



Health Literacy Status in Patients Undergoing Coronary Artery Bypass Graft Surgery

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Abstract

Background: Health literacy (HL) plays a key role in understanding illness, adhering to treatment, and achieving optimal health outcomes, particularly in patients undergoing complex procedures such as coronary artery bypass graft (CABG) surgery.

Objectives: This study aimed to investigate HL status among candidates for CABG at a university hospital.

Methods: This cross-sectional study was conducted at Heshmat Hospital, an academic center in northern Iran, in 2024. Health literacy (HL) was assessed using the Iranian Health Literacy Instrument for Adults (HELIA) questionnaire, which consists of 33 items across five components: reading, access, comprehension, evaluation, and decision-making/behavior, which is treated as a single combined domain. Total HL was categorized as follows: 0 - 50, inadequate; 50.1 - 66, borderline; 66.1 - 84, adequate; and 84.1 - 100, excellent.

Results: A total of 591 patients undergoing CABG were enrolled, with a mean age of 60.36 ± 9.53 years. The mean total HL score was 47.2 ± 13.58 . Based on the cutoff points, 60.2% of patients had inadequate HL, 31% had borderline HL, 8.3% had adequate HL, and only 0.5% had excellent HL. HL was positively associated with years of education ($r = 0.433$, $P < 0.001$) and negatively associated with age ($r = -0.181$, $P < 0.001$). Among the five HL domains, the lowest mean scores were in reading (41.79 ± 28.2) and evaluation (45.26 ± 16.42). The most common sources of health information were doctors and healthcare staff (28.6%) and friends and acquaintances (24.7%).

Conclusions: HL was inadequate or borderline in the vast majority of patients undergoing CABG at this center. Lower HL was associated with older age and lower educational attainment. Targeted educational programs, HL screening, and effective communication by healthcare teams are recommended.

Keywords: Coronary Artery Bypass Graft Surgery, Health Literacy, HELIA Questionnaire

1. Background

Cardiovascular diseases are among the leading causes of mortality and disability worldwide, including in Iran, and often require complex and costly therapeutic

interventions such as open-heart surgery (1, 2). Coronary artery bypass graft (CABG) surgery is one of the most effective techniques for managing coronary artery disease. The demand for this surgery is expected to increase by approximately 5% annually worldwide, and the number of

procedures is projected to exceed 1.3 million per year by 2026 (3, 4). The success of these interventions depends not only on the surgical team's skill but also, to a considerable extent, on the patient's active and informed participation in preoperative and postoperative care. In this context, health literacy (HL), defined as the cognitive and social skills that determine an individual's ability to access, understand, evaluate, and apply health information, plays a pivotal role (5). Patients with adequate HL are better able to understand medical instructions, adhere to treatment plans, recognize warning signs, and ultimately achieve better health outcomes. However, there is growing concern about inadequate HL, particularly among people with chronic diseases and older adults (6).

HL is a critical determinant of health worldwide. The World Health Organization has identified HL as an important factor influencing health and has recommended that countries establish mechanisms to coordinate and monitor activities aimed at improving it (7, 8). Healthcare systems continue to rely on written materials such as brochures without clear evidence that these materials are effective for all patients. Furthermore, no previous study has systematically assessed the multidimensional status of HL, including reading, accessing, comprehending, evaluating, and decision-making, among cardiac surgery candidates in northern Iran. Heshmat Hospital, a major referral and academic center, serves patients from socioeconomically diverse backgrounds, making it an appropriate setting for such research. Given the high annual volume of CABG procedures and the complex care pathways surrounding this surgery, understanding HL status in these patients is clinically important. Moreover, because sociocultural variables can influence HL, findings from other settings may not be generalizable (9).

2. Objectives

Although HL among patients with chronic diseases has been relatively well studied, research specifically focused on cardiac surgery remains limited, particularly in developing countries, including Iran. This study aimed to provide a comprehensive assessment of HL and its associated factors in this vulnerable population and to generate evidence that may help hospital policymakers to redesign patient education strategies.

3. Methods

3.1. Study Design and Setting

After approval of the study protocol by the university ethics committee, this cross-sectional study was conducted

in 2024 at Dr. Heshmat Heart Center, an academic referral hospital affiliated with Guilan University of Medical Sciences (GUMS).

3.2. Participants and Data Collection

The inclusion criteria were undergoing on-pump CABG, providing informed consent, and being able to communicate. The exclusion criteria were unwillingness to participate and incomplete questionnaire completion. Demographic information included age, sex, marital status, education level, employment status, smoking status, and body mass index (BMI).

The data collection tool was the Iranian HELIA questionnaire. Tavousi et al. developed and evaluated an instrument for measuring HL in adults and concluded that HELIA was valid, reliable, brief, and easy to use in various settings (10). Data were collected through direct interviews, and multiple responses were permitted where applicable.

The questionnaire consists of 33 items covering five components: reading, access, comprehension, evaluation, and decision-making/behavior. Each item has five response options scored from 1 to 5. The overall score is converted to a 0 - 100 scale by subtracting the minimum possible raw score from the obtained raw score and dividing the result by the difference between the maximum and minimum possible raw scores. To calculate total HL, the five subscale scores are summed and divided by five. HL was categorized as follows: 0 - 50, inadequate; 50.1 - 66, borderline; 66.1 - 84, adequate; and 84.1 - 100, excellent.

3.3. Anesthesia and Surgical Procedures

Cardiac surgery began in the morning between 8:00 and 9:00. Upon arrival in the operating room, standard monitoring was established, including electrocardiography using leads II and V5, pulse oximetry, continuous arterial blood pressure monitoring, central venous pressure monitoring, nasopharyngeal temperature monitoring, bispectral index monitoring, and end-tidal carbon dioxide (EtCO₂) monitoring. An 18-gauge intravenous catheter was placed. Anesthesia was induced with fentanyl 20 µg/kg and etomidate 0.2 mg/kg. After neuromuscular blockade with cisatracurium 0.2 mg/kg, patients underwent endotracheal intubation, and mechanical ventilation was initiated. Anesthesia was maintained with remifentanyl 0.01 µg/kg/h, propofol 50 - 150 mg/kg/min, and cisatracurium 0.6 mg/kg/h. An initial dose of heparin 300 units/kg was administered to achieve an activated clotting time of more than 480 seconds. At the end of surgery, the patient was transferred to the cardiac intensive care unit and hospitalized for at least 48 hours.

When standard clinical criteria were met, the patient was weaned from mechanical ventilation and extubated.

3.4. Sample Size and Sampling

Sampling was nonrandom, based on convenience sampling, and continued until the calculated sample size was reached. Using the formula for estimating the proportion of a qualitative attribute in a population and the findings of Khazaei et al. (11), with $P = 0.14$, $d = 0.2P$, $\alpha = 0.05$, and an assumed study power of 80%, the sample size was calculated as 591 participants.

$$n = \frac{z_{1-\frac{\alpha}{2}}^2 P Q}{d^2}$$

$$\alpha = 0.05, Z_{1-\frac{\alpha}{2}} = 1.961150826$$

$$d = 0.028$$

$$P = 0.14, n = 591$$

3.5. Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Guilan University of Medical Sciences before the study began (approval code: IR.GUMS.REC.1403.394). Informed consent was obtained from all participants, and data confidentiality was maintained throughout the study.

3.6. Statistical Analysis

Demographic information included age, sex, marital status, education level, employment status, smoking status, and BMI. The HELIA questionnaire consists of 33 items across five components: reading, access, comprehension, evaluation, and decision-making/behavior. Each item has five response options scored from 1 to 5. Scores were converted to a 0 - 100 scale, and total HL was calculated by averaging the five subscale scores. HL was categorized as inadequate (0 - 50), borderline (50.1 - 66), adequate (66.1 - 84), or excellent (84.1 - 100). Data were analyzed using SPSS software. Quantitative variables were summarized as means and standard deviations, whereas nominal and ordinal variables were summarized as absolute and relative frequencies.

Inferential analyses included analysis of variance (ANOVA) to compare mean age across HL levels and the chi-square test or Fisher exact test to examine associations between HL and qualitative variables. A significance level of 0.05 was used for all tests. Spearman correlation was

used to investigate correlations between the percentage score on the Iranian adult HELIA questionnaire and age (years), education (years), and BMI (kg/m^2) among patients scheduled for open-heart surgery.

4. Results

A total of 591 patients were included, with a mean age of 60.36 ± 9.53 years; 36.9% were women, and 36.5% were illiterate or had primary education. Other demographic characteristics are shown in Table 1.

Table 1. Demographic Characteristics of the Study Patients^a

Variables	Values
Gender	
Female	218 (36.9)
Male	373 (63.1)
Age, y	60.36 $\pm$ 9.53 (16 - 83)
Education level	
Illiterate/Primary school	216 (36.5)
Secondary school	211 (35.7)
High school and diploma	131 (22.2)
University degree	33 (5.6)
Employment status	
Employed	220 (37.2)
Unemployed	53 (9)
Housewife	179 (30.3)
Pensionary	139 (23.5)
Marital status	
Single	552 (93.4)
Married	39 (6.6)
Smoking	
Yes	236 (39.9)
No	355 (60.1)
BMI, kg/m^2	26.78 $\pm$ 3.48 (19.05 - 37.32)

^a Values are expressed as No (%) or mean $\pm$ SD (min - max).

Overall, 1181 sources of health information were recorded. The most common sources were asking doctors and healthcare workers (28.6%), asking friends and acquaintances (24.7%), radio and television (18.8%), and the internet (16.6%). Books, pamphlets, and educational brochures accounted for 0.7%, and 4.9% of participants reported that they did not know where to obtain the required information.

The mean total HL score was 47.2 ± 13.58 . As shown in Table 2, the mean scores for the five HELIA domains were reading, 41.79 ± 28.2 ; access, 47.06 ± 13.85 ; comprehension, 49.87 ± 13.63 ; evaluation, 45.26 ± 16.42 ; and decision-making/behavior, 48.16 ± 16.87 .

Table 2. Frequency Distribution of Responses Across Five Domains of the Iranian Adult Health Literacy Questionnaire and Corresponding Mean Domain Scores in CABG Candidates (N = 591)^a

Domain	Completely Difficult/Never	Difficult/Rarely	Neither/Sometimes	Easy/Most of the Time	Completely Easy/Always	Mean ± SD
Reading	507 (21.4)	556 (23.6)	650 (27.5)	508 (21.5)	143 (6.0)	41.79 ± 28.20
Access	154 (4.4)	917 (25.8)	1702 (48.0)	737 (20.8)	36 (1.0)	47.06 ± 13.85
Comprehension	113 (2.7)	1037 (25.1)	1821 (44.0)	1090 (26.3)	76 (1.9)	49.87 ± 13.63
Evaluation	200 (8.4)	555 (23.5)	1101 (45.8)	495 (20.9)	13 (0.6)	45.26 ± 16.42
Decision-making/Behavior	830 (6.5)	3287 (25.8)	4240 (33.3)	3490 (27.4)	510 (4.0)	48.16 ± 16.87

^a Values are expressed as No. (%) unless otherwise indicated.

Based on the overall HL cutoff points, 60.2% of participants had inadequate HL, 31% had borderline HL, 8.3% had adequate HL, and only 0.5% had excellent HL.

Fisher exact testing showed statistically significant associations between patient age groups and HL levels ($P = 0.0001$) and between education levels and HL rankings ($P = 0.0001$). The chi-square test showed a statistically significant association between BMI categories and HL levels ($P = 0.002$). One-way ANOVA showed statistically significant differences in mean age across HL levels ($P = 0.0001$) and in mean BMI across HL levels ($P = 0.016$). Fisher exact testing showed no statistically significant associations between sex, employment status, or marital status and HL ranking; similarly, the chi-square test showed no statistically significant association between smoking status and HL ranking.

Spearman rho analysis showed a negative correlation between the percentage HL score and age and a positive correlation between the percentage HL score and education level ($P < 0.001$) (Table 3). Overall, 91% of patients had inadequate (60.2%) or borderline (31%) HL. HL was lower among older patients and those with lower education levels. In addition, 19.8% of patients knew nothing about their own disease, and only 27% asked medical staff questions. Written instructions, such as brochures and consent forms, were largely ineffective.

Table 3. Correlation Between Percentage Scores on the Iranian Adult Health Literacy Questionnaire and Age, Education, and BMI

Variable and Status	Age (y)	Education (y)	BMI (kg/m ²)
Percentage score on the Iranian Adult Health Literacy questionnaire			
Spearman	-0.181	0.433	-0.031
P-value	$P < 0.001$	$P < 0.001$	$P = 0.449$
Type of correlation	Negative correlation	Positive correlation	No correlation

5. Discussion

The present study demonstrates a concerning level of HL among candidates for open-heart surgery at a major academic referral center in northern Iran. More than 91% of patients had either inadequate (60.2%) or borderline (31%) HL, and the mean total HL score was 47.2 ± 13.58 , within the inadequate-to-borderline range. Limited HL can impair patients' understanding of their disease, adherence to preoperative and postoperative instructions, treatment follow-up, and ultimately, clinical outcomes.

The strong positive association between education level and HL score and the negative association between age and HL are consistent with the broader literature identifying education as an important predictor of HL. The age-related decline may reflect both lower educational attainment in older generations and age-related cognitive challenges. Because only 5.6% of our patients had a university education and a substantial proportion were illiterate or had only primary or secondary education, this population may be particularly vulnerable.

Despite the growing availability of digital media, the two primary information sources were doctors and healthcare workers (28.6%) and friends and acquaintances (24.7%). Although reliance on healthcare professionals is encouraging, substantial reliance on nonprofessional sources may increase the risk of misinformation. The internet accounted for 16.6% of reported sources, underscoring the need for credible and easily understandable Persian-language health information online.

Across all five HL domains (reading, access, comprehension, evaluation, and decision-making/behavior), mean scores were low to moderate. The lowest scores were observed for reading (41.79%) and evaluation (45.26%). These findings suggest that patients may struggle not only with written materials such as brochures and consent forms but also with judging the validity and relevance of the information they receive, which can compromise informed decision-making.

Only 8 patients reported having read an educational brochure, and very few found preoperative or postoperative instructions easy or completely easy to understand. This finding suggests that although written materials are provided, there may be insufficient assessment of whether patients understand and act on them. Moreover, although only a small percentage identified the hospital as their information source, many acknowledged receiving guide sheets and forms, implying that the delivery methods may not be tailored to patients' literacy levels or individual circumstances. Notably, 19.8% of patients (117 individuals) stated that they did not know about their own disease, and only approximately 27% asked questions of medical staff. This passive dynamic emphasizes the need for healthcare providers to take an active role in patient education rather than waiting for patients to initiate questions.

The cumulative evidence from this study does not indicate a safe or acceptable situation. It highlights an urgent need for a comprehensive and operational educational plan led by medical staff, particularly responsible physicians. As Dr. Heshmat Rasht Educational and Therapeutic Center is a provincial referral and academic institution that trains medical students and residents, it is expected to maintain high academic standards in addressing such gaps. Meaningful improvement, however, requires a multistakeholder approach involving healthcare professionals, students, cardiology residents, cardiac surgeons, and anesthesiologists.

Our findings are consistent with domestic and international research. Khazaei et al. (11) reported that 39.64% of patients in Hamedan with a history of open-heart surgery had poor or moderate HL, a lower prevalence than that found in the present study, possibly because of differences in study populations or regional demographics. Similarly, a 2018 study found inadequate HL in 42% of cardiac patients in West Azerbaijan. El Bashir et al. (2023) reported inadequate HL in 36% - 54% of patients with acute coronary syndrome or heart failure in Qatar, also confirming associations with education and occupation (12). Moshavvegh et al. showed that HL affects quality of life in patients with type 2 diabetes both directly and through improved self-management behaviors (13). Solhi et al. found an association between HL and self-care among patients with hypertension (14).

More importantly, Fabbri et al. demonstrated that patients with heart failure and low HL had significantly higher risks of death (HR, 1.91) and readmission (HR, 1.30) (15). Lindahl et al. showed that low HL, independent of age and education, was associated with carotid artery plaque

and high cardiovascular risk (16). Van Schaik et al. found that 18% of coronary patients had reading difficulties and 52% had difficulty understanding written information, with low HL associated with higher cardiovascular risk, closely reflecting the domain-specific deficits in reading and evaluation found in our study (17). Collectively, these findings underscore that inadequate HL is not merely a communication barrier but may also be associated with adverse clinical outcomes. The main finding of this study is consistent with domestic and international studies reporting inadequate HL in patients with chronic diseases, demonstrating the global nature of the challenge posed by limited HL in healthcare systems (18, 19).

This research provides baseline data for future studies. The high prevalence of inadequate HL and its strong association with age and education highlight the need for targeted interventions. Routine HL screening for CABG candidates, educational materials written in simple language and supplemented with visual aids and interactive methods, training for nurses and physicians in effective communication with patients who have low HL, and targeted support for high-risk groups, particularly older adults and those with low HL, may be beneficial. Future studies should comprehensively examine postoperative outcomes, including complications, readmissions, quality of life, and healthcare costs, stratified by HL scores. Such evidence could further support the integration of HL-sensitive practices into routine cardiac care.

In summary, the present study indicates an unsafe and unacceptable level of HL among open-heart surgery candidates at this academic referral center. The combination of low HL, substantial reliance on nonprofessional information sources, and domain-specific deficits in reading and evaluation may contribute to poor understanding of treatment and adverse postoperative outcomes. Immediate, coordinated, multilevel interventions are needed to improve patient safety and satisfaction and to reduce the broader clinical and economic burden on the healthcare system.

5.1. Limitations

The primary limitation is the single-center design, which limits the generalizability of the findings to centers with different demographic characteristics. In addition, the cross-sectional design does not allow causal relationships to be examined. Selection bias, self-report bias, residual confounding, and the inability to infer temporal or causal relationships are additional limitations.

5.2. Conclusions

This study revealed a concerning level of low HL among patients undergoing CABG at a university hospital in northern Iran. More than 90% of patients had inadequate or borderline HL, highlighting a substantial gap in patients' ability to understand, evaluate, and act on health-related information. Older age and lower education level were the strongest determinants of low HL, identifying vulnerable subgroups that may benefit from targeted interventions. The substantial reliance on verbal information from healthcare providers and social networks, together with the limited effectiveness of written materials, suggests that current communication strategies are not adequately tailored to patients' literacy capabilities. Health systems should prioritize routine HL screening and develop clear, patient-centered educational tools to improve preoperative care and patient safety. Future research should examine the effects of such interventions on clinical outcomes and patient satisfaction in this high-risk surgical population.

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Footnotes

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