese), and low in red meat consumption [9]. Due to these properties, it is protective against diseases including cardiovascular disease, diabetes, various types of cancer, and depression [10]. Although the relationship between health

literacy and obesity has been shown [11,12] the lack of studies evaluating the relationship between food literacy with anthropometric measures and adherence to MetDiet in healthy adults led to this cross-sectional study being conducted.

METHODS

Study Design and Data Collection

This cross-sectional study was conducted via convenience sampling method among individuals living in Turkey from May to July 2021. The questionnaire form was shared to participants online with using free Google Forms. Their volunteer consent and anthropometric measurements were taken face to face. The sample number was calculated using Two Independent Means Power Analysis with the G-Power analysis program, and aimed to reach minimum 150 participant with type 1 error (α)=0.05 and 98 % reliability [13]. In this study, 604 people were reached with a questionnaire, but who did not answer all the questions and were over 65 years old were not included. Data from 551 volunteer adults, aged 18–65 years, were analyzed. This study evaluated descriptive characteristics, anthropometric measures, food literacy, and adherence to MetDiet with a questionnaire form.

Food Literacy

Food literacy was determined with Short Food Literacy Questionnaire (SFLQ) that developed by Krause et al. [3] and Turkish validity and reliability were done by Durmuş et al. [1]. The scale consists of 12 items, some of which are 4-point (very difficult, difficult, easy, very easy), and some are 5-point Likert-type (very bad, bad, medium, good, very good) items. A maximum of 52 points can be obtained from the scale. The SFLQ is the first validated questionnaire to empirically assess adult food literacy.

Mediterranean Diet

Adherence to MetDiet was determined with Mediterranean Diet Adherence Screener (MEDAS) that is a 14-item screening tool developed to measure dietary adherence to the MetDiet in the PREDIMED study, which evaluated the effect of the MetDiet on the prevention of cardiovascular diseases, carried out in a multi-center study in Spain [14]. Turkish validity and reliability were performed by Ozkan Pehlivanoğlu et al. [15]. Positive items get 1 point, do not reflect the items get 0 points. A total of 0–14 points can be obtained from the scanning tool [14], and it shows ≥7 points: modest adherence to the MetDiet and ≥9 points: strict adherence to the MetDiet [16].

Anthropometric Measurements

Body weight, height, waist circumference, hip circumference, neck circumference, were evaluated. The waist to hip ratio (WHR) and the waist to height ratio (WHtR) was determined. According to the WC, >94 cm mean risk, and >102 cm mean high risk in men, >80 cm mean risk, and >88 cm mean high risk in women for metabolic complications. According to the WHR, ≥0.90 in men and ≥0.85 in women mean risk for metabolic complications [17]. For the WHtR, <0.4 mean: attention, 0.4–0.5 mean: appropriate, 0.5–0.6 mean: consider action, and ≥0.6 mean: take action [18]. The BMI was calculated using the equation weight (kg) / height $(m)^2$, and BMI classification was based on WHO guidelines for adults: <18.50 kg/m^2: underweight, 18.50–24.99 kg/m^2: healthy weight, 25.00– 29.99 kg/m^2: overweight, and ≥30.0 kg/m^2: obesity [19].

The principles of the Declaration of Helsinki were followed in the conduct of this study. Ethical permission was obtained from the Clinical Research Ethics Committee of Ondokuz Mayıs University under decision number 2021/235.

Statistical Analysis

Continuous data was presented as the mean ± standard deviation (SD), and categorical data were presented as number (n) and percentage (%). Kolmogorov Smirnov test was used to check whether the data were normally distributed. The distribution of food literacy scores according to various variables was made using independent sample *t*-test and ANOVA test. The relationship of food literacy with anthropometric measurements and adherence to MetDiet was examined using Pearson's correlation. Linear and binary logistic regression models were fitted to model the effect of the SFLQ score on anthropometric measurements and MEDAS score. Both the crude and adjusted models were fitted. An adjusted model was built by controlling the effect of age, gender, education status, marital status for anthropometric measurements. The adjusted model was built by controlling the effect of age, gender, education status, marital status, and BMI for the MEDAS. Analyses were conducted using R 4.0.1 [20] and TURCOSA software [21]. $p<0.05$ was accepted as statistically significant.

RESULTS

A total of 551 adults, comprising 281 men (51.0%) and 270 women (49.0%), with a mean age of 32.99±13.27 years, participated in this study. The distribution of the SFLQ scores according to some variables are shown in Table 1. The mean of the SFLQ scores of women compared to the men and single people compared to the married people were higher ($p<0.001$). Those with a high level of education (high school and college) had higher SFLQ scores ($p<0.001$). Non-smokers had higher SFLQ scores ($p<0.001$). Adults who were underweight and had a normal BMI had higher mean SFLQ scores than the overweight and obese adults ($p<0.001$). For the WHtR of the adults in the risk category (take action and think about action), the SFLQ scores were lower ($p<0.001$). The waist circumference in the men and women and also only the WHR in the women in the risk category had lower SFLQ scores ($p<0.05$). Individuals with strict adherence to the MetDiet had higher SFLQ scores than those with low adherence ($p<0.05$).

The correlation and linear regression analysis of food literacy with anthropometric measurements and the MEDAS is given in Table 2. There was a weak negative correlation between the SFLQ score and all of the researched anthropometric measurements (NC, WC, and HC) (r=−0.213, −0.347, −0.180, and $p<0.001$, respectively), WHtR, WHR, and BMI (r=−0.323, −0.335, −0.226, and $p<0.001$, respectively) values of the individuals. There was a weak positive correlation between the MEDAS and SFLQ scores (r=0.247, $p<0.001$). The SFLQ score negatively affected all of the researched anthropometric measurements according to the regression analysis. The anthropometric measurement that was most affected by food literacy was the WC (β=−0.347, $p<0.001$), followed by the WHR and WHtR (β=−0.335 and −0.323, and $p<0.001$, respectively). There was significant negative regression with the SFLQ and anthropometric measurements (but not for the NC) when modeling according to age, gender, education level, and marital status. There was a positive correlation between the MEDAS score of all of the individuals and the SFLQ score (β = 0.235, $p<0.001$). This

relationship was also observed when modeling was performed according to age, gender, education level, marital status, and BMI (β=0.203, p<0.001).

Table 1 – Baseline characteristics of participants according to Short Food Literacy Questionnaire.

Variables	n	%	SFLQ		*p*
			M	SD	
Total			31.49	7.60	
Gender					<0.001*
Men	281	51.0	29.73	6.81	
Women	270	49.0	33.32	7.95	
Marital status					<0.001*
Single	310	56.3	32.95	7.77	
Married	241	43.7	29.61	6.95	
Education level					<0.001*
Primary school[a]	107	19.4	28.00	5.88	
High school[b]	233	42.3	31.61	7.75	
College[b]	211	38.3	33.13	7.65	
Smoking					0.049*
User	133	24.1	29.42	7.77	
Non-user	418	75.9	32.15	7.43	
Alcohol					0.165
User	59	10.7	30.19	7.86	
Non-user	492	89.3	31.65	7.56	
Chronic disease history					0.057
Available	87	15.8	29.89	8.62	
Non- available	464	84.2	31.79	7.37	
BMI (M±SD=25.33±4.85 kg/m^2)					<0.001*
Underweight[a]	21	3.8	37.93	7.17	
Healthy weight[b]	266	48.3	32.47	7.51	
Overweight[c]	183	33.2	30.36	7.53	
Obesity[c]	81	14.7	29.16	6.74	
WHtR (n=404, M±SD=0.51±0.10)					<0.001*
Attention[a]	30	7.4	37.65	6.96	
Appropriate[b]	173	42.8	33.64	7.84	
Consider action[c]	128	31.7	30.69	7.55	
Take action[c]	73	18.1	28.53	6.41	
WHR (n=404)					
Women (M±SD=0.81±0.10)					**<0.001***
No risk	182	67.4	34.83	7.82	
Risk	88	32.6	30.18	7.31	
Men (M±SD=0.92±0.09)					0.134
No risk	54	40.3	30.72	7.31	
Risk	80	59.7	28.84	6.68	
WC (n=404)					
Women (M±SD=81.65±15.35)					**<0.001***
No risk [a]	153	56.7	35.23	7.61	
Risk[ab]	47	17.4	32.65	7.97	
High risk[b]	70	25.9	29.58	7.35	
Men (M±SD=91.99±13.89)					**0.046***
No risk[a]	78	58.2	30.82	7.23	
Risk[ab]	32	23.9	28.43	6.73	
High risk[b]	24	17.9	27.20	5.67	
MEDAS (n=404) (M±SD=7.45±2.17)					
Low adherence[a]	136	33.7	30.54	7.32	**<0.001***
Modest adherence[a]	145	35.9	31.67	7.58	
Strict adherence[b]	123	30.4	34.28	8.22	

Note: ***p**<0.05. a-d: There is no difference between characters that are similar from up to down. Significant results are shown in bold. BMI: Body Mass İndex; HC: Hip Circumference; MEDAS: Mediterranean Diet Adherence Screener; NC: Neck Circumference; SFLQ: Short Food Literacy Questionnaire; WC: Waist Circumference; WHR: Waist to Hip Ratio; WHtR: Waist to Height Ratio.

The binary logistic regression analysis between the SFLQ score and MEDAS scores is shown in Table 3. According to the crude model, a 1-unit increase in the SFLQ score increased the acceptable adherence to MetDiet by 1.04 times (95% CI=1.01-1.07, P=0.005) and strict adherence to the MetDiet by 1.05 times (95% CI=1.03–1.09, p<0.001). It continued to affect the increase in adherence to a strict diet, even when modeled according to age, gender, education level, marital status, and BMI (95% CI=1.02–1.09, P=0.001). In addition to its association with MEDAS, the SFLQ score was more effective on strict adherence (Wald=13.446) to diet than modest (Wald=7.866) adherence to the diet.

The relationship between food literacy and anthropometric measurements is shown in Figure 1. A negative, weak, and significant regression was observed between the SFLQ score and the BMI, NC, WC, HC, WHR, and WHtR (β=−0.226, −0.213, −0.347, −0.180, −0.335, −0.323, and p<0.001, respectively) (Figure 1).

The distribution of food literacy score according to MEDAS score cut off is shown in Figure 2.

Table 2 – Linear regression analysis between Short Food Literacy Questionnaire score and anthropometric measurements and Mediterranean Diet Adherence Screener score.

Variables	Correlation	Crude Model			Adjusted Model		
	p	β	*t*	*p*	β	*t*	*p*
Anthropometric measurement*							
BMI (kg/m^2)	**<0.001**	-0.226	-5.440	**<0.001**	-0.112	-2.803	**0.005**
HC (cm)	**<0.001**	-0.180	-3.675	**<0.001**	-0.108	-2.132	**0.034**
NC (cm)	**<0.001**	-0.213	-4.374	**<0.001**	-0.021	-0.487	0.627
WC (cm)	**<0.001**	-0.347	-7.408	**<0.001**	-0.157	-3.641	**<0.001**
WHR	**<0.001**	-0.335	-7.120	**<0.001**	-0.130	-3.164	**0.002**
WHtR	**<0.001**	-0.323	-6.853	**<0.001**	-0.157	-3.633	**<0.001**
MEDAS score**	**<0.001**	0.235	4.841	**<0.001**	0.203	3.851	**<0.001**

Note: *Each model is adjusted by age, gender, education level, and marital status. **Each model is adjusted by age, gender, education level, marital status, and body mass index. Significant results are shown in bold. β: Standardized regression coefficient; BMI: Body Mass İndex; HC: Hip Circumference; MEDAS: Mediterranean Diet Adherence Screener; NC: Neck Circumference; SFLQ: Short Food Literacy Questionnaire; WC: Waist Circumference; WHR: Waist To Hip Ratio; WHtR: Waist to Height Ratio.

Table 3 – Binary Logistic Regression analysis between Short Food Literacy Questionnaire score and Mediterranean Diet Adherence Screener risk scores.

Variable	Crude Model			Adjusted Model*		
	Wald	OR (95% CI)	*p*	Wald	OR (95% CI)	*p*
Modest adherence	7.866	1.04 (1.01-1.07)	**0.005**	3.325	1.03 (0.99-1.06)	0.068
Strict adherence	13.446	1.05 (1.03-1.09)	**<0.001**	10.781	1.05 (1.02-1.09)	**0.001**

Note: Adjusted by age, gender, education level, marital status, and body mass index. Significant results are shown in bold.SFLQ: Short Food Literacy Questionnaire; MEDAS: Mediterranean Diet Adherence Screener.

DISCUSSION

This study evaluated the relationship between food literacy and adherence to the MetDiet and anthropometric measurements in adult individuals living in Turkey. The SFLQ score was associated with the anthropometric measurements, and was low in adults who had a risk of obesity. In this study, 66.3% of individuals had high adherence to the MetDiet, and when the SFLQ score was high, adherence to the MetDiet increased. According to this study, the sociodemographic and lifestyle factors were associated with food literacy, such as female gender, single marital status, high education level, and smoking (p<0.001). Similarly, in another study [22] conducted on 750 healthy adults living in Turkey, the women had higher food literacy. A cross-sectional study conducted in the Netherlands also supported a high incidence of food literacy in females [23].

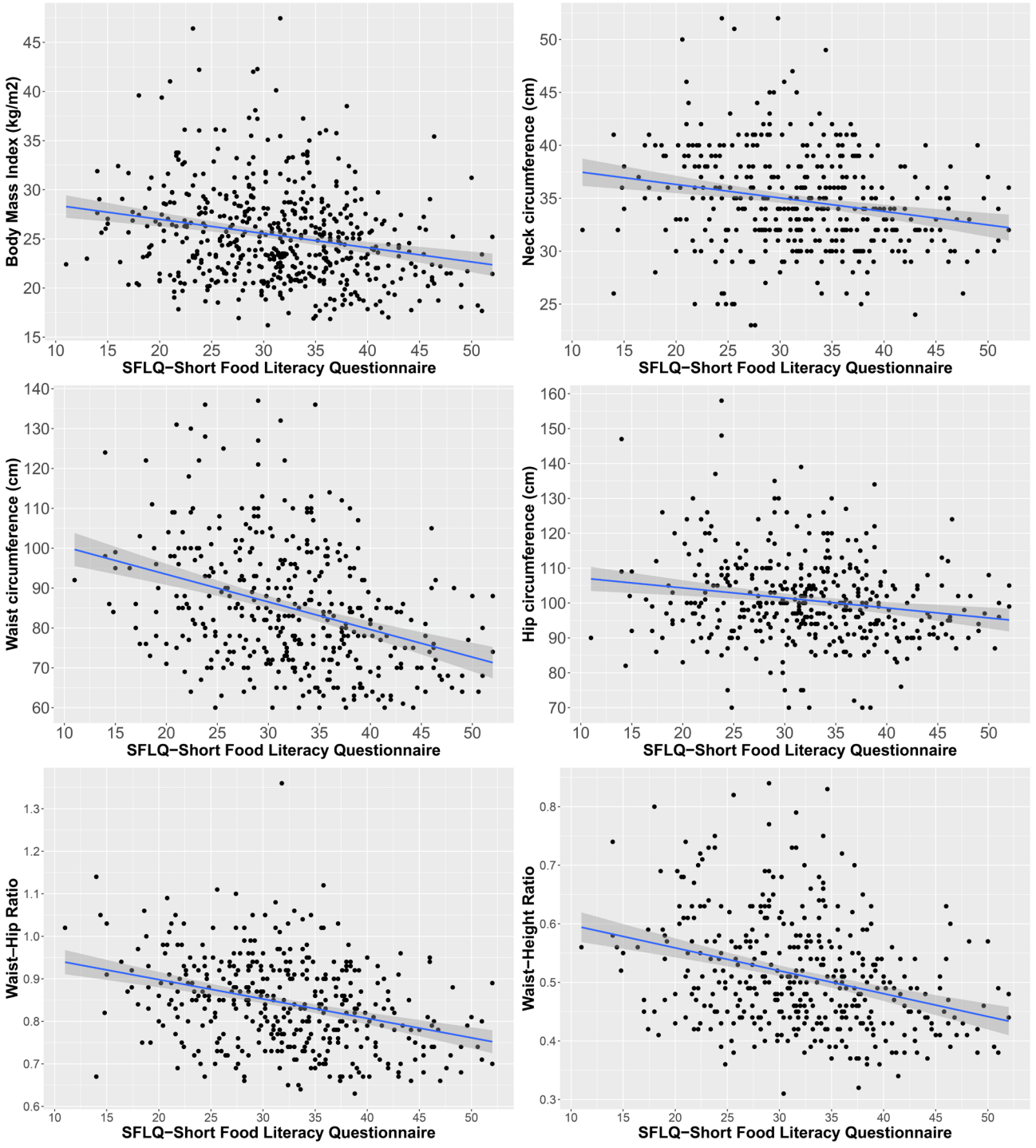
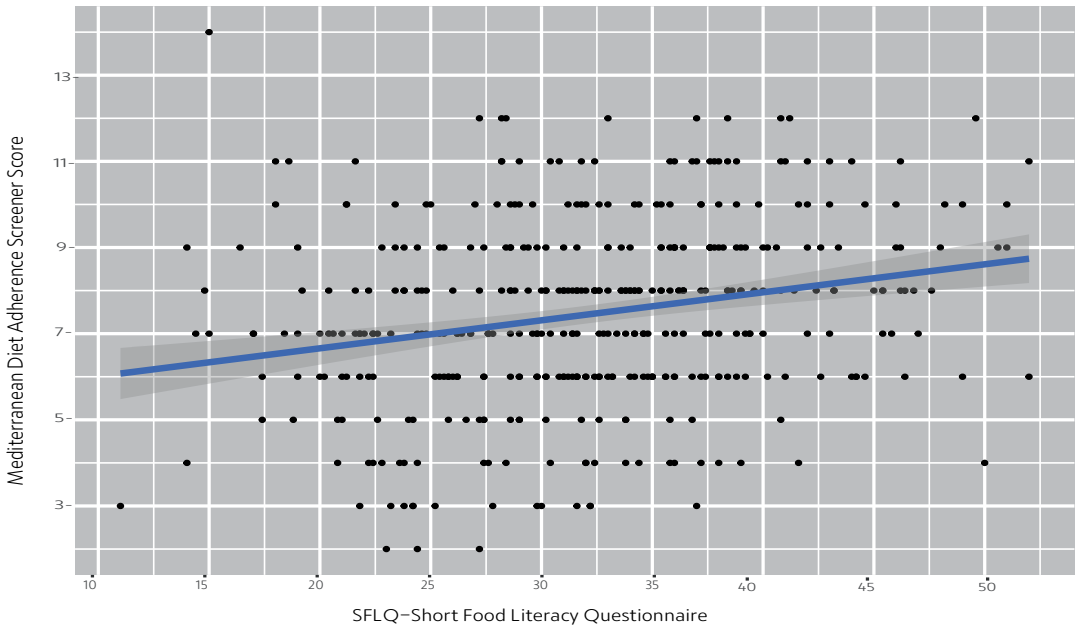
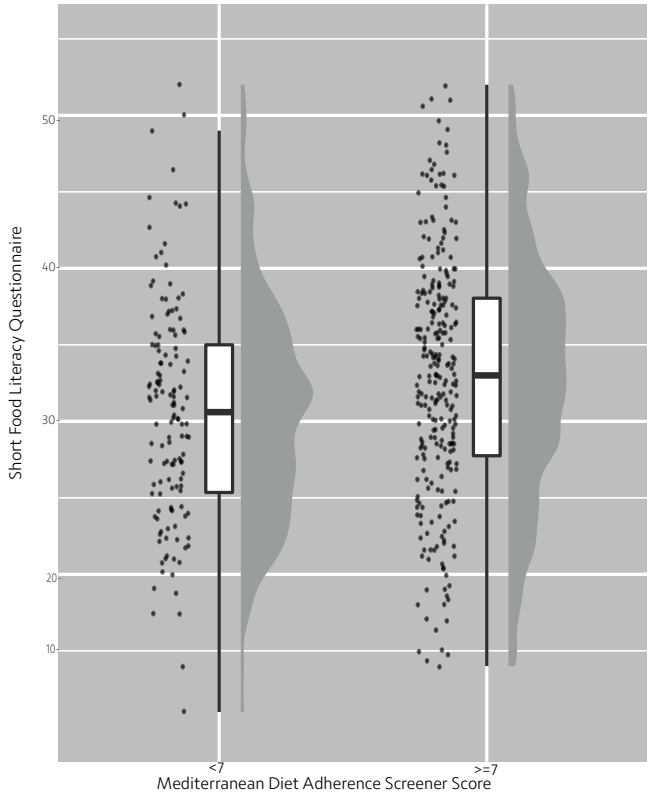


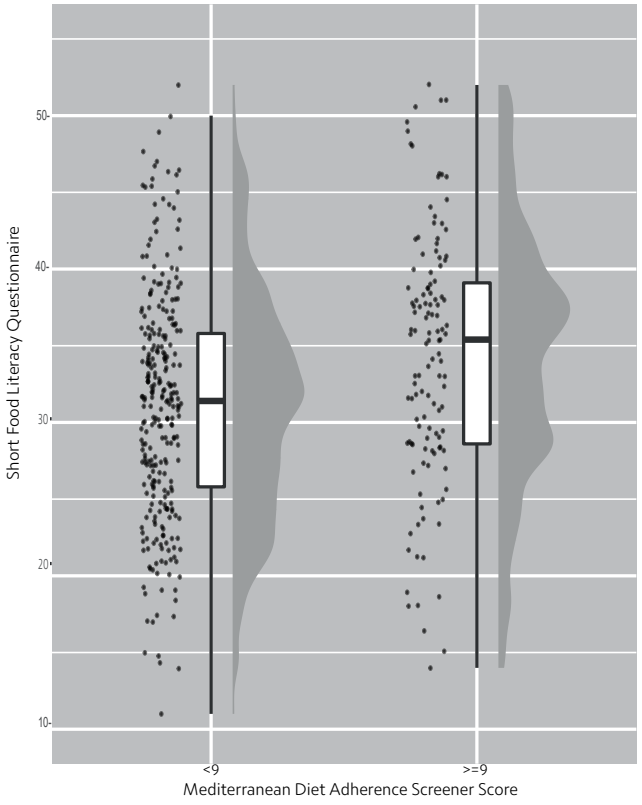
Figure 1 – The Relationship Between Short Food Literacy Questionnaire and Anthropometric Measurements.



2a. Distribution of SFLQ Score According to MEDAS Score



2b. Distribution According to MEDAS
≥7: modest adherence



2c. Distribution According to MEDAS
≥9: strict adherence

Figure 2 – Distribution of Short Food Literacy Questionnaire Score According to Mediterranean Diet Adherence Screener Score Cut Off.

In this study, the mean SFLQ score was low in the overweight and obese individuals. Moreover, it was high in adults who were at risk according to the WC, WHtR, and WHR (only women) measurement (p<0.001). In addition, there is a weak negative correlation between the SFLQ score and the NC, WC, and HC measurements, and the WHR, WHtR, and BMI values (r=−0.213, −0.347, −0.180, −0.323, −0.335, −0.226, and p<0.001, respectively). Moreover, the linear regression analysis supported the correlation results. Both the crude and adjusted models were compared according to age, gender, education level, and marital status in which the SFLQ score and anthropometric measurements showed negative regression (except NC). This study showed that adults with high obesity and abdominal obesity-related anthropometric measurements had low SFLQ scores. There are few studies on anthropometric measurements, and food literacy offers conflicting results. It was shown that a high BMI in adults was associated with low health literacy, similar to the current study [11]. In another study, there was no relationship between food literacy and the BMI (β=0.05, P=0.494) [23]. Increasing the food literacy of adults in Switzerland was associated with a decrease in the WHR [4]. The WHtR is a more effective predictor of cardiovascular disease when compared to the BMI and WC [24]. The increase in the measurement of the WC, which is used in the evaluation of abdominal obesity, has increased two-fold risk factors for diabetes, hypertension, and atherosclerotic cardiovascular disease [25]. In a study of 1147 adults in the South Asian population, increased adiposity independent of the BMI was revealed as a cardiometabolic risk factor [26]. According to this study, the most effective anthropometric measurement on food literacy was the WC, which is one of the abdominal obesity markers (β=−0.347, p<0.001). We found that measurements such as the BMI, WC, and WHtR were negatively associated with the SFLQ, indicating that food literacy may be an important factor in preventing obesity.

In this study, individuals with high adherence to the MetDiet had a high SFLQ score (p<0.05). There was a weak positive correlation between the MEDAS and SFLQ scores (r=0.247, p<0.001). Supporting the correlation between the individuals' MEDAS and SFLQ scores, there was a weak positive correlation between the MEDAS and SFLQ scores when the crude and adjusted models were compared according to age, gender, education level, marital status, and the BMI (β=0.235 and 0.203, p<0.001). According to the crude model, a 1-unit increase in the SFLQ score increased adherence to the MetDiet by 1.05 times (95% CI=1.03–1.09, p<0.001). The SFLQ score continued to be associated with strict diet adherence, even when modeled according to age, gender, education level, marital status, and the BMI. In an intervention study investigating food literacy in adolescents, showed a positive relationship between food literacy and food intake [27]. In a study involving 382 adults, nutritional information was associated with diet quality [28].

Food literacy is an ability accepted that people reflect their food-related knowledge on their food choices, and in addition, the individual knows the effect of this choice on their health. Moreover, it was derived from health literacy as its broader conceptual counterpart [29]. In a cross-sectional study of adolescents aged between 10 and 19 years in Nigeria, low health literacy was found in the obese individuals [30]. In a study it was found that nutrition literacy was not associated with BMI in adolescents [31]. Many studies have investigated the relationship between individuals' health and diet in recent years. There was a relationship between food literacy with adherence to national dietary recommendations and diet quality in adults living in Iran (β=0.12, P=0.04) [32]. An increase in fish consumption was shown for fish consumption among children aged between 11 and 13 years with nutrition education which including nutritional knowledge and cooking skills in the education [33] which are two components of the four items of food literacy [34]. Few studies have investigated food literacy and adherence to the MetDiet. Studies investigated the relationship between food literacy and diet quality, but these were mostly conducted on adolescents. Only one

study determined that food literacy was associated with the MetDiet, which was determined by the frequency of food consumption in individuals who had undergone kidney transplantation [13]. The food literacy program, in which 1092 people participated, positively affected individuals' food preferences, and caused healthy eating habits, such as increased consumption of vegetables and fruits [35]. A decrease in the use of added sugar and label reading behavior was determined with randomized controlled education that aimed to increase sugar literacy and knowledge, skills, and behaviors about sugary foods [36].

There were several limitations in this study. In evaluating abdominal obesity, only WC and HC measurements were used in this study. In future studies, evaluations including segmental body fat mass and basal metabolism measurements will positively contribute. In this study, due to the many samples, adherence to the MetDiet was inquired about with a validated scale. In studies with fewer participants, it would be possible to make 24-h food consumption records or food frequency questionnaires. Long-term follow-up studies with more participants are needed to reveal the relationship of food literacy with anthropometric measurements and adherence to MetDiet.

CONCLUSION

This cross-sectional study contained important results on the effect of food literacy on anthropometric measurements, especially the waist circumference. The fact that the adults had a high level of food literacy positively affected adherence to the MetDiet, which is a sustainable diet. This study revealed the importance of food literacy in the diet to include healthy nutritional components, provide ideal body weight, and circumference measurement, and prevent chronic diseases, especially those such as abdominal obesity and cardiovascular diseases.

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CONTRIBUTORS

All authors contributed to the concept and design of the studies. ZU, MSMC and YEÖ collected the data. ZU drafted the paper. All authors made critical revisions to the manuscript.