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Investigating e-health literacy and its relationship with self-care behaviors among Iranian Middle-aged type 2 diabetes: a cross-sectional study

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Abstract

Background E-health literacy is closely linked to a wide range of health outcomes, encompassing the control of diseases, self-efficacy, and the quality of life concerning health, as well as the attitudes and behaviors exhibited by patients. Therefore, we conducted this study to investigate e-health literacy and examine the relationship between e-health literacy and self-care behaviors in Iranian middle-aged type 2 diabetes.

Methods This cross-sectional study was conducted among 313 middle-aged (30–60 years) type 2 diabetics covered by the health care centers of Neyshabur City, Iran, in 2023. They were selected through a stratified random sampling method. Data was gathered using a demographic characteristics questionnaire, a Summary of Diabetes Self-care Activities, and an Electronic Health Literacy scale. Collected data were analyzed using multiple linear regression, t-test, one-way analysis of variance, and chi-square tests by SPSS software version 22, and the significance level was considered 0.05.

Results The mean age of the respondents was 48.41 ± 7.1 years. The mean (\pm SD) of the diabetes Self-care activities was 49.28 (14.9), and the mean (\pm SD) of e-health literacy was 20.6 (7.78). Most diabetics had low e-health Literacy 192(61.5%). After adjusting for the variables of type of treatment, measuring blood sugar at home, marital status, occupation and economic status, e-health literacy ($B = , 0.277, T = 4.5, P < .05$) was the statistically significant independent factor associated with diabetes self-care activities.

Conclusion Executing educational programs focusing on promoting e-health literacy can increase diabetes self-care activities, increasing overall diabetes's quality of life.

Keywords Health Literacy, Diabetes Mellitus, Information Literacy, Middle-aged, Self-care

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Background

Type 2 diabetes mellitus is a multifactorial chronic disease [1], and the most common type of diabetes in adults. Diabetes affects a large part of the population, and cases and prevalence are increasing in all countries with every income level [2]. Approximately 500 million individuals are currently affected by diabetes worldwide, with estimates indicating a potential escalation of 25% by the year 2030 and a substantial increase of 51% by 2045. It is expected to increase by more than 50% between 2017 and 2045 [3]. Approximately 422 million individuals across the globe suffer from diabetes, with the majority residing in low- and middle-income nations. Moreover, an estimated 1.5 million fatalities are directly linked to diabetes on an annual basis, and between 2000 and 2019, there was a 3% increase in diabetes mortality rates by age [4].

In addition to the aging population, environmental changes, the development of urbanization and lifestyle, the quality and quantity of diet, low physical activity, and the increase in body mass index are among the factors contributing to the rapid global increase in the prevalence and incidence of type 2 diabetes in decades [5].

Due to the increase in the prevalence of diabetes, without a doubt, the prevalence of its complications is also increasing, and in many cases, these complications are irreversible. Diabetes is the main cause of retinopathy, neuropathy, nephropathy and leg amputation, on the other hand, the risk of heart attack, stroke and death due to cardiovascular disease is higher in diabetic patients than in other patients [6]. Due to its nature, diabetes causes physical complications and death, as well as the use of health services by more people [7]. Its healthcare costs are estimated at 850 billion dollars annually [8].

One of the ways to prevent or postpone acute and chronic complications is timely diagnosis and self-care behaviors to effectively control and prevent disease progression [9]. Self-care in diabetic people means following a proper diet, regular physical activity, detection of increase or decrease in blood sugar, regular use of medications, and problem-solving skills (formulating a comprehensive array of feasible approaches for the resolution of issues, identifying the most suitable approach, implementing the approach, and assessing the efficacy of the approach.), and risk reduction behaviors [10]. In research conducted among Iranian diabetics, the mean of self-care behaviors was 24.54 [9] and 25.63 [11], which shows that diabetic people do not take care of themselves enough. Lack of self-care is one of the most important causes of death in diabetic people [12]. One of the influential factors in performing self-care behaviors is health literacy [9]. Low health literacy is associated with poor blood sugar control and microvascular and macrovascular

complications of diabetes and is an obstacle to improving health in diabetics [13].

Electronic health literacy (e-health literacy) refers to an individual's capacity to locate, evaluate, exchange, and use information from health communication technologies for their benefit and the benefit of others [14]. E-health literacy, which is the basic skill set for using information and communication technologies for health, is becoming increasingly important as e-health grows globally [15]. E-health literacy enables patients to actively participate in their healthcare by understanding and utilizing health information, which fosters patient empowerment [16]. For people who have high e-health literacy, their ability to search electronic resources and identify health resources is higher [17]. Also, they are less likely to be swayed by misleading online health information, such as that promoted by digital influencers [18]. Inadequate e-health literacy significantly impacts patient outcomes and healthcare costs. Patients with low e-health literacy struggle to understand health information, leading to poor disease management, increased hospitalizations, and higher mortality rates. This deficiency affects individual health and escalates overall healthcare expenses due to the need for more intensive medical interventions [19]. The studies conducted in Iran show patients' low [20] and average [21] e-health literacy.

E-health literacy is closely linked to a wide range of health outcomes, encompassing the control of diseases, self-efficacy, quality of life, and the attitudes and behaviors exhibited by patients [20, 21]. Electronic health literacy significantly influences self-care behaviors across various populations. E-Health literacy correlates with improved health promotion behaviors. Higher e-health literacy boosts confidence in managing health, leading to better self-care practices [22]. It affects self-management behaviors through self-efficacy, the intention to maintain health [23], lifestyle changes and medication adherence [24]. Patients with lower e-health literacy levels tend to have a lower physical activity levels and are more likely to be smokers [25].

Due to the increasing prevalence of chronic diseases, including diabetes, an expansion of the electronic world and the use of electronic resources to obtain information, it is necessary to have electronic health literacy to identify reliable information sources and use them correctly. Therefore, the present study aimed to investigate e-health literacy and examine its relationship with self-care behaviors in Iranian middle-aged type 2 diabetes.

Methods

Study design, setting and participants

This cross-sectional study was conducted the governmental health care centers of Neyshabur City, Iran,

among 313 middle-aged (30 to 60 years) type 2 diabetics. The study took place between March and September of 2023.

Eligibility criteria included age from 30 to 60 years old, at least six months have passed since the diagnosis of the disease, minimum secondary school education level, internet access and ability to use it and. Diabetic patients with physical or mental disability, history of cardiovascular and cerebral stroke, alcohol and drug abuse, and also, they with muscle joint disease who are prohibited from doing physical activity by the physician were excluded.

The sampling method was stratified-cluster sampling method. In this study, Neyshabur city was divided into four regions (north–south–east–west), and each region was considered one class. In each region (class), there are two healthcare centers. The healthcare centers located in each class were considered as clusters, and one cluster was randomly selected from each class, and four healthcare centers were selected. The sample size in each class was chosen according to the population living in each class (region). The samples were collected randomly from selected health care centers based on the health records, and then contacted by the researchers (two public health students) via phone call. After providing sufficient and appropriate explanations for the purpose of the study, they invited to participate in the study. If the invitation was accepted, the participants were set an appointment in health care centers (response rate = 100%). During questionnaire completion, two public health students were present to assist with any questions.

We used the primary information from previous studies [26, 27] to determine the sample size. We estimated the sample size using the following formula, where $\alpha = 0.05$, $B = 90\%$, $r = 0.47$ and considering about 10% attrition, the sample size was 220.

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2}{(\omega)^2} \quad \omega = \frac{1}{2} \log \frac{1+r}{1-r}$$

The collection of data was done using a survey instrument. The participants completed the questionnaire themselves completed the questionnaires, and they were given the freedom to withdraw or continue their participation in the study during the data collection phase.

The study was approved by the Neyshabur University of Medical Sciences Ethics Committee (Ethics Code: IR.NUMS.REC.1401.038). The study's aim was communicated to the participants, who were also assured of the confidentiality of their data. Finally, all participants signed a consent form.

Instruments

The questionnaire consisted of three parts:

Socio-demographic and health-related variables

This included assessing socio-demographic and health-related variables, including age, gender, marital status, body mass index (BMI), occupational status, fasting blood sugar, educational status, duration of diabetes, family history of diabetes, spouse's diabetes, type of treatment, suffering from other chronic diseases, having a glucometer at home, measuring blood sugar at home, and economic stats.

Electronic health literacy scale

The e-Health Literacy Scale (eHEALS) was designed by Norman et al. and contains eight items [28]. In this study, the Persian version of e-HEALS, validated by Bazm et al. [29], was used ($\alpha = 0.88$). In the present study, Cronbach's Alpha was used to evaluate internal consistency (0.79). The e-HEALS is a self-declaration based on the knowledge and understanding of what health information resources are available on the internet, where a person can search for useful health resources, how to access these resources, and how to use the internet to answer health-related issues, it focuses on the ability to evaluate online health information and distinguish poor quality sources from quality sources on the internet. The items were rated on a five-point Likert Scale from 1 for strongly disagree to 5 for strongly agree. The overall score of the scale ranges from 8 to 40, and higher scores indicate a higher e-Health Literacy. A score of 24 or higher on the e-HEALS denotes high e-health literacy [30].

Summary of diabetes self-care activities

This questionnaire was designed by Glasgow and Tobert and has 15 questions that examine the areas of diet (5 items), physical activity (2 items), blood sugar testing (2 items), foot care (4 items), medication use (1 item), and smoking (1 item) [31]. Except for a smoking question scored as 0 to 1, other items are scored based on an eight-point Likert scale (0 = no self-care to 7 = high self-care). The range of scores is between 0 and 99, and a higher score indicates higher self-care. In this study, the Persian version of summary of diabetes self-care activities, validated by Hamadzadeh et al. [32], was used ($\alpha = 0.84.9$). In the present study, Cronbach's Alpha was used to evaluate internal consistency (0.87).

Data analysis

We performed all the analyses using SPSS 22 (SPSS Inc, Chicago, IL, USA). The statistical description of the

socio-demographic and health-related variables was performed by applying frequencies, means, and standard deviations (SDs). Multiple linear regression, t-test and one-way analysis of variance were used to determine analytical goals. The level of significance was set to be < 0.05 .

Results

The respondents' mean (\pm SD) age was $48.41(\pm 7.1)$, ranging from 30 to 60 years.

The samples included 195 (62.3%) women and 118 (37.7%) men; of them, 222(79%) had a family history of diabetes, the majority 285(91.1%) were married and were self-employed 216(69%). There was a significant relationship between e-health Literacy and educational status, occupation, having a glucometer at home, measuring blood sugar at home, and economic status (Table 1).

The mean (SD) of the e-Health Literacy was 20.6 ± 7.78 , and the majority of diabetics had low e-Health Literacy 192(61.5%) (Table 2).

The multivariate linear regression test results showed that age, having a glucometer at home, measuring blood sugar at home, educational level and economic status, and occupation were significantly independent predictors of e-Health Literacy ($P < 0.05$) (Table 3).

Based on the multivariate linear regression results, after adjusting for the variables of age, marital status, type of treatment, measuring blood sugar at home, marital status, occupation, and economic status, the regression model showed that e-Health Literacy ($B = 0.277$, $T = 4.5$, $P < 0.05$) was a statistically significant independent factor associated with diabetes Self-care (Table 4).

Discussion

This study was conducted to investigate e-health literacy and examine the relationship between e-health literacy and self-care behaviors in Iranian middle-aged type 2 diabetics.

The results of this study indicate a significant positive relationship between e-health literacy and self-care behaviors in individuals with diabetes. Self-care behaviors are essential for the effective management of blood sugar levels in individuals with type 2 diabetes mellitus. Research highlights the importance of self-management practices, including dietary regulation, regular physical activity, blood glucose monitoring, medication adherence, and foot care, in achieving optimal blood sugar control and reducing the risk of diabetes-related complications [33, 34]. E-health literacy plays a vital role in shaping effective self-management of diabetes across different age groups [35, 36]. Consistent with our findings, other studies have also demonstrated a positive relationship between e-health literacy

Table 1 Demographic/Underlying Characteristics of Middle-aged Type 2 Diabetics and Their Relationships With e-Health Literacy ($N = 313$)

Variables	Frequency (%)	Mean (SD)	p-value
Age			
30–40	44(14.1%)	22.6 \pm 8.09	0.18 ^a
41–50	149(47.6%)	21 \pm 8.67	
51–60	120(38.3%)	19.5 \pm 6.23	
Gender			
Female	195(62.3%)	20.8 \pm 8.78	0.63 ^b
Male	118(37.7%)	20.36 \pm 7.68	
Educational Status			
Secondary school	146(46.6%)	17.7 \pm 7.14	< 0.001 ^{a*}
High school	111(35.5%)	20.9 \pm 6.86	
University	56(17.9%)	27.3 \pm 6.44	
Marital Status			
Single	5(1.6%)	22 \pm 18.8	0.08 ^a
Married	285(91.1%)	20.9 \pm 7.5	
Divorced	11(3.5%)	22 \pm 8.73	
The wife is dead	12(3.8%)	15.5 \pm 5.97	
Occupation			
Government employee	35(11.2%)	28.4 \pm 8.4	< 0.001 ^{a*}
Worker	25(8%)	18.7 \pm 6.4	
Self Employed	216(69%)	19.81 \pm 7.31	
Retired	37(11.8%)	19.7 \pm 6.7	
BMI			
Underweight (less than 18.5)	8(2.6%)	20 \pm 7.27	0.823 ^a
Healthy Weight (18.5 to 24.9)	82(26.3%)	20.89 \pm 8.7	
Overweight (25.0 to 29.9)	121(38.8%)	20.2 \pm 7.6	
Obese (30.0 or higher)	101(32.4%)	21.1 \pm 7.36	
Fasting blood sugar			
Controlled blood sugar (80–130)	93(29.7%)	21.3 \pm 7.5	0.088 ^b
Uncontrolled blood sugar (> 130)	220(70.3%)	20.4 \pm 7.9	
Family history of diabetic			
Yes	222(79%)	20.8 \pm 8.1	0.98 ^b
No	91(29.1%)	20.3 \pm 6.9	
spouse's diabetes			
Yes	31(9.9%)	18 \pm 4.95	0.056 ^b
No	282(90.1%)	20.9 \pm 7.9	
Type of treatment			
Insulin	28(8.9%)	21.7 \pm 7.3	0.767 ^a
Medicine	239(76.4%)	20.64 \pm 7.9	
Insulin and medicine	28(8.9%)	19.6 \pm 7.2	
None	18(5.8%)	21.1 \pm 8.07	
Having at least one other chronic disease			
Yes	243(77.6%)	20.49 \pm 7.7	0.365 ^b
No	70(22.4%)	21.34 \pm 7.8	

Table 1 (continued)

Variables	Frequency (%)	Mean (SD)	p-value
Having a glucometer at home			
Yes	186(59.4%)	21.7 ± 7.08	0.007 ^{b*}
No	127(40.6%)	19.17 ± 7.21	
Measuring blood sugar at home			
Yes	191(61%)	22.1 ± 7.7	< 0.001 ^{b*}
No	122(39%)	18.4 ± 7.35	
Economic Status			
Weak	95(30.4%)	17.7 ± 6.93	< 0.001 ^{a*}
Moderate	189(60.4%)	21.1 ± 7.5	
Good	29(9.3%)	27.6 ± 6.7	

^a One way Anova test, ^bT-test; *Significant

Table 2 E-health literacy levels of Middle-aged Type 2 Diabetics (N = 313)

E-health literacy level	Frequency (%)
Low	192(61.5%)
High	120(38.5%)
Mean (SD)	20.6 ± 7.78

and diabetes self-care management [37, 38]. Additionally, e-health literacy has been shown to enhance diabetes self-management by promoting self-efficacy, which mediates this relationship [36, 39]. Enhancing e-Health literacy improved patients' ability to manage their condition effectively [40]. The adverse effects of low health literacy on health behaviors highlight the significance of enhancing e-health literacy as a metric for evaluating health education initiatives [41, 42].

Given the growing availability of electronic resources and the potential to leverage this capacity, specialists should consider utilizing these tools to enhance patients' self-care practices. Additionally, government agencies should more closely monitor electronic health resources to prevent disseminating unreliable information. Finally, efforts should be made to enhance e-health literacy within the community, particularly among patients, to help them recognize and identify reliable sources of information.

Our study revealed that individuals with diabetes with moderate and stable economic status demonstrate better self-care behaviors than those with lower financial means. Economic status significantly influences adherence to diabetes self-care practices, with notable variations across different economic levels. Research has shown that individuals with higher income levels are more likely to adhere to self-care practices,

Table 3 Predictors of e-Health Literacy in middle-aged type 2 diabetics (N = 313)

Variables	B	T	P Value
Age^a			
30–40	0.142	2.31	0.018
41–50	0.096	1.58	0.114
51–60	Ref		
Gender			
Female	Ref		
Male	-0.091	-1.08	0.28
Educational status^a			
Secondary school	-0.4	-4.5	0.001
High school	-0.252	-2.69	0.007
University	Ref		
Marital Status			
Single	0.068	1.124	0.262
Married	0.122	1.57	0.117
Divorced	0.133	1.88	0.06
The wife is dead	Ref		
Occupation^a			
Government employee	0.194	2.6	0.01
Worker	0.049	0.68	0.497
Self Employed	0.163	1.79	0.074
Retired	Ref		
BMI			
Underweight (less than 18.5)	Ref		
Healthy Weight (18.5 to 24.9)	0.035	0.675	0.5
Overweight (25.0 to 29.9)	0.026	0.5	0.615
Obese (30.0 or higher)	0.027	0.452	0.651
Fasting blood sugar			
Controlled blood sugar (80–130)	Ref		
Uncontrolled blood sugar (> 130)	-0.05	-0.85	0.932
Family history of diabetic			
Yes	0.011	0.224	0.823
No	Ref		
Spouse's diabetes			
Yes	-0.068	-1.33	0.183
No	Ref		
Type of treatment			
Insulin	-0.068	-0.8	0.423
Medicine	-0.078	-0.8	0.418
Insulin and medicine	-0.087	-1.05	0.293
None	Ref		
Having at least one other chronic disease			
Yes	0.046	0.895	0.371
No	Ref		
Having a glucometer at home			
Yes	-0.02	-0.311	0.759
No	Ref		
Measuring blood sugar at home^a			
Yes	0.173	2.73	0.007
No	Ref		

Table 3 (continued)

Variables	B	T	P Value
Economic status^a			
Weak	Ref		
Moderate	0.097	1.54	0.123
Good	0.231	3.51	0.001

Multivariate Linear Regression

^a Significant

including following dietary guidelines, taking medication, and engaging in regular physical activity [43–45].

Lower economic status may affect limited access to resources, knowledge, and support necessary for effective self-care, leading to poorer health outcomes. However, at times, self-care practices can be cultivated regardless of economic status through community support and education, suggesting that interventions may mitigate the negative effects of low economic status on health behaviors.

In our study, people with diabetes who measured their blood sugar at home and who took insulin or medication had better self-care behaviors than those who took neither. Inconsistent with our results, the results of the study conducted in Ethiopia showed that those diabetes mellitus who were prescribed a tablet in conjunction with insulin were more inclined to exhibit good self-care behaviors in comparison to individuals following alternative therapeutic regimens [46]. Other studies have also demonstrated a positive relationship between treatment intensity and patients’ self-care behaviors. For instance, insulin users tend to adhere more closely to medical recommendations and exhibit better self-care behaviors than those using other treatment methods [47, 48]. Personalized blood glucose monitoring and feedback have shown significant potential in improving glycemic control and reducing diabetes complications [49]. Studies have shown that customized blood glucose monitoring not only improves glycemic management but also reduces diabetes-related distress, increases medication adherence, and enhances patient compliance [50].

Based on the results, it can be concluded that when diabetics self-monitor blood sugar, they receive feedback on their condition, increasing their involvement and better management of the disease. Self-monitoring of blood sugar provides the possibility of timely adjustment of self-care behaviors. While personalized monitoring shows promise in improving self-care behaviors, it is essential to consider that not all individuals may respond equally to these interventions. Some may require additional support or alternative strategies to achieve optimal self-management outcomes.

Based on our results, the majority of people with diabetes had low e-health Literacy. The status of e-health

Table 4 Predictors of Diabetes Self-care Activities in middle-aged type 2 diabetics (N = 313)

Variables	B	T	P Value
E-health Literacy			
	0.277	4.5	0.001
Age			
30–40	-0.053	-0.813	0.417
41–50	-0.034	-0.516	0.616
51–60	Ref		
Gender			
Female	Ref		
Male	-0.043	-0.69	0.431
Educational Status			
Secondary school	-0.033	-0.35	0.727
High school	-0.011	-0.128	0.899
University	Ref		
Marital Status			
Single	0.108	1.67	0.097
Married	0.171	2.065	0.04
Divorced	0.253	3.3	0.001
The wife is dead	Ref		
Occupation			
Government employee	-0.182	-2.28	0.023
Worker	-0.176	-2.291	0.025
Self Employed	-0.193	-1.98	0.043
Retired	Ref		
BMI			
Underweight (less than 18.5)	Ref		
Healthy Weight (18.5 to 24.9)	-0.006	-0.1	0.916
Overweight (25.0 to 29.9)	-0.011	-0.173	0.863
Obese (30.0 or higher)	-0.015	-0.23	0.818
Fasting blood sugar			
Controlled blood sugar (80–130)	Ref		
Uncontrolled blood sugar (> 130)	0.039	0.594	0.553
Family history of diabetic			
Yes	-0.028	-0.521	0.63
No	Ref		
spouse’s diabetes			
Yes	0.01	0.191	0.849
No	Ref		
Type of treatment			
Insulin	0.198	2.18	0.03
Medicine	0.267	2.5	0.01
Insulin and medicine	0.243	2.8	0.005
None	Ref		
Having at least one other chronic disease			
Yes	0.01	0.191	0.842
No	Ref		
Having a glucometer at home			
Yes	0.088	1.3	0.193
No	Ref		
Measuring blood sugar at home			
Yes	0.134	0.197	0.049

Table 4 (continued)

Variables	B	T	P Value
No	Ref		
Economic Status			
Weak	Ref		
Moderate	0.181	2.67	0.008
Good	0.219	3.1	0.002

literacy among patients varies across different studies. Research shows many patients have low e-health literacy, with varying abilities in locating, understanding, and utilizing digital health information effectively [47, 51]. In a study conducted among Hispanics with diabetes, participants reported significant difficulty in using the internet to find answers to health-related questions [48]. In an urban radiation therapy department, only 10% of patients demonstrated good e-health literacy [52]. Research has shown that the three most influential factors in lowering e-health literacy scores are evaluating health and online health resources, distinguishing between high- and low-quality information, and effectively using these resources to make informed health-related decisions [30, 53]. Other reasons for low e-health literacy could be attributed to the limited access to the internet and socio-economic factors [51, 54, 55]. Also, it seems that in Iran, unlike in Europe and the United States, health education resources that the Ministry of Health approves the Ministry of Health approves are either limited in number or less visible and promoted [53].

Most of the participants in this study lacked a university education, which can be associated with the low e-health literacy level of the participants, as individuals may lack the skills to navigate online health information effectively.

Patients' low e-health literacy and inability to recognize quality resources, leading to uncertainty in making health-related decisions. Health professionals have to raise awareness among patients and help them identify reliable sources. The content of sources, such as websites, Telegram channels, and other platforms that publish health-related information, should be carefully evaluated to ensure that inaccurate or misleading information is not disseminated.

Based on the results, e-health literacy has been found to decrease with the age of diabetes. In line with these findings, other studies have also reported lower e-health literacy among older adults [56, 57]. Our findings also showed that e-health literacy increases with higher education levels, consistent with previous research [58, 59].

In Iranian society, older adults typically have lower levels of education, which can impact their e-health literacy.

By developing and implementing targeted e-health literacy programs, healthcare providers can empower older individuals to engage more effectively with digital health resources, thereby improving their health behaviors and knowledge.

Also, we found a positive relationship between e-health literacy and the economic status of diabetes. Consisted with our results; other studies showed people with high financial status had higher e-health literacy [56, 60]. Different socio-economic levels are not uniform regarding internet access [61]. People with higher socio-economic status exhibit higher e-health literacy levels and are more likely to seek web-based information on health topics, leading to better adherence to health behaviors [56, 62].

Enhanced e-health literacy levels are pivotal in facilitating health decision-making processes and strengthening overall health outcomes [57]. Specific populations, particularly vulnerable groups, are more susceptible to experiencing challenges related to e-health literacy [63]. It is important to note that merely increasing access to technology is inadequate for addressing disparities in e-health literacy. The degree of technology adoption, ranging from intermediate to high levels, directly influences e-health literacy levels [64].

The impact of socio-economic status on e-health literacy underscores the need for policy interventions aimed at reducing disparities by targeting vulnerable populations. Efforts to improve health literacy should consider the diverse socio-economic backgrounds of individuals to ensure equitable access to and understanding of digital health resources. Addressing low e-health literacy through targeted interventions is crucial for empowering patients and enhancing their involvement in healthcare decisions, ultimately improving diabetes management outcomes.

The current study had several limitations. First, the cross-sectional design does not establish causation and changes over time in e-health literacy and Diabetes Self-care activities. Second, as all information collected in this study was based on self-reporting, the answers may have a socially desirable response bias.

Conclusion

E-health literacy among individuals with diabetes was low, with a positive correlation between e-health literacy and diabetes self-care activities. As a result, educational programs aimed at enhancing e-health literacy among Iranian diabetics are essential. Special attention should be given to older adults and those with lower education levels and economic status. Emphasizing the importance of diabetes self-care activities is crucial, and individuals with diabetes should be educated on adopting a healthy lifestyle to manage and prevent complications.

In conclusion, the results of this study indicated a relationship between e-health literacy and self-care activities in hypertensive patients. Our findings call attention to the low e-health literacy in hypertensive patients. As a result, educational programs aimed at enhancing e-health literacy among Iranian hypertensive patients are essential. Special attention should be given to those with lower education levels.

The M-CHWs' well understanding of their role was correlated with less experiencing work-related stress. Furthermore, the support of M-CHWs from their superior/ senior managers had a strong correlation with high professional knowledge and responsibility, teaching planning and assessment, and human resource.

Therefore, researchers should consider these factors to design qualified interventional research and programs, as well as high political support, should provide to M-CHWs via in-service educational courses to enhance teaching skill and mental health among M-CHWs.

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Authors' contributions

S.S, S.S and Y.Gh designed the study. S.S and Y.Gh collected data. S.S and Z.AB analyzed and interpreted results. S.S, M.T and S.S writhed the manuscript. S.J edited the manuscript. All authors reviewed the manuscript.

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Data availability

All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

Ethical approval for the study protocol was provided by the Ethics Committee of Neyshabur University of Medical Sciences (ethics code: IR.NUMS.REC.1401.038). All the participants voluntarily signed the informed consent form to participate in the study. All methods were performed following the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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