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Article

Associations of Health Literacy and Social Determinants of Health With Quality of Life in Patients With Atrial Fibrillation

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Abstract

Aims/Background: Atrial fibrillation (AF) is the most common clinically significant arrhythmia in adults. This study aimed to determine health literacy levels and quality of life (QoL) among patients with AF and examine their associations with sociodemographic and clinical characteristics. **Methods:** This cross-sectional correlational study was conducted among 115 consecutive eligible patients with AF who were admitted to the cardiology inpatient clinic or followed up at the cardiology outpatient clinic of Pamukkale University Hospitals between December 2022 and July 2023. Data were collected through face-to-face interviews using a patient information form, the Atrial Fibrillation Effect on Quality-of-Life Scale, and the Health Literacy Scale. The study assessed patients' health literacy and QoL and examined their associations with sociodemographic and clinical characteristics. Data were analyzed using descriptive statistics, independent-samples *t* test, one-way analysis of variance, *post hoc* tests, Pearson's correlation analysis, and exploratory multiple linear regression analysis. Statistical significance was set at $p < 0.05$. Benjamini–Hochberg false discovery rate (FDR) correction was applied to correlation analyses, and the statistical significance for these analyses was evaluated using an FDR-adjusted p value (q) of <0.05. **Results:** The mean total health literacy score and the mean overall quality of life score were 78.98 ± 18.41 and 40.813 ± 12.181, respectively. Health literacy differed significantly by sex, age, educational status, occupation, and income status. In the adjusted health literacy model, older age (β = –0.496, $p < 0.001$) and longer duration since AF diagnosis (β = –0.121, $p = 0.048$) were associated with lower total health literacy scores, whereas secondary/high school education (β = 0.239, $p = 0.002$) and university education (β = 0.316, $p < 0.001$) were associated with higher health literacy scores. Female sex and single marital status remained associated with lower overall QoL after adjustment. Total health literacy was not significantly correlated with overall QoL. Benjamini–Hochberg FDR correction indicated an association of access to information with overall QoL ($r = 0.280$, $q = 0.030$), daily activities ($r = 0.402$, $q < 0.001$), and treatment satisfaction ($r = 0.239$, $q = 0.042$). Total health literacy level ($r = 0.250$, $q = 0.039$), appraising information ($r = 0.247$, $q = 0.039$), and applying information ($r = 0.249$, $q = 0.039$) were positively associated with treatment satisfaction. The associations between total health literacy level and understanding information with daily activities did not remain statistically significant following FDR correction. **Conclusion:** Total health literacy level was not significantly associated with overall QoL, whereas selected health literacy dimensions exhibited FDR-adjusted associations with overall QoL, daily activities, and treatment satisfaction. These findings should be interpreted cautiously, and social determinants should be considered alongside health literacy when addressing QoL in patients with AF.

Keywords: atrial fibrillation; health literacy; quality of life; social determinants

1. Introduction

Atrial fibrillation (AF) is the most common clinically significant arrhythmia in adults [1,2,3,4]. Worldwide, AF impacts approximately 1%–2% of the population. It is estimated that 6–12 million people in the United States and 17.9 million people in Europe will be diagnosed with AF by 2050 and 2060, respectively [2,5,6,7]. AF is associated with high morbidity and mortality, thus imposing a significant burden on patients, public health, and health economics [2,7].

The management of AF focuses on alleviating symptoms and reducing the risk of complications. Lack of awareness regarding AF diagnosis and limited knowledge about the risks and benefits of treatments can lead to treatment noncompliance in patients [8,9]. An effective treatment process requires patient education, informed decision-making processes, regular monitoring, care, and self-management [9,10]. Health literacy is a key component of comprehensive patient care and is defined as "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions" [11,12,13]. Health literacy is closely related to the social determinants of health and socioeconomic status [14,15]. Further, social determinants of health are defined by the World Health Organization as "the circumstances in which people are born, grow, live, work, and age, and the systems put in place to deal with illness" [14]. The socioeconomic status of individuals is often measured using factors such as education, income, and occupation; it has been shown to influence various aspects of health, including cardiovascular diseases,

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mortality rates, lifespan, and health-related quality of life (QoL) [3,14,15]. Factors such as educational inequality, health-related social norms and expectations, and aging-associated cognitive decline increase the risk of limited health literacy [3,14]. Limited health literacy has been associated with poorer disease management, more emergency department visits, higher hospital admission rates, reduced use of preventive services, less participation in decision-making processes, poor adherence to treatment regimens, and higher mortality rates [8,16]. Therefore, health literacy skills are considered important determinants of health outcomes, making the assessment of health literacy in this population essential [16,17]. Optimal health literacy is important for improving QoL and health status. Disease knowledge, behavioral changes, and active participation in health management are important factors associated with health outcomes among patients with chronic diseases [1,13]. A study recommends the use of health-related QoL as an indicator of treatment success in clinical practice [1]. In addition to adverse clinical outcomes, such as stroke, heart failure, and mortality, AF negatively affects QoL [4,18,19]. Patients with AF have a significantly lower health-related QoL compared with other patients with coronary heart disease, healthy controls, and the general population [19,20]. Previous studies have reported an adverse effect of the cost of AF, its impact on functional status, symptoms impairing function such as palpitations, shortness of breath, dizziness, and lightheadedness, treatment burden, and prognostic uncertainty on QoL [1,21]. Disease management may be complicated by uncertainty and anxiety regarding the timing of AF episodes. AF is a chronic condition requiring complex, long-term management, and therefore maintaining medication adherence may be challenging. Limited health literacy further exacerbates these issues [7,9].

The contemporary management of cardiovascular diseases should focus on not only reducing morbidity and mortality but also improving QoL [13]. Guidelines advocate for equal access to quality AF care tailored to patients' needs by recommending individualized and multidisciplinary care approaches [20]. In this context, the present study aimed to determine the health literacy levels of individuals diagnosed with AF, assess their QoL, and examine the associations of sociodemographic and clinical factors with health literacy and QoL. It sought to support patient-centered approaches in AF management and improve understanding of the role of health literacy in disease management.

2. Methods

2.1 Study Design

This cross-sectional correlational study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology checklist for cross-sectional studies (**Supplementary File 1**).

2.2 Setting and Participants

The study was conducted on patients with AF who were admitted to the cardiology inpatient clinic or followed up at the cardiology outpatient clinic of Pamukkale University Hospitals between December 2022 and July 2023. Consecutive eligible patients receiving care in these settings during the study period were invited to participate. The inclusion criteria were as follows: age ≥18 years, a confirmed diagnosis of AF, consciousness and ability to communicate, and provision of voluntary informed consent to participate. Patients with advanced or end-stage comorbid conditions—including advanced chronic obstructive pulmonary disease, advanced cancer, uncontrolled thyroid dysfunction, end-stage heart failure, or severe cognitive or psychiatric disorders—were excluded only if these conditions impaired their ability to communicate effectively, provide informed consent, or reliably complete the study questionnaires. Stable or adequately managed comorbidities alone were not considered exclusion criteria. The sample size was determined using G*Power version 3.1.9.7 (developed by Faul, Erdfelder, Lang, and Buchner; Heinrich Heine University Düsseldorf, Düsseldorf, Germany) based on a two-sided bivariate correlation analysis. Assuming a medium effect size (r = 0.30), a statistical power of 0.90, and a significance level (α) of 0.05, a minimum sample size of 112 participants was required, and the study was completed with 115 patients. No participant was excluded after questionnaire completion.

2.3 Data Collection Tools

The data were collected using the Individual Identification Form, the Health Literacy Scale, and the Atrial Fibrillation Effect on Quality-of-Life Scale.

Individual Identification Form: The Individual Identification Form included questions on age, sex, marital status, educational status, occupation, income status, and duration since AF diagnosis.

Health Literacy Scale: The validity and reliability of the Turkish version of the scale developed by Sørensen et al. [22] were established by Aras and Bayık Temel in 2019 [23]. The Health Literacy Scale comprises 25 items scored on a 5-point Likert-type scale from 1 to 5. Higher scores indicate higher health literacy. The four subscales are Access to information (items 1–5), Understanding information (items 6–12), Appraising information (items 13–20), and Applying information (items 21–25). Total scores range from 25 to 125. Cronbach's alpha for the scale was 0.92 [23]. Permission to use the instrument was obtained from the scale adaptation authors.

Atrial Fibrillation Effect on Quality-of-Life Scale: The scale developed by Spertus et al. [24] is an AF-specific measure of QoL. The validity and reliability of the Turkish version were established by Güneş and Boyraz [25] in 2021. The scale comprises 20 items scored on a 7-point Likert-type scale from 1 to 7 and four subscales: Symp-

toms (items 1–4), Daily activities (items 5–12), Treatment concern (items 13–18), and Treatment satisfaction (items 19 and 20). The two treatment satisfaction items are scored separately and are not included in the calculation of the overall questionnaire score. Scale and subscale scores range from 0 to 100, and higher scores indicate better AF-specific health status and QoL. Scale and subscale scores are calculated using the following formula:

Score = 100 – [(total score of answers given to relevant questions – number of questions answered) × 100]/ (total number of questions answered × 6)

The Cronbach's alpha value of the scale was found to be 0.91 [25]. Permission to use the instrument was obtained from the scale adaptation authors.

2.4 Data Collection Procedure

The questionnaires were administered in face-to-face interviews by trained researchers with experience in cardiovascular nursing and questionnaire-based clinical research. Before data collection, the researchers reviewed the content, administration procedure, scoring instructions, and ethical requirements of the instruments.

2.5 Data Analysis

The data were analyzed using IBM SPSS Statistics for Windows, Version 22.0 (SPSS Inc., Chicago, IL, USA). Continuous variables with approximately normal distributions were summarized using mean and standard deviation, whereas variables with skewed distributions were summarized using median and interquartile range. Categorical variables were presented as frequencies and percentages. No missing data were identified in the dataset. Normality was assessed using skewness and kurtosis coefficients, which are provided in **Supplementary File 2**. For univariate distributions, skewness and kurtosis values between –2 and +2 were considered acceptable [26]. In this study, the skewness coefficients ranged from –1.036 to 0.674, whereas the kurtosis coefficients ranged from –0.521 to 2.337. The kurtosis coefficients in the treatment satisfaction and applying information subscales slightly exceeded the ±2 threshold to a certain extent. However, considering that the skewness values fell within acceptable limits, the deviations in the kurtosis values were small, and the sample size was 115, it was concluded that the distributions did not deviate from normality to a degree that would preclude the application of parametric analyses. Accordingly, the analyses were conducted after evaluating the other assumptions of the relevant parametric tests. The homogeneity of variances was assessed using Levene's test before conducting one-way analysis of variance (ANOVA). Between-group comparisons were performed using the independent-samples t test or one-way ANOVA, as appropriate, followed by Tukey's honestly significant difference (HSD) *post hoc* test. Pearson's correlation analysis was used to examine the correlations between continuous variables. To account for multiple testing, the raw p values obtained from the 25 correlations between the 5 health literacy measures and the 5 QoL outcomes were adjusted using the Benjamini–Hochberg false discovery rate (FDR) procedure (**Supplementary File 3**). Both unadjusted p values and FDR-adjusted p values (q values) were reported, and the statistical significance for these correlation analyses was evaluated using $q < 0.05$. Two multivariable linear regression models were constructed. The first model used total health literacy score as the dependent variable, with age, sex, marital status, income status, duration since AF diagnosis, educational status, and occupation as independent variables. The second model used the Atrial Fibrillation Effect on Quality-of-Life (AFEQT) overall score as the dependent variable, with total health literacy score and the same sociodemographic and clinical characteristics as independent variables. Covariates were selected based on their conceptual relevance as potential confounders and entered simultaneously using the enter method. Educational status and occupation were regrouped because of small subgroup sizes and entered as dummy variables. Multicollinearity was assessed using tolerance and variance inflation factor (VIF) values. Tolerance values below 0.20 and VIF values above 5 were considered indicative of problematic multicollinearity. Statistical significance was set at $p < 0.05$ for the primary analyses and $q < 0.05$ for the FDR-adjusted correlation analyses.

3. Results

Of the 115 participants, 58.3% were male and 41.7% were female; the mean age was 65.87 ± 15.13 years. Most participants were married (78.3%), and primary school was the most frequently reported educational status (23.5%). More than half were not employed, and 51.3% reported an income lower than their expenses. No participants reported an income higher than their expenses. The median duration since AF diagnosis was 10 months (interquartile range (IQR): 2–24), and 70.4% had been diagnosed with AF within the previous year (Table 1).

Patients' health literacy scores were generally slightly above the midpoint, with a mean of 78.98 ± 18.41. The total health literacy scores of men were significantly higher than those of women ($t = 3.463$; $p = 0.001$). Those aged 60 years and younger and university graduates had higher scores than the other groups. Marital status was not significantly associated with any health literacy dimension. Working patients had higher scores than nonworking patients. Those with income equal to their expenses had higher scores than those with income less than their expenses ($t = –3.144$; $p = 0.002$). Access to information scores exhibited significant differences according to the duration of AF diagnosis ($F = 4.145$; $p = 0.018$) (Table 2).

Patients' total QoL scores were found to be moderate, with an average of 40.813 ± 12.181. The QoL total scores of men were found to be significantly higher than those of

Table 1. Sociodemographic and clinical characteristics of patients with AF (*n* = 115).

Variables	Value/*n*	Percentage (%)
Age (Mean ± SD)	65.87 ± 15.13	
≤60	34	29.6
61–70	33	28.7
71–80	29	25.2
≥81	19	16.5
Sex		
Male	67	58.3
Female	48	41.7
Marital status		
Married	90	78.3
Single	25	21.7
Educational status		
Illiterate	18	15.7
Literate	19	16.5
Primary school	27	23.5
Secondary school	20	17.4
High school	18	15.7
University	13	11.3
Occupation		
Worker	18	15.7
Civil servant	10	8.7
Retired	42	36.5
Self-employed	7	6.1
Housewife	38	33.0
Income status		
Income less than expenses	59	51.3
Income equal to expenses	56	48.7
Duration since AF diagnosis (months), median (IQR)	10 (2–24)	
1–6 months	56	48.7
7–12 months	25	21.7
>1 year	34	29.6

Note: Continuous variables are presented as mean ± SD or median (IQR), and categorical variables as *n* (%). No participants reported an income higher than their expenses. Abbreviations: AF, atrial fibrillation; IQR, interquartile range; SD, standard deviation.

women ($t = 3.916$; $p < 0.001$). Patients aged 81 years and older experienced more limitations in daily activities ($F = 4.974$; $p = 0.003$). The total QoL scores of married patients were significantly higher than those of single patients ($t = 2.644$; $p = 0.009$). Daily activity scores also differed significantly by occupation ($F = 3.768$; $p = 0.007$). Patients with income less than expenses had significantly lower daily activity scores than those with income equal to expenses ($t = –2.088$; $p = 0.039$). This indicated an association of economic status with daily activities (Table 3).

Following Benjamini–Hochberg FDR correction, six correlations remained statistically significant. Access to information was positively correlated with overall QoL, daily activities, and treatment satisfaction. Total health literacy, appraising information, and applying information were positively correlated with treatment satisfaction. The associations of total health literacy and understanding information with daily activities did not retain statistical significance following FDR correction (Table 4).

In the multivariable linear regression model, older age ($\beta = –0.496$, $p < 0.001$) and longer duration since AF diagnosis ($\beta = –0.121$, $p = 0.048$) were associated with lower total health literacy scores. Those with secondary/high school education ($\beta = 0.239$, $p = 0.002$) and university education ($\beta = 0.316$, $p < 0.001$) had higher health literacy scores compared with participants with primary school education or below. Sex, marital status, income status, and occupation were not statistically significant in the adjusted model. Tolerance values were above 0.20, and VIF values were below 5, indicating no problematic multicollinearity (Table 5).

In the multivariable linear regression model, female sex ($\beta = –0.581$, $p = 0.001$) and single marital status ($\beta = –0.245$, $p = 0.014$) were associated with lower overall QoL scores after adjustment for the variables included in the model. Total health literacy, age, income status, duration since AF diagnosis, educational status, and occupation were not statistically significant. Tolerance and VIF values indicated no problematic multicollinearity (Table 6).

4. Discussion

This study evaluated the health literacy and QoL levels of patients with AF, revealing a close association of these variables with certain social determinants. The findings showed that health literacy levels were generally slightly above the midpoint, whereas QoL was low in certain subdimensions such as daily activities and symptoms. Certain sociodemographic and socioeconomic factors were significantly associated with patients' health literacy and QoL; however, the factors associated with each outcome differed. Sex was associated with both health literacy and QoL, whereas age, educational status, occupation, and income status were primarily associated with health literacy, and marital status was associated with QoL. Total health literacy was not significantly associated with overall QoL or daily activities in the FDR-adjusted correlation analyses, but it was positively correlated with treatment satisfaction. Access to information was positively correlated with overall QoL, daily activities, and treatment satisfaction.

In the present study, the mean health literacy score was slightly above the midpoint. Similarly, previous studies found that more than half of patients with AF had adequate health literacy. In addition, QoL and medication adherence improved significantly in studies using health literacy information technology systems [8,27]. In the present study, the total QoL score was found to be moderate. In particular, the low scores in the daily activities subscale indicated that patients experienced significant difficulties in physical functioning. Previous studies reported similar findings, emphasizing that symptoms such as fatigue, dyspnea, palpita-

Table 2. Health literacy according to the descriptive characteristics of patients with AF.

Demographic characteristics	n	Total health literacy	Access to information	Understanding information	Appraising information	Applying information
Sex		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Male	67	83.79 ± 15.82	15.98 ± 3.84	19.80 ± 4.72	27.35 ± 5.96	20.64 ± 3.25
Female	48	72.27 ± 19.81	12.52 ± 4.49	16.33 ± 5.28	24.20 ± 7.28	19.20 ± 4.62
t		3.463	4.441	3.702	2.556	1.954
p		<0.001	<0.001	<0.001	0.012	0.053
Age		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
≤60 years	34	96.38 ± 13.95	18.41 ± 3.85	23.00 ± 4.85	31.94 ± 4.77	23.02 ± 2.16
61–70 years	33	77.18 ± 10.93	14.51 ± 3.01	17.81 ± 3.20	25.21 ± 5.09	19.63 ± 2.82
71–80 years	29	70.69 ± 14.21	12.20 ± 3.06	16.06 ± 4.14	23.69 ± 5.49	18.72 ± 4.07
≥81	19	63.63 ± 18.09	11.21 ± 4.32	14.47 ± 4.40	20.52 ± 6.41	17.42 ± 4.67
F		28.632	23.539	22.551	22.707	14.279
p		<0.001	<0.001	<0.001	<0.001	<0.001
Post hoc		1 > 2, 1 > 3, 1 > 4, 2 > 4	1 > 2, 1 > 3, 2 > 3, 1 > 4, 2 > 4	1 > 2, 1 > 3, 1 > 4, 2 > 4	1 > 2, 1 > 3, 1 > 4, 2 > 4, 3 > 4	1 > 2, 1 > 3, 1 > 4, 2 > 4
Marital status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Married	90	79.45 ± 16.61	14.80 ± 4.09	18.34 ± 4.68	26.21 ± 6.24	20.10 ± 3.71
Single	25	77.28 ± 24.15	13.60 ± 5.53	18.40 ± 6.96	25.44 ± 8.25	19.84 ± 4.70
t		0.521	1.195	–0.047	0.508	0.292
p		0.675	0.320	0.970	0.667	0.771
Educational status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Illiterate	18	65.05 ± 15.21	11.16 ± 3.58	14.72 ± 3.43	21.55 ± 6.34	17.61 ± 4.45
Literate	19	65.00 ± 15.03	10.94 ± 2.63	14.84 ± 3.73	21.52 ± 5.56	17.68 ± 4.35
Primary school	27	75.29 ± 11.19	13.85 ± 2.93	16.92 ± 3.57	24.85 ± 4.86	19.66 ± 3.19
Secondary school	20	84.80 ± 10.94	15.60 ± 2.94	19.75 ± 3.57	28.20 ± 4.62	21.25 ± 2.71
High school	18	91.22 ± 17.55	17.50 ± 4.20	21.22 ± 5.21	30.22 ± 6.35	22.27 ± 2.99
University	13	100.46 ± 15.73	20.15 ± 3.80	25.38 ± 4.80	32.23 ± 6.27	22.69 ± 2.89
F		16.997	19.032	16.783	10.798	6.974
p		<0.001	<0.001	<0.001	<0.001	<0.001
Post hoc		3 > 1, 4 > 1, 5 > 1, 6 > 1, 3 > 2, 4 > 2, 5 > 2, 6 > 2, 4 > 3, 5 > 3, 6 > 3, 6 > 4	3 > 1, 4 > 1, 5 > 1, 6 > 1, 3 > 2, 4 > 2, 5 > 2, 6 > 2, 5 > 3, 6 > 3, 6 > 4, 6 > 5	4 > 1, 5 > 1, 6 > 1, 4 > 2, 5 > 2, 6 > 2, 4 > 3, 5 > 3, 6 > 3, 6 > 4, 6 > 5	4 > 1, 5 > 1, 6 > 1, 3 > 2, 4 > 2, 5 > 2, 6 > 2, 4 > 3, 5 > 3, 6 > 3, 6 > 4	4 > 1, 5 > 1, 6 > 1, 4 > 2, 5 > 2, 6 > 2, 5 > 3, 6 > 3
Occupation		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Worker	18	85.33 ± 16.50	16.22 ± 3.70	19.72 ± 5.20	27.83 ± 6.20	21.55 ± 3.10
Civil servant	10	101.50 ± 13.24	20.20 ± 3.64	26.30 ± 3.83	32.30 ± 4.90	22.70 ± 2.40
Retired	42	76.38 ± 15.33	14.14 ± 3.79	17.64 ± 4.05	25.07 ± 5.89	19.52 ± 3.82
Self-employed	7	94.57 ± 11.03	17.71 ± 2.87	22.14 ± 4.34	32.57 ± 3.73	22.14 ± 2.67
Housewife	38	70.05 ± 17.45	12.10 ± 4.00	15.71 ± 4.29	23.42 ± 6.75	18.81 ± 4.30
F		10.670	11.690	14.010	7.090	3.750
p		<0.001	<0.001	<0.001	<0.001	0.007
Post hoc		2 > 1, 1 > 3, 2 > 3, 4 > 3, 1 > 5, 2 > 5, 4 > 5	2 > 1, 2 > 3, 4 > 3, 1 > 5, 2 > 5, 3 > 5, 4 > 5	2 > 1, 2 > 3, 4 > 3, 1 > 5, 2 > 5, 3 > 5, 4 > 5	2 > 3, 4 > 3, 1 > 5, 2 > 5, 4 > 5	2 > 3, 1 > 5, 2 > 5, 4 > 5
Income status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Income less than expenses	59	73.91 ± 17.04	13.13 ± 4.12	16.83 ± 4.39	24.33 ± 6.32	19.61 ± 4.04
Income equal to expenses	56	84.32 ± 18.44	16.01 ± 4.33	19.96 ± 5.58	27.83 ± 6.66	20.50 ± 3.78

Table 2. Continued.

Demographic characteristics	n	Total health literacy	Access to information	Understanding information	Appraising information	Applying information
t		–3.144	–3.654	–3.353	–2.891	–1.217
p		0.002	<0.001	0.001	0.005	0.226
AF diagnosis		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1–6 months	56	82.80 ± 19.44	15.71 ± 4.61	19.41 ± 5.77	27.01 ± 6.85	20.66 ± 4.04
7–12 months	25	76.28 ± 16.57	13.76 ± 4.43	17.96 ± 4.30	24.92 ± 6.49	19.64 ± 3.29
>1 year	34	74.67 ± 17.10	13.17 ± 3.72	16.91 ± 4.62	25.27 ± 6.53	19.32 ± 4.10
F		2.465	4.145	2.576	1.178	1.404
p		0.090	0.018	0.081	0.312	0.250
Post hoc			1 > 3			

Note: *F*: analysis of variance (ANOVA); *t*: independent-samples *t* test; *post hoc*: Tukey, HSD. *Post hoc*: Numbers indicate groups in the order presented; ">" denotes a significantly higher score ($p < 0.05$).

tions, and exercise intolerance limited daily life in patients with AF [20,28,29]. A case–control study by Serpytis et al. [19] found that patients with AF had a lower QoL because they experienced a higher degree of activity limitation compared with individuals in the control group. The improvement in symptoms reduced the burden of AF [20,30,31]. Previous studies showed that multidisciplinary team management led by nurses, with personalized follow-up plans and the use of social media tools and artificial intelligence programs, reduced hospital admissions and improved medication adherence and QoL [5,15,32].

The present study found that, in unadjusted analyses, health literacy scores differed by sex, age, educational status, occupation, and income status. This indicated a close association of health literacy with social determinants [12,15]. The present study found that men had higher health literacy scores than women, consistent with the findings of Reading et al. [8], who reported lower health literacy levels in female patients with AF. In a study by Montbleau and colleagues, no difference was found in health literacy levels between patients with AF based on sex; however, it was emphasized that the sample size of 40 was insufficient and studies should be conducted with larger sample groups [27]. Previous studies on cardiovascular disease groups, including health literacy and AF, showed that health literacy levels were higher in men than in women [15,33]. This finding highlighted the need to develop sex-based health literacy education programs and policies and conduct more research in this area. Additionally, the present study revealed significant differences between age groups. It found that younger age groups had higher health literacy scores, which decreased with advancing age. Studies conducted on AF and other cardiovascular disease groups similarly showed that health literacy levels were low in older age groups [13,14,34]. Older adults have limited health literacy for various reasons, such as health-related social norms and expectations as well as aging-associated cognitive decline [14]. The present study demonstrated that the health literacy level was higher among younger, better-educated, and employed individuals, whereas older adults, those with lower educational attainment, and nonworking groups such as retirees and housewives exhibited lower health literacy levels. These findings underscore the need for age- and education-appropriate health literacy programs to enhance awareness, particularly among vulnerable populations [8,11,15]. Knowledge about AF has been shown to be directly related to educational status. Differences in educational opportunities between generations negatively impact general literacy. At the same time, single-session education has a weak association with patients' knowledge acquisition [14]. In this context, the development of education- and occupation-focused health literacy programs is important. The present study found that income status was associated with health literacy in the unadjusted analysis, with patients whose income equaled their expenses scoring higher. No participant reported income exceeding expenses, which possibly reflected the predominance of older, retired, unemployed, or economically inactive individuals and their subjective assessment of income adequacy. Studies conducted on patients with AF and other cardiovascular diseases also discovered that the health literacy level was lower among patients living in poor areas and with lower socioeconomic status [8,11]. The present study demonstrated an association of the duration of AF diagnosis with the access to information subdimension of health literacy. This indicated that individuals needed and sought more information about their disease during the initial diagnosis process. These results implied that health literacy may be an important factor associated with AF management and clinical outcomes [14,20]. This underscores the need to develop education programs and policies that are sex-specific, age-appropriate, and focused on health awareness among older individuals, that are education- and profession-focused, that provide equal economic opportunities, and that are appropriately timed. Further research is also needed to investigate these issues.

In the present study, several sociodemographic and socioeconomic factors, including sex, age, marital status, occupation, and income status, were significantly associ-

Table 3. QoL according to the descriptive characteristics of patients with AF.

Demographic characteristics	n	Total QoL	Symptoms	Daily activities	Treatment concern	Treatment satisfaction
Sex		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Male	67	44.36 ± 10.17	45.33 ± 21.04	25.21 ± 12.31	69.23 ± 10.55	58.45 ± 11.09
Female	48	35.86 ± 13.09	33.07 ± 18.76	15.49 ± 16.14	64.87 ± 13.23	57.29 ± 12.82
t		3.916	3.222	3.664	1.965	0.521
p		<0.001	0.002	<0.001	0.052	0.604
Age		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
≤60 years	34	42.62 ± 11.59	40.44 ± 20.76	25.55 ± 13.12	66.83 ± 12.47	58.33 ± 10.46
61–70 years	33	42.53 ± 12.64	40.40 ± 19.69	23.61 ± 16.28	69.19 ± 11.44	60.60 ± 8.14
71–80 years	29	41.18 ± 12.28	43.68 ± 23.56	20.04 ± 13.22	67.72 ± 12.32	56.32 ± 12.92
≥81 years	19	34.01 ± 10.66	34.21 ± 19.37	10.75 ± 12.69	64.91 ± 11.31	55.26 ± 16.71
F		2.551	0.783	4.974	0.554	1.083
p		0.059	0.506	0.003	0.647	0.359
Post hoc				1 > 4, 2 > 4, 3 > 4		
Marital status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Married	90	42.35 ± 11.96	42.73 ± 21.42	22.43 ± 14.06	68.67 ± 11.18	58.89 ± 11.29
Single	25	35.25 ± 11.53	31.17 ± 16.45	16.58 ± 16.64	62.89 ± 13.44	54.67 ± 13.19
t		2.644	2.499	1.766	2.187	1.593
p		0.009	0.014	0.080	0.031	0.114
Educational status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Illiterate	18	38.22 ± 17.47	33.10 ± 24.35	19.21 ± 22.99	66.97 ± 13.43	55.55 ± 15.12
Literate	19	40.59 ± 11.18	44.29 ± 17.96	18.42 ± 12.40	67.69 ± 11.68	56.57 ± 12.60
Primary school	27	40.50 ± 9.36	39.66 ± 17.99	17.97 ± 11.05	71.09 ± 8.55	58.02 ± 9.66
Secondary school	20	40.74 ± 11.20	37.50 ± 16.99	22.91 ± 12.40	66.66 ± 12.42	58.75 ± 9.15
High school	18	41.97 ± 11.02	42.82 ± 21.18	23.84 ± 11.87	65.58 ± 12.46	59.25 ± 10.26
University	13	43.87 ± 14.35	45.83 ± 29.75	28.04 ± 16.70	63.67 ± 14.41	60.25 ± 16.01
F		0.355	0.869	1.193	0.876	0.351
p		0.878	0.504	0.318	0.500	0.881
Occupation		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Worker	18	44.54 ± 12.22	46.76 ± 22.07	24.31 ± 12.52	70.06 ± 9.65	57.87 ± 10.87
Civil servant	10	43.79 ± 15.05	38.75 ± 27.36	33.54 ± 14.35	60.83 ± 15.29	60.00 ± 8.61
Retired	42	41.24 ± 10.69	41.77 ± 21.86	20.58 ± 12.36	68.45 ± 10.73	56.94 ± 13.26
Self-employed	7	45.50 ± 5.69	42.86 ± 12.89	27.08 ± 8.07	71.82 ± 13.07	61.90 ± 8.13
Housewife	38	36.91 ± 13.12	35.31 ± 18.37	15.95 ± 17.03	65.94 ± 12.58	57.89 ± 12.09
F		1.874	1.062	3.768	1.481	0.340
p		0.120	0.379	0.007	0.213	0.850
Post hoc				2 > 3, 1 > 5, 2 > 5		
Income status		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Income less than expenses	59	39.42 ± 11.77	37.92 ± 18.98	18.39 ± 14.23	68.45 ± 11.52	57.49 ± 12.45
Income equal to expenses	56	42.27 ± 12.53	42.63 ± 22.74	24.07 ± 14.92	66.31 ± 12.28	58.48 ± 11.18
t		–1.260	–1.208	–2.088	0.963	–0.451
p		0.210	0.229	0.039	0.338	0.653
Duration of AF diagnosis		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
1–6 months	56	40.07 ± 13.34	37.43 ± 20.80	21.73 ± 15.55	66.32 ± 13.09	58.63 ± 12.30
7–12 months	25	44.25 ± 10.56	46.50 ± 18.58	23.42 ± 14.29	70.56 ± 11.42	57.67 ± 10.18
>1 year	34	39.48 ± 11.09	40.19 ± 22.33	18.57 ± 13.84	66.91 ± 9.89	57.11 ± 12.33
F		1.310	1.642	0.854	1.143	0.184
p		0.274	0.198	0.428	0.323	0.832

Note: *F*: ANOVA; *t*: independent-samples *t* test; *post hoc*: Tukey, honestly significant difference (HSD). *Post hoc*: Numbers indicate groups in the order presented; ">" denotes a significantly higher score ($p < 0.05$).

Table 4. Relationship between QoL and health literacy of patients with AF (*n* = 115).

Health literacy variable	QoL outcome	*r*	95% CI for *r*	Raw *p*	FDR-adjusted *p* (*q*)
Access to information	Overall QoL	0.280	0.102–0.441	0.002	0.030
Access to information	Daily activities	0.402	0.236–0.545	<0.001	<0.001
Total health literacy	Treatment satisfaction	0.250	0.070–0.414	0.007	0.039
Applying information	Treatment satisfaction	0.249	0.069–0.413	0.007	0.039
Appraising information	Treatment satisfaction	0.247	0.067–0.412	0.008	0.039
Access to information	Treatment satisfaction	0.239	0.058–0.404	0.010	0.042
Total health literacy	Daily activities	0.212	0.030–0.380	0.023	0.082
Understanding information	Daily activities	0.192	0.009–0.362	0.040	0.124

Note: *r*, Pearson correlation coefficient; CI, confidence interval; *p*, unadjusted *p* value; *q*, Benjamini–Hochberg FDR-adjusted *p* value; FDR, false discovery rate; QoL, quality of life.

Table 5. Multiple linear regression analysis of factors associated with health literacy in patients with AF (*n* = 115).

Variables	B	SE	β	*t*	95% CI for B	Tolerance	VIF	*p*
Constant	126.131	9.759	—	12.924	106.780 to 145.482	—	—	<0.001
Age, years	–0.604	0.093	–0.496	–6.468	–0.789 to –0.419	0.580	1.724	<0.001
Female sex[1]	–7.643	4.223	–0.206	–1.810	–16.017 to 0.731	0.265	3.775	0.073
Single marital status[2]	–2.369	2.965	–0.053	–0.799	–8.248 to 3.510	0.768	1.302	0.426
Income equal to expenses[3]	0.350	2.645	0.010	0.132	–4.894 to 5.595	0.657	1.521	0.895
Duration since AF diagnosis, months	–0.043	0.022	–0.121	–2.005	–0.086 to –0.0005	0.941	1.062	0.048
Secondary/high school education[4]	9.323	2.995	0.239	3.113	3.384 to 15.262	0.579	1.728	0.002
University education[4]	18.306	4.303	0.316	4.254	9.773 to 26.838	0.619	1.616	<0.001
Employed[5]	2.451	3.264	0.061	0.751	–4.021 to 8.922	0.509	1.963	0.454
Housewife[5]	3.543	4.626	0.091	0.766	–5.630 to 12.716	0.243	4.122	0.446

Model statistics: $R^2 = 0.641$; adjusted $R^2 = 0.611$; $F(9, 105) = 20.857$; $p < 0.001$; Durbin–Watson = 1.568.

Notes: B, unstandardized regression coefficient; β, standardized regression coefficient; CI, confidence interval; SE, standard error; VIF, variance inflation factor. [1]Reference category: male. [2]Reference category: married. [3]Reference category: income less than expenses. [4]Reference category: primary school or below. [5]Reference category: retired. Employed includes workers, civil servants, and self-employed participants.

Table 6. Multiple linear regression analysis of factors associated with QoL in patients with AF (*n* = 115).

Variables	B	SE	β	*t*	95% CI for B	Tolerance	VIF	*p*
Constant	81.547	15.237	—	5.352	51.331 to 111.763	—	—	<0.001
Total health literacy	–0.123	0.095	–0.185	–1.295	–0.310 to 0.065	0.359	2.788	0.198
Age, years	–0.113	0.107	–0.140	–1.050	–0.325 to 0.100	0.415	2.411	0.296
Female sex[1]	–14.298	4.160	–0.581	–3.437	–22.547 to –6.048	0.257	3.893	0.001
Single marital status[2]	–7.214	2.885	–0.245	–2.501	–12.935 to –1.494	0.764	1.310	0.014
Income equal to expenses[3]	0.684	2.566	0.028	0.266	–4.405 to 5.772	0.657	1.522	0.790
Duration since AF diagnosis, months	0.008	0.021	0.033	0.372	–0.034 to 0.050	0.907	1.103	0.711
Secondary/high school education[4]	–2.918	3.036	–0.113	–0.961	–8.940 to 3.103	0.530	1.887	0.339
University education[4]	4.635	4.520	0.121	1.025	–4.328 to 13.597	0.528	1.895	0.308
Employed[5]	5.614	3.174	0.213	1.769	–0.681 to 11.909	0.507	1.973	0.080
Housewife[5]	8.789	4.500	0.341	1.953	–0.135 to 17.713	0.241	4.145	0.054

Model statistics: $R^2 = 0.236$; adjusted $R^2 = 0.162$; $F(10, 104) = 3.206$; $p = 0.001$; standard error of the estimate = 11.150.

Notes: B, unstandardized regression coefficient; β, standardized regression coefficient; CI, confidence interval; SE, standard error. [1]Reference category: male. [2]Reference category: married. [3]Reference category: income less than expenses. [4]Reference category: primary school or below. [5]Reference category: retired. Employed includes workers, civil servants, and self-employed participants.

ated with QoL or its specific dimensions among patients with AF. In particular, elderly individuals and patients with low economic status experienced more difficulties in daily activities. The QoL scores of male patients were higher than those of female patients. These findings suggested that women experienced more severe AF-related symptoms, re-

ported poorer QoL, and encountered greater difficulties in daily activities than men. The findings also emphasized that women experienced more difficulties and emotional burden in disease management and physical performance, and had lower QoL [4,6,21]. Antoun et al. [35] assessed sex inequality in QoL among patients with AF during the ongoing conflict in Syria. Syrian women with AF had lower QoL than men. This study also reported findings on healthcare challenges in resource-constrained settings. A study conducted using data from 250 centers in Europe found that women living in countries with low post-secondary education attainment, high rates of living alone, high sex inequality indices, and low average monthly income had lower QoL. The study also found a significant association of factors such as decreased physical mobility, decreased capacity for self-care and daily activities, increased pain levels, and moderate anxiety or depression with negative health outcomes [36]. The present study discovered that difficulties in physical activities increased with age and individuals aged 81 years and older experienced more limitations in daily activities. This finding supported the association between aging and physical independence and highlighted the need for a more comprehensive assessment of AF management in older adults. These findings were consistent with studies showing age and sex as important determinants of QoL [4,29,37]. This study showed that married patients had a higher QoL and experienced fewer symptoms than single patients, emphasizing the importance of psychosocial support and showing that social support systems can be decisive in an individual's process of coping with illness [13,38]. Married individuals may have better QoL because of the emotional and physical support they receive from their spouses. Social support has been associated with a reduced risk of cardiovascular disease and mortality [39,40]. A study conducted in the United States found that women without a spouse or partner had higher cardiovascular mortality rates compared with those who were married or had a partner. Social support has a protective effect on health, even among individuals with low socioeconomic status and older adults, and this relationship may be linked to the role of stress in the development and progression of cardiovascular disease [39]. The results of the present study indicated that occupation and income status were associated with daily activities in the unadjusted analyses. The incidence of AF was higher in unemployed individuals than in employed individuals [2,10]. Tan et al. [21] found that patients who were not working experienced greater difficulty in daily activities. The present study found that individuals with a good economic status experienced fewer limitations in daily activities. Another study also found that income status influenced daily activities, supporting the results of this study [21]. Previous studies demonstrated that the incidence of AF was higher in individuals with low socioeconomic status. Low income at the individual and household levels was associated with increased cardiovascular risk factors, adverse cardiac events, and mortality rates in patients with AF [3,13,41]. The Atherosclerosis Risk in Communities study reported that the incidence of AF was higher among participants with low household income compared with participants with high income statuses. High income and economic well-being were shown to increase access to healthcare services in patients with AF, positively influence healthcare providers' decision-making processes, and be associated with improved clinical outcomes [40,41]. These findings revealed that economic well-being was associated with individuals' physical and social lives and that access to economic and social resources provided a significant advantage in disease management.

The present study found an association between health literacy and certain subdimensions of QoL, particularly daily activities and treatment satisfaction; however, the correlation analyses between the total health literacy score and QoL did not reveal a significant relationship. The study results indicated that, although health literacy did not directly determine QoL, the dimension of access to information, in particular, had a positive correlation with QoL, daily activities, and treatment satisfaction. This finding showed that individuals' ability to easily access information was associated with daily activities and their satisfaction with treatment processes. A previous study also emphasized that patients with AF who searched for health information online had a higher QoL compared with those who did not and that greater access to information improved individuals' health management skills [17]. These findings suggested that access to health information might be relevant to selected aspects of AF-specific QoL; however, the observed associations should not be interpreted causally. The published data also indicate health literacy as an important factor in chronic disease management, improving treatment adherence, patient satisfaction, and self-management skills [17]. The present study found associations of the appraising information and applying information subscales with treatment satisfaction. These findings suggested that individuals' ability to appraise and apply health information might be related to their satisfaction with treatment processes [38]. Low health literacy is associated with a lack of knowledge about AF and its treatment, which can negatively impact patients' disease awareness and treatment adherence [40]. Individuals with limited health literacy may not fully understand AF risk factors and stroke prevention strategies, leading to difficulties in recognizing symptoms and managing medications. Furthermore, the risk of developing AF decreases with increasing education levels [3]. Therefore, it is recommended that integrated care approaches be adopted for individuals with low health literacy, individualized care plans be developed, and digital platforms that facilitate access to health information be used. Furthermore, health education programs that help develop information access and comprehension skills can support patient engagement and treatment adherence. Technological innovations enable the early detection

and long-term monitoring of AF, thereby helping reduce the disease burden [13,30]. The cross-sectional design does not permit conclusions regarding the temporal direction of the observed associations. Although greater access to health information may be related to better daily functioning or treatment satisfaction, reverse directionality is also plausible. Patients with better functional capacity, lower symptom burden, higher educational attainment, or greater social support may have greater opportunities and ability to access, understand, and use health information. Therefore, the observed domain-level correlations should not be interpreted as evidence that improvements in health literacy can lead to improvements in QoL.

Consistent with the correlation findings, total health literacy was not associated with overall QoL in the adjusted analysis. However, female sex and single marital status were still associated with lower overall QoL scores, suggesting a closer association of social factors with overall QoL than health literacy alone in patients with AF.

Limitation

Several methodological considerations should be acknowledged when interpreting the results of this study. The single-center design, relatively small sample size, and few participants in some subgroups might have limited the generalizability of the findings and reduced the statistical power of subgroup analyses. Although the sample size was adequate to detect a medium correlation (r = 0.30), the study might have been underpowered to detect smaller associations. Therefore, nonsignificant findings should be interpreted cautiously, and the possibility of Type II error cannot be excluded. Moreover, the use of self-reported measures might have introduced recall and response biases. To address multiple testing, the Benjamini–Hochberg false discovery rate (FDR) procedure was applied to correlation analyses. Nevertheless, the domain-level correlation analyses were exploratory, and the findings should be interpreted cautiously and confirmed in larger, multicenter studies. The cross-sectional design also precluded causal inferences. Multicenter and longitudinal studies with larger and more diverse samples should be conducted to confirm these findings and enable more robust analyses.

5. Conclusion

This study showed that total health literacy was not significantly associated with overall QoL. Benjamini–Hochberg FDR correction indicated that access to information was associated with overall QoL, daily activities, and treatment satisfaction, whereas total health literacy, appraising information, and applying information were associated with treatment satisfaction. Sociodemographic and socioeconomic factors were associated with health literacy, QoL, or specific QoL subscales in unadjusted and/or adjusted analyses, suggesting that social determinants should be considered alongside health literacy when addressing QoL in patients with AF. Future studies should further examine these associations using larger, multicenter, and longitudinal study designs. Policies and patient education programs should consider patients' social circumstances and health literacy needs to support QoL and promote equitable healthcare.

Key Points

• This study examined the associations of health literacy and social determinants with QoL among patients with AF.

• In unadjusted analyses, health literacy differed significantly by sex, age, educational status, occupation, and income status.

• Sex and marital status were associated with overall QoL in the adjusted analysis.

• Total health literacy was not significantly associated with overall QoL after FDR correction or in the adjusted analysis.

• Benjamini–Hochberg FDR correction indicated a positive correlation of access to information with overall QoL, daily activities, and treatment satisfaction, as well as a positive correlation of total health literacy, appraising information, and applying information with treatment satisfaction.

• These findings highlight the importance of considering social determinants and specific dimensions of health literacy when developing patient-centered strategies to support quality of life in patients with atrial fibrillation.

Availability of Data and Materials

The datasets used and analyzed in the present study are available from the corresponding author upon reasonable request.

Author Contributions

GB: Conception and design of the study, preparation of the manuscript draft, data analysis and interpretation, supervision, writing—review and editing, conceptualization. NE: Conception and design of the study, preparation of the manuscript draft, data acquisition, and writing of the manuscript. Both authors gave final approval of the version to be published. Both authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

The study conformed to the principles of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of Pamukkale University (E-60116787-020-294427). Patients were informed about the purpose of the study, and their informed consent was obtained.

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Conflicts of Interest

The authors declare no conflicts of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/BJHM53355.

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