EXPLORING KEY DETERMINANTS OF HEALTH LITERACY IN TYPE 2 DIABETES PATIENTS: A CROSS-SECTIONAL STUDY

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Health literacy (HL) is a critical factor in the management of type 2 diabetes mellitus (T2DM), yet many patients lack adequate understanding, leading to poor health outcomes. This study assessed HL among patients with T2DM and identified associated factors. This cross-sectional study involved 358 diabetic outpatients who completed a self-reported questionnaire, including the Health Literacy - Short Form (HL-SF12), Diabetes Self-Management Instruments (DSMI-20), and Multi-Dimensional Support Scale (MDSS). Analysis using SPSS 26.0 revealed an average HL score of 26.3 ± 5.3, with 88.9% of participants demonstrating inadequate HL. Patients under 60 years old, those with higher education, a monthly income over 5 million VND, diabetes duration of less than 5 years, non-alcohol consumers, and effective self-managers showed notably higher HL scores ($p < 0.05$). Four factors are likely to influence the HL, including "Age" ($\beta = -0.23$; 95% CI: -0.27, -0.19; $p < 0.001$), "Educational level" ($\beta = 3.56$; 95% CI: 2.49, 4.64; $p < 0.001$), "Income" ($\beta = 1.25$; 95% CI: 0.54, 1.96; $p = 0.001$), and "Self-management" ($\beta = 0.12$; 95% CI: 0.08, 0.16; $p < 0.001$. Recommendations include reinforcing health information sources and education programs, to enhance comprehension and self-management skills, contributing to more effective care and education strategies for T2DM patients, particularly elderly patients.

Keywords: Health literacy, health knowledge, type 2 diabetes mellitus.

I. INTRODUCTION

Diabetes mellitus (DM), particularly type 2 diabetes (T2DM), is a growing health concern, posing significant challenges for the medical community and society. According to the International Diabetes Federation (IDF), 536.6 million individuals aged 20 - 79 were living with diabetes globally in 2021, with projections of 643 million by 2030 and 783 million by 2045.[1,2] Notably, 87.5% of undiagnosed cases are found in low and middle-income countries, including Vietnam.[1] In 2021, diabetes caused over 6.7 million deaths, with complications and treatment costs reaching an estimated 966 billion USD, accounting for 11.5% of total global health expenditure. These figures highlight the urgent need for a global focus on solutions to combat the rising challenge of diabetes.[2]

Effectively managing diabetes demands active collaboration between healthcare providers and patients, with patients actively participating in treatment decisions and engaging in self-management and goal-setting.[3] However, individuals with poor health literacy may struggle with these tasks and may not effectively access healthcare information. Health literacy refers to the extent to which individuals or organizations can actively search for, comprehend, and apply information and services to make health-related decisions and take actions for themselves and others.[3] Studies suggest that insufficient health literacy is linked to diminished treatment outcomes, such as

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lower health status, a lack of understanding regarding medical conditions, and decreased interaction with healthcare providers.[3] This leads to higher mortality rates, suboptimal use of preventive healthcare services, poor health self-management, increased complications, and heightened hospitalization rates.

Vietnam is a lower-middle-income country, and the prevalence of diabetes rose nearly 6 times among the population aged 25 - 64 years old in Vietnam during the last 10 years.[4] It is worth noting that up to 69.9% of diabetes cases are undiagnosed and of those diagnosed, only 28.9% are managed at a medical facility.[5] Tobe able to well manage diabetes conditions, increasing health literacy is extremely important. Many studies showed that good health literacy would help people with type 2 diabetes control their blood sugar, reduce disease-related treatment costs, and improve their current health status.[6] Understanding the current state of health literacy and identifying factors related to the health literacy of individuals with T2DM will assist researchers and healthcare professionals in devising effective strategies to enhance disease knowledge, strengthen self-management capabilities, and consequently improve overall health outcomes. Hence, this study aims to delineate the present state of health literacy among outpatients receiving treatment for type 2 diabetes at Thanh Nhan Hospital and examine factors associated with health literacy among this demographic.

II. MATERIALS AND METHODS

1. Subjects

The study includes T2DM outpatients at Thanh Nhan Hospital during the study period. Pregnant individuals with T2DM and those previously interviewed are excluded.

2. Methods

Study Design

This study adopted a cross-sectional study design. The reporting of this study was based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.[7]

Data Source

The sample size (n) was calculated using the formula:

$$n = Z^2_{(1-\alpha/2)} \cdot \frac{p(1-p)}{d^2}$$

n: Number of Type 2 Diabetes patients in the study.

p: The proportion of patients with adequate health literacy from a similar study (p = 0.36).[8]

$Z_{1-\alpha/2} = 1.96$ with $\alpha = 0.05$.

d: Desired margin of error (d = 0.05).

This calculation determined a minimum required sample size of 354 patients; the actual study included 358 subjects. The sampling method was carried out as follows: the researcher selected the first patient from the outpatient list at the Examination Department and then chose every 2nd patient thereafter to participate in the survey. This method ensured a representative sample from the outpatient population. Data collection occurred over a period of 6 months, averaging about 60 - 70 patients per month.

Measurement tools

(1) General Characteristics

- Demographic Characteristics

Age, gender, ethnicity, religion, education level, occupation, marital status, income, smoking history, alcohol consumption history, BMI (height, weight).

- Type 2 Diabetes-Related Characteristics

Current health status, duration of diabetes, complications (if any), treatment methods, blood glucose levels, HbA1c levels.

(2) Self-Management

To measure self-management activities, the study employs the Diabetes Self-Management Instruments - Revised (DSMI-20). The DSMI-20 evaluates self-management behaviors over the past three months and consists of 20 questions using a 4-point Likert scale: 1 = never, 2 = rarely, 3 = often, and 4 = always. It demonstrates strong reliability, with an overall internal consistency (Cronbach's α) of 0.925 and ranging from 0.838 to 0.892 for the four factor groups.[9] Total scores range from 20 to 80, with higher scores indicating more frequent self-management activities and improved diabetes management. Testing on 30 individuals with type 2 diabetes in Vietnam resulted in a Cronbach's α of 0.957 for the overall scale, and 0.890, 0.840, 0.930, and 0.868 for the four factor groups.

(3) Social Support

To measure social support, the study utilized the Multi-Dimensional Support Scale (MDSS). This scale assesses the ability to receive emotional, practical, and informative support from family and friends (6 items) and healthcare professionals (5 items). In Vietnam, Nguyen Hoang Long adapted the MDSS, resulting in a Cronbach's alpha of 0.74 for the total scale (11 items). Participants evaluated their perceived support from family and friends and healthcare professionals within a 2 to 5-minute timeframe. Support capacity is calculated by summing frequency scores, ranging from 0 (never) to 3 (frequently). Scores from family and friends range from 0 to 18, while those from healthcare professionals range from 0 to 15, with higher scores indicating better perceived social support.[10]

(4) Health Literacy

Health literacy is assessed using the HL-SF12 tool developed by Duong Van Tuyen and colleagues. This tool was validated with a convenient sample of 403 patients from three departments of a community-based general hospital in North Taiwan, with reference data from a population of 928. The HL-SF12 shows strong internal consistency, evidenced by a Cronbach's α of 0.87. It was tested on 30 individuals with type 2 diabetes in Vietnam, resulting in a Cronbach's α of 0.907 for the overall scale. The scoring ranges from 0 to 50, with questions 1 to 12 scored on a 4-point Likert scale (0 = very difficult to 3 = very easy). The reliability analysis met the criterion of Cronbach's α ≥ 0.70 for satisfactory reliability. Health literacy scores from 0 to 33 indicate inadequate health literacy, while scores from 34 to 50 signify adequate health literacy.[11]

Data Collection

Step 1 involves researchers contacting Thanh Nhan Hospital to obtain study approval. In Step 2, investigators are selected from the nursing staff and trained on the research tool and methodology. Step 3 focuses on identifying patients based on specific criteria and explaining the study's purpose and content to participants. In Step 4, direct interviews are conducted using the structured questionnaires, with supervision to ensure data completeness. After the interviews, Step 5 requires investigators to verify the questionnaires and request any necessary supplements. Finally, Step 6 involves using management codes to reference medical records and gather relevant patient information, followed by collecting the questionnaires, cleaning the data, and preparing for data entry. The estimated total time to complete the survey is between 30 to 45 minutes *(see Figure 1).*

Data Analysis

The collected data are analyzed using SPSS 26.0 software. The study aims to statistically describe the frequency of demographic characteristics (age, gender, educational level, income), type 2 diabetes-related factors (smoking, alcohol consumption, disease duration, complications, HbA1C), health literacy, self-management, and social support among

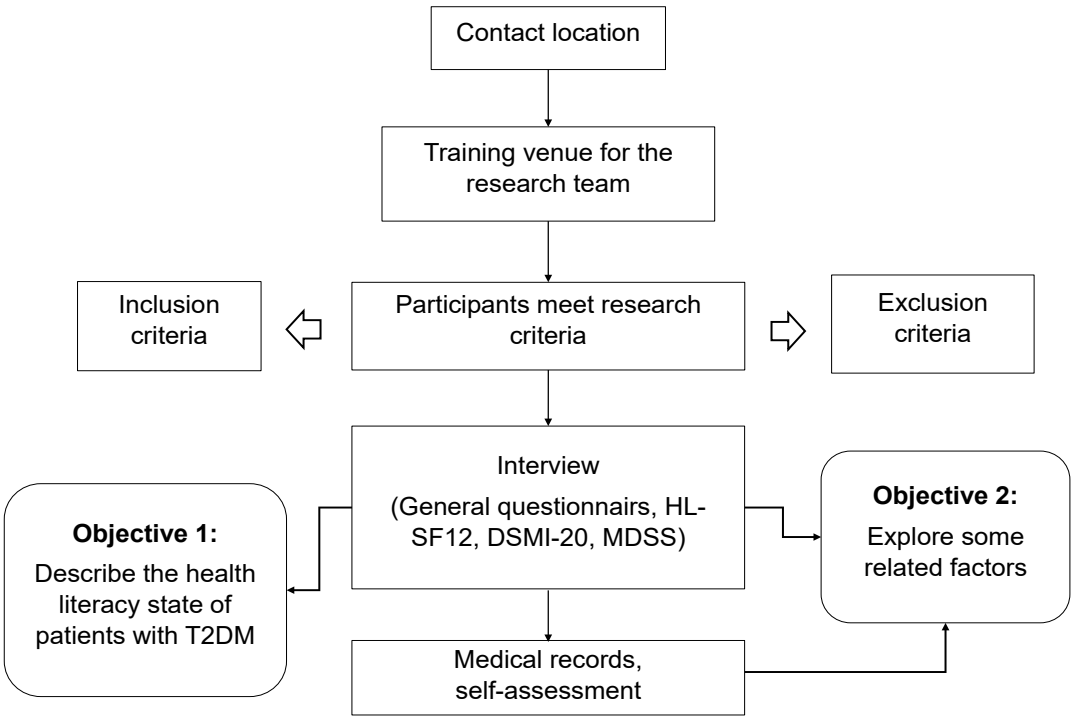

Figure 1. Data collection process

T2DM patients. It also explores correlations between these variables and health literacy using ANOVA, t-tests, and Pearson analysis. Finally, a multivariate linear regression model identifies and eliminates non-significant factors affecting health literacy, highlighting the overall contribution of risk factors ($p < 0.05$).

3. Research ethics

This study obtained an Institutional Review Board (IRB) review exemption from the IRB of Hai Phong Univeristy of Medicine and Pharmacy (No. 722/QD-YDHP signed on the 18th of April, 2023). The study also obtained consent from the leadership of Thanh Nhan Hospital. Informed consent was obtained from all participants.

III. RESULTS

1. Health literacy characteristic of T2DM patients

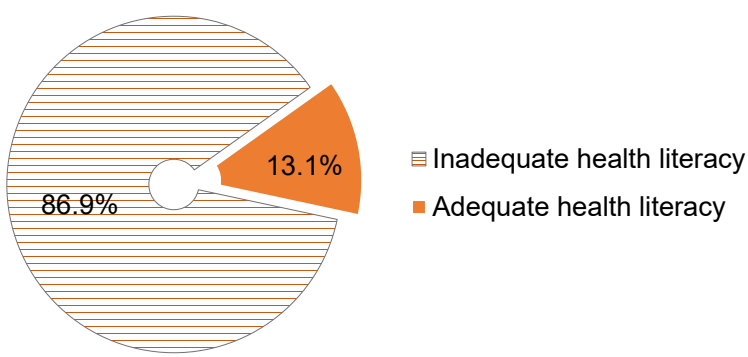

Chart 1. Assessment of health literacy level

The mean health literacy score for individuals with type 2 diabetes mellitus is 26.3 ± 5.3, with scores ranging from 13 to 44. A significant majority (88.9%) of patients exhibit inadequate health literacy, while only 13.1% demonstrate sufficient health literacy.

2. The related factors associated with health literacy among T2DM patients

Health literacy in patients with type 2 diabetes mellitus is significantly influenced by age, education, and income. Those under 60, with at least a high school education, and a monthly income of ≥ 5 million VND show higher health literacy ($p < 0.001$). Gender does not significantly affect health literacy ($p = 0.924$). Patients diagnosed with diabetes for less than 5 years and those who abstain from alcohol also demonstrate higher health literacy ($p < 0.001$). Additionally, patients without complications exhibit better health literacy than those with complications ($p = 0.05$). Smoking does not significantly impact health literacy ($p = 0.295$).

Table 1. Correlation between general characteristics and health literacy

Characteristics		n (%)	Health literacy (HL-SF12)	F, p$^{\chi}$
Age	≤ 60 years old	81 (22.3)	33.38 ± 5.48	F = 35.990 *p < 0.001*
	≥ 60 years old	278 (77.7)	24.51 ± 3.41	
Gender	Male	137 (38.3)	26.70 ± 5.20	F = 0.009 p = 0.924
	Female	221 (61.7)	26.12 ± 5.39	
Educational level	< High school level	289 (80.7)	24.66 ± 3.54	F = 34.623 *p < 0.001*
	≥ High school level	69 (19.3)	33.38 ± 5.77	
Income (VND/ month)	≤ 5 milion	208 (58.1)	24.54 ± 3.58	F = 74.302 *p < 0.001*
	≥ 5 milion	150 (41.9)	28.84 ± 6.25	
Smoking	Yes	51 (14.2)	26.94 ± 5.70	F = 1.099 p = 0.295
	No	307 (85.8)	26.24 ± 5.25	
Drinking alcohol	Yes	46 (12.8)	29.02 ± 6.71	F = 21.427 *p < 0.001*
	No	312 (87.2)	25.95 ± 4.97	
Duration of diabetes	≤ 5 years	118 (33.0)	28.69 ± 6.29	F = 29.580 *p < 0.001*
	≥ 5 years	250 (67.0)	25.19 ± 4.34	
Complications	Yes	228 (63.7)	25.61 ± 5.04	F = 3.857 *p = 0.050*
	No	130 (36.3)	27.64 ± 5.56	

χ: Independence sample t-test

Patients who effectively self-manage type 2 diabetes and achieve target HbA1c levels have higher health literacy than those with inadequate management and elevated HbA1c levels ($p < 0.001$). However, social support does not significantly correlate with health literacy in this population ($p = 0.169$) *(see Table 2).*

Table 2. Correlation between self-management, social support, HbA1c and health literacy

Characteristics	Mean ± *SD* (Min - Max)	Health literacy (HL-SF12)		p[ɣ]
Self-management (DSMI-20)	50.10 ± 10.65 (36 - 71)	r =	0.399**	< *0.001*
Social support (MDSS)	25.20 ± 3.60 (16 - 33)	r =	0,073	0.169
HbA1c	8.08 ± 1.48 (5.3 - 13.1)	r =	- 0.198*	< *0.001*

ɣ: Pearson Correlation

3. Model predicting factors associated with health literacy among T2DM patients

The linear regression model, comprising 8 statistically significant independent variables (Adjusted R^2 = 0.664; ANOVA for F(8, 349) = 89.305; p < 0.001), explains 66.4% of the health literacy level in patients with type 2 diabetes mellitus, with the remaining 33.6% attributed to external factors and random error. The model fits the data well, with a Durbin-Watson value of 1.839 indicating no first-order autocorrelation. The residual plot shows a bell-shaped pattern with a mean close to 0 and a standard deviation of 0.989, supporting the assumption of normal distribution.

Among the 8 independent variables, four significantly influence health literacy: “Age” (β = -0.23; 95% CI: -0.27, -0.19; p < 0.001), “Educational level” (β = 3.56; 95% CI: 2.49, 4.64; p < 0.001), “Income” (β = 1.25; 95% CI: 0.54, 1.96; p = 0.001), and “Self-management” (β = 0.12; 95% CI: 0.08, 0.16; p < 0.001). Educational level is the most significant factor, accounting for 69.0% of the variance, followed by income at 24.2%. Age negatively impacts health literacy, while self-management contributes only 2.3%.

Table 3. Linear regression model exploring factors associated with health literacy

Characteristics	β	95% CI	t	p	Level of impact
Age	-0.23	-0.27 - -0.19	-11.27	< *0.001*	4.5%
Educational level	3.56	2.49 – 4.64	6.52	< *0.001*	69.0%
Income	1.25	0.54 – 1.96	3.46	*0.001*	24.2%
Duration of diabetes	-0.36	-1.14 – 0.42	-0.92	0.360	
Complications	0.29	-0.46 – 1.04	0.77	0.441	
Drinking alcohol	-0.31	-1.32 – 0.71	-0.59	0.554	
Self-management (DSMI-20)	0.12	0.08 – 0.16	5.98	< *0.001*	2.3%
HbA1c	-0.15	-0.43 – 0.13	-1.05	0.295	
Constant	31.37				

**β: Standardized Coefficients Beta; CI: Confidence Interval*

IV. DISCUSSION

On the average, individuals with Type 2 Diabetes Mellitus (T2DM) scored 26.3 ± 5.3 points in health literacy, but a significant majority (88.87%) have inadequate health literacy, contrasting with the 13.1% who exhibit a good understanding of health. This highlights a critical challenge for healthcare systems worldwide, where individuals struggle to navigate health information effectively. Among the factors related to health literacy in patients with type 2 diabetes mellitus, educational level, income, age, and self-management strongly and significantly influence health literacy, with $p < 0.05$. Educational level emerges as the most influential factor ($\beta = 3.56$; 95% CI: 2.49, 4.64; $p < 0.001$). Consistent with prior research, higher educational levels are associated with increased health literacy, and conversely, lower educational levels are linked to lower health literacy. This trend aligns with findings from the "International Adult Literacy Assessment," indicating that individuals with lower educational levels tend to have lower health literacy compared to those with higher educational levels.[12] This suggests that individuals in the study sample may struggle to understand health care-related information, affecting their ability to evaluate preventive health information for accuracy, reliability, and quality.

Income also significantly influences health literacy among patients with T2DM, with a 1 million VND increase in monthly income being associated with a 1.25-fold increase in health literacy ($\beta = 1.25$; 95% CI: 0.54, 1.96; $p = 0.001$). Limited health literacy correlates with lower household income, as low-income adults often experience disparities in healthcare access, including lack of insurance, restricted access to services, and lower care quality.[13] This highlights the necessity for government initiatives to enhance social welfare, implement more free health examination and treatment programs, and provide remote health consultations and education. Such measures would assist individuals facing challenges in accessing healthcare and improve care quality in accordance with the population's education and income levels.

There is a positive correlation between the average health literacy score (HL-SF12) and the average self-management score (DSMI-20) with $r = 0.442$; $n = 358$; $p < 0.001$). As patients' health literacy increases (higher HL-SF12 scores), their self-management of type 2 diabetes mellitus improves, and vice versa. An extensive systematic study published in the Australian Journal of Primary Health in October 2020 evaluated the role of health literacy in the self-management of type 2 diabetes, incorporating 33 studies in the analysis. The findings indicated a positive correlation between health literacy and self-monitoring ($r = 0.19$; 95% CI: 0.11, 0.27; $p < 0.00001$), diet and exercise ($r = 0.12$; 95% CI: 0.07, 0.18; $p = 0.009$), self-care (0.24; 95% CI: 0.16, 0.31; $p < 0.00001$), and social support ($r = 0.2$; 95% CI: 0.07, 0.33; $p < 0.001$).[14] In our study, health literacy shows a stronger positive correlation compared to the Australian study ($r = 0.442$); nevertheless, both studies reveal statistically significant positive correlations between health literacy and self-management in patients with type 2 diabetes.

While educational level, income, and self-management exhibit positive effects, age negatively impacts health literacy, indicated by $\beta = -0.23$; 95% CI: -0.27, -0.19; $p < 0.001$. This suggests that with each additional year, patients' health literacy decreases by 0.23 times. Consistent with this, Hussein and colleagues (2018) found that younger individuals with type

2 diabetes tend to have better health literacy.[15] Environmental factors, such as a lack of specialized advice on self-care strategies, poor communication and coordination of services, and inadequate information about healthcare services, contribute to the dependence of most elderly individuals on their children, relatives, or healthcare professionals, resulting in limited health literacy compared to younger individuals.

In addition, previous studies have suggested a relationship between the duration of diabetes and health literacy, where patients with longer durations of the disease tend to accumulate more knowledge and experience, potentially leading to improved health literacy and self-management.[16] However, in our study, no significant correlation was observed between diabetes duration and health literacy ($p > 0.05$). This lack of association could be attributed to factors such as limited access to healthcare education and information, as well as the influence of other variables like education level and income. Similar findings are reported by Lee et al. (2025), who also found no clear relationship between diabetes duration and health literacy, highlighting the potential impact of socio-economic and psychological factors on health literacy.[17]

Hence, physicians and healthcare organizations can use the insights from this study to develop targeted interventions for improving health literacy among type 2 diabetes patients. In accordance with the objectives outlined in Healthy People 2023, health literacy is achieved when a society offers accurate health information and accessible services that individuals can easily comprehend and use to guide their decisions and actions. Physicians should prioritize educational initiatives tailored to different educational levels, focusing on enhancing understanding of disease-related information, medication instructions, and emergency response. Recognizing the diverse information-seeking preferences, healthcare organizations should leverage various channels such as newspapers, word of mouth, and healthcare professionals to disseminate crucial health information. Additionally, the study underscores the importance of addressing socio-economic disparities by advocating for social welfare programs, free health examinations, and remote health consultations.

Limitations of the study

Alongside previous research on assessing health literacy in individuals with type 2 diabetes, this study holds significance for physicians and healthcare organizations. Conducted at Thanh Nhan Hospital in Vietnam, its cross-sectional design limits causal inferences, and the sample size is too small for generalization to the broader population. The relatively nascent research field lacks sufficient high-quality data for robust comparative analysis. Therefore, there is a critical need for timely interventions, development of self-management education programs, and improvements in care quality. Future research should focus on the relationships among the variables investigated within such programs to further advance knowledge.

V. CONCLUSION

The study revealed important findings regarding health literacy in type 2 diabetes patients. With an average score of 26.3 ± 5.3, over 88% lacked sufficient understanding. Key factors influencing health literacy included educational level, income, and self-management, with educational level being the most significant. A positive correlation between health literacy and self-management was noted, while age negatively affected literacy,

especially in older patients. To enhance health literacy, it is essential to develop targeted educational programs, utilize visual aids, engage community organizations for outreach, conduct regular health literacy assessments, provide self-management support tools, and advocate for policies prioritizing health literacy in diabetes education.

Conflict of interests

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Data availability

Please contact the corresponding author for data availability.

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