Ann Med Res

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The relationship between health literacy and digital healthy diet literacy and dietary habits of pregnant women in different trimesters

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MAIN POINTS

- Health literacy and digital healthy diet literacy are positively correlated with women who are pregnant.
- Pregnant women with higher health literacy tend to make healthier dietary choices and use reliable sources of information.
- Educational interventions during prenatal care can help improve both health and digital diet literacy, thereby enhancing maternal and fetal outcomes.

Cite this article as: Ozkan HD, Gobel P, Dogan Guney H. The relationship between health literacy and digital healthy diet literacy and dietary habits of pregnant women in different trimesters. *Ann Med Res*. 2025;32(9):408–414. doi: 10.5455/annalsmedres.2025.07.184.

ABSTRACT

Aim: This study aimed to investigate the relationship between health literacy, digital healthy diet literacy, and dietary habits of pregnant women in different trimesters.

Materials and Methods: This study included 189 pregnant women who had registered for routine prenatal care. The participants were interviewed about their demographic characteristics, general health, smoking and alcohol consumption, medical history, and general dietary habits. In addition, a questionnaire with the Health Literacy Scale and the Digital Healthy Diet Literacy Scale was completed.

Results: A positive, weak, and statistically significant correlation was found between prepregnancy body mass index (BMI) and the Health Literacy Scale ($p<0.05$). A positive, weak, and statistically significant relationship was found between health literacy and digital healthy eating literacy ($r = 0.278$; $p = 0.007$).

Conclusion: As the health literacy of pregnant women improves, so does their digital healthy diet literacy. These results demonstrate the importance of promoting health literacy to support healthy dietary behaviors during pregnancy.

Keywords: Pregnancy trimesters, Health literacy, Diet, Obesity, Women health

Received: Jul 10, 2025 **Accepted:** Aug 18, 2025 **Available Online:** Sep 25, 2025

INTRODUCTION

Pregnancy is a critical time for women to experience physiological and psychological changes. Healthy lifestyle and dietary habits during pregnancy are important for both the mother and the baby to reduce risks such as gestational hypertension, diabetes, premature birth, low birth weight, macrosomia, and cesarean delivery both in the short and long term [1,2]. Pregnancy is a period in which health services are frequently used and weight gain and changes in dietary habits are observed. Various health information that pregnant women receive from different sources during this period may also cause confusion [3–5].

General literacy forms the basis of health literacy. On average, 26% of the adult population in the world does not have basic literacy skills, and two-thirds of this population are women [6,7]. A study conducted in Austria, Bulgaria, Germany, Greece, Ireland, the Netherlands, Poland, and Spain within the scope of the European Health Literacy Survey (HLS-EU) showed that the average health literacy index was 33.78 out of 50 points, and 47.60% of individuals had limited health literacy [8–10]. In Turkey, a health literacy study was conducted with the participation of 4924 adults in 23 provinces in 12 regions. The study found that the average health literacy index was 30.4, and people with limited (inadequate or problematic) health literacy made up 57.9% of society [11].

Increasing women's educational level in the reproductive period contributes to increasing health literacy rates and thus reducing infant/child mortality rates [12]. Low health literacy is now viewed as a global problem. Promoting health literacy is a public health goal that has a significant impact on soci-

ety's health and well-being [5,10]. During pregnancy, health literacy encompasses cognitive and social skills that enable women to access health information and prepare for childbirth and parenthood [13,14]. Pregnant women with high levels of health literacy receive parental care earlier and more frequently and are knowledgeable about birth control, fertility, prenatal screenings, correct use of prescription drugs, folic acid-vitamin use, and many issues related to reproductive health [6,7,12]. It is crucial to create strategies that will raise pregnant women's health literacy because the mother's lifestyle during pregnancy has an impact on the child's health later in life, ensuring the mother and the child stay healthy [15,16].

Improving the quality of daily nutrition and changing unhealthy dietary habits play a vital role in preventing CNRDs. Inadequate nutritional education and healthy dietary habits can lead to significant problems during pregnancy [17,18]. Web-based resources are mostly used to obtain information about a healthy lifestyle and proper dietary habits. Healthcare professionals and healthcare organizations actively use social media platforms to share their experiences and opinions. However, health and diet information from nonscientific and unreliable sources can often be perceived as reliable by the public, which may lead to the spread of low-quality content on websites [19–21]. Studies in the literature have evaluated dietary habits and health literacy during pregnancy. However, very few studies have examined health literacy and digital literacy for healthy eating and dietary habits of women during pregnancy.

Studies in the literature have examined dietary habits and health literacy during pregnancy. However, very few studies have examined the general health literacy, digital health literacy, and dietary habits of women during pregnancy, especially with trimester-specific comparisons. Therefore, the present study was designed to assess the health literacy and digital health literacy of pregnant women for healthy eating, compare these measures across trimesters, and examine their association with age and pre-pregnancy BMI. This approach fills a gap in the literature by incorporating DNL into prenatal research and providing trimester-by-trimester stratified analyses in a primary care setting.

MATERIALS AND METHODS

The study included 189 pregnant women aged 20–45 years with a live singleton fetus, without diagnosed psychiatric or chronic illness, who presented to the Gynecology and Obstetrics Outpatient Clinic of Ankara Koru Sincan Hospital between January and February 2024 for routine pregnancy check-ups and agreed to participate in the study. This study excluded pregnant women with pregnancy complications, maternal or fetal risks, or other diseases.

The "Informed Volunteer Consent Form" was given to each study participant, and their verbal and written consent was obtained. The Ankara Medipol College Ethics Committee for Non-Interventional Clinical Research approved the study (decision no:1, date: 09.01.2024). The Declaration of Helsinki was followed in the study.

Data collection

The questionnaire drawn up by the researchers was presented to the participants at the start of the study in a personal interview that lasted around 15 minutes. The questionnaire includes questions about the demographic characteristics, general health information, medical history, general dietary habits, and anthropometric measurements, as well as the Health Literacy Scale (HLS) and Digital Healthy Diet Literacy Scale Short Form (DDL-SF).

HSL-SF: Duong et al created the scale in 2019 [22]. The scale is scored according to the following formula: index = (average-1) x 50/3). To determine the average, the total score of the scale is divided by the number of scale points. The method produces an index score ranging from 0 to 50, with a higher score indicating greater HLL. The scale comprises 12 questions [22] with 4-point Likert response options ranging from 1 (very difficult) to 4 (very easy). Karahan et al. examined the validity and reliability in Turkey in 2021 [22].

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DDL-SF: The HLS, which evolved from the original "Digital Healthy Diet Literacy" Scale, was developed by Duong et al. in 2020 and includes four diet-related questions [24]. The scale is scored using the following formula: Index = (Average-1) x 50/3). The algorithm results in an index score ranging from 0 to 50, with a higher score indicating more knowledge about healthy eating. The scale comprises four items with 4-point Likert response options ranging from 1 (very difficult) to 4 (very easy) [24]. Karahan and his colleagues conducted the Turkish validity and reliability study in 2021 [23].

Anthropometric measurements

At the beginning of the study, the researcher dietitian measured body anthropometric measurements and recorded them in the questionnaire form.

Body weight: The participants' weights were measured with a fixed weighing device on an empty stomach without consuming any liquids. Prepregnancy weights were taken verbally from the participants.

Height: The participants' height was measured using a non-stretchable measuring tape while standing upright with closed

https://doi.org/10.5455/annalsmedres.2025.07.184

feet. The participants' heights were measured in "cm" form from the top of the head to the ground without shoes, with the individuals standing against a flat wall and their head, body, hips, and heels leaning against the wall.

Body Mass Index (BMI): Normal is defined as 18.50–24.99 kg/m^2, overweight is defined as 25.00–29.99 kg/m^2, and obesity is defined as ≥30.00 kg/m^2 [7]. Before pregnancy, the BMI of individuals was determined by dividing body weight by the square of height, and the World Health Organization (WHO) standards were used to assess BMI categorization. The reference range for BMI is 18.50–24.99 kg/m^2, overweight is 25.00–29.99 kg/m^2, and obesity is ≥30.00 kg/m^2 [24].

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics, version 27.0 (Armonk, NY: IBM Corp.). Descriptive statistics (n, %, median [IQR]) and frequency tables were used to summarize the data. Non-normally distributed variables were analyzed using nonparametric methods. Comparisons across three independent groups were performed using the Kruskal–Wallis H test (χ^2 test statistic). Correlations between two quantitative variables were evaluated using Spearman's rank correlation coefficient. A p-value < 0.05 was considered statistically significant.

Sample size and power: The minimum sample size was determined a priori using G*Power (version 3.1) for a two-tailed correlation test (H_0: $\rho = 0$), with $\alpha = 0.05$, power $(1-\beta) = 0.80$, and an expected effect size of r = 0.40 based on prior literature reporting moderate associations between eHealth/health literacy and HRBs [25]. This analysis indicated a required sample of N = 46 participants. Our final sample (N = 189) exceeded this threshold; therefore, the study was adequately powered. Additionally, for three-group comparisons analyzed with nonparametric methods (Kruskal–Wallis), we used the common ANOVA approximation in G*Power (F tests → fixed effects, omnibus, one-way). Assuming a medium effect size (f = 0.25), $\alpha = 0.05$, and power = 0.80, the required total sample size was N = 158, which was also exceeded by our study sample.

RESULTS

24.9%, 33.9%, and 41.3% of the pregnant women were in the second trimester, and 41.3% in the third trimester. Of the pregnant women, 36% had a normal BMI class and 49.2% were between 25 and 29 years old. Of the pregnant women who participated in the study, 41.8 were found to have been pregnant only once overall, 36.5% had a bachelor's degree, 48.7% were employed, and 59.3% earned enough money to cover their expenses (Table 1).

Of the pregnant women who took part in the survey, 54.5% stated that they had received nutritional information, 43.7% received it from doctors or nutritionists, 31.1% from television, newspapers, magazines and other sources and 23.3% from other medical professionals. It was found that the appetite of 38.1% decreased in the 1st trimester, 43.8% increased in the 2nd trimester, and 35.7% increased/did not change in the 3rd trimester, and 54% of them ate 3 main meals and 40.7% consumed 1.500-2.499 ml of water daily (Table 2).

Table 3 shows the change distribution of foods consumed during the pregnancy period. The products with increased consumption were milk (33.3%), yogurt/ayran/kefir (45.2%), egg (40.9%), cheese (44.1%), oilseeds (54.8%), vegetables (51.6%), fresh fruits (63.4%), dried fruits (48.4%), and mineral water (30.1%). The products with decreased consumption were white bread and its types (38.7%), rice, bulgur, pasta, etc. (33.3%), biscuits, crackers, chips (52.7%), desserts (49.4%), pita bread, lehmann, pizza, etc. (54.8%), sugary and carbonated beverages (44.1%), and tea and coffee (51.6%). The products not consumed due to pregnancy were offal, suzuki, salami, sausages, etc. (62.4%), and sugary and carbonated drinks (46.2%) (Table 3).

The digital measure of healthy eating and the health literacy scale did not change significantly between the trimesters

Table 1. Distribution of participants' sociodemographic characteristics.

Variable (N=189)	n	%
Trimester		
1st	61	24.9
2nd	72	33.9
3rd	56	41.3
Age class ($\overline{\chi} \pm SD \rightarrow 29.62 \pm 4.58$ years)		
≤24	47	20.6
25-29	64	40.2
≥30	78	30.2
Prepregnancy BMI category		
Slim	31	16.4
Normal	68	36.0
Overweight	49	25.9
Obese	41	21.7
Total number of pregnancies		
1	79	41.8
2	60	31.7
3 and above	50	26.5
Educational level		
Primary school	17	9.0
Secondary school	21	11.1
High school or equivalent	34	18.0
College	25	13.2
Undergraduate	69	36.5
Postgraduate	23	12.2
Working status		
Working	92	48.7
Not working	97	51.3
Economic level		
Income is below the expenses	38	20.1
Income equals expenses	112	59.3
Income exceeds expenses	39	20.6

https://doi.org/10.5455/annalsmedres.2025.07.184

Table 2. Distribution of participants' nutritional status.

Variable (N=189)	n	%
Status of receiving nutritional information		
Received	103	54.5
Did not receive	86	45.5
Person from whom nutritional information is obtained		
Doctor/dietitian	45	43.7
Other health care personnel	24	23.3
Social media, TV, newspaper, or magazine	32	31.1
Other (Specify)	2	1.9
1st trimester appetite status		
Increased	50	26.5
Decreased	72	38.1
Unchanged	67	35.4
1st trimester appetite status		
Increased	56	43.8
Decreased	31	24.2
Unchanged	41	32.0
1st trimester appetite status		
Increased	20	35.7
Decreased	16	28.6
Unchanged	20	35.7
Number of main meals consumed		
2	87	46.0
3	102	54.0
Water consumption		
<1.500 ml	46	24.3
1.500-2.499 ml	77	40.7
≥2.500 ml	66	34.9

(p>0.05). The trimesters are similar in terms of the aforementioned characteristics. Health literacy and prepregnancy BMI scores were positively, weakly, and statistically significantly correlated (p<0.05). As prepregnancy BMI values increased, health literacy scale scores increased (Table 4).

The digital healthy eating scale and health literacy were positively, weakly, and statistically significantly correlated (r = 0.278; p = 0.007). The health literacy scale scores increased in parallel with the digital healthy eating scale (Table 5).

DISCUSSION

The most notable finding of this study is that the health literacy and digital healthy diet literacy scores of pregnant women varied by trimester and were positively associated with prepregnancy BMI, while no significant association was found with age. In addition, pregnant women usually ate three main meals, and their appetite often increased in the second and third trimesters. The consumption of milk and dairy products, eggs, fresh vegetables, and fruits increased; the consumption of white bread, rice, bulgur, pasta, biscuits, crackers, chips, desserts, pita bread, lehmann, and pizza, which led to rapid weight gain, decreased; and products such as offal, suzuki, salami, and sausage were not consumed during pregnancy.

Pregnant women's interest in health literacy varies depending on many factors, such as number of pregnancies, age, socioeconomic status, educational level, dietary habits, nutritional knowledge level, and physical activity status. Pregnant women who are employed, have higher incomes, and have higher education levels have higher levels of health literacy. The number of pregnancies, number of children alive, increasing gestational age, and level of health literacy is often inversely correlated. This could be because fewer people are using health services and more pregnancies and children are present [26,27]. The participants in this study were found to have a high level of education and above average scores in digital literacy for healthy eating and health literacy.

Health care providers aim to reduce postpartum hospital stays. In this context, women's self-care skills and health literacy are becoming increasingly important. In a study of 258 pregnant women in China, higher health literacy positively impacted postpartum health behaviors, self-care skills, and healthy lifestyles [28]. A study of 323 pregnant women in Iran found that high health literacy levels were associated with positive pregnancy outcomes. Women with excellent (34.1%) and adequate (33.1%) health literacy were significantly more aware of prenatal care, folic acid intake, exercise before and during pregnancy, pregnancy symptoms, and breastfeeding [16]. In a study conducted with 238 pregnant women in Turkey, the average health literacy score was found to be 30.45±6.56, and the importance of improving pregnant women's health literacy and knowledge and attitudes about being healthy was emphasized [29]. In this study, the health literacy knowledge of pregnant women was at a sufficient level, consistent with the literature. The health literacy scale showed no statistically significant differences between the trimesters.

Research has shown that there is either no correlation between health literacy and BMI in pregnant women or a negative correlation between the two [30,31]. In this study, an inverse relationship was observed between the participants' health literacy scores and BMI, and health literacy scale scores increased as pregnancy weight gain and pre-pregnancy BMI values increased. The reason for the inverse relationship may be that awareness about health increases as BMI increases.

Nutritional literacy is affected by sociodemographic characteristics and dietary habits. Nutritional knowledge and nutrition literacy are related. Individuals can access and apply nutrition information using digital technology as the level of nutrition knowledge increases, which increases e-healthy nutrition literacy [19,21,32].

Individuals can access and apply nutrition information using digital technology as the level of nutritional knowledge increases, which increases e-healthy nutrition literacy [19,21,32]. Carolan et al. found that underweight, obese, and under 18-year-old women had a lower level of knowledge compared with women in other age groups (25–29, 30-34 and

https://doi.org/10.5455/annalsmedres.2025.07.184

Table 3. Distribution of foods consumed during pregnancy.

Variable (N=189)	No change		Consuming less		Consuming more		Consumption started during pregnancy		Not consuming due to pregnancy	
	n	%	n	%	n	%	n	%	n	%
Milk	79	41.9	16	8.6	63	33.3	26	14.0	4	2.2
Yogurt,ayran, kefir	73	38.6	14	7.5	85	45.2	12	6.5	4	2.2
Cheese	94	49.5	6	3.2	83	44.1	6	3.2	-	-
Egg	79	41.9	22	11.8	77	40.9	8	4.3	2	1.1
Red meat	101	53.7	18	9.7	65	34.4	2	1.1	2	1.1
Chicken/turkey meat	94	49.5	47	24.7	41	21.5	-	-	8	4.3
Fish	100	52.7	26	14.0	45	23.7	2	1.1	16	8.5
Offal (liver, etc.)	39	20.4	30	16.1	2	1.1	-	-	118	62.4
Sujuk, salami, sausage, etc.	35	18.3	30	16.1	6	3.2	-	-	118	62.4
Dried legumes	101	53.7	12	6.5	63	33.3	10	5.4	2	1.1
Oilseeds (e.g., hazelnuts)	65	34.4	-	-	104	54.8	18	9.7	2	1.1
Vegetables	75	39.8	8	4.3	98	51.6	8	4.3	-	-
Fresh fruits	57	30.1	6	3.2	120	63.4	6	3.2	-	-
Dried fruits	67	35.4	8	4.3	91	48.4	20	10.8	2	1.1
White bread and its types	71	37.6	73	38.7	18	9.7	2	1.1	24	12.9
Types of Whole-Grain Bread	79	41.9	41	21.5	45	23.7	22	11.8	2	1.1
Rice, bulgur, pasta, etc.	83	44.1	63	33.3	33	17.2	-	-	10	5.4
Biscuits, crackers, and chips	20	10.8	100	52.7	18	9.7	-	-	51	26.9
Desserts	55	29.0	93	49.4	12	6.5	-	-	29	15.1
Pekmez	100	52.7	45	23.7	16	8.6	14	7.5	14	7.5
Pita, lehmann, pizza, etc.	45	23.7	104	54.8	2	1.1	-	-	39	20.4
Sugary, carbonated beverages	12	6.5	83	44.1	6	3.2	-	-	87	46.2
Fresh fruit juices	91	48.4	37	19.4	22	11.8	12	6.4	26	14.0
Mineral water	59	31.2	47	24.7	57	30.1	16	8.6	10	5.4
Tea, coffee	73	38.7	98	51.6	-	-	-	-	18	9.7

Table 4. Comparison of scale scores according to age, BMI, and trimester.

Variable	1st trimester (n = 61) Median (IQR)	2nd trimester (n = 72) Median (IQR)	3rd trimester (n = 56) Median (IQR)	p-value
Health Literacy Scale	33.3 (13.2--60)	35.9 (6.6--85)	40.4 (16.7--85)	0.126
Digital Healthy Diet Literacy Scale	33.3 (27.1--52.1)	30.6 (27.1--46.9)	35.4 (15.6--53.4)	0.286
Correlations				
Variable		Age (year)	Prepregnancy BMI (kg/m²)	
Health Literacy Scale	r	-0.094	0.259	
	p	0.369	**0.012**	
Digital Healthy Diet Literacy Scale	r	0.042	0.097	
	p	0.692	0.353	

The Kruskal–Wallis H test was used for comparisons among the three independent groups. Spearman's correlation coefficient was used to examine the relationships between two non-normally distributed quantitative variables.

Table 5. Examining the relationships of the scales.

Correlation*		Health Literacy Scale	Digital Healthy Diet Literacy Scale
Health Literacy Scale	r	1.000	0.278
	p	-	**0.007**
Digital Healthy Diet Literacy Scale	r	0.278	1.000
	p	0.007	-

"Spearman" correlation coefficient was used to examine the relationships between two quantitative variables that do not have a normal distribution.

≥35 years old) and with normal BMI [33]. In this study, a very weak relationship was found between digital healthy diet literacy and weight gain.

Although individuals frequently consult physicians for health issues, health information is widely accessed through social media and the internet. The ability to find, understand, and evaluate health information using digital services and technologies is a prerequisite for health literacy [34,35]. In a study conducted on pregnant and lactating women, the media sources that the participants most frequently used

https://doi.org/10.5455/annalsmedres.2025.07.184

to obtain nutritional or dietary information were television (57.0%), newspapers/magazines (50.0%), and the Internet (20.0%). Doctors/health professionals and television are the most trusted non-print sources to obtain nutritional information, and those with low nutritional literacy use television and newspapers/magazines less than those with sufficient levels of nutrition [30]. The sources people used to obtain health-related information and the medical professionals they consulted did not differ significantly from the levels they achieved on the digital healthy diet. However, individuals who most frequently preferred a doctor/dietitian to access health-related information had higher digital healthy diet literacy scores.

Nutritional information and nutrition literacy are integral to health literacy. Studies have shown that high health literacy and digital healthy nutrition literacy scores are associated with healthier eating behaviors, and there is a positive relationship between health literacy and e-healthy diet literacy [24,31,36]. Our study found a positive relationship between the scales. The higher the scores on the healthy eating scale, the higher the scores on the HLS.

One of the strengths of this study is that it is one of the few studies that simultaneously assesses general health literacy and digital healthy eating literacy in pregnant women and compares these scores across trimesters. Second, the use of validated and culturally adapted measurement tools (HLS and DDL-SF) increases the results' reliability and comparability. Finally, trained researchers conducted face-to-face interviews to collect data, minimizing the risk of missing or incorrect responses. However, certain limitations should be noted. No causal relationship between education level and dietary behavior can be established in the cross-sectional design. The study was conducted at a single center, which may limit the generalizability of the results to other regions or health facilities. In addition, dietary behavior and prepregnancy weight are based on self-reporting, which is subject to recall and reporting errors.

The low health and diet literacy levels found in previous studies emphasize the need for targeted interventions during pregnancy. Our findings support the development of evidence-based strategies to improve general and digital diet literacy in prenatal care, which can contribute to better maternal health and optimal weight management.

CONCLUSION

This study found that the health literacy and digital healthy diet literacy of pregnant women were positively correlated, and the scores varied across trimesters. The mother should increase her health literacy because this can be a warning sign for the mother and the unborn child. Nutrition education and health literacy should be included as subjects in prenatal care and workshops to help pregnant women who lack health literacy and increase their knowledge of healthy eating. Future research on the variables that may influence the dietary habits and digital healthy eating and health literacy of pregnant women needs to be conducted on larger samples.

Ethics Committee Approval: Ethical approval for the study was obtained from the Ankara Medipol University Ethics Committee (decision no: 2024/1, date: 08.01.2024).

Informed Consent: Written informed consent was obtained from all participants prior to their inclusion.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Author Contributions: Conception: HDO, PG, HDG; Design: HDO, PG, HDG; Supervision: HDG; Materials: HDO, PG, HDG; Data Collection and/or Processing: HDO, PG, HDG; Writing: HDO, HDG; Writing –Review & Editing: HDO.

Financial Disclosure: This research received no financial support.

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https://doi.org/10.5455/annalsmedres.2025.07.184