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The performance of physical activity and health-related quality of life in patients with heart failure: a cross-sectional study

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ABSTRACT

Introduction: Physical activity (PA) is one of the recommendations for people living with heart failure. However, patients frequently do not comply with it, which often negatively impacts their health. This study aimed to describe self-reported PA performance and determine predictors regarding health-related quality of life (HRQOL) among heart failure (HF) patients.

Methods: A cross-sectional design was adopted, and data were collected using a questionnaire comprising demographic characteristics, illness-related factors, self-report health status (SRHS) questionnaire, international PA questionnaire, and Minnesota Living with Heart Failure questionnaire. Subsequently, data were analyzed using Pearson correlation coefficient, t-test, one-way ANOVA, and hierarchical multiple regression.

Results: The mean age for the total participants of 180 HF patients was 59.92 ± 11.90 years, with 60% being male, and the mean HRQOL score was 42.96 ± 20.47. HRQOL had significant correlations with HF medication (r= 0.20, p< 0.01), health status (HS) (r= 0.35, p< 0.01), PA (r= -0.52, p< 0.01), and HRQOL was associated with the New York Heart Association (NYHA) classification (F= 94.57, p< 0.001). Meanwhile, age, gender, job, marital status, religion, level of education, hemoglobin, body mass index, length of diagnostic HF, and comorbidities did not have a significant relationship with HRQOL. Three variables were significant predictors of HRQOL, namely HS (β= 0.21, p< 0.01), NYHA Class III (β= 0.15, p< 0.05), and PA (β= -0.31, p< 0.001).

Conclusions: Regular PA is crucial in improving HRQOL of HF patients. In addition, HS, HF medication, and NYHA Class should be considered in providing care for HF patients aimed at improving HRQOL.

Keywords: heart failure, health-related quality of life, physical activity.

Introduction

Heart failure (HF) is a serious issue in public health, with cases consistently increasing annually (Shahim et al., 2023). Several advanced and innovative treatments have been introduced in providing care for HF patients. However, the uncertainty of prognosis and illness progression tend to impact the morbidity and mortality rates (Gerges et al., 2015), necessitating the improvement of Health-related Quality of Life (HRQOL) (Alanazi et al., 2023). The New York Heart Association (NYHA) classification is an important indicator for patients in carrying out daily activities, as it has a direct relationship with symptoms experienced by HF patients (Gallagher et al., 2019). Symptoms frequently experienced include shortness of breath (SOB), dyspnea, and fatigue and can influence physical, mental, or social health, which are crucial aspects of HRQOL (Uchmanowicz & Gobbens, 2015; Wu et al., 2016). Meanwhile, HRQOL serves as a parameter for illness severity, treatment response, symptom progression,

and a measure for re-hospitalizations (Jarab et al., 2023; Tegegne et al., 2022). It is essentially a complex concept that includes both the physical and psychosocial dimensions of an individual (Fitz et al., 2021; Floegel & Perez, 2016). Therefore, maintaining good HRQOL is one of the primary objectives in comprehensive management for HF patients (Rankin et al., 2019).

Physical activity (PA) is one of the rehabilitative measures for HF patients (Esnaasharieh et al., 2022). Performance provides positive benefits on several factors such as exercise capacity, functional capacity, physical performance, physical fitness, and cardiopulmonary exercise of patients (da Silva et al., 2013; Lindgren & Borjesson, 2021). These factors can directly relate to the rate of re-hospitalization, morbidity, and mortality (Fitz et al., 2021). The American College of Cardiology (ACC) and the American Heart Association (AHA) recommend that stable HF patients engage in routine PA alongside continuous medication therapy (Ponikowski et al., 2016). The American College of Sports Medicine (ACSM) also recommends that moderate PA for more than 30 minutes five days per week or vigorous PA for more than 20 minutes three days per week can improve and maintain health of adults (Varghese et al., 2016). Performance of PA can improve immunology for patients with HF, as there is an increase in oxygen intake in the body, facilitating peripheral metabolism (Hummel et al., 2016), and inhibiting progressive cardiac remodeling (Nayor et al., 2016). However, symptoms of HF such as dyspnea, fatigue, and shortness of breath (SOB) can impede the patient from doing PA based on recommendations. Therefore, promoting PA remains a challenge for patients facing a condition associated with HF symptoms.

Previous studies found that only 30% to 56% of HF patients engaged in routine PA at a recommended level of 20 to 30 minutes per 3 to 5 days per week (Andreae et al., 2019; Heidenreich et al., 2022). Low PA may be prevalent in people with HF but the research on this topic is limited in Indonesian people. An estimated 22.8% of Indonesian adults have a low PA level; likewise, low PA is an important risk factor for increasing incidence and mortality rates of HF in Indonesia (Lam, 2015). Moreover, absence of PA can have detrimental effects on health and stimulate the progression of HF severity (Andreae et al., 2019; Nayor et al., 2016). Therefore, understanding the benefits of performing PA in an effort to improve HRQOL is crucial. However, it should be noted that several studies have argued that demographic characteristics and illness-related factors play a role in changes in HRQOL among patients with HF. Therefore, the current study aimed to investigate the relationship between demographic characteristics, illness-related factors, PA, and HRQOL in HF patients, and to identify predictive factors influencing HRQOL.

Materials and Methods

Study design and Participants

This study used a cross-sectional design, and a convenience sampling method was used to obtain respondents who met the inclusion criteria of HF patients according to the International Classification of Diseases (ICD) tenth revision (code number 150), aged >18 years, and classified as NYHA Class I to III in a cardiology outpatient department of North Sulawesi-Indonesia. The exclusion criteria were patients experiencing acute attacks (dyspnea, fatigue) and patients with decreased consciousness. Respondents who agreed to participate were provided with informed consent, and the study was approved by the Hospital Institutional Review Board (HIRB) (PP04.03/XIX.3/3580/2023). The sample size estimation was calculated using the G-Power software 3.1.9.2 version with an effect size of 0.15, an α level of 0.05, a power of 0.80, and an additional 10% missing data rate. The participants were a total of 180 patients with HF, consisting of males (n =-108) and females (n=72).

Instruments

The following measuring tools were adopted: (1) Demographic characteristics questionnaire (age, gender, job, marital status, income level, religion, living arrangement, and education); (2) Illness-related factors consist of hemoglobin (Hgb), body mass index (BMI), length of diagnostic HF, NYHA classes, HF standard medications, and comorbidity using Charlson Comorbidity Index (CCI) (a high score shows the seriousness of comorbidities) (Charlson et al., 1987); (3) Health status (HS) using the modified 4-item Self-Rated Health Subscale (SRHS) (a higher score showing lower HS) (Lawton et al., 1982); (4) PA using international PA questionnaire (IPAQ), comprising 27 items covering four domains, namely occupational, transportation, housework, and leisure time (a high score shows better PA performance) (Craig et al., 2003); (5) HRQOL using the Minnesota Living with Heart Failure Questionnaire (MLHFQ), comprising 21 items including physical, emotional dimensions, and other dimensions (a higher score shows poorer HRQOL) (Rector, 2005).

Table 1. Characteristics of the respondents (n= 180)

Variable	n (%)	Mean ± SD
Demographic characteristics		
Age (year)		59.98 ± 11.86
Gender		
Male	108 (60.0)	
Female	72 (40.0)	
Job		
Yes	109 (60.6)	
No	71 (7.1)	
Marital status		
Married	167 (92.3)	
Single/widow/widowed	13 (7.1)	
Religion		
Christian	132 (73.3)	
Others	48 (26.7)	
Living arrangements		
With families	132 (73.3)	
Others	48 (26.7)	
Income level		
Low	55 (30.6)	
Moderate	33 (18.3)	
High	92 (51.1)	
Education		
Elementary school	37 (20.6)	
Junior high school	36 (20.0)	
Senior high school	81 (45.0)	
College and above	26 (14.4)	
Illness-related factors		
Hgb (g/dL)		12.88 ± 1.79
BMI (kg/m^2)		25.10 ± 4.56
< 18.5	3 (1.7)	
18.5 to 24.9	101 (56.1)	
25.0 to 29.9	57 (31.7)	
> 30	19 (10.6)	
Length of diagnostic HF (month)		32.29 ± 35.81
Comorbidities (CCI number)		2.87 ± 1.44
Cardiovascular		
Hypertension	121 (67.2)	
CAD and MI	77 (42.7)	
Valvular disease	6 (3.3)	
Non-cardiovascular		
DM	50 (27.8)	
Chronic renal insufficiency	32 (17.8)	
Hepatitis and Cirrhosis	3 (1.7)	
HF medication		
Diuretics	76 (57.8)	
ACEi	67 (37.2)	
ARBs	47 (26.1)	
Beta-blocker	25 (13.9)	
Aldosterone inhibitor	24 (13.3)	
Health status		10.15 ± 1.92
FTSST (second)		8.46 ± 6.30
< 6	106 (58.9)	± 0.87
6 to 16	45 (25.0)	10.50 ± 4.10
> 16	29 (16.1)	20.93 ± 2.97
NYHA Classes		
Class I	43 (23.9)	
Class II	93 (51.7)	
Class III	44 (24.4)	
HRQOL overall		42.96 ± 20.47

ACEi: angiotensin-converting enzyme inhibitors; ARBs: angiotensin II receptor blockers;
BMI: body mass index; CAD: coronary artery disease; DM: diabetes mellitus; Hgb, hemoglobin;
MI, myocardial infarction; NYHA: New York Heart Association

Statistics

Before data analysis, inspection was conducted to minimize errors and missing values, assess the distribution, normality of data on the main variables, homogeneity of variance, homoscedasticity, and linearity for each statistical procedure. The results found that the normality of the main variables was accepted; therefore, the relationship between demographic characteristics, illness-related factors, PA, and HRQOL was analyzed using Pearson correlation coefficient, t-test, and One-way ANOVA. Data transformation was conducted on total PA using LOQ 10. Hierarchical multiple regressions were used to explain predictors related to HRQOL, and relevant variables with cut-off point value of $p< 0.20$ to HRQOL were included in the regression model. NYHA Classes, level of education, and marital status were transformed into dummy variables.

Results

Demographic characteristics, illness-related factors, PA, and HRQOL

A total of 180 HF patients participated in this study, and the demographic characteristics as well as illness-related factors are presented in Tables 1 and 2. The average age of respondents was 59.92 ± 11.90 years, with 60% being male. A significant number had an education level of senior high school (45%) and were married (92.3%). Table 2 shows that the mean Hgb was (12.88 ± 1.79) g/dL, the length of diagnostic HF was (32.29 ± 35.81) months, mean comorbidities was (2.87 ± 1.44), and HS was (10.12 ± 1.91). The majority had NYHA Class II (57.8%), and the mean PA score was (3009.84 ± 4903.37) MET-second/week (data transformed using LOQ 10 was 3.03 ± .69).

Table 1 and the Appendix show that the average HRQOL score of respondents was (43.14 ± 20.74). The most prevalent HRQOL issues were in physical dimension, with an average of (18.44 ± 8.20). The breakdown of five highest and lowest problems affecting HRQOL of respondents is as follows: difficulty walking or climbing stairs (2.60 ± 1.36); feeling tired, fatigued, or having low energy (2.49 ± 1.27); SOB (2.41 ± 1.30), difficulty sleeping at night (2.37 ± 1.15); difficulty going far from home (2.34 ± 1.29) (highest problems); feeling a burden to family/friends (1.52 ± 1.19); difficulty concentrating/remembering (1.47 ± 1.20); loss of self-control (1.42 ± 1.21); side effects from medications (1.12 ± 1.02); and swelling in ankles or legs (0.99 ± 1.33) (lowest problems).

Association between demographic characteristics, illness-related factors, and HRQOL

Tables 2 and 3 show that HRQOL had significant relationships with several variables. There was a weak positive correlation with HF medication ($r= 0.20$, $p< 0.01$), a moderate positive correlation with HS ($r= 0.35$, $p< 0.01$), but a strong negative relationship with PA (PA)

Table 2. Correlation between demographic characteristics, illness-related factors, and HRQOL (n = 180)

		1	2	3	4	5	6	7	8
1	Age								
2	Hb	-0.04							
3	BMI	0.07	0.10						
4	Length of HF	0.15	0.01	0.05					
5	CCI	0.54**	-0.23**	-0.01	-0.01				
6	HF Medication	0.08	-0.07	0.09	-0.09	0.08			
7	Health Status	-0.18*	-0.16*	-0.13	-0.01	0.09	0.03		
8	IPAQ total	-0.06	0.05	0.04	0.01	-0.06	-0.11	-0.23**	
9	MLHFQ overall	0.06	-0.10	-0.07	0.07	0.10	0.15	**0.24****	**-0.24****

* $p < .05$, ** $p < .01$ level of significance (2-tailed). Hgb: hemoglobin; BMI: body mass index; CCI: Charlson comorbidity index; HF: heart failure; PA: physical activity; LOQ: limit of quantitation; HRQOL: health-related quality of life

(r= -0.52, p< 0.01). HRQOL was associated with NYHA Classification (F= 94.57, p< 0.001), while post hoc analysis showed that NYHA Class III had a mean score (68.14 ± 20.47) higher than Class I (29.42 ± 14.67), and Class II (37.30 ± 13.56). On the other hand, variables such as age, gender, job, marital status, religion, education level, Hgb, BMI, length of diagnostic HF, and comorbidities had no significant relationship with HRQOL among HF patients.

Table 4 shows the predictors of HRQOL. Model 1: education and marital status were entered as predictors accounting for 3.9% of the variance in HRQOL, with significant variable being senior high school (β= -0.21, p< 0.05). Model II, six predictors namely comorbidities, length of diagnostic HF, HF medication, HS, NYHA Class, and PA were included in the model. The results showed that, after controlling for education and marital status, R2 increased by 19% of the variance (p< 0.001) from 0.06 to 0.23. Significant

Table 3. Association between demographic characteristics, illness-related factors, and HRQOL (n =180)

Variable	*n*	HRQOL				Post hoc test
		Mean	*SD*	*t / F*	p	
Gender[a]						
Male	108	42.85	21.08	-0.23	0.817	
Female	72	43.58	20.36			
Job[a]						
Yes	109	41.82	20.65	1.07	0.288	
No	71	45.18	20.87			
Marital status[a]						
Married	167	42.70	20.92	-1.03	0.305	
Single	13	48.85	18.02			
Religion[a]						
Christian	132	42.65	20.19	-0.53	0.598	
Others	48	44.50	22.37			
Living arrangement[a]						
Alone	4	42.75	24.10	-0.04	0.969	
With family	176	43.15	20.73			
Income level[b]						
Low	55	44.80	19.77	0.28	0.760	
Moderate	33	41.73	20.44			
High	92	42.66	21.56			
Education[b]						
Elementary	81	48.22	20.29	1.73	0.162	
Middle school	36	42.86	21.53			
High school	26	39.79	20.47			
College	37	46.77	20.24			
NYHA Class[b]						
Class I (A)	43	37.98	18.79	**8.36**	**< 0.001**	A < C
Class II (B)	104	41.32	18.68			B < C
Class III (C)	33	55.64	24.75			
FTSST (second)[b]						
< 6 (A)	103	35.50	16.48	**26.01**	**< 0.001**	A < B
6 to < 16 (B)	42	47.31	18.31			A < C
>16 (C)	35	60.66	23.04			B < C

a T-test (t); b One-way ANOVA (F); Bold values: significant with HRQOL

Table 4. Predictors variables on HRQOL (n= 180)

Variables	Model 1		Model 2		Model 3	
	β	*t*	*β*	*t*	*β*	*t*
Education Elementary	0.13	1.68	0.13	1.94	0.08	1.36
NYHA Class III			-0.10	-1.06	-0.06	-0.65
Hgb			0.01	0.09	0.04	0.60
CCI			-0.03	-0.49	0.03	0.43
HF Medication			0.08	1.22	0.08	1.23
HS			0.06	0.85	0.04	0.59
FTSST			**0.52**	**5.40**[b]	**0.36**	**3.88**[b]
Occupational					**-0.20**	**-2.57**[a]
Transportation					-0.08	-0.90
Housework					**-0.22**	**-2.03**[a]
Leisure time					-0.04	-0.43
F	2.81		8.64[b]		10.19[b]	
R^2 Change	0.016		0.244[b]		0.140[b]	
R^2	0.016		0.260		0.400	
Adjusted R^2	0.010		0.230		0.361	

ap< .05, bp< .001 level of significance (2-tailed); Bold values: predictors of HRQOL
Hgb: hemoglobin; HF: heart failure; HS: health status; NYHA: New York Heart Association; FTSST: five times sit to stand test

variables in Model II were senior high school (*β*= -0.19), HS (*β*= 0.27), and NYHA Class III (*β*= 0.17). When PA was included in Model III, R^2 increased by 7.9% (p< 0.001) from 0.229 to 0.308. Significant variables were HS (*β*= 0.21), NYHA Class III (*β*= 0.15), and PA (*β*= -0.31).

Discussions

Analysis showed that HF patients tended to have issues with HRQOL, specifically patients with higher NYHA classes (Smolis-Bak et al., 2015). Furthermore, the HRQOL of the respondents was moderate. Issues commonly faced by patients with higher NYHA Class such as SOB, dyspnea, and fatigue had an impact on restricting PA (Santos-Lozano et al., 2017). This was supported by the current study, where the five highest issues faced were in the physical dimension (see Appendix 2 and 3). The impact of chronic illness like HF could affect the psychological, social, and emotional problems of patients (Cheng et al., 2024).

Tables 2 and 3 show that HF medication and HS correlated with HRQOL of patients. While HF medication had a positive effect in reducing the workload of heart, the side effects could lead to a decrease in heart rate, cardiac output, as well as dehydration and electrolyte imbalance (Girerd et al., 2023; Maria et al., 2023). This could significantly decrease HRQOL of patients (Girerd et al., 2023). Similarly, HS was one of the indicators for HRQOL, where HS decreased with HRQOL (Butler et al., 2022).

One of the HS issues included perceived changes in HS compared to the previous year. A significant number of patients had limitations in participating in preferred activities and felt better with general health (see Appendix 1). Therefore, maintaining good HS was necessary to improve HRQOL status. This supported previous results that maintaining good HS could provide positive benefits for PA (Myers et al., 2015). However, demographic characteristics and illness-related factors such as age, gender, job, marital status, religion, education, Hgb, BMI, length of diagnostic HF, and comorbidities did not correlate with HRQOL. There were contradictions with studies that found HRQOL to be associated with age, gender, Hgb, and comorbidities (Dmitrieva et al., 2022; Marx et al., 2022; Shuvy et al., 2020).

Table 2 shows a significant negative relationship between PA and HRQOL, indicating that increasing PA performance tended to benefit the improvement of HRQOL. Several studies found that performing routine PA could increase cardiorespiratory fitness, exercise capacity, and functional capacity in HF patients, positively impacting the improvement of HRQOL (Brubaker et al., 2020; Lindgren & Borjesson, 2021; Tegegne et al., 2022). Moreover, performing PA for more than 30 minutes could also increase Interleukin 6 (IL 6), which is beneficial for skeletal muscle metabolism and oxygen consumption, and in inhibiting the progression of HF severity (Hummel et al., 2016; Nayor et al., 2016; Ribeiro-Samora et al., 2017). Furthermore, the benefits of routine PA can improve HS (Table 2). However, PA performance might decline with an increase in the number of HF medications used (Table 2); therefore, monitoring the use of HF medications was found necessary as medication side effects could decrease PA (Sharma et al., 2019).

Predictors of HRQOL

Analysis showed that out of eight variables included as predictors of HRQOL, only three were significant, namely HS, NYHA Class III, and PA, accounting for 30.8% of the variance in HRQOL (Table 3). A low HS and a higher NYHA Class could lead to a decrease in HRQOL, while

increasing PA was found beneficial and crucial for HRQOL improvement. A decrease in HS and a higher NYHA Class tended to negatively impact HRQOL.

Relevance in practice

This study aimed to clarify HRQOL of HF patients and the variables impacting the changes. Therefore, the empirical data could serve as a guide in providing care for patients. HF medication, HS, NYHA Class, and PA were significant variables affecting HRQOL changes. Moreover, HS, NYHA Class III, and PA were predictors of HRQOL.

This study had several limitations. Firstly, the generalizability of the results was limited due to the use of non-probability sampling and a cross-sectional design. Correlations between demographic characteristics, illness-related factors, PA, and HRQOL should not be interpreted to reflect causal relationships. Therefore, longitudinal designs should be implemented for future studies. Secondly, objective measurements of LVEF were not included in participants using echocardiography to identify left ventricular systolic function. This necessitated the adoption of LVEF to identify left ventricular systolic function. Thirdly, cultural differences might affect outcomes, specifically regarding demographic characteristics (age, gender, job, marital status, religion, and education). Consequently, the influence of culture on HRQOL among people living with HF should be considered.

Conclusion

In conclusion, the decrease in HRQOL among HF patients required more efforts to improve PA performance and prevent the progression of illness severity. Factors such as HF medication, HS, and NYHA Class were associated with HRQOL development. Furthermore, predictor factors such as HS, NYHA Class III, and PA played a significant role in HRQOL. These results could serve as a reference for patients, families, or healthcare providers in developing care strategies and improving HRQOL among HF patients.

Author Contributions

DMR and HMC were accountable for the modelling studies. The other authors were accountable for the data collection, and analyzing the clinical outcomes of the respondents. All authors have equally contributed to the study design, data analysis, and writing of the study.

Conflict of Interest

This study has no conflicts of interest.

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