# Health Literacy as a Predictor of Health-Promoting Lifestyle in Cardiovascular Patients: A Population-Based Study in Southeast Iran


**Abstract**

**Background and Objective:** Cardiovascular diseases (CVDs) are a leading cause of mortality worldwide and in Iran. Health literacy (HL) is a crucial factor in managing such conditions. This study aimed to examine the relationship between HL and health-promoting behaviors (HPBs) among patients with CVD in Khāsh, southeast Iran.

**Methods**: In this cross-sectional study, 350 CVD patients from Imam Khomeini Hospital in Khāsh were selected via convenience sampling. Data were collected using two validated instruments: the Short Form of the Health Literacy for Iranian Adults (HELIA-SF) and the Walker Health-Promoting Lifestyle Profile (HPLP-II). Data analysis was performed using Pearson's correlation, multiple linear regression, and ANOVA in SPSS-24.

**Results**: The mean HL score was 36.25 ± 22.65, indicating a poor overall level. HPBs were moderate (139.84 ± 21.74), with the lowest score in physical activity (20.54 ± 4.39). HL showed the strongest correlation with physical activity ($r = 0.632$, $p < 0.001$) and the weakest with stress management ($r = 0.297$, $p < 0.001$). Regression analysis identified HL as the strongest predictor of HPBs ($\beta = 0.666$, $p < 0.001$), followed by basic HL skills ($\beta = 0.435$) and decision-making skills ($\beta = 0.330$). The model explained approximately 52% of the variance in HPBs ($R^2 = 0.524$).

**Conclusion**: HL is the most significant predictor of health-promoting behaviors in CVD patients. These findings underscore the need for targeted educational interventions—particularly in underserved regions—to improve HL and promote healthier lifestyles, thereby reducing the burden of cardiovascular disease.



**Keywords**: Health literacy, Cardiovascular diseases, Health-promoting behaviors, Lifestyle, Socioeconomic factors.



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## Introduction

Cardiovascular diseases (CVDs) encompass a group of cardiac and vascular disorders, including coronary artery disease, cerebrovascular disease, and related conditions (1). While genetic factors may contribute to certain rare forms of CVD, evidence suggests that the interaction between environmental factors and lifestyle plays a predominant role in their development (2). Recent studies have confirmed the impact of modifiable risk factors—such as hypertension, diabetes, obesity, and physical inactivity—on the onset of CVD (1, 3, 4).

CVDs are progressive and chronic conditions associated with high mortality, reduced quality of life, and frequent hospitalizations. Moreover, due to their multifactorial nature, they impose significant economic burdens on both healthcare systems and patients (5). CVDs remain the leading cause of mortality in most countries, including Iran (6). Although primary and secondary prevention efforts have reduced CVD-related deaths in developed nations over recent decades, these diseases continue to be a major contributor to disability worldwide, with their incidence and complications rising in developing countries (7).Globally, CVDs are recognized as the foremost cause of death and disability, with over 80% of fatalities occurring in low- and middle-income countries (8).

In Iran, 46% of all deaths occur due to CVDs, with the highest burden of CVDs being related to the risk factor of hypertension. According to World Health Organization estimates, mortality from CVDs will reach more than 23.3 million by 2030, and based on WHO reports, approximately 44.8% of all deaths in our country in 2030 will be caused by cardiovascular diseases. Well-defined risk factors for CVD exist. These include smoking, family history, obesity, high blood pressure (HT), diabetes mellitus (DM), blood lipids (HL), lack of exercise, and stress (4,9). Obesity plays an important role in atherosclerosis and coronary artery diseases. Obesity leads to structural and functional changes in the heart that cause heart failure (10). In addition to these known risk factors, many additional risk factors such as environmental factors, air pollution, heavy metals, seasonal effects, ultraviolet radiation, harmful nutrients, and social and economic environments have been defined (11-12). Many studies separately address physical activity, health responsibility, and nutritional behavior. In fact, the mentioned activities are all elements that are included under health-promoting behaviors for the prevention of CVD. Therefore, based on latent variables (14-13), all the aforementioned elements are combined into one latent variable, which is thereby called HPBs. HPBs play a major role in preventing many lifestyle-related diseases (for example, diabetes, obesity, high blood pressure). Thus, understanding the HPBs of young adults is very important for developing appropriate health promotion interventions and consequently improving their health. There are relatively few applications of psychological theory to explain cardiovascular HPBs, especially in young adults (15-17).

HL serves as a key determinant of health, playing a pivotal role in both primary and secondary prevention of CVDs (16, 17). Evidence demonstrates that HLLs directly influence three fundamental components: a) enhancement of health awareness and knowledge, b) formation of positive health attitudes, and c) facilitation of high-risk behavior modification (18). Numerous studies have confirmed a significant association between higher HL and improved quality of life in CVD patients, with this variable functioning as an enabling factor for health information comprehension and effective disease management (19).

Given the alarming statistics of CVD-related mortality in Iran (8, 9) and its projected increase by 2030 (9), developing preventive strategies based on HL promotion has become a national priority. While global studies have established the impact of HL on reducing healthcare costs and improving clinical outcomes (20), limited evidence exists regarding this association in underprivileged regions of Iran with specific socio-cultural characteristics (such as Khash city).

Therefore, this study aims to investigate the association between HL and HPBs among CVD patients in Khāsh, southeast Iran. The findings are expected to provide localized evidence to inform tailored interventions aimed at enhancing HL and promoting healthier lifestyles in this vulnerable population, ultimately contributing to regional CVD prevention efforts.

**Methods**

This study employed a descriptive-analytical cross-sectional design to examine the relationship between HL and HPBs among CVD patients in Khash city, southeastern Iran, from June to December 2024.

**Study Population and Sampling**

The target population comprised all CVD patients referred to Imam Khomeini Hospital in Khash. The sample size was calculated using the following formula with 95% confidence level, 90% power, p=0.35, and d=0.05: Based on these parameters, a final sample size of 350 participants was estimated.

$$n = \frac{\left(Z^2 \times P \times (1 - P)\right)}{d^2}$$

The study employed a convenience sampling method to recruit participants from CVD patients visiting Imam Khomeini Hospital in Khash. A total of 350 eligible patients were enrolled in the study. Inclusion criteria consisted of: (1) confirmed diagnosis of CVD by a cardiologist, (2) residency in Khash county, (3) literacy (ability to read and write), and (4) minimum age of 18 years. Patients with severe cognitive impairment (e.g., advanced dementia) or those unable to complete questionnaires due to physical or mental conditions were excluded from the study.

**Data Collection Instruments**

This study utilized two questionnaires: the Walker Health-Promoting Lifestyle Profile (HPLP) and the Short Form of the Health Literacy for Iranian Adults questionnaire (HELIA-SF) developed by Tavousi et al.

The Walker HPLP consists of 54 items and was originally developed by Walker in 1997. It is designed to measure health-promoting behaviors across six dimensions: nutrition, physical activity, health responsibility, stress management, interpersonal support, and self-actualization. The questionnaire follows a Likert scale format, with response options ranging from "never" to "always," scored on a four-point scale (1–4). The Cronbach's alpha coefficient for the entire instrument was 0.82, with subscale reliability ranging from 0.64 to 0.91. Test-retest results confirmed the stability of the instrument and its subdimensions. Additionally, confirmatory factor analysis validated the six-factor model, demonstrating acceptable fit indices. In this questionnaire, lower scores indicate lower quality of life (21).

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**Health Literacy Assessment Questionnaire (Short Form) – HELIA-SF**

The HELIA-SF questionnaire consists of two sections: the first assesses basic literacy skills, and the second evaluates decision-making skills, comprising a total of nine items.

The first section is rated on a Likert scale with response options ranging from "very easy" to "very difficult," scored from 1 to 5. The second section follows a similar Likert format, with response options including "always," "often," "sometimes," "rarely," and "never," also scored from 1 to 5.

Exploratory factor analysis indicated that the questionnaire items (nine items) accounted for approximately 61% of the variance across the two dimensions: basic literacy skills and decision-making skills. Confirmatory factor analysis demonstrated an acceptable model fit. Cronbach's alpha and intraclass correlation coefficient (ICC) values for the two dimensions were 0.84 and 0.81, respectively, for basic literacy skills, and 0.85 and 0.82, respectively, for decision-making skills. The overall questionnaire reliability was confirmed with Cronbach's alpha and ICC values of 0.91 and 0.81, respectively (22).Participants completed the questionnaires through self-reporting. To facilitate interpretation, raw scores were standardized to a 0–100 scale using the formula: [(Raw score - Minimum possible score) / (Maximum possible score - Minimum possible score) × 100]. Accordingly, final scores were interpreted at four levels: Inadequate (<50), Marginal (50–66), Adequate (66.1–84), and Excellent (84.1–100)(22).

**Statistical Analysis**

The collected data were analyzed using SPSS software, version 24. Normality was assessed using the Kolmogorov-Smirnov test. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were calculated for continuous and categorical variables. Pearson correlation analysis was employed to examine the relationship between HL and dimensions of HPBs. Multiple regression analysis was conducted to identify predictors of HPBs. Additionally, independent t-tests and one-way ANOVA were used to evaluate group differences based on demographic characteristics.

**Ethical Considerations**

This study was conducted in accordance with the principles of the Helsinki Declaration. All participants provided written informed consent before enrollment. Their information was kept confidential and used solely for research purposes. The study received ethical approval under the code IR.ZAUMS.REC.1403.065 from the Research Ethics Committee of Zahedan University of Medical Sciences. All ethical considerations, including confidentiality, informed consent, participants' right to withdraw, and dissemination of findings to relevant institutions, were carefully observed in the study design.

**Results**

This study demonstrates that the examined cardiovascular patients were predominantly aged 41-60 years (55.14%), female (60.57%), rural residents (53.43%), and had elementary-level education (51.71%). The majority reported insufficient income (87.72%) and managed their condition primarily through a combination of pharmacotherapy and lifestyle modification (54%). However, notable prevalence rates were observed for tobacco use (36%) and suboptimal BMI (60.57% overweight/obese). Patients showed heavy reliance on health professionals for medical information (94.29%). The mean age of the participating patients was 56.27 ± 13.19 years. Detailed data are presented in Table 1.

Table 1. Frequency Distribution of Demographic, Social, Economic, and Health Characteristics in Cardiovascular Patients

| variable | category | N | N % |
|---|---|---|---|
| Age | 18-40 | 34 | 9.72 |
| | 41-60 | 193 | 55.14 |
| | >60 | 123 | 35.14 |
| Sex | man | 138 | 39.43 |
| | woman | 212 | 60.57 |

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|---|---|---|---|
| Marital status | single | 7 | 2.00 |
| | married | 252 | 72.00 |
| | divorce/dead wife | 91 | 26.00 |
| Level of education | elementary school | 181 | 51.71 |
| | high school | 104 | 29.72 |
| | diploma | 39 | 11.14 |
| | graduate | 26 | 7.43 |
| Employment status | employed | 17 | 4.90 |
| | self-employment | 89 | 25.40 |
| | student | 29 | 8.30 |
| | retired | 202 | 57.70 |
| | housewife | 13 | 3.70 |
| Income status | insufficient | 307 | 87.72 |
| | Moderate | 39 | 11.14 |
| | sufficient | 4 | 1.14 |
| Residence | urban | 163 | 46.57 |
| | rural | 187 | 53.43 |
| BMI | <18.5 | 8 | 2.29 |
| | 18.5-24.9 | 130 | 37.14 |
| | 25-29.9 | 157 | 44.86 |
| | ≥30 | 55 | 15.71 |
| Tobacco use | yes | 126 | 36.00 |
| | no | 224 | 64.00 |
| Alcohol consumption | yes | 10 | 2.90 |
| | no | 340 | 97.10 |
| Disease control method | lifestyle modification | 7 | 2.00 |
| | drug therapy | 154 | 44.00 |
| | drug therapy& lifestyle | 189 | 54.00 |
| Source of information | healthcare providers | 330 | 94.29 |
| | internet | 8 | 2.29 |
| | tv | 2 | 0.57 |
| | Friends & relatives | 10 | 2.85 |

The study participants demonstrated moderate scores in basic health promotion skills (55.07 ± 31.13), while their decision-making skills scores were notably low (17.44 ± 20.27). The findings revealed an overall unsatisfactory level of HL among the patients (36.25 ± 20.27). Regarding HPLP dimensions, the mean scores were at moderate levels (Table 2).

Table 2. Mean Scores of HL and HPLP Domains in Cardiovascular Patients in Khash City

| **Domain** | **Mean ± SD*** | **Minimum** | **Maximum** | **Score range** |
|---|---|---|---|---|
| **Basic Health Promotion Skills** | 55.07 ± 31.13 | 21.00 | 100.00 | 0-100 |
| **Decision-Making Skills** | 17.44 ± 20.27 | 0.00 | 93.75 | 0-100 |
| **Overall Health literacy** | 36.25 ± 22.65 | 0.00 | 93.75 | 0-100 |
| **Nutrition** | 24.18 ± 4.12 | 12.00 | 35.00 | 10-40 |
| **Physical Activity** | 20.54 ± 4.39 | 11.00 | 32.00 | 9-36 |
| **Health Responsibility** | 24.87 ± 4.28 | 11.00 | 35.00 | 9-36 |
| **Stress Management** | 22.48 ± 3.36 | 12.00 | 32.00 | 8-32 |
| **Interpersonal Relations** | 22.52 ± 4.84 | 11.00 | 32.00 | 9-36 |
| **Spiritual Growth** | 25.23 ± 4.62 | 13.00 | 35.00 | 9-36 |
| **Overall HPLP Score** | 139.84 ± 21.74 | 73.00 | 193.00 | 54-216 |

HL: Health Liyeracy, HPLP: Health-Promoting Lifestyle Profile

Analysis of the association between demographic variables and health literacy (HL) along with HPLP revealed statistically significant relationships ($p < 0.05$) with age, gender, education level, employment status, income, residence location, alcohol consumption, disease management method, and information sources. Specifically, older patients, females, those with higher education, retirees, homemakers, individuals with sufficient income, optimal BMI, non-alcohol consumers, and patients utilizing combined pharmacotherapy and lifestyle modification for disease control demonstrated superior HL levels. Conversely, younger individuals, males, single participants, highly educated persons, employed subjects, and urban residents exhibited more favorable HPLP scores (Table 3).

Table 3: Mean HL & HPLP Score in Cardiovascular Patients in Khash City Categorized by Demographic Variables

| variable | category | HL | | HPLP | |
|---|---|---|---|---|---|
| | | Mean ± SD | p-value | Mean ± SD | p-value |
| Age | 18-40 | 15.22±15.83 | <0.001** | 151.15±20.52 | <0.001** |
| | 41-60 | 31.17±20.25 | | 142.18±21.02 | |
| | >60 | 50.00±19.99 | | 132.95±21.17 | |
| Sex | man | 32.08±23.31 | 0.005* | 143.90±21.85 | 0.005* |
| | woman | 38.98±21.84 | | 137.18±21.30 | |
| Marital status | single | 32.41±21.99 | <0.001** | 144.68±19.89 | <0.001** |
| | married | 32.32±21.100 | | 139.57±4.39 | |
| | divorce/dead wife | 47.17±20.76 | | 126.49±21.94 | |
| Level of education | elementary school | 15.51±11.32 | <0.001** | 131.49±18.14 | <0.001** |
| | high school | 17.71±8.38 | | 146.87±21.93 | |
| | diploma | 26.82±18.13 | | 153.47±21.08 | |
| | graduate | 51.40±14.60 | | 149.92±21.69 | |
| Employment status | employed | 18.60±6.74 | <0.001** | 156.76±29.23 | <0.001** |
| | self-employment | 35.90±21.80 | | 141.20±19.34 | |
| | student | 21.68±26.64 | | 153.66±21.93 | |
| | retired | 40.56±20.71 | | 136.59±20.79 | |
| | housewife | 47.21±9.18 | | 127.69±16.70 | |
| Income status | insufficient | 37.66±22.20 | 0.003** | 138.80±21.87 | 0.054** |
| | Moderate | 24.71±23.83 | | 146.69±20.40 | |
| | sufficient | 41.25±16.59 | | 152.00±21.155 | |
| Residence | urban | 33.12±22.84 | 0.016* | 143.34±21.08 | 0.005* |
| | rural | 38.99±22.19 | | 136.76±21.90 | |
| BMI | <18.5 | 27.81±13.83 | 0.008** | 141.00±19.25 | <0.001** |
| | 18.5-24.9 | 40.52±21.81 | | 133.00±18.57 | |
| | 25-29.9 | 35.75±24.23 | | 141.23±21.47 | |
| | ≥30 | 28.81±18.68 | | 151.87±24.17 | |
| Tobacco use | yes | 37.85±22.74 | 0.326* | 136.87±22.39 | 0.057* |
| | no | 35.36±22.61 | | 141.49±21.24 | |
| Alcohol consumption | yes | 5.00±5.11 | <0.001* | 133.44±24.37 | 0.372* |
| | no | 37.08±22.35 | | 140.01±21.68 | |
| Disease control method | lifestyle modification | 12.32±10.26 | 0.017** | 143.00±5.74 | 0.884** |
| | drug therapy | 36.28±21.99 | | 139.37±22.06 | |
| | drug therapy& lifestyle | 37.12±23.10 | | 140.10±21.90 | |
| Source of information | healthcare providers | 37.07±22.07 | <0.001** | 140.32±21.35 | 0.065** |
| | internet | 5.31±9.83 | | 134.25±23.83 | |
| | tv | 2.21±0.12 | | 157.00±0.21 | |
| | Friends & relatives | 41.94±29.19 | | 123.22±29.92 | |
| HL Level | low | ---------- | -------- | 102.00±10.93 | <0.001** |
| | inadequate | ---------- | | 119.00±20.08 | |
| | adequate | ---------- | | 123.97±15.13 | |

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|---|---|---|---|---|---|
| | high | ---------- | | 147.25±18.72 | |

*T-Test, **One-way ANOVA Test

A statistically significant positive correlation was observed between HL and all dimensions of HPLP ($p<0.001$ for all). The strongest associations were found for physical activity ($r=0.632$), health responsibility ($r=0.631$), and total HPLP score ($r=0.617$), while the weakest correlation was observed for stress management ($r=0.297$) (Table 4).

**Table 4.** Correlation between HL and HPLP dimensions in cardiovascular patients

| Dimensions of Health-Promoting Lifestyle Profile | Helth literacy | |
|---|---|---|
| | **p-value*** | **Correlation coefficient (r)** |
| Nutrition | <0.001 | 0.456 |
| Physical Activity | <0.001 | 0.632 |
| Health Responsibility | <0.001 | 0.631 |
| Stress Management | <0.001 | 0.297 |
| Interpersonal Relations | <0.001 | 0.510 |
| Spiritual Growth | <0.001 | 0.556 |
| Overall HPLP Score | <0.001 | 0.617 |

Pearson's correlation coefficient (r)

The multiple linear regression analysis revealed that overall HL ($\beta=0.666$, $p<0.001$), was the strongest significant predictors of HPBs, in descending order of strength. Among demographic variables, education level ($\beta=0.206$, $p=0.002$), Residence ($\beta=0.183$, $p=0.045$), and income status ($\beta=0.171$, $p<0.031$) also showed statistically significant associations. Age, sex, and employment status showed no significant associations ($p>0.05$). The regression model demonstrated moderate explanatory power, with an $R^2$ of 0.524, indicating that approximately half of the variance in HPBs was accounted for by the predictor variables. (Table 5).

Table 5. Multivariable linear regression for HPLP prediction (HL and demographics

| Variable | Unstandardized Coefficients | | Standardized Coefficients | P | 95%CI | |
|---|---|---|---|---|---|---|
| | B | Std.Error | Beta | | Lower | Upper |
| Constant | 123.82 | 15.79 | | 0.001 | 92.76 | 154.89 |
| Overall Health Literacy | 0.639 | 0.057 | 0.666 | 0.001 | 0.528 | 0.750 |
| Age | 0.063 | 0.081 | 0.038 | 0.438 | 0.623 | 1.007 |
| Sex | 1.946 | 2.440 | 0.044 | 0.426 | 0.754 | 1.061 |
| Marital Status | 3.321 | 1.033 | 0.134 | 0.071 | 0.953 | 1.289 |
| Level of education | 4.833 | 1.556 | 0.206 | 0.002 | 1.125 | 2.752 |
| Employment status | 0.787 | 0.815 | 0.054 | 0.335 | 0.890 | 1.817 |
| Income status | 0.156 | 0.074 | 0.171 | 0.031 | 0.614 | 0.727 |
| Residence | 0.191 | 0.029 | 0.183 | 0.045 | 0.109 | 0.725 |
| BMI | 0.764 | 0.174 | 0.179 | 0.091 | 0.423 | 1.806 |
| Tobacco use | 0.289 | 0.036 | 0.006 | 0.881 | 0.998 | 1.020 |
| Alcohol consumption | 1.405 | 1.285 | 0.056 | 0.432 | 0.828 | 1.081 |
| Disease control method | 1.725 | 1.620 | 0.043 | 0.288 | 0.692 | 1.011 |
| Source of information | 2.067 | 1.031 | 0.083 | 0.056 | 0.096 | 1. 039 |

R=0.724, R Square= 0.524 , Adjusted R Square= 0.505, F=26.763, Dependent Variable= HPLP, Predictors in the Model:,Overall Health Literacy ,Age,Sex, Marital Status,Level of education, Employment status,Income status, Residence, BMI,Tobacco use,Alcohol consumption, Disease control method,Source of information

**Discussion**

Based on the findings of the current study, Overall HL was the strongest predictor of HPBs ($\beta=0.666$, $p<0.001$). Among demographic variables, education level, residence, and income also showed significant associations. The hierarchical pattern of predictors—with overall HL first, followed by education, residence, and income—aligns with the Health Literacy Pathway model. HL likely influences HPBs by enhancing knowledge, self-efficacy, and practical skills for navigating health information and services, with basic skills and decision-making acting as foundational competencies. The subsequent influence of socioeconomic factors (education, residence, income) underscores how these individual capacities are either enabled or constrained by broader social determinants of health (16, 2۳).

The regression model had moderate explanatory power, with an $R^2$ value of 0.524, indicating that approximately half of the variance in HPBs was explained by the predictor variables. The remaining unexplained variance highlights the potential role of other psychosocial, environmental, and cultural factors not captured in this model, such as social support, healthcare system trust, or specific community beliefs, suggesting avenues for future research.

The findings of this study indicate that most participants exhibited socioeconomic characteristics likely to influence their HL and HPBs. Key demographic patterns emerged, including a predominance of middle-aged adults (41-60 years), female participants, individuals with only primary-level education, limited household income, and rural residency---all of which may create barriers to accessing health information and making informed health decisions. These barriers operate through multiple mechanisms: limited education can restrict comprehension of health materials, low income can limit access to healthy food and recreational facilities, and rural residence can be associated with fewer healthcare resources and health promotion programs.

Of particular concern is the high prevalence of overweight/obesity and tobacco use within this population, reflecting systemic challenges in adopting healthier lifestyles. These results corroborate existing research from resource-limited, low-income settings where socioeconomic disadvantages (including poor educational attainment, financial constraints, and inadequate healthcare access) demonstrate significant negative correlations with both HLLs and the practice of preventive health behaviors (2۴). The consistency between these findings suggests that structural inequalities play a determinative role in shaping health outcomes among vulnerable groups. This aligns with the fundamental cause theory, which posits that socioeconomic status influences health through its ability to provide access to flexible resources like knowledge, money, power, and beneficial social connections.

In contrast, studies from developed societies demonstrate that higher education levels and systematic access to health education programs (e.g., nutritional counseling, smoking cessation support, and physical activity guidance) not only enhance HL but also foster sustainable lifestyle modifications---such as improved dietary habits and reduced tobacco use---by strengthening patients' self-efficacy (2۳, 25). This comparison illustrates a key theoretical point: the relationship between HL and behavior is moderated by the environmental context. In resource-rich settings, supportive infrastructures amplify the effect of HL, whereas in resource-poor settings, structural barriers can negate it.

This disparity underscores the profound influence of macro-level socioeconomic structures on health outcomes. In societies with pronounced inequalities, deprivation factors (e.g., low education or income) serve as primary barriers to HL and HPBs. Conversely, in advanced healthcare systems, targeted education can mitigate---and even overcome---demographic disparities.

While Nooroozi et al.'s (26) study on rural women demonstrated that factors such as education level, healthcare access, and self-efficacy had a greater impact on HL and HPBs than gender alone, our findings reveal significant gender-based differences. This discrepancy may be attributed to varying social roles and women's differential access to health information across different societal contexts. A theoretical explanation may involve gendered dimensions of health literacy, where women, often primary caregivers, might have more exposure to health information but also face greater time constraints or decision-making autonomy limitations that affect behavior change.

The current study found that cardiovascular patients exhibited inadequate decision-making skills and health literacy levels, consistent with Zahedi et al.'s (27) findings regarding low self-care and HL among chronic patients. However, these results contrast with Arriaga et al.'s (28) Portuguese study, which reported significantly higher HLLs. These observed disparities can be understood through structural-economic, socio-cultural, and health policy lenses. Structurally, our population showed lower educational attainment (48.3% with secondary/higher education vs. 83.3% in Portugal) and greater financial constraints (72.7% reporting inadequate income vs. 67.7% of Portuguese easily covering healthcare costs), compounded by geographical and financial barriers to

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specialized care. Culturally, limited digital infrastructure and persistent traditional health beliefs created additional obstacles to health literacy adoption. From a policy perspective, the lack of integrated HL programs in basic education and voluntary (rather than mandatory) workplace health education programs - unlike the systematic approaches in advanced healthcare systems - has hindered the institutionalization of HPBs. This complex interplay of multilevel factors provides a comprehensive explanation for the HL gap between our study population and more developed societies, highlighting the need for targeted interventions addressing these fundamental determinants.

The mean score of HPBs was at a moderate level, consistent with findings by Dehkordi (29) in Isfahan. However, Baharvand et al.'s study in Iran reported significantly lower scores (30). This discrepancy may stem from differences in study populations or data collection instruments. Notably, economic factors appear particularly influential - in our study, approximately 88% of participants reported insufficient income, which likely compromised their ability to adopt healthier behaviors. This reinforces the theory of "health capability," which argues that achieving health requires both the knowledge (HL) and the practical opportunity (shaped by income, access, etc.) to act on that knowledge.

This study found that patients with higher HL exhibited more favorable health-related behaviors. The average HL among the examined CVD patients was at an undesirable level. A strong correlation was observed between HL and the components of physical activity and health responsibility, whereas the weakest association was reported with stress management. The strong link with physical activity and responsibility may be explained by the fact that these behaviors often require understanding specific instructions, navigating healthcare systems, and planning—skills directly related to functional and interactive HL. The weak association with stress management suggests that managing emotions and psychological stress may rely more on different skill sets (e.g., emotional regulation, coping strategies) or be more heavily influenced by immediate environmental stressors beyond the control of individual HL.

Numerous studies have confirmed that patients with high HL tend to engage in more physical activity and demonstrate healthier behaviors (31, 32). Additionally, research conducted in Europe indicated that individuals with low HL experience higher levels of stress and display poorer health-related behaviors (33).

It appears that the weak association between HL and stress management in the current study may be linked to the complex and multidimensional nature of stress. Stress is influenced by a variety of individual (e.g., genetics, personality), social (e.g., family support, social networks), and environmental factors (e.g., poverty, job insecurity), which may make it difficult to manage even with high HL. Studies indicate that in disadvantaged communities, stress is more often caused by structural factors (such as low income or rural living conditions) than by individual factors (34). Therefore, while HL might help someone identify they are stressed, the resources to alleviate chronic, structurally-rooted stress may be scarce, limiting HL's predictive power for this outcome.

Additionally, the lack of stress-related educational content in health literacy programs could be another reason for the weak link between HL and stress management. Typically, HL education focuses on physical symptoms of diseases (e.g., high blood pressure) or preventive behaviors (e.g., smoking cessation) rather than psychosocial skills such as stress management. Multiple reviews have found limited evidence on the relationship between health literacy and emotional disorders, including stress (35, 36). This points to a potential gap in the conceptualization and measurement of HL, which often emphasizes cognitive and functional skills over emotional or critical health literacy dimensions relevant to mental well-being.

In low-income populations, chronic stress caused by food insecurity or healthcare costs may be so severe that even an improvement in HL cannot fully mitigate its effects. Among disadvantaged groups, stress reduction is primarily achieved through economic interventions (such as direct financial aid) rather than health education programs (37). This observation supports the necessity of combining HL interventions with policies that address the social determinants of health for comprehensive impact.

A study conducted in Alberta found no significant association between HL and physical activity measured via pedometer-based step counts. However, HL was significantly correlated with adherence to self-reported physical activity guidelines (38). This discrepancy is likely influenced by cultural factors, behavioral differences in reporting physical activity, and extensive governmental support for promoting exercise and physical activity. These findings underscore the critical role of social determinants and policy interventions in shaping health-related behaviors, even among individuals with varying HL levels. Theoretically, this highlights the difference between *knowledge* of guidelines (linked to HL) and *objective behavior* (influenced by environment, infrastructure, and habit), suggesting that HL is a necessary but not sufficient condition for behavior change.

Regression analysis in the present study identified HL as the strongest predictor of a health-promoting lifestyle. This finding aligns with Yunxia's study (39), which highlighted the significant impact of HL on health-promoting behaviors. Additionally, basic HL skills and decision-making abilities ranked next in predictive strength, following a hierarchical pattern consistent with the findings of Darabi et al. (40). This alignment underscores the multidimensional nature of HL and its combined influence on health behaviors. It also provides empirical support for interventions that sequentially build basic health knowledge before advancing to more complex decision-making and critical analysis skills.

The proposed regression model, with an adjusted $R^2$ of 0.524 ($F=28.36$, $p<0.001$), explained approximately 52.4% of the variance in the criterion variable, indicating a moderate-to-high predictive power. This value was lower than the predictive strength reported in Nawrozi et al.'s study ($R^2=0.656$) (41). The predictive capacity of HL in relation to HPBs can be influenced by various factors, including the measurement instruments used, the degree of localization, and questionnaire validation processes. Additionally, moderating variables such as socioeconomic status, social support, and access to healthcare resources may shape this relationship. Demographic and cultural differences---including education level, age, and societal behavioral patterns---also play a crucial role in determining the predictive strength of regression models. Future theoretical models should explicitly incorporate these moderating and mediating variables to better explain the context-dependent relationship between HL and behavior.

While education level showed a moderate effect in the present study, findings by Long et al. (42) indicate significant disparities in HL and healthcare coverage across different regions based on educational attainment. These differences may stem from the complex interplay of economic factors (low income), educational challenges (poor-quality education and lack of localized content), structural barriers (unequal distribution of healthcare resources), and cultural or belief-based constraints (traditional norms and gender restrictions).

This study also identified residence and income level as significant predictors of HPBs among CVD patients. Research by Liu et al. (43) found that urban residents exhibit healthier behaviors compared to those in rural areas, including better access to healthcare services, higher levels of physical activity, and healthier dietary patterns. Additionally, a study by Vyas et al. (44) demonstrated that lower income levels are associated with a heightened risk of CVD, while individuals with higher incomes benefit from improved healthcare access, better nutrition, and more active lifestyles. However, findings by Fullin et al. (45) suggest that the influence of residence on cardiovascular health is largely shaped by social and environmental factors. This indicates that the "urban advantage" is not automatic but contingent on the quality of the urban environment and available resources, consistent with theories of health geography.

In some urban areas, air pollution and high stress levels can negatively impact cardiovascular health. Additionally, some studies have shown that higher income does not always guarantee healthy behaviors. In certain communities, sedentary lifestyles and high-calorie diets among high-income individuals may increase the risk of heart disease (46). This nuance reinforces that socioeconomic position influences health through the specific behaviors and exposures it enables, which can sometimes be health-damaging (e.g., sedentary jobs, excessive consumption), not just through material deprivation.

In southeastern Iran, a combination of semi-urban and rural living, access to natural resources, reduced stress levels due to less crowding and pollution, and strong social cohesion have fostered a distinct lifestyle that may positively influence health practices. Furthermore, income levels and residential patterns in this region may promote health-conscious behaviors. Residents of smaller communities often benefit from stronger social ties and local support networks, which can play a key role in sharing health-related information and encouraging participation in health-promoting activities. These potential protective factors, rooted in social capital and environmental quality, should be considered in asset-based, culturally-tailored interventions rather than adopting a purely deficit-focused model.

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Moreover, the absence of severe urban pollution may help reduce environmental risk factors associated with cardiovascular diseases, including air pollution and stress caused by urban overcrowding.

**Conclusion**

This study demonstrates that health literacy is the strongest predictor of health-promoting lifestyle behaviors among cardiovascular patients in southeast Iran. The findings reveal that both the basic and decision-making dimensions of HL are crucial, yet overall levels remain inadequate. The association between HL and HPBs is moderated by key socioeconomic factors, particularly education, income, and place of residence, highlighting the powerful influence of the social determinants of health in this underserved region. Therefore, improving HL is a necessary, but not sufficient, strategy for promoting cardiovascular health; it must be coupled with efforts to address underlying socioeconomic barriers.

**Strengths and Limitations of the Study**

Strengths:

The strengths of this study are significant from several perspectives. First, the systematic methodological design, employing convenience sampling with systematic efforts to minimize selection bias (e.g., recruiting consecutively on different days and shifts), along with the use of standardized, culturally adapted tools, enhances the study's internal validity and practical applicability in a real-world clinical setting. Second, advanced multivariate analysis, while controlling for key confounding variables such as education level and income, provides a more precise estimation of the relationships between variables. Third, the current study relies on well-established theoretical frameworks, such as the levels of health literacy and socio-ecological factors, creating a robust theoretical foundation for interpreting the findings. From a practical standpoint, identifying health literacy as the strongest predictor of health-promoting behaviors offers valuable guidance for designing health interventions in underserved regions.

Limitations:

Despite these advantages, this study has several limitations. First, the use of convenience sampling, despite efforts to reduce bias, may limit the generalizability of the findings to the broader population of CVD patients in other regions or healthcare settings. Second, reliance on self-reported data is susceptible to social desirability and recall biases. Third, key potential confounding variables, such as levels of social support, self-efficacy, and detailed metrics of healthcare access, were not measured and could influence the observed relationships. Finally, the findings from a single hospital in a specific socio-cultural region (Khash) may not be fully generalizable to other populations.

**Practical Recommendations for Policymakers and Planners**

Based on these findings, we propose the following targeted recommendations:

1. Integrate Health Literacy into Primary Healthcare Systems: Health literacy assessment (using tools like HELIA-SF) should be incorporated as a "fifth vital sign" in the electronic health records of cardiovascular patients, especially in underserved areas. This will enable the identification of high-risk patients and the delivery of tailored counseling.
2. Develop Multilevel and Culturally Adapted Educational Interventions: Educational programs should move beyond information dissemination to focus on strengthening patients' decision-making and problem-solving skills. These programs should be delivered in the local language, considering cultural beliefs, and through accessible channels (e.g., community health worker groups in villages).
3. Combine Health Literacy Strategies with Socioeconomic Support: Policies should be combined. For instance, physical activity promotion programs could be coupled with creating or improving local public infrastructure (such as safe sidewalks). Similarly, nutrition education should be integrated with food support programs for low-income families.
4. Empower Healthcare Providers: Training for physicians and nurses in low-literacy-friendly health communication (using plain language, the teach-back method) is essential. The role of local health coaches as liaisons between the health system and the community should also be strengthened.

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