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The Relationship Between e-Health Literacy and Health Beliefs Regarding Cardiovascular Disease in Elderly Individuals with Type 2 Diabetes

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Abstract

Objective: Given that elderly people with diabetes are at high risk for cardiovascular complications, it is essential to understand the relationship between eHealth literacy and health beliefs regarding cardiovascular diseases. This study was conducted to examine the relationship between e-health literacy and health beliefs regarding cardiovascular disease in elderly individuals with type 2 diabetes.

Methods: This study is a descriptive and cross-sectional study. The study was conducted between February 2024 and June 2024 with 326 individuals with type 2 diabetes. The study data collected descriptive characteristics form, e-Health Literacy Scale (e-HLS) and Health Beliefs Related to Cardiovascular Disease Scale (HBCVDS).

Results: The mean age of the elderly individuals with type 2 diabetes included in the study was 70.21±6.18 years and 53.10% were female. The mean score on the e-HLS and HBCVDS were moderate. The factors affecting e-HLS were smoking, smartphone use, Accessing health resources from the internet, average daily internet usage time (91 minutes or more), positive effect of the internet on health.

Conclusions: In this study, both the e-health literacy and the health beliefs related to heart disease of elderly individuals with diabetes were found to be at a moderate level. As the electronic health literacy of individuals with diabetes increases, their health beliefs about heart disease also improve. Therefore, educational programs aimed at enhancing electronic health literacy and the promoting use of digital tools offer an important opportunity to improve these individuals' health beliefs and behaviors related to cardiovascular diseases.

Keywords: Elderly, Type 2 Diabetes, E-Health Literacy, Cardiovascular Disease, Nursing

Öz

Tip 2 Diyabetli Yaşlılarda Kardiyovasküler Hastalığa İlişkin Sağlık İnançları ile E-Sağlık Okuryazarlığı Arasındaki İlişki

Amaç: Diyabetli yaşlı bireyler kardiyovasküler komplikasyonlar için yüksek risk altındadır, bu nedenle e-sağlık okuryazarlığı ile kardiyovasküler hastalıkla ilgili sağlık inançları arasındaki ilişkiyi anlamak önemlidir. Bu çalışma, yaşlı tip 2 diyabetli bireylerde e-sağlık okuryazarlığı ile kardiyovasküler hastalığa ilişkin sağlık inançları arasındaki ilişkinin incelenmesi amacıyla yapılmıştır.

Yöntem: Çalışma tanımlayıcı ve kesitsel türdedir. Çalışma, Şubat - Haziran 2024 tarihleri arasında 326 tip 2 diyabetli bireyle gerçekleştirilmiştir. Çalışma verileri, tanımlayıcı özellikler formu, e-Sağlık Okuryazarlığı Ölçeği (e-HLS) ve Kardiyovasküler Hastalıklarla İlgili Sağlık İnançları Ölçeği (HBCVDS) ile toplanmıştır.

Bulgular: Çalışmaya dahil edilen tip 2 diyabetli yaşlıların ortalama yaşı 70.21±6.18 yıl olup, %53.10'u kadındır. E-HLS ve HBCVDS ortalama puanları orta seviyedeydi. E-HLS'yi etkileyen faktörler sigara içme, akıllı telefon kullanımı, internet üzerinden sağlık kaynaklarına erişim, günlük ortalama internet kullanım süresi (91 dakika ve üzeri) ve internetin sağlık üzerindeki olumlu etkisi yer almaktadır.

Sonuç: Bu çalışmada, diyabetli yaşlı bireylerin e-sağlık okuryazarlığı ve kardiyovasküler hastalığa ilişkin sağlık inançları orta seviyededir. Diyabetli bireylerin e-sağlık okuryazarlığı arttıkça, kardiyovasküler hastalıklarla ilgili sağlık inançları da artmaktadır. Bu nedenle, e-sağlık okuryazarlığını artırmaya yönelik eğitim programları ve dijital araçların kullanımının teşvik edilmesi, bu bireylerin kardiyovasküler hastalıklarla ilgili sağlık inançlarını ve davranışlarını iyileştirmek için önemli bir fırsat sunmaktadır.

Anahtar Kelimeler: Yaşlı, Tip 2 Diyabet, E-Sağlık Okuryazarlığı, Kardiyovasküler Hastalık, Hemşirelik

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INTRODUCTION

The epidemiology of the global population is shifting towards aging. By 2030, it is expected that 1 in 6 people worldwide will be 60 years or older, and by 2050, the population aged 60 and above will double (WHO, 2024). With the increase in the elderly population, there is also a rise in chronic diseases. Type 2 diabetes, which is one of the most prevalent chronic diseases, significantly affects an individual's independence and family. It is a condition that progresses with complications, can lead to organ damage if left untreated, greatly reduces the quality of life, and has high treatment costs. Approximately half of the diabetic population is over 65, and its prevalence in the elderly aged 75-79 reaches up to 24% (Sun et al., 2023). When poorly managed, diabetes becomes a well-known risk factor for cardiovascular diseases (CVD) (Joseph et al., 2022).

Diabetes is strongly associated with CVD. The prevalence of CVD is higher in adults with diabetes compared to those without, and individuals with type 2 diabetes have twice the risk of dying from cardiovascular disease compared to healthy individuals (Yun & Ko, 2021). Cardiovascular disease is currently the leading cause of death worldwide (WHO, 2021). According to the 2019 update of the American Heart Association's Heart Disease and Stroke Statistics, the prevalence of CVD is approximately 35-40% among patients aged 40 to 60, 75-78% among those aged 60 to 80, and the incidence exceeds 85% in patients over the age of 80 (Benjamin et al., 2019). Type 2 diabetes is the most common etiological factor for cardiovascular disease. Approximately 90% of patients diagnosed with diabetes have type 2 diabetes, and more than 95% of them are over 60 years old (Galicia-Garcia et al., 2020). Unfortunately, despite well-established evidence that diabetes increases the risk of CVD, most individuals with diabetes are not aware that they are more susceptible to cardiovascular disease or its related complications due to their condition (Shukhratovna et al., 2022).

Interventions that increase awareness and knowledge of CVD risk factors should be incorporated into strategies aimed at reducing the prevalence and burden of CVD in individuals with diabetes. However, knowledge is a necessary but not sufficient component of behavior change (Simons-Morton et al., 2012). Therefore, other factors, such as health beliefs that influence the emergence of health behaviors, must also be targeted.

The Health Belief Model (HBM) is a behavior change theory that integrates cognitive theory and the theory of need motivation from a psychological perspective (Lei, 2017). According to HBM, individuals must first believe they are susceptible to diseases (perceived susceptibility), recognize the risks and perceived severity, and adopt self-management behaviors (Karimy et al., 2012). Health beliefs can determine the degree to which patients adhere to recommendations and maintain self-care behaviors (Harvey & Lawson, 2009). Studies in the literature have shown that the HBM has been successfully applied to explain and predict preventive health behaviors (Dehghani-Tafti et al., 2015).

The prevention of cardiovascular diseases in type 2 diabetes begins with the development of positive lifestyle behaviors (Coll et al., 2020). Diabetes requires patients to actively self-manage their condition in their daily lives. Therefore, the ability of individuals with diabetes to effectively use health information and health services is crucial. Good diabetes self-management is closely related to health literacy, defined as "the degree to which individuals can acquire, process, and understand the basic health information and services required to make appropriate health decisions" (Sarkar et al., 2006; Berkman et al., 2010). In the digital age, individuals with diabetes access health information through electronic platforms. The ability of individuals to acquire, process, and understand health information in electronic environments is assessed through eHealth literacy, an extension of the health literacy concept (Cutilli & Bennett, 2009). eHealth literacy is defined as the ability to search, find, understand, evaluate, and apply health information from electronic sources to address or solve health problems. Individuals with lower eHealth literacy skills struggle to access reliable eHealth information (Norman & Skinner, 2006). A meta-analysis conducted by Kim et al., (2023) on the results of cross-sectional studies suggested that eHealth literacy has a positive and significant correlation with health-related behaviors, including self-management behaviors, adherence to treatment, disease management, and preventive measures. There is extensive literature suggesting that eHealth literacy is an important factor influencing diabetes outcomes (Friis et al., 2016). Electronic health literacy helps individuals improve their health and is crucial in the management of cardiovascular diseases (Yekaninejad et al., 2024). Higher levels of eHealth literacy are associated with better health outcomes, particularly in chronic disease management, where self-monitoring and informed decision-making play important roles (Poureslami et al., 2017). However, older adults with chronic conditions, such as diabetes, face different challenges navigating digital health environments due to age-related cognitive decline, lower digital literacy, and barriers in health literacy (Wang & Luan, 2022). These challenges can limit their ability to effectively access and apply online health information, which may negatively impact their health beliefs and behaviors related to CVD.

Given that elderly individuals with diabetes are at high risk for cardiovascular complications, it is essential to understand the relationship between eHealth literacy and health beliefs regarding cardiovascular diseases. Low eHealth literacy can result in lower awareness of cardiovascular disease risk factors, poorer adherence

to recommended health behaviors, and worse health outcomes (Nagori et al., 2024). Conversely, individuals with higher eHealth literacy may have a more accurate understanding of their susceptibility to cardiovascular disease and the benefits of preventive actions such as adherence to medication, managing blood sugar levels, and making lifestyle changes. The relationship between eHealth literacy and cardiovascular disease health beliefs plays a critical role in the management of cardiovascular diseases, especially among elderly diabetic patients. As the prevalence of diabetes and cardiovascular disease continues to rise globally, understanding how eHealth literacy influences health beliefs in this demographic group is becoming increasingly important (Ernsting et al., 2019).

Information and beliefs about CVD are important factors that guide individuals towards preventive actions. Although information itself does not directly predict health behaviors, it can initiate changes in health behaviors. At the same time, beliefs can either promote a healthy lifestyle or act as barriers to preventive actions. Most existing research examining the impact of health literacy on health outcomes has treated health literacy as simply the ability to read and understand health information, rather than focusing on the use of online health information (Al-Kaabi et al., 2015). A review of the literature reveals a lack of studies that explore the relationship between eHealth literacy and cardiovascular disease health beliefs in individuals with diabetes. Therefore, this study was conducted to examine the relationship between e-health literacy and health beliefs regarding cardiovascular disease in elderly individuals with type 2 diabetes. By gaining a deeper understanding of this relationship, we can develop targeted interventions to improve cardiovascular health outcomes and promote better disease management in this vulnerable population. By supporting older individuals to use digital health resources correctly and effectively, public health nurses can correct health beliefs based on misinformation and improve self-care behaviors. In this way, individual awareness can be increased in the management of diabetes and cardiovascular diseases and complications can be prevented.

METHOD

Study Design

Cross-sectional study.

Research Questions

1. What are the levels of e-health literacy and health beliefs related to cardiovascular disease in individual with elderly individuals type 2 diabetes?

2. Is there a relation between e-health literacy and health beliefs related to cardiovascular disease in individual with elderly individuals type 2 diabetes?

3. What are the predictors of health beliefs related to cardiovascular disease?

Study Setting and Sample

The study was carried out in the internal medicine outpatient clinic and diabetes outpatient clinic of a training and research hospital in İstanbul, Türkiye, between February 2024 and June 2024.

The study population comprised individuals with type 2 diabetes presenting to the internal medicine outpatient clinic and diabetes outpatient clinic of a training and research hospital. Inclusion criteria for sampling were over 65 years old, treatment with oral antidiabetic drugs and/or insulin, ability to read and write in Turkish, being at least a primary school graduate (to fill the scales) and agreement with participation in the study.

Convenience sampling was used and individuals with type 2 diabetes fulfilling the inclusion criteria were included in the study. The sample size was calculated by using G*Power 3.1.9.7. (Faul et al., 2007). In the analysis, Exact was selected from the test family and “correlation: Bivariate normal model” was selected from the statistical test. The correlation value was taken as 0.2 and the required number of samples was calculated as at least 319 with a 5% margin of error for the correlation analysis (α=0.05, h0 correlation value 0 and 95% power (1-β=0.95). The study was completed with a total of 326 individuals with type 2 diabetes who met the inclusion criteria.

Data Collections Tools

A descriptive characteristics form, e-Health Literacy Scale (e-HLS) and Health Beliefs Related to Cardiovascular Disease Scale (HBCVDS) were utilized to collect data.

Descriptive Characteristics Form

The descriptive characteristics form was prepared in light of the literature and is composed of questions about age, gender, education, marital status, smoking, alcohol intake, time from the diagnosis of diabetes, type of treatment, HbA1c% levels, information regarding heart disease, family history of heart disease, smartphone use, and internet use (Altaş et al., 2022; Kim et al., 2018; Guo et al., 2021). The HbA1c% information of individuals with diabetes was obtained from the e-Nabız application with patient consent (the most recent value was used as the reference).

e-Health Literacy Scale (e-HLS)

This scale was developed in English by Norman & Skinner (2006) and was validated for Turkish by Uskun et al. (2022). The scale was designed to measure individuals’ knowledge, comfort, and skills in finding, evaluating, and applying electronic health information related to health

problems. The scale is 8 items long and unidimensional. It uses a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The lowest possible score on the scale is 8, and the highest possible score is 40. A higher score indicates a higher level of eHealth literacy. The Cronbach's Alpha value of the Turkish version of the scale was found to be 0.97. The scale's goodness-of-fit indices : x^2/sd=4.645, RMSEA=0.096, CFI=0.990, SRMR=0.024, GFI=0.964, AGFI=0,900, NFI=0.987 (Uskun et al., 2022). In the present study, Cronbach's alpha on the scale was found to be 0.99.

Health Beliefs Related to Cardiovascular Disease Scale (HBCVDS)

Health beliefs related to heart disease were measured by the health beliefs related to CVD scale (Tovar et al., 2010). This scale consists of 25 items among four subscales that were developed to measure health beliefs related to CVD in adults with type 2 diabetes. The evaluation of the scale is done with both its sub-dimensions and the total score. Sample items include: "I feel I will have a heart attack or stroke sometime during my life" (susceptibility); "My whole life would change if I had a heart attack or stroke" (severity); "Increasing my exercise will decrease my chances of having a heart attack or stroke" (benefits); and "I do not have time to exercise for 30 minutes a day on most days of the week" (barriers). Response options ranged from strongly disagree (= 1) to strongly agree (= 4) with higher scores indicating stronger beliefs. Cronbach Alpha was found to be .77 for the total scale, .91 for the susceptibility sub-factor, .71 for the severity sub-factor, .91 for the benefits sub-factor and .62 for the barriers sub-factor. The validity and reliability of the scale in Turkish was conducted by Karahan Okuroglu & Ercan Toptaner (2018). The Turkish scale consists of 4 sub-dimensions and 25 items in total. Permission to use the scale was obtained from the scale owner via e-mail. In the current study, Cronbach's alpha for the scale was found to be 0.85.

Data Collection

The individuals with type 2 diabetes who fulfilled the inclusion criteria were informed about the aim and scope of the study after they were examined in clinics. The data collection process was collected face-to-face methods. Before the individuals with type 2 diabetes filled in the data collection tools, their informed consent was obtained. Data collection lasted 30 minutes on average for each patient. The questionnaire form was checked and received completely after being answered by the patients. In this way, missing data was prevented.

Ethical Consideration

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Bakırköy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (Date: 06.11.2023/ Decision number: 2023-21-04). Informed consent was obtained from all the individuals with type 2 diabetes before initiation of the study. Besides, permission was received from the hospital where the study was conducted (Date:27.12.2023 / Decision number: 11/7). Permission was also obtained from the researchers developing the scales used for data collection via e-mail.

Statistical Analysis

Obtained data were analyzed by using the Statistical Package for the Social Sciences-version 22.0. Descriptive statistics including mean, standard deviation and percentage were used to express data about descriptive characteristics and the e-HLS and HBCVDS scores. Since data collected with the e-HLS and HBCVDS had a normal distribution (Skewness/Kurtosis value for e-HLS: 0.139/-1.403; Skewness/Kurtosis value for HBCVDS: –0.353/1.473) (George and Mallery, 2019), parametric tests were used for the analysis of the data. Independent samples t-test was used to determine the differences in the mean scores on the e-HLS and HBCVDS in terms of sociodemographic characteristics between two groups and Bonferroni corrected one-way ANOVA was used to determine the differences between three or more groups. The relation between the mean score on the e-HLS and the mean score on the HBCVDS was examined by utilizing Pearson correlation analysis. Multiple linear regression analysis was performed to determine the predictors affecting the HBCVDS score. $p<.05$ was considered as statistically significant.

RESULTS

Participant Characteristics

The mean age of the elderly individuals with type 2 diabetes included in the study was 70.21±6.18 years. Of all the individuals with type 2 diabetes, 53.10% were female. The average HbA1c% of individuals with type 2 diabetes is 7.01%, and 50.90% of them have had a diabetes diagnosis for more than 11 years. Additionally, 49.40% of individuals with type 2 diabetes are overweight. Approximately half of the individuals were on oral medication (56.70%). Also, 65.00% of the individuals with type 2 diabetes had a chronic disease in addition to diabetes. Among individuals with type 2 diabetes, 62.00% are receiving medication for cardiovascular issues, and 58.90% have a close family member with heart disease. Additionally, 76.10% of individuals with type 2 diabetes own a smartphone, and 71.20% reported accessing health information sources through the internet or social media. Furthermore, 36.60% of the participants stated that they use the internet every day (Table 1).

Table 1. Demographic characteristics of the participants (n= 326)

Characteristics	n (%)	X ± SD (Min-Max)
Age (year)		70.21 ±6.18 (65-90)
Gender		
Female	173 (53.10)	
Male	153 (46.90)	
Education level		
Primary school	163 (50.00)	
Middle school	93 (28.50)	
High school	53 (16.30)	
University or a higher education level	17 (5.20)	
Marital status		
Married	262 (80.40)	
Unmarried	64 (19.60)	
Occupation		
Not working	130 (39.90)	
Retired	158 (48.50)	
Working	38 (11.70)	
Income		
Income less than expenses	63 (19.30)	
Income equals expenses	220 (67.50)	
Income more than expenses	43 (13.20)	
Smoking		
I have never smoked	118 (36.20)	
I quit smoking	115 (35.30)	
I'm smoking	93 (28.50)	
Alcohol intake		
I have never drunk alcohol	211 (64.70)	
I quit alcohol	90 (27.60)	
I drink alcohol	25 (7.70)	
HbA1c%		7.01±1.53 (4.90±15.00)
Duration of medication (years)		11.54±7.13(1-30)
Duration of diabetes (years)		12.46±8.02 (1-50)
Less than 5 years	74 (22.70)	
6-10 years	86 (26.40)	
More than 11 years	166 (50.90)	
Body Mass Index (kg/m^2)		28.86±4.51(19.53-44.44)
Normal weight (18.5-24.9)	57 (17.50)	
Overweight (25.0-29.9)	161 (49.40)	
Obesity class I (30.0-34.9)	74 (22.70)	
Obesity class II (35.0-39.9)	29 (8.90)	
Obesity class III (more than 40)	5 (1.50)	
Medication types		
Oral medication	185 (56.70)	
Oral medication + insulin injection	76 (23.30)	
Insulin injection	65 (19.90)	
Complication		
No	177 (54.30)	
Yes	149 (45.70)	

Table 1. Demographic characteristics of the participants (n= 326)

Characteristics	n (%)	X ± SD (Min-Max)
Frequency of going to diabetes control		
Quarterly	119 (36.50)	
Once every six months or once a year	128 (39.30)	
Once a year	63 (19.30)	
Every two to three years	16 (4.90)	
Chronic disease other than diabetes		
No	114 (35.00)	
Yes	212 (65.00)	
The situation of using heart/ blood pressure, or heart rate medication		
No	124 (38.00)	
Yes	202 (62.00)	
A family history of heart disease		
No	134 (41.10)	
Yes	192 (58.90)	
Smartphone use		
No	78 (23.90)	
Yes	248 (76.10)	
Access to health information sources*		
Internet, social media	232 (71.20)	
From healthcare professionals	32 (9.80)	
From newspapers, television, or news	18 (5.50)	
From family or friends	26 (8.00)	
Frequency of internet use		
Every day	129 (36.60)	
Most days of the week	76 (23.30)	
A few days of the week	22 (6.70)	
Never	99 (30.40)	
Average daily internet use time		
0-59 min	192 (58.90)	
60-90 min	78 (23.90)	
91 min or more	56 (17.20)	
Do you think the internet has a positive impact on your health?		
No	134 (41.10)	
Undecided	117 (35.90)	
Yes	75 (23.00)	

X= Mean, SD= Standard Deviation, Min= Minimum, Max= Maximum

** Multiple options have been selected*

Table 2. The Mean Scores on the e-HLS and HBCVDS and their Correlations (n= 326)

	Mean	SD	Min-Max	Correlation
e-HLS	**20.76**	**10.88**	**8.00-40.00**	
HBCVDS	**61.74**	**8.88**	**34.00-90.00**	
Susceptibility	**11.38**	**3.52**	**5.00-20.00**	
Severity	**11.03**	**2.93**	**5.00-20.00**	
Benefits	**17.06**	**3.49**	**6.00-24.00**	
Barriers	**22.26**	**3.42**	**10.00-32.00**	
e-HLS*HBCVDS				r= 0.128; p=.020**

SD= Standard Deviation, r= correlation, Pearson correlation, p<.05***

Table 3. The comparison of the mean scores on the e-HLS and the HBCVDS between descriptive characteristics

Characteristics	e-HLS	HBCVDS
Gender		
Female	20.38±10.95	62.90±8.36
Male	21.13±10.82	60.42±9.31
t – test	-0.625 p=.553	2.536 p=.012*
Education level		
(1) Primary school	18.37±10.31	61.38±8.42
(2) Middle school	21.29±10.90	62.08±8.12
(3) High school	24.56±10.52	61.69±10.77
(4) University or a higher education level	29.00±10.18	63.58±11.04
ANOVA	8.669 p=.000* 1vs4<.05 2vs4<.05	0.380 p=.768
Marital status		
Married	21.05±11.02	61.98±8.86
Unmarried	19.59±10.26	60.76±8.94
t – test	0.962 p= .337	0.988 p=.324
Occupation	40.80±16.86	89.62±17.52
(1) Not working	20.02±10.97	62.00±8.23
(2) Retired	19.34±10.67	62.00±9.72
(3) Working	29.23±7.22	59.68±7.08
ANOVA	14.243 p=.000* 1vs3<.05	1.164 p=.314
Income		
(1) Income less than expenses	20.41±9.78	61.33±8.10
(2) Income equals expenses	20.15±10.86	62.00±9.32
(3) Income more than expenses	24.44±11.99	61.04±7.69
ANOVA	2.872 p=.058	0.293 p=.746
Smoking		
(1) I have never smoked	18.66±9.94	62.50±8.20
(2) I quit smoking	19.58±10.59	60.65±10.06
(3) I'm smoking	24.89±11.35	62.13±8.06
ANOVA	10.091 p=.000* 1vs3<.05	1.402 p=.248
Alcohol intake		
(1) I have never drunk alcohol	19.82±11.02	62.78±8.64
(2) I quit alcohol	21.46±10.44	60.35±9.47
(3) I drink alcohol	26.20±9.73	58.04±7.05
ANOVA	4.173 p=.016* 1vs3<.05	4.827 p=.009* 1vs2<.05 1vs3<0.05
Duration of diabetes (years)		
(1) Less than 5 years	26.45±9.16	63.20±10.26
(2) 6-10 years	22.67±10.52	62.27±8.12
(3) More than 11 years	17.24±10.49	60.82±8.52
ANOVA	22.875 p=.000* 1vs2<.05 1vs3<.05	2.056 p=.130

Table 3. The comparison of the mean scores on the e-HLS and the HBCVDS between descriptive characteristics

Characteristics	e-HLS	HBCVDS
Body Mass Index (kg/m^2)		
(1) Normal weight (18.5-24.9)	21.85±11.21	61.43±10.49
(2) Overweight (25.0-29.9)	21.28±10.73	60.95±8.02
(3) Obesity class I (30.0-34.9)	18.48±10.85	62.35±8.89
(4) Obesity class II (35.0-39.9)	21.62±10.89	64.96±9.38
(5) Obesity class III (more than 40)	20.40±11.69	56.00±8.03
ANOVA	1.095 p=.359	2.120 p=.078
Medication types		
(1) Oral medication	22.06±10.73	61.71±8.97
(2) Oral medication + insulin injection	20.03±11.42	62.36±8.94
(3) Insulin injection	17.98±10.20	61.13±8.61
ANOVA	3.697 p=.026* 1vs3<.05	0.342 p=.711
Complication		
No	21.41±10.54	62.13±8.99
Yes	20.00±11.25	61.28±8.74
t – test	1.168 p=.244	0.858 p=.392
Frequency of going to diabetes control		
(1) Quarterly	20.46±10.33	59.00±8.34
(2) Once every six months or once a year	20.69±10.62	60.89±9.33
(3) Once a year	20.93±11.16	62.46±8.58
(4) Every two to three years	20.18±9.08	61.50±8.82
ANOVA	0.023 p=.999	1.678 p=.155
Chronic disease other than diabetes		
No	22.84±11.09	61.91±9.58
Yes	19.65±10.62	61.66±8.49
t – test	2.546 p=.011*	0.244 p=.807
The situation of using heart/ blood pressure, or hearth rate medication		
No	23.61±10.93	60.86±9.46
Yes	19.46±10.62	62.15±8.59
t – test	3.238 p=.001*	-1.216 p=.225
A family history of heart disease		
No	21.30±10.96	62.39±9.62
Yes	20.39±10.83	61.29±8.32
t – test	0.747 p=.456	1.099 p=.272
Smartphone use		
No	10.11±5.07	60.79±8.17
Yes	24.11±10.03	62.04±9.08
t – test	-11.848 p=.000*	-1.088 p=.278
Access to health information sources *		
(1) Internet, social media	23.08±10.91	61.91±9.48
(2) From healthcare professionals	19.06±8.82	63.31±8.74
(3) From newspapers, television, or news	12.44±6.70	59.27±2.39
(4) From family or friends	12.69±6.45	60.07±4.07

Table 3. The comparison of the mean scores on the e-HLS and the HBCVDS between descriptive characteristics

Characteristics	e-HLS	HBCVDS
ANOVA	12.355 p=.000* 1vs3<.05 1vs4<.05	0.845 p=.497
Frequency of internet use		
(1) Every day	29.98±9.65	62.18±10.07
(2) Most days of the week	25.55±7.74	61.94±8.08
(3) A few days of the week	17.36±8.02	63.50±7.20
(4) Never	9.74±4.15	60.63±8.10
ANOVA	104.706 p=.000* 1vs3<.05 1vs4<.05	0.919 p=.432
Average daily internet use time		
(1) 0-59 min	15.00±8.57	61.00±8.56
(2) 60-90 min	27.35±8.01	63.46±9.37
(3) 91 min or more	31.35±7.90	61.92±9.05
ANOVA	115.608 p=.000* 1vs2<.05 1vs3<.05	2.160 p=.117
Do you think the internet has a positive impact on your health?		
(1) No	13.66±9.00	62.16±7.66
(2) Undecided	23.06±8.53	60.97±9.85
(3) Yes	29.86±8.74	62.21±9.34
ANOVA	88.167 p=.000* 1vs2<.05 1vs3<.05	0.693 p=.501

F= One-way ANOVA, Bonferroni, t= Independent sample t-test <.05

Table 4. Predictors of HBCVDS

Independent Variables	B	SE	Beta (β)	t	p	F	Model (p)	R^2	Durbin Watson
Constant	58.358	1.181	-	49.412	0.000*	5.691	0.000*	0.051	1.950
e-HLS	0.122	0.045	0.150	2.721	0.007*				
Gender (Female)	2.173	0.986	0.122	2.203	0.028*				
Alcohol intake (never)	3.955	1.866	0.119	2.120	0.035*				

***SE:** standard error of coefficient, **β:** standardized regression coefficient, **R^2:** proportion of variation in dependent variable explained by regression model, **p:** the level of statistical significance, *p<.05*

The Relationship Between The e-HLS and HBCVDS Mean Scores

The mean score on the e-HLS was moderate at 20.76±10.88 and the mean score on the HBCVDS was moderate at 61.74±8.88. There was a weak, positive correlation between the mean score on the e-HLS and the mean score on the HBCVDS (r=0.128; p=.020) (Table 2).

The Comparison of The Mean Scores On The e-HLS and The HBCVDS Between Descriptive Characteristics

The average e-HLS score of individuals with a university degree or higher among those with type 2 diabetes was found to be significantly higher compared to individuals with other education levels. Employed individuals had significantly higher e-HLS scores compared to those who were unemployed, and individuals with less than 5 years of diabetes duration had significantly higher e-HLS scores compared to those with 6 years or more. Individuals who did not use cardiovascular medications had significantly higher e-HLS scores. Those who owned a smartphone, used the internet daily, spent an average of 91 minutes or more on the internet per day, and believed that the internet had a positive effect on health, all had significantly higher e-HLS scores (p<.05) (Table 3).

Affecting Factors on HBCVDS

The factors affecting HBCVDS were e-HLS (β= 0.150), gender (female) (β= 0.122) and alcohol intake (never) (β= 0.119) (Table 4).

DISCUSSION

In this study, both electronic health literacy and the health beliefs related to heart disease of individuals with diabetes were found to be at a moderate level. As the electronic health literacy of individuals with diabetes increases, their health beliefs about heart disease also increase. In the literature report, similar scores in terms of e-health literacy (Kim et al., 2018; Lee and Shim, 2025). A study conducted in Taiwan showed that mobile e-health literacy is directly related to diabetes self-care behaviors and knowledge of computers, the internet, and mobile technologies, and indirectly affects health outcomes (Guo et al., 2021). This study emphasizes that e-health literacy can help improve diabetes management and glycemic control. In a study conducted in Turkey, it was observed that as the e-health literacy of individuals with diabetes increased, their self-care management also improved (Altaş et al., 2022). E-health literacy enables individuals to easily access accurate and up-to-date health information. The internet and digital health platforms allow individuals to gain information about diabetes management, receive nutrition and exercise advice, and access medical resources. Accessing and utilizing this information helps protect individuals from cardiovascular disease risk. E-health literacy facilitates individuals' access to cardiovascular disease-related information and educational materials. Digital resources such as educational videos, online courses, and health blogs encourage individuals to learn more about their conditions and take a more active role in managing their diseases (Guo et al., 2023). E-health literacy is an important factor that helps individuals with type 2 diabetes improve their self-care and health status. This is achieved through various means, such as easy access to information, health management tools, education and awareness, self-management, and motivation. Therefore, increasing e-health literacy is considered an important strategy for managing cardiovascular disease risk.

The average e-HLS score was significantly higher for individuals with type 2 diabetes who owned a smartphone, used the internet daily, had an average daily internet usage time of 91 minutes or more, and believed that the internet had a positive effect on health. Individuals who own a smartphone may use more digital tools to access health information and manage healthcare services. In particular, having internet access can facilitate access to information and increase individuals' e-health literacy. Individuals with an average daily internet usage time of 91 minutes or more may be more exposed to health information on digital platforms. Since health information shared on the internet can affect individuals' health, it is crucial to access accurate health information (Kasparian et al., 2017). These findings suggest that individuals with type 2 diabetes search for various information they consider important from the internet. This time may provide a sufficient opportunity to research, read, and understand information. Individuals who believe the internet is a positive tool for health may be more motivated to develop their digital health literacy skills. This perception may lead to more information-seeking and learning behaviors. Individuals who actively use smartphones and the internet may be more familiar with technology and possibly have higher educational levels, which could contribute to higher e-HLS scores. Education generally contributes to health literacy (Guo et al., 2023).

Individuals with low health literacy are less likely to have knowledge about diabetes and to maintain healthy lifestyle behaviors. Health-promoting behaviors were found to be associated with e-health literacy (Kim et al., 2018). This suggests that health literacy should be considered an important factor in the management of chronic diseases. Health literacy has potential effects on health beliefs. The components of the Health Belief Model, such as perceived susceptibility, barriers, self-efficacy, severity, and benefits, are influenced by health literacy. In individuals with diabetes, educational interventions based on the Health Belief Model have shown an increase in self-efficacy, perceived benefits, and susceptibility scores (Ağralı & Akyar, 2022; Jalilian et al., 2014).

Perceived severity, perceived barriers, and perceived benefits are significantly associated with self-care behaviors in patients. The higher the perceived severity, the better the self-care behaviors (De Melo et al., 2013). This may be because individuals who are more aware of diabetes and its serious complications are more likely to recognize it as a health threat and consciously adopt healthy behaviors. Perceived barriers, on the other hand, can prevent individuals from engaging in recommended behaviors (Jalilian et al., 2014). Patients with higher perceived benefit levels were more likely to engage in better self-care behaviors (Dehghani-Tafti et al., 2015). In order for individuals with diabetes to reduce the morbidity and mortality risk of CVD, they need to adopt perceived susceptibility, perceived severity, and perceived barriers and benefits related to CVD.

The regression analysis indicated that factors influencing cardiovascular disease risk factors (CVD) include e-health literacy, being female, and alcohol consumption. A study conducted in the Canadian diabetes population found that gender, perceived severity, perceived benefits, and perceived barriers are significant predictors of self-care behaviors. It was also found that women had healthier dietary behaviors compared to men (De Melo et al., 2013). Therefore, gender differences should be considered in

health education for individuals with diabetes. Individuals with diabetes who have higher levels of e-health literacy may feel more confident in acquiring, understanding, and applying diabetes-related information, and thus engage in health-promoting behaviors such as self-management of diabetes. This suggests that a strategy to promote healthy behaviors in individuals with diabetes should also include efforts to increase their e-health literacy (Kim et al., 2018).

This study found a relationship between e-health literacy and health beliefs regarding CVD in elderly individuals with type 2 diabetes. The findings showed that individuals with higher e-HLS levels had more positive health beliefs regarding CVD prevention and management. Specifically, these individuals were found to perceive their CVD risks better, have higher perceptions of the benefits of health behaviors, and make more active efforts to prevent the diseases.

Individuals with high e-HLS levels were more likely to use digital platforms to easily and accurately access information about CVD, understand this information, and apply it in health management, which may have contributed to strengthening their health beliefs. On the other hand, individuals with low e-HLS levels faced issues such as exposure to incorrect information about CVD, inadequate perception of health risks, and low motivation to prevent the disease. These results highlight that e-HLS is a critical determinant in CVD prevention and management in elderly individuals with type 2 diabetes. Therefore, educational programs aimed at increasing electronic health literacy and the use of digital tools by nurses offer an important opportunity to improve these individuals' health beliefs and behaviors related to CVD.

LIMITATIONS

This study has several limitations. The first limitation is that data was collected from only one hospital, which may reduce the generalizability of the results. The second limitation is that the e-health literacy and cardiovascular disease health beliefs scale is a self-reported measurement tool, meaning it is based on individuals' own beliefs.

CONCLUSION

In this study, both electronic health literacy and the health beliefs related to heart disease of individuals with diabetes were found to be at a moderate level. As the electronic health literacy of individuals with diabetes increases, their health beliefs about heart disease also increase. Individuals with high e-HLS levels were more likely to use digital platforms to easily and accurately access information about CVD, understand this information, and apply it in health management, which may have contributed to strengthening their health beliefs. On the other hand, individuals with low e-HLS levels faced issues such as exposure to incorrect information about CVD, inadequate perception of health risks, and low motivation to prevent the disease. These results highlight that e-HLS is a critical determinant in CVD prevention and management in elderly individuals with type 2 diabetes. Therefore, educational programs aimed at increasing electronic health literacy and the use of digital tools by nurses offer an important opportunity to improve the health beliefs and behaviors of these individuals regarding cardiovascular diseases. In addition, support for the use of technology, awareness programs to strengthen health beliefs, and continuous family and community support will increase success in the long-term health management of the elderly.

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