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ORIGINAL RESEARCH ARTICLE

Prevalence of low health literacy levels in decompensated heart failure compared with acute myocardial infarction patients

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Abstract

Aims Health literacy (HL) is a health determinant in cardiovascular diseases as the active participation of patients is essential for optimizing self-management of these conditions. We aimed to estimate the prevalence of low HL level in patients hospitalized for acute myocardial infarction (AMI) or acute decompensated heart failure (ADHF) and explore low HL determinants.
Methods and results A prospective cross-sectional study was performed in three cardiology units. HL level was assessed using Brief Health Literacy Screen (BHLS) and categorized as low or adequate. Dimensions of HL were assessed with the Health Literacy Questionnaire (HLQ). Associations with sociodemographic factors, disease history, and comorbidities were explored. A total of 208 patients were included, mean ± SD age was 68.5 ± 14.9 years, and 65.9% were men. Patients with ADHF were significantly older and more often women than AMI patients. Prevalence of low HL was 36% overall, 51% in ADHF patients, and 21% in AMI patients ($P < 0.001$). After adjustment for sociodemographic factors, patients with lower income (€<10 000 per year, adjusted odds ratio = 10.46 95% confidence interval [2.38; 54.51], $P = 0.003$) and native language other than French (adjusted odds ratio = 14.36 95% confidence interval [3.76; 66.9], $P < 0.002$) were more likely to have low HL. ADHF patients presented significantly lower HLQ scores than AMI patients in five out of the nine HLQ dimensions reflecting challenges in access to healthcare.
Conclusions Prevalence of low HL was higher among ADHF patients than among AMI patients. Low HL ADHF patients needed more support when accessing healthcare services, and these would require more adaptation to respond to low HL patients' needs.

Keywords Cardiovascular diseases; Heart failure; Myocardial infarction; Health literacy; Epidemiology

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The study was performed at the Louis Pradel Cardiology Hospital in partnership with the RESHAPE laboratory at the University of Lyon.

Introduction

Cardiovascular diseases (CVDs) represent the leading cause of morbidity and mortality worldwide and cause more than half of all death across the European region.[1] Recent guidelines raise the need to integrate patients health literacy (HL) level to improve CVD management and prevention.[2] HL is defined as 'people's knowledge, motivation and competences to access, understand, appraise, and apply health information'[3]; it is considered as a mediator between social determinants

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and health outcomes by affecting health-related behaviour and access to/use of healthcare services.[4] Low HL is associated with limited knowledge of health conditions and medications,[5] poorer overall health status,[6] and increased likelihood of re-hospitalization and mortality.[7] Patients with low HL encounter difficulties making healthy lifestyle choices and navigating through complex healthcare systems and environments.[8] In patients with CVD, HL should be considered in interventions designed to increase patients' self-management skills.

After an emergency hospitalization for acute decompensated heart failure (ADHF) or acute myocardial infarction (AMI), patients require specific skills and knowledges to fully adhere to complex medication regimens and lifestyle changes.[2,9] A low socioeconomic status has been associated with a higher prevalence of risk factors and poorer outcomes of CVDs,[10,11] leading to health inequalities.[12] HL level has been shown to be a potentially modifiable mediator of the effect of socioeconomic status on health outcomes[13]; in parallel, it is also known to be associated with cardiovascular risk.[2] AMI and ADHF share a high early readmission rate that is particularly higher for low HL patients.[14,15] There is evidence for providing better discharge advice and adapting communication to the level of literacy to optimize medication adherence and self-care in order to improve outcomes.[16,17] The prevalence of low HL widely varies in the literature from 17.5% to 97% for heart failure patients[18] and from 14.3% to 49.6% for coronary diseases patients,[19] mostly based on North American data.

A wide variety of HL measurement tools have been used,[9,16] targeting either objective HL (people are asked to respond to situations where their HL skills are required for good performance) or subjective HL (people self-report on their perceived level of HL or difficulty of situations encountered).[20] For CVD, most studies used measurements based on objective HL tools that were developed prior to subjective measures.[9] However, assessment of subjective HL has several benefits, particularly the exploration of the three dimensions of HL: functional, critical, and interactive,[21] which reflect the need of the population regarding healthcare system understanding and utilization, which is key for disease self-management. An other benefit of subjective HL is to decrease the risk of stigma because people are asked for their opinions.[20]

Given the importance of HL in CVD patients' empowerment for self-management, the lack of subjective HL measurements in European context in this population and the potential difference between ADHF and AMI, our objective was to assess the prevalence of low HL level and to compare it between ADHF and AMI patients. Our second objective was to explore factors associated with low HL and the different types of difficulties encountered in these two CVDs.

Methods

Study design and population

The reporting of the results follows the STROBE guidelines for cross-sectional studies.[22] We conducted a cross-sectional study within three units in a French cardiology teaching hospital: a cardiology intensive care unit and two conventional cardiology units. This hospital is a public and university hospital and is located in Lyon within the Rhône department, East of France. Consecutive patients hospitalized for ADHF or AMI were prospectively screened for inclusion during a 15 week recruitment period from 24 June to 12 December 2019. The research assistants went to the hospital every day of the inclusion period (except weekends and annual vacation). Patients were included if they were at least 18 years old, were capable of communicating abilities in French, and were not institutionalized after discharge. Patients were excluded if they had severe dementia and vital prognosis engaged in the short term. Healthcare managers or physicians in each unit referred all eligible patients hospitalized for ADHF or AMI to the research coordinator on a daily basis. Patient diagnosis were given by medical staff at the time of the interview and validated on the patient's electronic medical record. Eligible patients received information letters and were included after having given oral consent. Patients were interviewed during their hospital stay, before discharge to home.

Data collection was conducted in French during face-to-face structured interviews by two trained research coordinators. To ensure standardization of data collection, the two interviewers carried out together the first four interviews. Electronic medical files were used to collect data on cardiac function and to confirm the validity and exhaustiveness of declared medical history and healthcare utilization.

Collected data

The questionnaire was composed of four parts: (1) socioeconomic characteristics, (2) history and characteristics of the disease, (3) subjective HL using the Brief Health Literacy Screen questionnaire (BHLS), and (4) subjective multidimensional HL using the Health Literacy Questionnaire (HLQ).

All information were recorded in an electronic case report form (eCRF) developed by a Datamanager of the *Hospices Civils de Lyon* with Ennov Clinical® 7.5.720 software.

Main outcome: health literacy

We focused on subjective HL because we aimed to explore HL difficulties perceived by patients when engaging with health practitioners and services. We decided to use two comple-

mentary approaches associating a short questionnaire, which discriminates rapidly between adequate and low HL levels (BHLS) and a longer questionnaire aiming at describing and understanding difficulties faced by patients (HLQ). According to patients' preferences, these two questionnaires were either self-administered or orally administered by the research assistant who limited themselves to reading or repeating the questions without rephrasing the sentences or influencing the answers.

The BHLS is a short three-question validated instrument measuring reading and verbal understanding, need for assistance, and confidence, which corresponds to subjective fundamental HL[23]; it takes 2 min to complete. The BHLS has been translated and validated in French.[24] The three questions are (1) 'How often do you have problems learning about your medical condition because of difficulty understanding written information?'; (2) 'How often do you have someone help you read hospital materials?'; (3) 'How confident are you filling out medical forms by yourself?'. Each question is rated on a 5-point Likert scale, and the total BHLS score ranges from 3 to 15. Patients are categorized as either low (total score $\leq$9) or adequate fundamental HL (total score $>$9).

The HLQ is a validated, multidimensional assessment tool identifying strengths and challenges related to engaging with health information and services; its take 20 to 40 min to complete.[25] HLQ results report a measure of subjective HL including fundamental literacy, interactive literacy (skills to extract information and derive meaning from different forms of communication), and critical literacy (cognitive skills to apply critically analyses and use the information to exert greater control during life).[21] HLQ is validated in French.[26] HLQ is composed of 44 items measuring nine scales each comprising four to six items, and following different aspects of HL: (1) feeling understood and supported by healthcare providers, (2) having sufficient information to manage own health, (3) actively managing own health, (4) social support for health, (5) active appraisal of health information, (6) ability to actively engage with healthcare providers, (7) navigating the healthcare system, (8) ability to find good health information, and (9) understanding health information well enough to know what to do. A 4-point response scale is used to assess Domains 1 to 5 (*strongly disagree* to *strongly agree*), and a 5-point scale is used to assess Domains 6 to 9 (*cannot do or always difficult* to *always easy*).

Data analysis

Based on the hypothesis of an expected prevalence of low HL of 39%[18] in the study population, a sample size of 210 patients was needed to estimate low HL prevalence with a 6.5% margin of error. Based on hospitalization data in the past year in the participating units, we estimated that this sample size was achievable within a 6-month inclusion period, and that this sample would be composed of about 100 patients of each disease (ADHF and AMI), enabling a 10% margin of error to estimate the prevalence of low HL in the subgroups of AMI and ADHF patients.

Descriptive statistics were used to summarize participant demographic and clinical characteristics and HL scores. Frequency and percentages were calculated for categorical variables, including HL categories (BHLS). Means and standard deviations (SDs) were calculated for continuous variables, including self-care subscales (HLQ).

We first described characteristics of the population and compared characteristics between the two CVDs using Student's *t* test for continuous outcomes and χ^2 or Fisher test for categorical variables. The prevalence of low HL (BHLS score $\leq$9) with its 95% confidence interval (CI) was calculated in the whole population and in the two subgroups (ADHF and AMI) and then stratified on sex and age to explore the influence of these factors.

The nine dimensions of HLQ scores were compared between the two CVD using Student's *t* test and between HL level estimated by the BHLS.

To explore differences in the prevalence of low HL between CVD, logistic regression analyses were conducted to estimate the association between HL level and type of CVD while controlling for potential confounders. The dependent variable was HL (BHLS score $\leq$9), and we included as independent variables CVD (ADHF/AMI), and all the variables found in the univariate analyses to be associated with HL level with a *P* value $<$0.20: socioeconomic status [sex, age, marital status, native language (French vs. foreign), educational level, employment status, annual income, and health insurance type], risk factors (obesity, blood pressure, atrial fibrillation, dyslipidaemia, and physical activity), and proxies of severity (length of stay, first hospitalization). The same model was also applied for each disease (AMI and DHF), detailed in Appendix 3.

An a priori value of alpha $P = 0.05$ was set for statistical significance. The statistical analyses were conducted using the R software version x64 3.5.2.[27,28]

Ethics approval

The study received approval from an ethics committee (ID-RCB: 2019-A00799-48) according to French legislation, which provided a waiver of written informed consent for this study. An information letter was given to the patients before the administration of questionnaires. Patients were informed that they had the right not to participate as required by law in France. The study was registered on Clinical Trials (NCT03949309), and the investigation conforms with the principles outlined in the Declaration of Helsinki.

Results

Participant characteristics

Two hundred and eight patients aged 68.5 ± 14.9 (mean ± SD) years met the inclusion/exclusion criteria. The sample was mainly composed of men (65.9%), one-third lived alone (29.5%), and most were French (86.5%). *Table 1* describes socioeconomic characteristics and CVD risk factors of included population and comparison between ADHF and AMI patients. Patients with ADHF were significantly older, had a lower education level and income, and were more often foreigners. Regarding disease history, the index admission was

Table 1 Participant's characteristics

	Total *N* = 208	Acute myocardial infarction *N* = 102	Acute decompensated heart failure *N* = 106	*P* value
Sex (*N* = 208)				0.015
Men	137 (65.9%)	76 (74.5%)	61 (57.5%)	
Women	71 (34.1%)	26 (25.5%)	45 (42.5%)	
Age (*N* = 208), mean (SD)	68.5 (14.9)	62.7 (13.1)	74.2 (14.5)	<0.001
Less than 65	92 (44.2%)	65 (63.7%)	27 (25.5%)	
65 or more	116 (55.8%)	37 (36.3%)	79 (74.5%)	
Marital situation (*N* = 208)				0.127
In a couple	133 (63.9%)	71 (69.6%)	62 (58.5%)	
Single	75 (36.1%)	31 (30.4%)	44 (41.5%)	
Type of cohabitation (*N* = 207)				0.490
Live alone	61 (29.5%)	27 (26.7%)	34 (32.1%	
Live as a family/couple	146 (70.5%)	74 (73.3%)	72 (67.9%)	
Education levels (*N* = 207)				<0.001
No school	79 (38.2%)	25 (24.5%)	54 (51.4%)	
Primary or secondary	89 (43.0%)	50 (49.0%)	39 (37.1%)	
Middle or university	39 (18.8%)	27 (26.5%)	12 (11.4%)	
Employment status (*N* = 208)				<0.001
Unemployed	24 (11.5%)	11 (10.8%)	13 (12.3%)	
Employed	55 (26.4%)	46 (45.1%)	9 (8.5%)	
Retired	129 (62.0%)	45 (44.1%)	84 (79.2%)	
Annual income (*N* = 166)				0.001
<€10 000	41 (24.7%)	13 (15.1%)	28 (35.0%)	
€10 000–€19 999	52 (31.3%)	24 (27.9%)	28 (35.0%)	
>€20 000	73 (44.0%)	49 (57.0%)	24 (30.0%)	
Health insurance (*N* = 204)				0.234
Welfare assistance	18 (8.8%)	6 (5.9%)	12 (11.7%)	
General health insurance	186 (91.2%)	95 (94.1%)	91 (88.3%)	
Native language (*N* = 208)				0.012
French	168 (80.8%)	90 (88.2%)	78 (73.6%)	
Foreign	40 (19.2%)	12 (11.8%)	28 (26.4%)	
Nationality (*N* = 208)				0.005
French	180 (86.5%)	96 (94.1%)	84 (79.2%)	
Foreign	28 (13.5%)	6 (5.88%)	22 (20.8%)	
Obesity (*N* = 183)	57 (31.1%)	20 (24.1%)	37 (37.0%)	0.086
Active smoking (*N* = 204)	57 (27.9%)	44 (43.6%)	13 (12.6%)	<0.001
Hypertension (*N* = 204)	99 (48.5%)	41 (40.6%)	58 (56.3%)	0.035
Obstructive sleep apnoea (*N* = 205)	43 (21.0%)	12 (11.9%)	31 (29.8%)	0.003
Atrial fibrillation(*N* = 204)	56 (27.5%)	10 (9.90%)	46 (44.7%)	<0.001
Dyslipidaemia (*N* = 202)	62 (30.7%)	29 (28.7%)	33 (32.7%)	0.647
Physical activity (*N* = 202)[a]				<0.001
Low	94 (46.5%)	27 (27.3%)	67 (65.0%)	
Moderate	53 (26.2%)	32 (32.3%)	21 (20.4%)	
High	55 (27.2%)	40 (40.4%)	15 (14.6%)	
Information received at the hospital (*N* = 203)[b]	159 (78.3%)	92 (92.0%)	67 (65.0%)	<0.001
Declared help managing treatment (*N* = 137)[c]	25 (18.2%)	4 (5.71%)	21 (31.3%)	<0.001
Length of stay (*N* = 198), mean (SD)	5.7 (4.7)	3.3 (3.8)	9.1 (4.3)	<0.001
Number of treatments at discharge (*N* = 203), mean (SD)	8.1 (2.4)	8.2 (1.7)	7.9 (2.9)	0.54
First hospitalization (*N* = 205)	112 (54.6%)	83 (82.2%)	29 (27.9%)	<0.001

Abbreviation: SD, standard deviation.

[a]Physical activity is described according to frequency and intensity. Low: no physical activity or light exertion such as walking your dog or slow walking; moderate: at least 30 min three times a week or activities like dancing or gardening; and high: 30 min a day every day or three times a week of intense activity (e.g. running and team sport).

[b]Patients were asked 'Did you receive any information at the hospital (about treatments, pathology, future appointments etc.)?' (answer yes or no).

[c]Patients were asked 'Do you receive any help in taking the treatments?' (answer yes or no).

significantly more often a first event in AMI than ADHF (82% vs. 28%, $P < 0.001$). The length of stay was significantly longer for ADHF (9 days vs. 3 days for AMI, $P < 0.001$).

Prevalence of low health literacy

In the total study population, low HL level (BHLS score ≤9) was found in 36.1% (95% CI [29.8; 42.8]) of patients (75/208). Prevalence of low HL in ADHF patients (54/106) was 50.9% (95% CI [41.5 ;60.3]), significantly higher than 20.6% (95% CI [13.9; 29.4] in AMI patients (21/102; $P < 0.001$). Prevalence of low HL in overall population was higher among women (43.7%; 95% CI [31.9; 56.0]), among patients over 65 years (40.5%; 95% CI [31.5; 50.0]), and prevalence of low HL remained significantly higher in ADHF after stratification on age and sex. Prevalence of low HL level was also higher among patients with a history of previous hospitalization (48.4% for the whole population and 33.3% and 52.0% for AMI and ADHF patients, respectively; *Table 2*) than in those who had a first event.

Health literacy difficulties and difference between the two cardiovascular diseases

Table 3 displays the results of the HLQ questionnaire by dimension. Overall, whatever the CVD, patients had lower scores on 'actively managing my health' (Scale 3), 'appraisal of health information' (Scale 5), and 'ability to find good information' (Scale 8) dimensions. The highest scores were found for 'social support for health scale' (Scale 4) and

Table 2 Prevalence of low health literacy (Brief Health Literacy Screen score ≤9) in the whole sample and in the two cardiovascular disease groups, stratified on sex, age, and first hospitalization (yes/no)

	Total	Acute myocardial infarction *N* = 102 [95% CI]	Acute decompensated heart failure *N* = 106 [95%CI]	*P* value*
Total population (*N* = 208)	36.1% [29.8%; 42.8%]	20.6% [13.9%; 29.4%]	50.9% [41.5%; 60.3%]	<0.001
Age <65 years (*N* = 92)	30.4% [21.3%; 40.9%]	18.5% [9.92%; 30.0%]	59.3% [38.8%; 77.6%]	<0.001
Age ≥65 years (*N* = 116)	40.5% [31.5%; 50.0%]	24.3% [11.8%; 41.2%]	48.1% [36.7%; 59.6%]	0.026
Men (*N* = 137)	32.1% [24.4%; 40.6%]	19.7% [11.5%; 30.5%]	47.5% [34.6%; 60.7%]	0.001
Women (*N* = 71)	43.7% [31.9%; 56.0%]	23.1% [8.97%; 43.6%]	55.6% [40.0%; 70.4%]	0.016
First hospitalization (*N* = 112)	25.0% [17.3%; 34.1%]	18.1% [10.5%; 28.0%]	44.8% [26.4%; 64.3%]	0.009
Not the first hospitalization (*N* = 93)	48.4% [37.9%; 59.0%]	33.3% [13.3%; 59.0%]	52.0% [40.2%; 63.7%]	0.246

Abbreviation: CI, confidence interval.
*P value for comparison of prevalence of low health literacy between acute myocardial infarction and acute decompensated heart failure groups using χ^2 test.

Table 3 Health Literacy Questionnaire dimensions according to the cardiovascular disease

	Total *N* = 208	Acute myocardial infarction *N* = 102	Acute decompensated heart failure *N* = 106	*P* value
Scale 1. Feeling understood and supported by healthcare providers (HPS)				
Mean (SD), *N* = 206	3.02 (0.62)	3.09 (0.59)	2.96 (0.64)	0.141
Scale 2. Having sufficient information to manage my health (HSI)				
Mean (SD), *N* = 204	2.80 (0.45)	2.84 (0.47)	2.75 (0.44)	0.183
Scale 3. Actively managing my health (AMH)				
Mean (SD), *N* = 206	2.71 (0.57)	2.63 (0.60)	2.80 (0.53)	0.031
Scale 4. Social support for health (SS)				
Mean (SD), *N* = 206	3.26 (0.52)	3.27 (0.50)	3.26 (0.54)	0.952
Scale 5. Appraisal of health information (CA)				
Mean (SD), *N* = 204	2.43 (0.57)	2.51 (0.55)	2.36 (0.57)	0.047
Scale 6. Ability to actively engage with healthcare providers (AE)				
Mean (SD), *N* = 204	3.65 (0.69)	3.78 (0.62)	3.51 (0.74)	0.005
Scale 7. Navigating the healthcare system (NHS)				
Mean (SD), *N* = 204	3.27 (0.75)	3.39 (0.69)	3.16 (0.79)	0.030
Scale 8. Ability to find good health information (FHI)				
Mean (SD), *N* = 196	3.22 (0.85)	3.46 (0.78)	2.98 (0.85)	<0.001
Scale 9. Understand health information well enough to know what to do (UHI)				
Mean (SD), *N* = 204	3.47 (0.76)	3.62 (0.67)	3.33 (0.82)	0.007
Mean HLQ	2.97 (0.51)	3.05 (0.50)	2.89 (0.50)	0.019

Abbreviations: SD, standard deviation; HLQ, Health Literacy Questionnaire.
For Scales 1 to 4, the range is 0–4, and for Scale 5 to 9, the range is 0–5; higher scales reflect a higher health literacy.

'ability to actively engage with healthcare providers' (Scale 6). Regarding the two groups of CVDs, scores for Scales 5 ('appraisal of health information'), 6 ('ability to actively engage with healthcare providers'), 7 ('navigating the healthcare system'), 8 ('ability to find good health information'), and 9 ('understand health information well enough to know what to do') were significantly lower in ADHF than in AMI patients. Conversely, score for Scale 3 ('actively managing my health') was lower in AMI patients. Scores of other scales were not significantly different between the two groups of patients.

Low HL patients compared with adequate HL patients had broadly similar patterns of challenges within the two CVD for HLQ Scales 2, 6, 8, and 9 of the HLQ (Appendix 2). However, ADHF patients with low HL had significantly more difficulties in three HLQ dimensions; 'feeling understood and supported by healthcare providers' (Scale 1, $P < 0.001$), 'appraisal of health information' (Scale 5, $P = 0.01$), and 'navigating the healthcare system' (Scale 7, $P = 0.012$; Appendix 2).

Determinants of health literacy level

In univariate analyses, low HL patients presented, in comparison to adequate HL patients, the following characteristics: lower educational level, lower annual income (€<20 000), less likely to be French native speaker, and being first hospitalized for the same disease; these differences were observed for the two CVD (Appendix 1). After adjusting for these characteristics and other potential confounders (associated with a $P < 0.20$ in univariate analyses), low health literate patients were more likely to have low income (€<10 000, adjusted odds ratio = 10.46; 95% CI [2.38; 54.51]; $P = 0.003$) and native language other than French (adjusted odds ratio = 14.36; 95%

Table 4 Factors associated with the probability of having a low level of health literacy (BHLS score ≤9)

	Univariate analysis			Multivariate analysis		
	Crude OR	95% CI	*P* value	Adj.OR	95% CI	*P* value
Reason of admission			<0.001			
AMI	Ref.			Ref.		
ADHF	3.96	2.17; 7.45		1.85	0.48; 7.08	0.36
Women	1.64	0.91; 2.96	0.10	1.01	0.31; 3.06	0.99
Age	1.02	1.00; 1.04	0.07	0.99	0.94; 1.05	0.79
Education level						
No school	5.46	2.26; 14.82	<0.001	0.35	0.06 1.78	0.22
Primary or secondary	1.69	0.68; 4.61	0.28	1.11	0.28; 4.56	0.87
Middle or university	Ref.			Ref.		
Income						
<€10 000	8.13	3.49; 20.02	<0.001	10.46	2.38 ;54.51	**0.003**
€10 000–€19 999	2.63	1.18; 6.01	0.02	4.04	1.18; 15.04	**0.03**
>€20 000	Ref.			Ref.		
Native language			<0.001			
French	Ref.			Ref.		
Other than French	6.01	2.88; 13.20		14.36	3.76; 66.91	<**0.002**
Marital situation			0.07			
Single	Ref.			Ref.		
In couple	1.70	0.95; 3.06		1.51	0.53; 4.30	0.43
Medical insurance			0.02			
General health insurance	Ref.			Ref.		
Welfare assistance	3.14	1.18; 6.01		0.58	0.08; 4.57	0.59
Professional status						
Unemployed	Ref.			Ref.		
Employed	0.57	0.20; 1.65	0.28	5.47	0.83; 46.15	0.09
Retired	1.13	0.47; 2.86	0.79	3.84	0.47; 37.08	0.22
Obesity	0.50	0.26; 0.95	0.03	1.16	0.40; 3.48	0.78
Physical activity			0.002			
Low	Ref.			Ref.		
Moderate	0.58	0.29; 1.16	0.13	1.14	0.37; 3.61	0.82
High	0.25	0.11; 0.54	0.001	0.91	0.24; 3.40	0.88
Atrial fibrillation	1.83	1.03; 3.29	0.03	0.97	0.29; 3 .18	0.96
Hypertension	1.99	1.06; 3.76	0.04	1.86	0.49; 7.09	0.36
Dyslipidaemia	0.52	0.28; 0.96	0.04	0.86	0.31; 2.42	0.76
Length of stay	1.06	0.99; 1.12	0.001	0.99	0.85; 1.14	0.86
First hospitalization	0.36	0.20; 0.64	0.001	0.44	0.14; 1.36	0.15

Abbreviations: ADHF, acute decompensated heart failure; Adj, adjusted; BHLS, Brief Health Literacy Screening questionnaire; CI, confidence interval; OR, odds ratio.

CI [3.76; 66.9];$P < 0.002$) (*Table 4*). Exploratory results by disease are presented in Appendix 3.

Discussion

Exploring HL in CVD patients is of particular importance as HL has been shown to be mediating the effect of other determinants, such as socioeconomic status, on self-assessed health and even on health[13] and has the advantage to be potentially improved.

We estimated that within a CVD population, 36.1% presented a low HL level using the three-item BHLS.[23] The prevalence of low HL was higher within the ADHF population than the AMI population (50.9% vs. 20.6%), and this difference remained in all age and gender categories. We identified that main challenges faced by our CVD population were finding and understanding enough information to manage their health (Scales 5, 8, and 9 regarding linked with functional HL) and engagement with providers regarding interactive HL (Scale 6).

Our results are consistent with existing literature regarding prevalence of low HL in European general population (limited HL 47%; ranged 29–66%)[13] and in patients with CVD (low HL levels 30.5% in AMI patients and 39% in ADHF patients).[18,19] These results showed the high prevalence of CVD patients with inadequate HL and particularly ADHF patients who had more difficulties in several domains of the HLQ, that is, appraisal of health information, feeling supported by healthcare providers, and navigating the healthcare system. In this study, native language other than French and low income were also associated with low HL, which is consistent with available literature. However, no association was found with other known socioeconomic determinants of HL such as low education level, age, or gender.[29,30] This might be because of a lack of statistical power, but also because these association, as well as the mediating effect of HL, may vary across different countries, different cultures, and different health systems.[13]

Using HLQ provided us more qualitative insights on the HL challenges faced by the patients and the healthcare providers. For both CVD, patients had little commitment to their healthcare and relied primarily on health services and professionals. They had difficulties understanding health information and were confused in case of contradictory information. They were also more dependent on others to find information when they needed it. More specifically, ADHF patients had more HL difficulties compared with AMI patients in appraisal of health information, feeling supported by healthcare providers, and navigating the healthcare system. Some of these difficulties might be linked with other determinants such as poorer education or lower socioeconomic status. However, it could also be associated with the particularly complex self-management of a chronic condition such as ADHF that is often a recurrent exacerbation of a long-standing disease in elderly patients with high comorbidity burden, complex medication regimens and drug adjustment, no resolutive treatment, and signs and symptoms that require daily monitoring. The competence and skills required for daily self-care are far greater than in AMI and might partially explain why the ADHF group needed more help regarding care information on how to navigate within the healthcare system. This shows that ADHF patients require special attention to improve their skills to promote health, prevent disease, and live with chronic disease, and this can only be addressed by repetitive information adapted to the individual medical and social situation and to HL assessment in the different domains of the HLQ. In contrast, AMI patients seemed to experience more difficulties for actively managing their health. This might be explained by AMI patients being younger and having received interventional procedures that may be perceived as resolutive. These elements could provide them greater confidence in their future ability to manage their health, engage with health providers, and navigate through the health system. However, these patients have to adhere to a preventive treatment and for lifestyle modification. They suddenly have to take several preventive medications with no perceived positive impact on their daily life but only possible side effects, whereas ADHF patients have often a heavy daily health management. Our results regarding HLQ difficulties differ from the only previous French study using HLQ as measurement tool for HL in a diabetes population.[26] Some differences may be explained by a selection bias because this study was mainly composed of women and was selected within diabetic patients' association providing efficient educational activities and information. Some differences might also be explained by the disease itself or other determinants associated with the disease.

This is the first study that compares HL in ADHF and AMI patients within the same design and setting, in consecutive patients and using two complementary tools for assessing HL. Available studies regarding HL and CVD are mostly coming from studies conducted in North America,[2,14] which impairs the generalizability to other settings. Although our study cannot claim to apply to every other contexts of care, this is to our knowledge the first to report data on consecutive patients in a real-life setting for two acute CVDs in Europe. The use of two HL measurement tools in the present study enabled a comprehensive assessment of HL. These tools are complementary, the short and quickly administered BHLS, focusing on fundamental HL, and the HLQ, investigating fundamental, critical, and interactive dimensions as proposed by Nutbeam.[21] The HLQ dimensions show the complexity and the diversity of HL concept, which is evolving over time and depends on life course of patients' lives. It allows to explore more in depth the concepts of access, use, understanding, appraisal, use of health information (individual's skills), and study of the relationship with healthcare providers, services,

and systems (organizational level). Additionally, subjective HL measurements decrease the risk of stigmatization and are easier to integrate in clinical daily practice even though they do not objectively evaluate individual skills.[20] This is particularly true for the BHLS, which could be used in routine practice during the hospitalization period to assess potential difficulties of patients. Evaluating HL in the care setting would enable professionals to adapt the communication (oral and written) of information during the rest of the hospitalization in order to best prepare patients for discharge.[30,31] Existing educational programmes dedicated to post-AMI or ADHF patients do not have the capacity to accommodate all patients and are often not dedicated nor accessible to low HL patients. Our results highlight that low HL patients constitute more than one-third of patients and that they present specific needs. This advocates for the need to propose patients information adapted to their HL and to develop programmes designed for improving their HL in every domain of the HLQ.[32] These interventions will have to target the specificities of each disease to fit with the different characteristics. One can thus imagine that for younger patients with little connection to the healthcare system (AMI), a digital format would be more appropriate than for chronic and mostly elderly patients (ADHF). Indeed, engaging with digital health and remote monitoring requires, in addition to internet access, an adequate level of eHealth literacy that is composed of multiple types of literacies.[33]

Limitations

This study has some limitations. First, even though BHLS has been used in its French version,[24,34] it has not yet been rigorously validated in a hospitalized French population, but the English version is validated.[29,30] Second, BHLS measured only fundamental HL, but we added the HLQ in order to get an evaluation of all HL dimensions: fundamental, critical, and interactive. Third, the cross-sectional design of this study did not allow concluding about the causal link and the temporality of the association between the health and social factors studied and HL. There might be a selection bias due to the small sample size and the mono-centric setting of this study. Finally, including consecutively all eligible patients is time consuming, but it allowed to be representative of hospitalized patients meeting our eligibility criteria over a 6-month period in three departments at the same time.

Conclusion

The ADHF patients presented a higher prevalence of low HL than AMI patients did and they faced more HL difficulties to access, appraise, and apply health information. This translates in lower engagement with healthcare providers and difficulties to navigate the healthcare system, which are related to the specific features of heart failure management. These results may help to create a context-specific response to patients' needs. As recommended in HL and CVD literature, these results will guide the design of an educational intervention tailored to low HL ADHF patients in order to increase their empowerment, get better outcomes, and decrease health inequities.

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Conflict of interest

None declared.

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Appendix 1: Description of the total population and by cardiovascular disease

	Total population			AMI			ADHF		
	Adequate *N* = 133	Low *N* = 75	*P* value	Adequate *N* = 81	Low *N* = 21	*P* value	Adequate *N* = 52	Low *N* = 54	*P* value
Sex (*N* = 208)	—	—	0.136	—	—	0.934	—	—	0.536
Men	93 (69.9%)	44 (58.7%)	—	61 (75.3%)	15 (71.4%)	—	32 (61.5%)	29 (53.7%)	—
Women	40 (30.1%)	31 (41.3%)	—	20 (24.7%)	6 (28.6%)	—	20 (38.5%)	25 (46.3%)	—
Age (*N* = 208)	67.1 (14.7)	71.0 (15.2)	0.076	62.4 (12.8)	63.6 (14.5)	0.747	74.4 (14.5)	73.9 (14.6)	0.850
Less than 65	64 (48.1%)	28 (37.3%)	0.174	53 (65.4%)	12 (57.1%)	0.653	11 (21.2%)	16 (29.6%)	0.436
65 or more	69 (51.9%)	47 (62.7%)	—	28 (34.6%)	9 (42.9%)	—	41 (78.8%)	38 (70.4%)	—
Marital status (*N* = 208)	—	—	0.101	—	—	1.000	—	—	0.107
In couple	91 (68.4%)	42 (56.0%)	—	56 (69.1%)	15 (71.4%)	—	35 (67.3%)	27 (50.0%)	—
Single	42 (31.6%)	33 (44.0%)	—	25 (30.9%)	6 (28.6%)	—	17 (32.7%)	27 (50.0%)	—
Type of cohabitation (*N* = 207)	—	—	1.000	—	—	0.950	—	—	1.000
Live alone	39 (29.5%)	22 (29.3%)	—	22 (27.5%)	5 (23.8%)	—	17 (32.7%)	17 (31.5%)	—
Live as a family/couple	93 (70.5%)	53 (70.7%)	—	58 (72.5%)	16 (76.2%)	—	35 (67.3%)	37 (68.5%)	—
Education level (*N* = 207)	—	—	<0.001	—	—	0.039	—	—	0.029
Primary and secondary	65 (48.9%)	24 (32.4%)	—	40 (49.4%)	10 (47.6%)	—	25 (48.1%)	14 (26.4%)	—
Middle and university	32 (24.1%)	7 (9.5%)	—	25 (30.9%)	2 (9.52%)	—	7 (13.5%)	5 (9.43%)	—
No school	36 (27.1%)	43 (58.1%)	—	16 (19.8%)	9 (42.9%)	—	20 (38.5%)	34 (64.2%)	—
Employment status *N* = 208	—	—	0.156	—	—	0.879	—	—	0.941
Unemployed	15 (11.3%)	9 (12.0%)	—	8 (9.9%)	3 (14.3%)	—	7 (13.5%)	6 (11.1%)	—
Employed	41 (30.8%)	14 (18.7%)	—	37 (45.7%)	9 (42.9%)	—	4 (7.69%)	5 (9.26%)	—
Retired	77 (57.9%)	52 (69.3%)	—	36 (44.4%)	9 (42.9%)	—	41 (78.8%)	43 (79.6%)	—
Annual income *N* = 166	—	—	<0.001	—	—	0.014	—	—	0.004
<€10 000	14 (13.3%)	27 (44.3%)	—	8 (11.8%)	5 (27.8%)	—	6 (16.2%)	22 (51.2%)	—
€10 000–€19 999	32 (30.5%)	20 (32.8%)	—	16 (23.5%)	8 (44.4%)	—	16 (43.2%)	12 (27.9%)	—
€20 000–€50 000	59 (56.2%)	14 (23.0%)	—	44 (64.7%)	5 (27.8%)	—	15 (40.5%)	9 (20.9%)	—
Health insurance *N* = 204	—	—	0.037	—	—	0.090	—	—	0.415
Welfare assistance	7 (5.3%)	11 (15.1%)	—	3 (3.7%)	3 (15.0%)	—	4 (8.0%)	8 (15.1%)	—
General health insurance	124 (94.7%)	62 (84.9%)	—	78 (96.3%)	17 (85.0%)	—	46 (92.0%)	45 (84.9%)	—
Native language *N* = 208	—	—	<0.001	—	—	0.016	—	—	0.001
French	121 (91.0%)	47 (62.7%)	—	75 (92.6%)	15 (71.4%)	—	46 (88.5%)	32 (59.3%)	—
Other than French	12 (9.0%)	28 (37.3%)	—	6 (7.4%)	6 (28.6%)	—	6 (11.5%)	22 (40.7%)	—
Nationality (*N* = 208)	—	—	<0.001	—	—	0.016	—	—	0.011
French	126 (94.7%)	54 (72.0%)	—	4 (19.0%)	2 (2.5%)	—	37 (68.5%)	47 (90.4%)	—
Foreign	5 (3.76%)	15 (20.0%)	—	4 (19.0%)	2 (2.5%)	—	17 (31.5%)	5 (9.62%)	—
Obesity (*N* = 183)	29 (25.4%)	28 (40.6%)	0.048	13 (19.4%)	7 (43.8%)	0.054	16 (34.0%)	21 (39.6%)	0.712
Active smoking (*N* = 204)	39 (30.0%)	18 (24.3%)	0.480	32 (39.5%)	12 (60.0%)	0.160	7 (14.3%)	6 (11.1%)	0.851
Blood pressure (*N* = 204)	56 (43.1%)	43 (58.1%)	0.055	32 (39.5%)	9 (45.0%)	0.846	24 (49.0%)	34 (63.0%)	0.219

(*Continues*)

	Total population			AMI			ADHF		
	Adequate $N = 133$	Low $N = 75$	*P* value	Adequate $N = 81$	Low $N = 21$	*P* value	Adequate $N = 52$	Low $N = 54$	*P* value
OSA ($N = 205$)	26 (19.8%)	17 (23.0%)	0.727	9 (11.1%)	3 (15.0%)	0.701	17 (34.0%)	14 (25.9%)	0.493
Atrial fibrillation ($N = 204$)	29 (22.3%)	27 (36.5%)	0.044	8 (9.9%)	2 (10.0%)	1.000	21 (42.9%)	25 (46.3%)	0.879
Dyslipidaemia ($N = 202$)	33 (25.6%)	29 (39.7%)	0.053	23 (28.4%)	6 (30.0%)	1.000	10 (20.8%)	23 (43.4%)	0.028
Physical activity $N = 202$	—	—	0.002	—	—	0.683	—	—	0.109
Low	50 (38.5%)	44 (61.1%)	—	21 (26.2%)	6 (31.6%)	—	29 (58.0%)	38 (71.7%)	—
Moderate	35 (26.9%)	18 (25.0%)	—	25 (31.2%)	7 (36.8%)	—	10 (20.0%)	11 (20.8%)	—
High	45 (34.6%)	10 (13.9%)	—	34 (42.5%)	6 (31.6%)	—	11 (22.0%)	4 (7.55%)	—
Help with taking treatments ($N = 203$)	9 (10.1%)	16 (33.3%)	0.002	3 (5.26%)	1 (7.69%)	0.569	6 (18.8%)	15 (42.9%)	0.063
First hospitalization for *infarctus* ($N = 101$)	—	—	—	15 (71.4%)	68 (85.0%)	0.198	—	—	—
Number of hospitalization for *infarctus* ($N = 18$)	—	—	—	2.42 (1.38)	2.33 (1.37)	0.906	—	—	—
Stenting ($N = 100$)	—	—	—	65 (81.2%)	17 (85.0%)	1.000	—	—	—
Type of infarction ($N = 102$)	—	—	—	—	—	0.327	—	—	—
STEMI ST+	—	—	—	50 (61.7%)	16 (76.2%)	—	—	—	—
NSTEMI ST−	—	—	—	31 (38.3%)	5 (23.8%)	—	—	—	—
First decompensation ($N = 104$)	—	—	—	—	—	—	13 (25.0%)	16 (30.8%)	0.662
Number of hospitalization for decompensated heart failure	—	—	—	—	—	—	4.22 (3.9)	4.03 (3.5)	0.844
Severity (NYHA)($N = 54$)	—	—	—	—	—	—	—	—	0.276
II	—	—	—	—	—	—	1 (3.8%)	4 (14.3%)	—
III	—	—	—	—	—	—	18 (69.2%)	14 (50.0%)	—
IV	—	—	—	—	—	—	7 (26.9%)	10 (35.7%)	—
Type of heart failure ($N = 94$)	—	—	—	—	—	—	—	—	0.666
LVEF $< 45\%$	—	—	—	—	—	—	29 (61.7%)	32 (68.1%)	—
LVEF $> 45\%$	—	—	—	—	—	—	18 (38.3%)	15 (31.9%)	—
Follow-up in therapeutic patient education ($N = 104$)	—	—	—	—	—	—	1 (2.0%)	1 (1.85%)	1.000
PRADO planned ($N = 103$)	—	—	—	—	—	—	29 (58.0%)	27 (50.9%)	0.603
Defibrillation ($N = 97$)	—	—	—	—	—	—	15 (28.3%)	15 (31.2%)	0.916
Mechanical support ($N = 97$)	—	—	—	—	—	—	5 (9.6%)	8 (16.3%)	0.478
Length of stay ($N = 198$)	5.27 (4.9)	6.50 (4.1)	0.065	3.4 (4.3)	2.9 (1.1)	0.409	8.2 (4.5)	7.9 (4.0)	0.745
Number of treatments at discharge ($N = 203$)	7.99 (2.4)	8.22 (2.3)	0.504	8.11 (1.7)	8.4 (1.4)	0.394	7.80 (3.3)	8.14 (2.6)	0.566
First hospitalization	84 (63.6%)	28 (38.4%)	0.001	—	—	—	—	—	—

Abbreviations: LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; OSA, obstructive sleep apnoea; PRADO, inpatient return home service.

Appendix 2: Health literacy (HL) challenges measured by HLQ according to the cardiovascular disease and low/adequate HL using the Brief Health Literacy Screening cut-off 9

	Acute myocardial infarction *N* = 102			Acute decompensated heart failure *N* = 106		
	Low *N* = 21	Adequate *N* = 81	*P* overall	Low *N* = 54	Adequate *N* = 52	*P* overall
Scale 1. Feeling understood and supported by healthcare providers (HPS) Mean (SD), *N* = 206	2.96 (0.57)	3.12 (0.59)	0.279	2.75 (0.62)	3.18 (0.59)	<0.001
Scale 2. Having sufficient information to manage my health (HSI) Mean (SD), *N*	2.64 (0.34)	2.89 (0.49)	0.01	2.65 (0.39)	2.86 (0.46)	0.013
Scale 3. Actively managing my health (AMH) Mean (SD), *N* = 206	2.67 (0.53)	2.61 (0.62)	0.704	2.70 (0.55)	2.89 (0.48)	0.061
Scale 4. Social support for health (SS) Mean (SD), *N* = 206	3.24 (0.62)	3.27 (0.47)	0.8	3.31 (0.49)	3.22 (0.58)	0.395
Scale 5. Appraisal of health information (CA) Mean (SD), *N* = 204	2.39 (0.57)	2.55 (0.55)	0.265	2.22 (0.51)	2.50 (0.59)	0.01
Scale 6. Ability to actively engage with healthcare providers (AE) Mean (SD), *N* = 204	3.41 (0.73)	3.88 (0.55)	0.01	3.29 (0.77)	3.73 (0.64)	0.002
Scale 7. Navigating the healthcare system (NHS) Mean (SD), *N* = 204	3.14 (0.73)	3.45 (0.68)	0.079	2.97 (0.82)	3.35 (0.71)	0.012
Scale 8. Ability to find good health information (FHI) Mean (SD), *N* = 196	2.71 (0.81)	3.65 (0.65)	<0.001	2.67 (0.83)	3.28 (0.76)	<0.001
Scale 9. Understand health information well enough to know what to do (UHI) Mean (SD), *N* = 204	3.05 (0.82)	3.77 (0.54)	0.001	2.96 (0.44)	3.69 (0.61)	<0.001
Somme.HLQ	2.86 (0.32)	3.10 (0.52)	0.01	2.69 (0.55)	3.09 (0.36)	<0.001

Abbreviations: HLQ, Health Literacy Questionnaire; SD, standard deviation.

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Appendix 3

Table A1 Factors associated with the probability of having a low level of health literacy (Brief Health Literacy Screening score ≤9) for acute myocardial infarction patients

	Univariate analysis			Multivariate analysis		
	Crude OR	95% CI	*P* value	Adj.OR	95% CI	*P* value
Women	1.22	0.39; 3.46	0.716	1.19	0.13; 8.20	0.863
Age	1.01	0.97; 1.04	0.724	0.96	0.86; 1.07	0.493
Education level						
No school	7.03	1.57; 50.20	0.021	0.59	0.02; 13.11	0.733
Primary or secondary	3.12	0.75; 21.43	0.162	3.74	0.47; 48.70	0.244
Middle or university	Ref.			Ref.		
Income						
<€10 000	5.50	1.27; 24.52	0.021	3.00	0.21; 42.23	0.397
€10 000–€19 999	4.40	1.28; 16.50	0.021	7.35	1.10; 68.13	0.051
>€20 000	Ref.			Ref.		
Native language			0.012			
French	Ref.			Ref.		
Other than French	5.00	1.39; 18.15		12.57	1.26; 161.10	0.035
Marital situation			0.839			
Single	Ref.			Ref.		
In couple	0.90	0.29; 2.49		0.42	0.05; 2.43	0.365
Professional status						
Unemployed	Ref.			Ref.		
Employed	0.65	0.15; 3.40	0.575	1.31	0.11; 18.60	0.831
Retired	0.67	0.15; 3.50	0.600	1.08	0.05; 22.72	0.957
Obesity	3.23	0.99; 10.38	0.047	1.36	0.20; 8.72	0.754
Physical activity			0.002			
Low	Ref.			Ref.		
Moderate	0.98	0.28; 3.48	0.974	1.62	0.24; 11.54	0.619
High	0.62	0.17; 2.21	0.452	0.99	0.14; 7.38	0.993
Atrial fibrillation	1.01	0.14; 4.49	0.987	0.76	0.02; 14.83	0.863
Hypertension	1.25	0.46; 3.37	0.654	1.34	0.24; 7.78	0.732
Dyslipidaemia	0.93	0.33; 2.88	0.887	1.16	0.22; 7.38	0.864
Length of stay	0.96	0.73; 1.09	0.650	1.04	0.67; 1.35	0.129
First hospitalization for AMI	0.44	0.15; 1.43	0.155	0.17	0.01; 1.53	0.125

Abbreviations: Adj, adjusted; AMI, acute myocardial infarction; CI, confidence interval; OR, odds ratio.

Table A2 Factors associated with the probability of having a low level of health literacy (Brief Health Literacy Screening score ≤9) for acute decompensated heart failure patients

	Univariate analysis			Multivariate analysis		
	Crude OR	95% CI	*P* value	Adj.OR	95% CI	*P* value
Women	1.38	0.64; 3.01	0.415	0.29	0.05; 1.25	0.112
Age	1.00	0.97; 1.02	0.849	0.99	0.92; 1.06	0.805
Education level						
No school	2.38	0.67; 9.01	0.182	0.53	0.07; 3.52	0.517
Primary or secondary	0.78	0.21; 3.08	0.718	0.41	0.06; 2.91	0.365
Middle or university	Ref.			Ref.		
Native language			0.269			
French	Ref.			Ref.		
Other than French	5.27	2.04; 8.10		24.32	4.20; 230.45	0.001
Marital situation			0.072			
Single	Ref.			Ref.		
In couple	2.06	0.94; 4.59		18.23	3.48; 140.49	0.002
Professional status						
Unemployed	Ref.			Ref.		
Employed	1.46	0.26; 8.51	0.665	9.04	0.54; 197.83	0.136
Retired	1.22	0.38; 4.09	0.736	0.95	0.05; 15.25	0.974
Obesity	1.27	0.56; 2.90	0.564	0.57	0.15; 2.08	0.395
Physical activity			0.002			
Low	Ref.			Ref.		
Moderate	3.60	1.11; 14.07	0.043	1.03	0.13; 8.46	0.978
High	3.02	0.76; 13.88	0.129	0.83	0.08; 8.31	0.866
Atrial fibrillation	1.15	0.53; 2.52	0.726	2.99	0.82; 12.44	0.110
Hypertension	1.77	0.81; 3.93	0.154	1.06	0.28; 3.84	0.930
Dyslipidaemia	0.34	0.14; 0.81	0.018	0.09	0.01; 0.43	0.005
Length of stay	0.98	0.90; 1.08	0.743	0.84	0.71; 0.97	0.023
First hospitalization for ADHF	1.33	0.56; 3.19	0.512	1.54	0.34; 7.44	0.575

Abbreviations: ADHF, acute decompensated heart failure; Adj, adjusted; CI, confidence interval; OR, odds ratio.