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E-Health Literacy Among Liver Transplant Recipients: Assessment of Digital Health Competencies and Sociodemographic Correlates

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Abstract

Objective

This study aimed to assess e-health literacy levels among liver transplant recipients and investigate the relationship between e-health literacy and sociodemographic factors.

Methods

A cross-sectional study was conducted including 250 adult liver transplant recipients who underwent transplantation between January 2024 and June 2025. The E-Health Literacy Scale (E-HEALS) was used to assess participants' e-health literacy. Sociodemographic characteristics including age, gender, education level, monthly income, marital status, donor type, and post-transplant duration were recorded.

Results

The mean E-HEALS score was 24.9 ± 8.7 (range: 8–40). Significant associations were found between e-health literacy and age ($p < 0.001$), education level ($p < 0.001$), marital status ($p = 0.047$), and income level ($p = 0.003$). Younger patients (18–40 years) demonstrated higher e-health literacy compared to older age groups. University graduates showed significantly higher scores than those with lower education levels. No significant associations were found with gender, donor type, or post-transplant duration.

Conclusion

E-health literacy among liver transplant recipients varies significantly based on sociodemographic factors, particularly age and education. These findings suggest the need for tailored digital health education programs to address disparities and improve health information access for vulnerable patient populations.

Introduction

Liver transplantation represents a definitive treatment for end-stage liver disease, with advancing surgical techniques and immunosuppressive therapies leading to improved survival rates over recent decades (1, 2). However, successful long-term outcomes depend not only on surgical excellence but also on patients' ability to navigate complex post-transplant care requirements, including medication adherence, recognition of complications, and lifestyle modifications (3, 4).

The digital revolution has fundamentally transformed how patients access and utilize health information. E-health, defined as the use of information and communication technologies for health, has become

increasingly prevalent in healthcare delivery (5). Patients now have unprecedented access to online health resources, telemedicine platforms, electronic health records, and mobile health applications (6, 7). This digital transformation necessitates a new form of literacy—e-health literacy—which Norman and Skinner define as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem" (8).

E-health literacy encompasses multiple dimensions beyond basic computer skills, including traditional literacy, health literacy, information literacy, scientific literacy, media literacy, and computer literacy (9). For transplant recipients, adequate e-health literacy may facilitate better understanding of their condition, improved medication management, earlier recognition of complications, and enhanced communication with healthcare providers (10, 11).

Despite the growing importance of digital health competencies, limited research has examined e-health literacy specifically among solid organ transplant recipients. Previous studies have documented that e-health literacy levels vary significantly across different patient populations and are influenced by various sociodemographic factors including age, education, and socioeconomic status (12, 13, 14). Understanding these patterns in transplant populations is crucial for developing targeted interventions.

Liver transplant recipients represent a unique population with distinct characteristics. They often require lifelong medical management, frequent healthcare interactions, and continuous monitoring for complications (15, 16). The ability to effectively utilize digital health resources could potentially improve self-management capabilities and health outcomes in this population (17). However, disparities in digital health literacy may inadvertently widen health inequities if certain patient subgroups lack the skills necessary to benefit from technological advances (18, 19).

The objective of this study was twofold: first, to assess the overall level of e-health literacy among liver transplant recipients at our center; and second, to investigate the relationships between e-health literacy levels and various sociodemographic factors including age, gender, education level, income, marital status, donor type, and time since transplantation.

Methods

Study Design and Population

This study was approved by the Ethics Committee of Inonu University (approval number :2025/7269, date 20 july 2025) As this was not a prospective interventional study, informed consent was not required. All adult patients (≥18 years) who underwent liver transplantation between January 2024 and June 2025 were eligible for inclusion. Exclusion criteria included: patients who declined to participate, those with early postoperative mortality, and illiterate patients who could not complete the assessment instruments.

During the study period, 284 adult patients underwent liver transplantation at our center. Of these, 34 patients were excluded based on the exclusion criteria, resulting in a final study population of 250 participants.

Data Collection

Sociodemographic data collected included age, gender, education level (primary school, high school, university), monthly income (categorized as <$1000, $1000-2500, >$2500 USD), marital status (married, single, divorced), donor type (living or cadaveric), and time since transplantation (<6 months, 6-12 months, >12 months).

Additionally, participants were asked about their perceptions regarding the usefulness of the internet in making health decisions and the importance of access to online health resources. These items were rated on a 5-point Likert scale ranging from 1 (not useful/important at all) to 5 (very useful/important).

E-Health Literacy Assessment

The E-Health Literacy Scale (E-HEALS), originally developed by Norman and Skinner (8), was used to measure e-health literacy. The Turkish version of the scale, validated by Coşkun and Bebiş (20), was administered to participants. The E-HEALS consists of eight items that assess perceived skills and comfort with using the internet for health-related purposes. Each item is rated on a 5-point Likert scale (1=strongly disagree to 5=strongly agree), yielding a total score ranging from 8 to 40. Higher scores indicate greater e-health literacy.

The eight items assess the following competencies:

1. Knowledge of available online health resources
2. Knowledge of where to find helpful health resources
3. Knowledge of how to find helpful health resources
4. Skills to use the internet to answer health questions
5. Ability to use found health information
6. Skills to evaluate online health resources
7. Ability to distinguish high-quality from low-quality resources
8. Confidence in using online information for health decisions

Statistical Analysis

Descriptive statistics were used to summarize sociodemographic characteristics and E-HEALS scores. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent samples t-tests were used to compare E-HEALS scores between two groups, while one-way ANOVA was used for comparisons across three or more

groups. Post-hoc pairwise comparisons were conducted using appropriate tests when overall group differences were significant. A p-value of <0.05 was considered statistically significant.

Results

Participant Characteristics

The final study cohort comprised 250 liver transplant recipients. Table 1 presents the sociodemographic characteristics of the study population. The majority of participants were male (63.6%, n=159), aged 41-64 years (60.4%, n=151), and married (80.4%, n=201). Nearly half had completed only primary school education (47.6%, n=119), while 35.6% (n=89) had high school education and 16.8% (n=42) had university education. A substantial proportion (68%, n=170) reported monthly income below $1000. The vast majority received living donor transplants (91.2%, n=238), with only 8.8% (n=22) receiving cadaveric grafts. More than half of participants (58.4%, n=146) were more than 12 months post-transplant.

Perceptions of Internet Usefulness and Importance

Table 2 summarizes participants' perceptions regarding the usefulness of the internet for health decisions and the importance of accessing online health resources. Nearly half of participants (48.4%) rated the internet as useful or very useful for making health decisions, while 19.6% considered it not useful or not useful at all. Regarding the importance of access to online health resources, 54.8% rated it as important or very important, while 20.8% considered it not important or not important at all. A substantial proportion of participants (30.8% and 23.2%, respectively) remained neutral on these questions.

E-Health Literacy Scores

The overall mean E-HEALS score for the entire cohort was 24.9±8.7 (range: 8-40), indicating moderate e-health literacy levels. Detailed responses to individual E-HEALS items revealed that participants demonstrated variable confidence across different dimensions of e-health literacy. For items assessing knowledge of available resources and where to find them, 44.4% and 48.4% of participants agreed or strongly agreed, respectively. When asked about confidence in using internet information to make health decisions, 45.6% agreed or strongly agreed, while 31.6% disagreed or strongly disagreed.

Association Between E-Health Literacy and Sociodemographic Factors

Age: A highly significant association was found between age and e-health literacy ($p<0.001$). Younger participants (18-40 years) demonstrated the highest mean E-HEALS score (27.8±7.8), followed by the middle-aged group (41-64 years; 25.0±8.8) and older participants (>65 years; 21.4±8.5). Post-hoc analyses revealed significant differences between all age groups: 18-40 vs. 41-64 years ($p=0.042$), 18-40 vs. >65 years ($p<0.001$), and 41-64 vs. >65 years ($p=0.014$)(Table 3).

Gender: No significant difference in E-HEALS scores was observed between male (25.2±8.9) and female (24.4±8.5) participants (p=0.48) (Table 3)..

Marital Status: Marital status was significantly associated with e-health literacy (p=0.047). Single participants had the highest mean score (28.4±8.0), followed by divorced (25.1±6.4) and married participants (24.4±8.9). Post-hoc analysis revealed a significant difference between married and single participants (p=0.041), but no significant differences between married and divorced (p=0.76) or single and divorced participants (p=0.22) (Table 3)..

Education Level: Education level showed a highly significant association with e-health literacy (p<0.001). University graduates demonstrated the highest E-HEALS scores (29.7±5.3), followed by high school graduates (25.6±8.7) and primary school graduates (22.8±8.9). All pairwise comparisons were statistically significant: primary school vs. high school (p=0.019), primary school vs. university (p<0.001), and high school vs. university (p=0.01) (Table 3)..

Income Level: Monthly income was significantly associated with e-health literacy (p=0.003). Participants earning $1000-2500 had the highest mean score (27.8±8.3), followed by those earning >$2500 (25.3±10.9) and <$1000 (23.7±8.6). The difference between the lowest and middle-income groups was highly significant (p<0.001), while other pairwise comparisons were not significant (Table 3)..

Donor Type: No significant difference was found between recipients of living donor (25.0±8.8) and cadaveric donor (24.8±7.6) transplants (p=0.942) (Table 3)..

Post-Transplant Duration: Time since transplantation showed no significant association with e-health literacy (p=0.094). Participants <6 months post-transplant had a mean score of 27.3±8.9, compared to 24.2±9.3 for those 6-12 months post-transplant and 24.4±8.7 for those >12 months post-transplant (Table 3).

Discussion

This study provides important insights into the e-health literacy landscape among liver transplant recipients, revealing moderate overall levels with significant sociodemographic disparities. The mean E-HEALS score of 24.9 ± 8.7 indicates that while many transplant recipients possess basic digital health competencies, substantial room for improvement exists, particularly given the increasing digitalization of healthcare delivery.

The strong inverse relationship between age and e-health literacy aligns with previous research across various patient populations (21, 22). Younger transplant recipients demonstrated significantly higher e-health literacy, likely reflecting greater familiarity with digital technologies and more frequent internet use for health information seeking (23). This age-related digital divide poses challenges for healthcare delivery, as older patients—who often have more complex health needs—may be least equipped to

benefit from digital health innovations (24). This finding underscores the need for age-appropriate digital health education interventions tailored to older transplant recipients.

Education emerged as another powerful predictor of e-health literacy, with university graduates scoring significantly higher than those with lower educational attainment. This finding is consistent with the broader health literacy literature, which consistently demonstrates education as a primary determinant of health information processing capabilities (25, 26). The relationship between formal education and e-health literacy likely reflects multiple factors, including enhanced critical thinking skills, greater health knowledge, and increased confidence in navigating complex information systems (27). For transplant programs serving predominantly lower-education populations, this finding highlights the importance of providing accessible, simplified digital health resources and offering hands-on training to build digital skills.

The significant association between income level and e-health literacy, with middle-income participants demonstrating the highest scores, reflects the complex interplay between economic resources and digital access. Lower-income individuals may face barriers including limited internet access, older technology, and competing priorities that restrict time for health information seeking (28, 29). Addressing these socioeconomic disparities in e-health literacy requires multifaceted approaches, including ensuring affordable internet access, providing devices for telehealth access, and offering digital literacy training programs (30).

Interestingly, single participants demonstrated higher e-health literacy than their married counterparts. This finding may reflect several factors: single individuals may be more self-reliant in health information seeking, younger age distribution among single participants, or different patterns of social support and information sharing (31). However, this finding should be interpreted cautiously given the relatively small number of single participants.

The absence of significant associations between e-health literacy and gender, donor type, or post-transplant duration provides additional insights. The lack of gender differences contrasts with some earlier studies showing male advantages in digital literacy, suggesting that gender gaps in technology use may be narrowing in contemporary populations (32). The lack of association with donor type indicates that e-health literacy is determined more by individual characteristics than by clinical factors. The absence of a relationship with post-transplant duration suggests that e-health literacy levels remain relatively stable over time without active intervention, highlighting the importance of early assessment and education in the post-transplant period.

Our findings regarding participants' perceptions of internet usefulness reveal a generally positive but not universal attitude toward online health resources. While approximately half viewed online health resources as useful and important, substantial proportions remained neutral or negative. This heterogeneity in perceptions underscores the need for healthcare providers to assess individual patients' readiness and preferences for digital health tools rather than assuming uniform enthusiasm for technology-based interventions.

These findings have several important clinical implications. Transplant programs should conduct systematic assessments of e-health literacy to identify patients who may struggle with digital health tools and require additional support. Digital health education should be incorporated into standard post-transplant care pathways, with content and delivery methods tailored to patients' age, education level, and baseline digital skills. When implementing new digital health initiatives such as patient portals, mobile apps, or telemedicine services, programs should ensure that these tools are accessible to patients with varying levels of e-health literacy, following principles of universal design and health literacy best practices. Particular attention should be directed toward older patients and those with lower educational attainment, who may benefit from one-on-one training, peer support programs, or family member involvement in digital health activities. Transplant programs should also advocate for broader societal initiatives to address digital divides, including affordable internet access and community-based digital literacy programs.

Several limitations should be acknowledged. First, the cross-sectional design precludes conclusions about causality or changes in e-health literacy over time. Longitudinal studies are needed to understand how e-health literacy evolves during the post-transplant trajectory and whether interventions produce sustained improvements. Second, the E-HEALS relies on self-reported perceptions rather than objective performance measures, potentially introducing social desirability bias or inaccurate self-assessment. Third, the study was conducted at a single center, which may limit generalizability to other populations with different demographic characteristics or healthcare contexts. Fourth, we did not assess actual internet usage patterns, quality of information sources accessed, or health outcomes associated with different e-health literacy levels.

Future research should examine the relationship between e-health literacy and clinical outcomes, including medication adherence, complication rates, hospital readmissions, and quality of life. Intervention studies are needed to develop and evaluate educational programs designed to enhance e-health literacy among transplant recipients. Additionally, qualitative research could provide deeper insights into the barriers and facilitators that transplant recipients experience when attempting to use digital health resources. Finally, research should investigate the role of caregivers and family members in supporting patients with low e-health literacy.

Conclusion

This study demonstrates that liver transplant recipients exhibit moderate e-health literacy with significant variation based on sociodemographic factors, particularly age and education level. As healthcare increasingly incorporates digital technologies, understanding and addressing disparities in e-health literacy becomes crucial for ensuring equitable access to health information and services. Transplant programs should implement systematic assessment and targeted interventions to enhance digital health competencies across all patient subgroups, with particular attention to older patients and those with lower educational attainment. By addressing these disparities, healthcare systems can better position all transplant recipients to benefit from the expanding array of digital health tools and resources.

Abbreviations

E-HEALS
E-Health Literacy Scale
E-health
Electronic health

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Inonu University (Approval No: 2025/7269, Date: 20 July 2025). All participants provided informed consent before inclusion in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Deniz Yavuz Baskiran designed and supervised the study. MHC contributed to data collection and statistical analysis. Sezai Yilmaz provided critical revision of the manuscript. All authors read and approved the final version of the manuscript.

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Conflicts of Interest and Source of Funding

The authors declare that there is no financial or other conflict of interest related to this article.

Author Statement

- This research has not been sent to any other journal. It has not been published anywhere before.
- There is no conflict of interest between the authors in the study.
- No financial support was received from any person or institution for the research.
- Consent was obtained from the participants to participate in the study.

Ethical Considerations Statement

This study was conducted in full compliance with the principles of research and publication ethics. All data were collected in accordance with ethical standards, with due regard to confidentiality and voluntary participation. This study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Tables

Table 1. Sociodemographic and Clinical Characteristics of Study Participants

Parameter		n	%
Gender	Female	91	36.4
	Male	159	63.6
Age	18-40	54	21.6
	41-64	151	60.4
	>65	45	18
Marital Status	Married	201	80.4
	Single	34	13.6
	Divorced	15	6
Education	Primary School	119	47.6
	High School	89	35.6
	University	42	16.8
Income (USD)	<1000	170	68
	1000-2500	76	30.4
	>2500	4	1.6
Donor Type	Living	238	91.2
	Cadaver	22	8.8
Post-transplant Duration (Months)	< 6	50	20.0
	6-12	54	21.6
	>12	146	58.4

Table 2: Patients' Perceptions of Internet Usefulness and Importance to Online Health Resources

Usefulness of the Internet in Making Health Decisions		
Option	n	%
1 = Not useful at all	25	10.0
2 = Not useful	24	9.6
3 = Neutral	77	30.8
4 = Useful	91	36.4
5 = Very useful	30	12.0
Importance of Access to Online Health Resources		
Option	n	%
1 = Not important at all	22	8.8
2 = Not important	30	12.0
3 = Neutral	58	23.2
4 = Important	89	35.6
5 = Very important	48	19.2

Table 3: Comparison of E-Health Literacy Scale (E-HEALS) Scores According to Sociodemographic and Clinical Characteristics

Parameter		Point	p Value
Gender	Female	24.4±8.5	p= 0.48
	Male	25.2±8.9	
Age	18-40	27.8±7.8	**p<0.001**
	41-64	25±8.8	**18-40 vs 41-64 p=0.042**
	>65	21.4±8.5	**18-40 vs >65 p<0.001**
			41-64 vs >65 p=0.014
Marital Status	Married	24.4±8.9	**p=0.047**
	Single	28.4±8	**Married vs Single p=0.041**
	Divorced	25.1±6.4	Married vs Divorced p=0.76
			Single vs Divorced p=0.22
Education	Primary School	22.8±8.9	**p<0.001**
	High School	25.6±8.7	**Primary School vs High School p=0.019**
	University	29.7±5.3	**Primary School vs University p<0.001**
			High School vs University p=0.01
Income (USD)	<1000	23.7±8.6	**p=0.003**
	1000-2500	27.8±8.3	**<1000 vs 1000-2500 p<0.001**
	>2500	25.3±10.9	<1000 vs >2500p=0.78
			1000-2500 vs >2500 p= 0.56
Donor Type	Living	25±8.8	p= 0.942
	Cadaver	24.8±7.6	
Post-transplant Duration (Months)	< 6	27.3±8.9	p=0.094
	6-12	24.2±9.3	
	>12	24.4±8.7	