

Impact of Self-Management Behavior on Heart Failure Patients' Quality of Life: A Retrospective Study

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Abstract

Background

The purpose of this study was to investigate the variables that significantly affect heart failure patients' quality of life, and particularly, to identify the impact of self-management behavior on the quality of life.

Methods

This retrospective study used heart failure patients' data from cardiovascular outpatient clinics at two tertiary medical centers in Korea. We enrolled 119 patients who completed echocardiography and stress tests and responded to questionnaires on self-management behavior and quality of life. We collected more data on general and disease-related characteristics and anthropometric and serum blood test results through electronic medical record review. We analyzed data using the classification and regression tree to explore the influencing factors and their characteristics in patients with high and low quality of life.

Results

Patients' mean age was 74.61 years, and women represented 52.1% of the sample. It showed that the cardiac systolic function ($\beta = 0.26, p = .013$) and self-management behavior ($\beta = 0.20, p = .048$) were two major influential factors on heart failure patients' quality of life. Therefore, HF patients' self-management behavior is a significant modifiable factor that can improve their quality of life.

Conclusions

Healthcare providers should be aware of the importance of heart failure patients' self-management and help promote their quality of life by enhancing their self-management behavior.

Introduction

Heart failure (HF) is a heterogeneous series of clinical syndromes associated with a poor prognosis, in which the body is unable to supply the proper amount of blood for metabolism due to decreased heart function [1]. According to 2013–2016 data from the National Health and Nutrition Examination Survey in the United States, the prevalence of HF continues to rise over time; it was estimated to be approximately 6.2 million, compared with an estimated 5.7 million between 2009 and 2012 [2]. This phenomenon has become a global problem with the increased aging population, and hospitalization due to HF is the leading cause of overall hospitalization in the United States and European countries [3, 4]. HF cannot be completely cured and requires lifelong management. Repeated hospitalizations of the patients affect the health care system, resulting in a high social and economic burden [3]. A systematic review of 16 studies (between 2004–2016) analyzed the cost associated with HF and reported that the annual medical expenses ranged from \$868 to \$25,532, with the lifetime cost for a patient with HF estimated at \$126,819 [5].

Patients with HF can be divided into four classes using the New York Heart Association (NYHA) classification based on the severity of symptoms and related physical effort needed [6]. They can also be divided into stages A (high risk of developing HF in the future) to D (advanced HF) [7]. The assessment for HF patient classification should consider not only a careful clinical evaluation but also the patient's psychosocial factors, for instance, the quality of life (QoL), which can be a more important factor outside the hospital management [8]. Patients with HF usually suffer from a variety of physical symptoms such as dyspnea, dizziness, edema, lack of energy, and sleep disturbance, and psychological problems such as stress, anxiety, and depression along with changes in heart function, further reducing HF patients' overall QoL [9]. The treatment goal for HF is to control the worsening symptoms, reduce re-hospitalizations, and maintain survival [10]. Accordingly, a patient's self-management plays an important role in HF management. Patients need to recognize their exacerbating symptoms and manage related factors, and through this, they will be able to improve their QoL and lower their mortality. Thus, self-management is a necessary focus in life-long HF care, which the patients should continue throughout their lives [10, 11], while healthcare providers should ensure the best possible QoL of HF patients [12].

Recently, many studies on HF patients' self-management and QoL have been conducted. However, according to a systematic review of 30 studies, there was a discrepancy among the individual study results, which examined the relationship between health-related QoL and self-management of HF patients [13]. The discrepancy also appeared in interventional studies. One systematic review of 19 randomized controlled trials reported that some self-management interventions significantly affected the QoL of patients with HF, but others did not [14]. As such, many studies have emphasized the importance of HF patients' self-management and QoL; however, their results have been inconsistent. The purpose of this study was to consider various possible factors influencing the QoL of HF patients and to investigate the impact of self-management behavior on the QoL.

Materials And Methods

Study design and participants

This study used a retrospective observational design. Participants for the present study were adult patients with HF who visited the cardiovascular outpatient clinics at two large tertiary medical centers in Seoul and Suwon city, Korea, for regular medical follow-ups between July 2017 and August 2019. We selected 119 patients who had performed relevant serum blood tests, echocardiography, and stress tests and responded to the surveys on self-management behavior and the QoL. We collected their data retrospectively by electronic medical record review.

Study Variables

Self-management behavior was measured using the European Heart Failure Scale [15], a 12-item questionnaire related to self-care behavior in HF patients. Also, their QoL was assessed using a

measuring tool provided by the World Health Organization (WHOQOL-BREF) [16]. The patients' stress levels were measured using the heart rate variability (HRV) measurement tool.

All patients underwent a comprehensive transthoracic echocardiographic evaluation, a standard 2-dimensional and Doppler echocardiographic examination, according to the recommendations of the American Society of Echocardiography [17]. Left ventricular systolic function was defined using the left ventricular ejection fraction (EF), calculated according to the modified Simpson's method (i.e., subtracting left ventricular end-systolic dimension from left ventricular end-diastolic dimension). Left ventricular diastolic function was defined as the early mitral inflow velocity to early diastolic mitral septal annular velocity (E/E'), calculated using pulsed-wave Doppler and tissue Doppler echocardiography. The evaluation was conducted using GE Vivid 7 (GE Healthcare, Horten, Norway) or iE33 (Philips Medical Systems, Andover, MA, USA), performed by 6 sonographers and 2 echocardiologists in one medical center. In the other medical center, it was conducted using Vivid E95 (GE Healthcare, Horten, Norway) or EPIQ CVX (Philips Medical Systems, Andover, MA, USA), which was performed by 8 sonographers and 2 echocardiologists. In this study, we only collected EF for cardiac systolic function and E/E' for cardiac diastolic function from the patients' echocardiographic results.

Electronic medical record review was performed to collect the participants' general and disease-related characteristics, anthropometric data, and serum blood test results, including hemoglobin A1C (HbA1C), high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol, triglyceride, and high sensitivity C-reactive protein (hs-CRP).

Statistical analyses

Data were analyzed using SPSS version 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to explain the participants' general and disease-related characteristics, levels of stress, self-management behavior, and QoL. Independent samples *t*-tests and χ^2 tests were conducted to identify the differences in the variables according to the levels of low and high QoL. The two QoL levels were created by using a median split for the QoL measure. To examine the factors affecting the QoL, we performed a multiple linear regression analysis. Lastly, the predictive model for QoL of HF patients was developed using decision tree analysis. Decision tree analysis is a data-mining technique designed to partition the whole data set into subgroups based on splitting criteria [18]. The tree model structure is made up of root nodes, splitting nodes (parent nodes), and terminal nodes (child nodes). We used the classification and regression tree (CART) method, where parent nodes can have multiple child nodes.

Results

The mean age of the patients was 74.61 years, and 52.1% were women. The differences in the variables according to the groups with low and high QoL are presented in Table 1. There were statistical differences in EF ($t = -3.57, p < .001$), E/E' ($t = 2.03, p = .045$), and self-management behavior ($t = -2.33, p < .022$) between low and high QoL groups. Patients with high QoL showed significantly higher EF, lower E/E', and

better self-management behavior scores than those with low QoL. Other variables showed no statistical differences between the groups.

Table 1
Participants' general and disease-related characteristics (N= 119)

Characteristics	Low QoL (n= 59)	High QoL (n= 60)	t or χ^2	p
Age (range: 35–96), M (SD)	74.98 (10.87)	74.23 (11.75)	0.36	.719
< 60, n (%)	4 (6.8)	7 (11.7)	1.64	.651
60–69, n (%)	13 (22.0)	9 (15.0)		
70–79, n (%)	19 (32.2)	21 (35.0)		
≥ 80, n (%)	23 (39.0)	23 (38.3)		
Spouse*, n (%)			0.51	.476
Yes	35 (60.3)	40 (66.7)		
No	23 (39.7)	20 (33.3)		
Educational Level*, n (%)			1.42	.492
≤ Middle school	32 (56.1)	33 (55.0)		
≤ High school	17 (29.8)	14 (23.3)		
≥ College/University	8 (14.0)	13 (21.7)		
Economic Status*, n (%)			1.42	.491
Low	9 (34.6)	12 (22.2)		
Middle	13 (50.0)	33 (61.1)		
High	4 (15.4)	9 (16.7)		
Occupation*, n (%)			0.34	.562
Yes	11 (19.0)	14 (23.3)		
No	47 (81.0)	46 (76.7)		
Family History*, n (%)			0.66	.416
Yes	9 (15.8)	13 (21.7)		
No	48 (84.2)	47 (78.3)		

Note. *Excluded, no response. QoL, quality of life; NYHA, New York Heart Association; HbA1C, hemoglobin A1C; HDL, high density lipoprotein; LDL, low density lipoprotein; hs-CRP, high sensitive C-reactive protein; EF, ejection fraction; E/E', early mitral inflow velocity/early diastolic mitral annular velocity.

Characteristics	Low QoL (<i>n</i> = 59)	High QoL (<i>n</i> = 60)	<i>t</i> or χ^2	<i>p</i>
Body Mass Index (kg/m ²), <i>M</i> (<i>SD</i>)	24.45 (4.29)	24.69 (3.11)	-0.34	.733
Waist Circumference (cm), <i>M</i> (<i>SD</i>)	88.54 (10.10)	88.29 (10.06)	0.10	.919
Heart Failure Duration (y), <i>M</i> (<i>SD</i>)	7.23 (4.87)	8.62 (5.57)	-1.43	.155
Number of Hospitalizations, <i>M</i> (<i>SD</i>)	1.28 (0.97)	1.08 (0.88)	1.07	.286
Treatment*, <i>n</i> (%)				
Medication, <i>n</i> (%)			0.01	.981
Yes	57 (98.3)	59 (98.3)		
No	1 (1.7)	1 (1.7)		
Internal Intervention, <i>n</i> (%)			2.48	.115
Yes	19 (32.8)	12 (20.0)		
No	39 (67.2)	48 (80.0)		
Surgery, <i>n</i> (%)			0.68	.411
Yes	10 (17.2)	14 (23.3)		
No	48 (82.8)	46 (76.7)		
NYHA Class*, <i>n</i> (%)			4.40	.222
I	9 (17.6)	15 (25.4)		
II	23 (45.1)	30 (50.8)		
III	15 (29.4)	8 (13.6)		
IV	4 (7.8)	6 (10.2)		
Systolic Blood Pressure (mmHg), <i>M</i> (<i>SD</i>)	121.51 (17.77)	127.33 (14.37)	-1.97	.501
Diastolic Blood Pressure (mmHg), <i>M</i> (<i>SD</i>)	68.93 (11.84)	73.07 (13.52)	-1.77	.079
HbA1C (%), <i>M</i> (<i>SD</i>)	6.64 (1.10)	6.88 (1.10)	-0.66	.517
HDL (mg/dL), <i>M</i> (<i>SD</i>)	49.47 (15.06)	46.77 (11.95)	1.00	.319
LDL (mg/dL), <i>M</i> (<i>SD</i>)	85.76 (37.36)	85.13 (30.38)	0.09	.926

Note. *Excluded, no response. QoL, quality of life; NYHA, New York Heart Association; HbA1C, hemoglobin A1C; HDL, high density lipoprotein; LDL, low density lipoprotein; hs-CRP, high sensitive C-reactive protein; EF, ejection fraction; E/E', early mitral inflow velocity/early diastolic mitral annular velocity.

Characteristics	Low QoL (<i>n</i> = 59)	High QoL (<i>n</i> = 60)	<i>t</i> or χ^2	<i>p</i>
Total Cholesterol (mg/dL), <i>M</i> (<i>SD</i>)	147.00 (47.50)	150.81 (34.25)	-0.50	.619
Triglyceride (mg/dL), <i>M</i> (<i>SD</i>)	115.86 (65.05)	133.43 (71.18)	-1.31	.195
hs-CRP (mg/dL), <i>M</i> (<i>SD</i>)	1.15 (1.45)	2.88 (6.02)	-1.28	.215
EF (%), <i>M</i> (<i>SD</i>)	50.17 (19.01)	60.92 (13.27)	-3.57	< .001
E/E', <i>M</i> (<i>SD</i>)	16.93 (8.69)	14.03 (5.97)	2.03	.045
Stress (0–100), <i>M</i> (<i>SD</i>)	50.23 (20.45)	40.33 (21.93)	1.29	.203
Self-Management Behavior (1–5), <i>M</i> (<i>SD</i>)	3.28 (0.60)	3.54 (0.56)	-2.33	.022

Note. *Excluded, no response. QoL, quality of life; NYHA, New York Heart Association; HbA1C, hemoglobin A1C; HDL, high density lipoprotein; LDL, low density lipoprotein; hs-CRP, high sensitive C-reactive protein; EF, ejection fraction; E/E', early mitral inflow velocity/early diastolic mitral annular velocity.

The factors that significantly influenced the patients' QoL are shown in Table 2. Multiple linear regression analysis was performed with EF, E/E', and self-management behavior as the independent variables based on their significance in the univariate analysis to identify the major factors that predict the QoL. The regression model for the patients' QoL was shown to be significant ($F = 5.03$, $p = .003$). The value of the adjusted R^2 was .11, corresponding to the explanatory power of 11.0% for QoL. The major influencing factors on the QoL were EF ($\beta = 0.26$, $p = .013$) and self-management behavior ($\beta = 0.20$, $p = .048$).

Table 2
Factors influencing quality of life in heart failure patients

Variables	<i>B</i>	SE (<i>B</i>)	β	<i>t</i>	<i>p</i>
EF	0.01	0.01	0.26	2.53	.013
E/E'	-0.01	0.01	-0.04	-0.44	.665
Self-Management Behavior	0.23	0.12	0.20	2.00	.048
Overall: $R^2 = .14$, Adjusted $R^2 = .11$, $F = 5.03$, $p < .003$					
<i>Note.</i> EF, ejection fraction; E/E', early mitral inflow velocity/early diastolic mitral annular velocity.					

To perform the CART analysis, we selected EF and self-management behavior as the candidate predictors based on the regression analysis. The prediction model by CART analysis for the QoL in HF patients is shown in Table 3 and Fig. 1. The EF (cut-off value: 36%) was shown to be the primary determinant of the patient's QoL. The lowest QoL group (Node 1; predictive QoL value of 3.08 out of 5) with 6 patients (5.0%) had $EF \leq 36\%$, and their self-management score was lower than 3.29 out of 5. Contrarily, the highest QoL group (Node 5; predictive QoL value of 4.02) with 25 patients (21.0%) had $EF > 69\%$. In the group with EF

≤ 36%, if the patients' self-management score was higher than 3.29 (15 patients, 12.6%), they showed a predictive QoL value of 3.24 (Node 2). The group, which had EF between 37% and 69%, was divided into two nodes (Nodes 3 and 4). Node 3 (predictive QoL value of 3.66) included patients with self-management behavior score ≤ 4.04 (63 patients, 52.9%), and Node 4 (predictive QoL value of 4.09) included patients with self-management behavior score > 4.04 (10 patients, 8.4%).

Table 3
Quality of life in heart failure patients of each node based on CART

Node	Definition	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>B</i>	<i>SE</i> (<i>B</i>)	β	<i>t</i>	<i>p</i>
Node 1	EF ≤ 36 & Self-Management ≤ 3.29	6 (5.0%)	2.70 (0.25)					
Node 2	EF ≤ 36 & Self-management > 3.29	15 (12.6%)	3.24 (0.62)	0.54	0.30	0.26	1.81	.043
Node 3	36 < EF ≤ 69 & Self-Management ≤ 4.04	63 (52.9%)	3.66 (0.69)	0.97	0.27	0.69	3.65	< .001
Node 4	36 < EF ≤ 69 & Self-Management > 4.04	10 (8.4%)	4.09 (0.39)	1.39	0.32	0.55	4.35	< .001
Node 5	EF > 69	25 (21.0%)	4.11 (0.54)	1.42	0.28	0.82	5.02	< .001
Overall: $R^2 = .26$, Adjusted $R^2 = .23$, $F = 9.80$, $p < .001$								
<i>Note.</i> CART, classification and regression tree; EF, ejection fraction.								

Discussion

This study attempted to explore the factors influencing HF patients' QoL and the importance of self-management on their QoL. Among HF patients' various physical, psychological, behavioral, and diagnostic test results, EF and self-management behavior were factors that significantly influenced their QoL.

Previous studies have shown that EF is an important hallmark in HF patients that reflects the disease prognosis and patient outcomes, such as worsening symptoms, hospital readmission, mortality, and QoL [9, 19, 20]. Since HF cannot be ultimately cured, a necessary treatment strategy is to maintain the functional capacity and improve the QoL by continuous lifetime monitoring with the cooperation of healthcare providers and the patients themselves [10, 21]. Regular observation of the echocardiography results is essential to manage HF patients' treatment goals, as it is a simple and intuitive measurement for the evaluation of EF. Although increased EF can bring satisfaction to healthcare providers and patients, it is not easy to improve. Various medical treatments, such as pharmacological therapy, cardiac revascularization, resynchronization, and ventricular assist devices, have been availed of to improve the HF patient's EF; however, everyone does not get complete improvement with uniform treatment, so

various studies are ongoing to determine the most favorable and optimal treatment [22, 23]. In addition, measuring EF through echocardiography has also been reported to have limitations, such as limited reliability due to inter- and intra-observer variability and poor image quality [24, 25]. Further, the concerns that QoL and the diverse symptoms of HF patients are not always associated with EF, which is a useful but simplistic parameter to assess the complexity of HF, should be considered in clinical practice [26].

Self-management behavior can be a modifiable factor in improving QoL in HF patients. In the present study, self-management of HF patients was one of the significant factors impacting their QoL. As we further noticed with the prediction model, even in the low EF group, if the self-management behavior score was relatively high, the relative QoL score was also high. It is in line with the results of a recent systematic review that showed evidence that HF patients can improve their QoL by promoting their self-care behaviors [13]. Previous studies suggested that self-management interventions like education, support, and guidance can improve the QoL in HF patients with diverse delivery methods such as face-to-face interaction, telephonic conversation, accessing websites, mobile applications [27–30].

Self-management of HF is the patients' comprehensive behavior, including maintaining self-care for physical and psychological stability and self-monitoring the possible worsening signs and symptoms [10]. Maintaining self-care includes taking prescribed medications, doing proper and regular physical activity, limiting salt and water uptake, keeping an adequate body weight, and so on. Self-monitoring also includes observing the signs and symptoms related to HF experienced by patients themselves and responding appropriately before advanced outcomes occur [10, 31]. For patients with chronic conditions like HF, self-management represents a critical strategy for improved treatment outcomes that the patient should accept as an aspect of their daily routine for their lifetime rather than a short-term event [32]. Nevertheless, it is an ongoing challenge for healthcare providers and patients to enable self-management behavior and continue to be stable without giving up. Some studies emphasized HF patients' role in decision-making based on the knowledge and trial and error experience for self-management adherence [33–35]. Additionally, some studies highlighted the role of healthcare providers in improving self-management in HF patients through constant and multifaceted efforts, such as interactive education, teach-back, retraining, and support using diverse and customized delivery methods [27, 28, 36]. Regardless of the patient's initial low or high EF, efforts to improve the self-management ability of HF patients will both promote their self-care and ultimately contribute to the achievement of the goal of treatment by enhancing the patients' QoL.

This study has several limitations. First, this was a retrospective study based on a relatively small and convenient sample, which may not represent the population and therefore has poor generalizability. Second, there may be differences in application to other participants since we analyzed using the median value of the QoL. Third, we used the E/E' as a representative value for cardiac diastolic function in this study. However, diverse parameters, such as left atrial volume index, lateral early diastolic mitral annular velocity, the ratio of early diastolic transmitral flow velocity to late diastolic transmitral flow velocity (E/A), and E-wave deceleration time, can be considered for assessing diastolic function, and the assessment method we used is not applicable to certain populations with arrhythmia, mitral stenosis, mitral

regurgitation, or mitral valve prosthesis [37]. In addition to the quantitative variables of EF and E/E', the qualitative variables of left ventricular systolic dysfunction and diastolic dysfunction should be considered. Future research should be expanded to include an increased number of participants and comprehensive (both quantitative and qualitative) measurement tools of cardiac function to examine the validity of the prediction model in this study. Nevertheless, this study has strength in confirming that self-management is an important factor impacting the QoL in HF patients.

Conclusions

The EF and self-management behavior are factors significantly affecting the QoL in HF patients. Furthermore, self-management behavior should be considered as an important and modifiable factor that can increase QoL as a treatment goal of HF patients. Further ongoing research is needed to understand ways of effectively improving patients' self-management adherence.

Abbreviations

CART: Classification and regression tree; E/A: Early diastolic transmitral flow velocity to late diastolic transmitral flow velocity; E/E': Early mitral inflow velocity to early diastolic mitral septal annular velocity; EF: Ejection fraction; HbA1C: Hemoglobin A1C; HDL: High-density lipoprotein; HF: Heart failure; HRV: Heart rate variability; hs-CRP: High sensitivity C-reactive protein; LDL: Low-density lipoprotein; NYHA: New York Heart Association; QoL: Quality of life; WHOQOL-BREF: World Health Organization quality of life instrument short form

Declarations

Ethics approval and consent to participate

The study was conducted with the approval of the Institutional Review Board (IRB) of Ajou University (IRB No. AJIRB-MED-SUR-19-349). As this study was a retrospective study, it was not possible to obtain direct consent from the subjects. Informed consent was waived, and the IRB approved the waiver. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

All authors have read and agreed to the published version of the manuscript.

Competing interests

All authors declare that they have no competing interests.

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Authors' contributions

Study conceptualization was performed by JAA. Data curation was performed by EYC, JSP and JAA. Formal analysis was performed by JAA, DM and HSL. Funding acquisition was performed by JAA. Supervision was performed by EYC, JSP and JAA. Writing was performed by JAA and DM. All authors have read and approved the manuscript.

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Availability of data and materials

The data that support the findings of this study are available from the authors upon reasonable request and with permission of the medical centers where the authors collected the data retrospectively.

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Figures

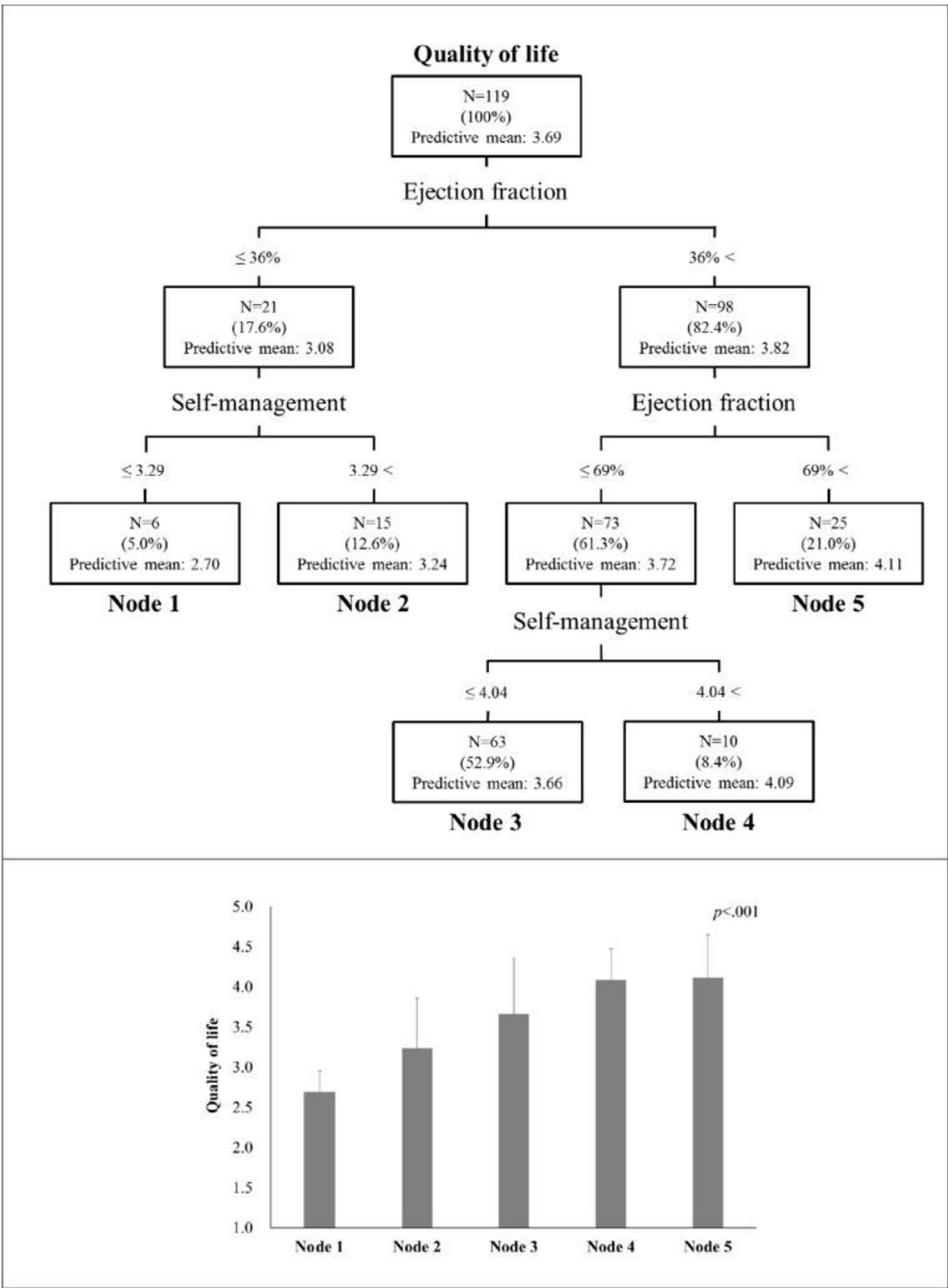


Figure 1

Classification and regression tree for quality of life in heart failure patients.