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Association between adherence to the Mediterranean diet and e-healthy diet literacy among pregnant women

Asociación entre la adherencia a la dieta mediterránea y la alfabetización electrónica en alimentación saludable en gestantes

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ABSTRACT

Introduction: The Mediterranean diet (MD) is recognized as a healthy dietary pattern that supports maternal and fetal health during pregnancy. As access to digital nutrition information continues to expand, e-healthy diet literacy (e-HDL) may play an important role in shaping dietary behaviors. This study aimed to investigate the relationship between adherence to the MD and e-HDL among pregnant women (PW).

Methods: This cross-sectional study was conducted among 400 PW residing in Niğde, Türkiye, between January and May 2025. Data were collected through face-to-face interviews using the Mediterranean Diet Adherence Screener (MEDAS) and the e-Healthy Diet Literacy Scale (e-HDL). Anthropometric measurements, including height and body weight, were obtained using a stadiometer and a calibrated scale, respectively. The data were analyzed using correlation and multiple linear regression analyses.

Results: The mean MEDAS and e-HDL scores were 4.8 (1.5) and 35.7 (9.4), respectively, and 88.0% of participants had low Mediterranean diet adherence. MEDAS scores were positively associated with total e-HDL scores ($r=0.259$, $p<0.001$), Information Evaluation (IE) ($r=0.226$, $p<0.001$), and Application ($r=0.244$, $p<0.001$). e-HDL ($\beta=0.280$, $p<0.001$) and educational level ($\beta=0.148$, $p=0.003$) were independently associated with MD adherence.

Conclusions: Higher e-HDL was associated with better adherence to the MD among PW. Enhancing e-HDL through digital nutrition education may support the adoption of healthier dietary behaviors during pregnancy.

Funding: The authors declare that there has been no funding to carry out this study.

Keywords: Pregnant women; Mediterranean Diet; Health Literacy; Digital Health; Healthy Eating

RESUMEN

Introducción: La dieta mediterránea (DM) es reconocida como un patrón alimentario saludable que favorece la salud materna y fetal durante el embarazo. A medida que continúa aumentando el acceso a la información nutricional digital, la alfabetización electrónica en alimentación saludable (e-HDL) puede desempeñar un papel importante en la configuración de los comportamientos alimentarios. Este estudio tuvo como objetivo investigar la relación entre la adherencia a la DM y la e-HDL en mujeres embarazadas.

Métodos: Este estudio transversal se llevó a cabo en 400 mujeres embarazadas residentes en Niğde, Türkiye, entre enero y mayo de 2025. Los datos se recopilieron mediante entrevistas presenciales utilizando el Cuestionario de Adherencia a la Dieta Mediterránea (MEDAS) y la Escala de Alfabetización Electrónica en Alimentación Saludable (e-HDL). Las mediciones antropométricas, incluidas la talla y el peso corporal, se obtuvieron utilizando un estadiómetro y una báscula calibrada, respectivamente. Los datos se analizaron mediante análisis de correlación y regresión lineal múltiple.

Resultados: Las puntuaciones medias de MEDAS y e-HDL fueron 4,8 (1,5) y 35,7 (9,4), respectivamente, y el 88,0% de las participantes presentó baja adherencia a la dieta mediterránea. Las puntuaciones de MEDAS se asociaron positivamente con la puntuación total de e-HDL ($r=0,259$; $p<0,001$), la Evaluación de la Información (IE) ($r=0,226$; $p<0,001$) y la Aplicación ($r=0,244$; $p<0,001$). La e-HDL ($\beta=0,280$; $p<0,001$) y el nivel educativo ($\beta=0,148$; $p=0,003$) se asociaron de forma independiente con la adherencia a la dieta mediterránea.

Conclusiones: Una mayor alfabetización electrónica en alimentación saludable (e-HDL) se asoció con una mejor adherencia a la dieta mediterránea (DM) en mujeres embarazadas. El fortalecimiento de la e-HDL mediante programas de educación nutricional digital podría favorecer la adopción de hábitos alimentarios más saludables durante el embarazo.

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Palabras clave: Mujeres embarazadas; Dieta Mediterránea; Alfabetización en Salud; Salud Digital; Alimentación Saludable

HIGHLIGHTS

- Mediterranean diet adherence was low among the majority of pregnant women.
- e-Healthy diet literacy was positively associated with Mediterranean diet adherence.
- e-Healthy diet literacy was independently associated with Mediterranean diet adherence after adjustment for sociodemographic factors.
- e-Healthy diet literacy may be relevant to supporting healthier dietary behaviors during pregnancy.

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INTRODUCTION

Pregnancy is a critical period in the life course during which adequate nutrition plays a vital role in supporting fetal growth and development, as well as facilitating the maternal physiological and metabolic adaptations required for a healthy pregnancy¹. Although the importance of nutrition during pregnancy is well recognized, many women may fail to meet their nutrient requirements. Therefore, rather than focusing on individual nutrients, examining dietary patterns that reflect overall diet quality may provide a more comprehensive understanding of their impact on maternal and infant health². The Mediterranean diet (MD) is a healthy dietary pattern characterized by the preferential use of extra virgin olive oil for cooking and salad dressing; daily consumption of fruits, vegetables, whole grains, legumes, and nuts; and moderate intake of fish and seafood, eggs, cheese, yogurt, and lean poultry³. Although adherence to the MD during pregnancy is known to confer significant benefits for maternal and fetal health, studies have reported that pregnant women (PW) often fail to consume its key components at recommended levels and generally exhibit low adherence to this dietary pattern¹. As in the general population, maintaining healthy dietary behaviors during pregnancy requires not only adequate nutritional knowledge but also the ability to accurately interpret health information and apply it effectively in daily life². With the rapid digitalization of information access, e-healthy diet literacy (e-HDL) has emerged as an important concept. It refers to an individual's ability to access nutrition-related information from digital sources, understand and evaluate its reliability, and apply this information to support healthy dietary behaviors⁴. Previous studies have shown that individuals with higher e-HDL are more likely to make healthier food choices, have better diet quality, and demonstrate greater adherence to the MD^{5,6}. However, evidence regarding the relationship between e-HDL and adherence to the MD during pregnancy remains limited. Therefore, this study aimed to evaluate the relationship between e-HDL and adherence to the MD among pregnant.

METHODS

Participants and study design

This cross-sectional study utilized a convenience sampling approach and collected data through face-to-face interviews with PW residing in Niğde, Türkiye, between January and May 2025. An a priori power analysis performed using G*Power, based on the relevant literature⁷, indicated that a minimum sample size of 170 participants was required to achieve 90% power at a 5% significance level and 95% confidence interval. Ultimately, 400 PW participated in the study. Ethical approval for the study was obtained from the Ethics Committee of Niğde Ömer Halisdemir University (Date:03/12/2024, decision number: 2024/20-34). PW aged 19–45 years with internet access were eligible for inclusion. Those with severe chronic diseases that could affect nutritional status, those following a medically prescribed special diet under the supervision of a physician or dietitian, and those who did not complete the questionnaire were excluded. The study was conducted in accordance with the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants prior to data collection.

Measures

Questionnaire form

Data were collected through a structured questionnaire comprising three sections: sociodemographic characteristics, dietary habits, and anthropometric data. Mediterranean diet adherence and e-healthy diet literacy were assessed using the Mediterranean Diet Adherence Screener (MEDAS) and the e-Healthy Diet Literacy Scale (e-HDL), respectively.

Mediterranean Diet Adherence Screener (MEDAS)

Adherence to the MD was assessed using the MEDAS, originally developed by Martínez-González et al.⁸ and validated for the Turkish population by Özkan Pehlivanoğlu et al.⁹. The scale consists of 14 items assessing dietary habits, including the type of fat used and the consumption of key food groups such as fruits and vegetables. Each item is scored as either 0 or 1 based on the participant's reported consumption, and the total MEDAS score is calculated by summing all item scores. Adherence to the MD was classified according to the established MEDAS cutoff value of 7 points, with scores <7 indicating low adherence and scores ≥7 indicating high adherence.

e-Healthy Diet Literacy Scale (e-HDL)

PW's e-HDL levels were assessed using the e-HDL scale, which was developed by Van Duong et al.¹⁰ and subsequently validated in Turkish by Onbaşı et al.¹¹. The scale consists of 15 items organized into five sub-factors: Information Access (IA), Information Evaluation (IE), Perceived Reliability (PR), Interaction/Sharing (I/S), and Application (A). The scale comprises five subdimensions and uses different Likert-type response categories across its items. Total scores range from 15 to 71, with higher scores indicating greater e-healthy diet literacy. The Turkish version of the scale demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.77.

Anthropometric measurements

Participants' height (cm) and body weight (kg) were measured by the researcher using a stadiometer with the head positioned in the Frankfort plane and a calibrated scale, respectively¹², and recorded on the questionnaire form. Pre-pregnancy body weight was obtained through self-report. Pre-pregnancy body mass index (BMI) was calculated by dividing pre-pregnancy body weight (kg) by height squared (m^2). Body mass index (BMI) was classified according to the World Health Organization (WHO) criteria. Participants were categorized as normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), or obese (≥ 30.0 kg/m^2)¹³.

Data analysis

Statistical analyses were performed using IBM SPSS Statistics version 26. Continuous variables are presented as mean (standard deviation [SD]), while categorical variables are expressed as frequencies (n) and percentages (%). The normality of data distribution was assessed using both visual methods (histograms and probability plots) and analytical tests. Differences between two groups were assessed using the independent samples t-test, while comparisons among three or more groups were performed using one-way analysis of variance (ANOVA). When significant differences were identified, Tukey's post hoc test was applied for multiple comparisons. Associations between variables were evaluated using Spearman's correlation analysis. Multiple linear regression analysis was conducted to identify factors associated with adherence to the Mediterranean diet. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 presents the general characteristics of the PW included in the study. The mean age of the participants was 28.3 (6.0) years, with 56.0% aged 19–28 years. Nearly half had completed high school education (50.0%), reported a moderate-income level (46.8%), and were in their second trimester of pregnancy (47.0%). The mean pre-pregnancy BMI was 28.9 (3.9) kg/m², and 49.5% of the participants were classified as obese before pregnancy. The mean MEDAS score was 4.8 (1.5), and 88.0% of the participants had low adherence to the MD. The mean e-HDL total score was 35.7 (9.4) (Table 1).

Table 1. Characteristics of the study participants (n=400)

		n (%) or Mean (SD)
Age (years), mean (SD)		28.3 (6.0)
Age groups, n (%)	19-28	224 (56.0)
	29-45	176 (44.0)
Education level, n (%)	Primary/secondary school	151 (37.8)
	High school	200 (50.0)
	Undergraduate/ Postgraduate	49 (12.2)
Income, n (%)	Low	130 (32.5)
	Middle	187 (46.8)
	High	83 (20.7)
Pregnancy trimester, n (%)	First trimester	65 (16.3)
	Second trimester	188 (47.0)
	Third trimester	147 (36.7)
Pre-pregnancy BMI (kg/m²)		28.9 (3.9)
Pre-pregnancy BMI classification, n (%)	Normal (18.5-24.99 kg/m ²)	74 (18.5)
	Overweight (25.0-29.99 kg/m ²)	128 (32.0)
	Obesity (≥30 kg/m ²)	198 (49.5)
MEDAS total score, mean (SD)		4.8 (1.5)
Adherence to the MD (Cutoff: <7 vs. ≥7)	Non-adherent	352 (88.0)
	Adherent	48 (12.0)

e-HDL total score, mean (SD)	35.7 (9.4)
Information Access (IA)	6.0 (2.1)
Information Evaluation (IE)	10.3 (6.9)
Perceived Reliability (PR)	6.7 (1.7)
Interaction/Sharing (I/S)	3.8 (1.3)
Application (A)	8.9 (2.5)

Abbreviations: MEDAS: Mediterranean Diet Adherence Screener; BMI: Body Mass Index; e-HDL: e-Healthy Diet Literacy Scale; MD: Mediterranean Diet

Note. Age was categorized according to the median value.

Table 2 presents MEDAS and e-HDL scores according to selected participant characteristics. Mean MEDAS scores differed significantly by educational status and pre-pregnancy BMI category ($p < 0.05$). PW with a high school or undergraduate/postgraduate education had significantly higher MEDAS scores than those with a primary/middle school education ($p < 0.05$). In addition, women who were overweight before pregnancy had higher MEDAS scores than those with a normal pre-pregnancy BMI ($p < 0.05$). No significant differences in MEDAS scores were observed according to age group, income level, or pregnancy trimester ($p > 0.05$). e-HDL scores differed significantly only according to income level ($p < 0.05$). PW with a low-income level had significantly lower e-HDL scores compared with those with moderate- or high-income levels (Table 2).

Table 2. Comparison of Mediterranean diet adherence and e-healthy diet literacy according to sociodemographic and pregnancy-related characteristics

Variables	MEDAS Mean (SD)	p	e-HDL Mean (SD)	p
Age group				
19-28	4.7 (1.4)	0.608	35.6 (9.5)	0.696
29-45	4.8 (1.7)		36.0 (9.3)	
Education level				
Primary/secondary school	4.5 (1.6) ^a	0.021	36.2 (8.8)	0.636
High school	4.9 (1.5) ^b		35.0 (9.6)	

Undergraduate/ Postgraduate	5.1 (1.6) ^b		36.3 (10.5)	
Income				
Low	4.6 (1.3)		32.7 (8.9) ^a	
Middle	4.7 (1.6)	0.276	37.4 (9.2) ^b	<0.001
High	5.0 (1.7)		36.8 (9.6) ^b	
Pregnancy trimester				
First trimester	4.6 (1.6)		33.4 (10.1)	
Second trimester	4.8 (1.4)	0.644	36.4 (9.5)	0.073
Third trimester	4.7 (1.6)		35.0 (8.8)	
Pre-pregnancy BMI				
Normal (18.5-24.99 kg/m ²)	4.5 (1.4) ^a		36.4 (9.9)	
Overweight (25.0-29.99 kg/m ²)	5.0 (1.6) ^b	0.043	36.5 (8.9)	0.263
Obesity (≥30 kg/m ²)	4.7 (1.5) ^{ab}		35.0 (9.5)	

Independent samples t-test was used for comparisons between two groups and One-Way ANOVA was used for comparisons among three or more groups. Post-hoc analyses were performed using Tukey test.

Note. Different superscript letters indicate statistically significant differences between groups ($p < 0.05$).

Table 3 presents the correlations between Mediterranean diet adherence (MEDAS score) and selected variables. A significant positive correlation was observed between the MEDAS score and the total e-HDL score ($r = 0.259$, $p < 0.001$). In addition, significant positive correlations were found between MEDAS scores and the IE ($r = 0.226$, $p < 0.001$) and A ($r = 0.244$, $p < 0.001$) sub-factors.

Table 3. Correlations Between Mediterranean Diet Adherence (MEDAS) Scores and Selected Variables

Variables	MEDAS score (r)	p
Age	0.009	0.858
Pre-pregnancy BMI (kg/m ²)	-0.023	0.653
e-HDL total score	0.259	<0.001
Information Access (IA)	0.067	0.183
Information Evaluation (IE)	0.226	<0.001
Perceived Reliability (PR)	0.068	0.173

Interaction/Sharing (I/S)	0.045	0.371
Application (A)	0.244	<0.001

Spearman correlation analysis was performed.

Abbreviations: MEDAS: Mediterranean Diet Adherence Screener; BMI: Body Mass Index; e-HDL: e-Healthy Diet Literacy Scale.

Table 4 presents the results of the multiple linear regression analysis examining factors associated with MD adherence among PW. e-HDL ($\beta=0.280$, $p<0.05$) and educational status ($\beta=0.148$, $p<0.05$) were significantly associated with MD adherence. In contrast, age, income level, pregnancy trimester, and pre-pregnancy BMI were not significantly associated with MD adherence ($p>0.05$).

Table 4. Factors Associated with Mediterranean Diet Adherence in Pregnant Women

Variables	B	95% CI Lower Bound	95% CI Upper Bound	Beta (β)	p
e-HDL	0.046	0.030	0.062	0.280	<0.001
Age (years)	0.008	-0.017	0.033	0.031	0.536
Educational status	0.345	0.117	0.572	0.148	0.003
Income	0.013	-0.198	0.224	0.006	0.902
Pregnancy trimester	-0.078	-0.299	0.143	-0.035	0.489
Pre-pregnancy BMI (kg/m^2)	0.021	-0.018	0.061	0.054	0.285

Multiple linear regression analysis was performed.

Abbreviations: CI: Confidence Interval; BMI: Body Mass Index; e-HDL: e-Healthy Diet Literacy Scale.

DISCUSSION

In this study, which aimed to investigate the relationship between adherence to the MD and e-HDL among PW, the majority of participants (88.0%) were found to have low adherence to the MD. PW with higher e-HDL levels demonstrated greater adherence to the MD. Furthermore, e-HDL was significantly associated with MD adherence after adjustment for age, income level, pregnancy trimester, and pre-pregnancy BMI. Among the sub-factors of e-HDL, IE and A were

found to be associated with adherence to the MD. The independent association between e-HDL and MD adherence suggests that e-HDL may be a relevant factor to consider in future interventions aimed at promoting healthy dietary behaviors during pregnancy.

Maintaining a balanced and nutritious diet during pregnancy is emphasized as a key strategy for supporting both maternal and fetal health¹⁴. The MD is a healthy and balanced dietary pattern that has been shown to reduce the risk of gestational hypertension, gestational diabetes, and low birth weight, while also promoting favorable metabolic outcomes in offspring^{15,16}. Our findings indicated that adherence to the Mediterranean diet was generally low among PW (mean MEDAS score: 4.8 (1.5)). Additionally, higher educational status was associated with greater adherence to the MD. In studies conducted in Türkiye among both healthy PW and those with gestational diabetes, Mediterranean diet adherence scores have been reported to range between 5.71 (1.51) and 8.02 (2.15), indicating that adherence to the MD during pregnancy is generally at a moderate level^{17,18}. Evidence from studies involving PW in South Africa and Spain likewise indicates that adherence to the MD is low among a considerable proportion of this population^{19,20}. Moreover, educational status was independently associated with adherence to the MD in the present study. Previous studies have shown that PW with higher educational and income levels, lower pre-pregnancy BMI, and older maternal age tend to exhibit greater adherence to the MD. Nevertheless, the overall level of adherence during pregnancy has generally been reported to be low, with considerable variation observed across countries^{20,21}. The low adherence to the MD observed in the present study suggests that many PW may be unable to meet recommended dietary goals during pregnancy, underscoring the need for effective nutrition counseling and targeted interventions to support healthy eating behaviors. Given the association observed between educational status and MD adherence in the present study, women with lower educational levels may warrant particular consideration when planning prenatal nutrition counseling strategies.

In the present study, overweight PW, based on their pre-pregnancy BMI, demonstrated higher MEDAS scores compared with their normal-weight counterparts. This finding may initially seem contrary to previous evidence suggesting that greater adherence to the MD is associated with a lower risk of overweight and obesity¹. However, women who were overweight before pregnancy

may have been more likely to adopt conscious dietary behaviors and demonstrate greater adherence to the MD during pregnancy, given their increased risk of pregnancy complications such as gestational diabetes, preeclampsia, and excessive gestational weight gain²². Furthermore, adherence to the MD during pregnancy has been associated with higher diet quality, adequate and balanced nutrient intake, and healthier lifestyle behaviors². Therefore, the greater attention paid to dietary habits and the adoption of healthier eating behaviors by overweight PW in an effort to reduce potential pregnancy-related health risks may explain the higher MD adherence scores observed in this group. However, due to the cross-sectional design of the study, the direction of the relationship between adherence to the MD and pre-pregnancy BMI cannot be determined.

e-HDL refers to an individual's ability to seek, understand, critically evaluate, and apply nutrition information available through digital platforms to support healthy dietary behaviors²³. In the present study, PW with low-income levels had lower e-HDL scores than those with moderate- and high-income levels. This finding is consistent with recent studies indicating that income is an important socioeconomic factor associated with access to digital resources and the ability to obtain, understand, and utilize health information²⁴⁻²⁶. Limited access to the internet, digital technologies, and online resources may be associated with lower e-HDL levels among PW with lower income levels. Therefore, socioeconomic disparities should be taken into consideration when designing and implementing digital nutrition interventions.

In the present study, e-HDL scores increased in parallel with MEDAS scores. This finding supports the existing literature suggesting that nutrition and health literacy are associated with individuals' ability to make healthy food choices, critically evaluate nutrition-related information, and translate this knowledge into everyday dietary practices²⁷. Similarly, Kundakçı et al. reported that adherence to the Mediterranean diet increased with higher levels of health literacy among PW with gestational diabetes¹⁷. Improved e-HDL skills during pregnancy may encourage greater consumption of key components of the MD, including vegetables, fruits, whole grains, legumes, and olive oil²⁸. Furthermore, the finding that e-HDL was strongly and significantly associated with MD adherence after adjustment for age, income level, pregnancy trimester, and pre-pregnancy BMI, suggests that healthy eating behaviors during pregnancy are associated not only with

sociodemographic factors but also with e-HDL. Moreover, the finding that the IE and A sub-factors of e-HDL were associated with MD adherence suggests that the ability to understand and apply nutrition information may be relevant to healthy dietary behaviors. Pregnancy is a critical life stage during which women experience increased health-related information needs, particularly regarding nutrition and fetal development²⁹. Consequently, PW frequently rely on online and electronic resources to obtain timely access to health information throughout this period²⁴. Today, PW can easily access nutrition-related information through the internet; however, access to information alone is not sufficient. The ability to accurately understand, interpret, and apply this information according to individual needs is equally important³⁰. To our knowledge, evidence on the association between e-Healthy Diet Literacy and Mediterranean diet adherence in PW is scarce. Nevertheless, Batu et al.⁶ demonstrated that higher health literacy and digital healthy nutrition literacy levels were associated with greater adherence to the MD among women residing in rural areas. These findings suggest that e-HDL may be an important factor to consider in interventions aimed at promoting adherence to the MD during pregnancy, thereby supporting both maternal and offspring health.

Strengths and Limitations

This study has several strengths. To the best of our knowledge, it is among the first studies in Türkiye to investigate the relationship between e-HDL and adherence to the MD among pregnant women, contributing novel evidence to the literature. The relatively large sample size (n=400) increased statistical power, and adjustment for key confounders, including age, education, income, pregnancy trimester, and pre-pregnancy BMI, strengthened the findings. However, some limitations should be acknowledged. The cross-sectional design precludes causal inference, and self-reported data may be subject to recall bias. MD adherence was assessed using MEDAS without detailed dietary records or biochemical measures. Furthermore, as the study was conducted in a single geographical region, the findings may not be generalizable to all pregnant women. Future randomized controlled trials are needed to determine whether improving digital nutrition literacy can enhance MD adherence and pregnancy outcomes.

CONCLUSIONS

In conclusion, adherence to the MD was low among the PW included in this study, and e-HDL was independently associated with MD adherence. These findings highlight the potential relevance of skills related to accessing, understanding, evaluating, and applying reliable nutrition information in digital environments to healthy dietary behaviors during pregnancy. Developing and implementing accessible digital nutrition education programs, particularly for PW with lower income and educational levels, may be considered as a potential strategy for supporting MD adherence during pregnancy, although longitudinal and intervention studies are needed to determine the direction and causal nature of these relationships.

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AUTHORS' CONTRIBUTIONS

C.Ş.K.: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. C.M.İ.: Formal analysis, Writing – original draft. K.E.: Data curation. M.S.: Supervision. All authors critically reviewed this and previous versions of the paper.

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CONFLICTS OF INTEREST

The authors state that there are no conflicts of interest when writing the manuscript.

DATA AVAILABILITY

Provision of data on request to the corresponding author.

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