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Socioeconomic and Psychosocial Vulnerabilities in Low-Income Heart Failure Patients in Japan: A Single-Center Cohort Study

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Low-income status is an important social determinant of health in patients with heart failure（HF）. In this retrospective study of 88 patients hospitalized for acute HF, 26.1% were classified as low-income based on public assistance or resident tax exemption. Low-income patients exhibited poorer physical performance, lower grip strength, and reduced cognitive function, as well as a higher prevalence of social isolation, particularly perceived loneliness. Low-income status was independently associated with social isolation. Mortality and HF readmission rates at 6 and 12 months did not differ between income groups. These findings indicate that low-income HF patients face greater physical, cognitive, and psychosocial vulnerabilities despite similar short-term clinical outcomes, highlighting the potential value of multidisciplinary approaches focusing on social support and functional maintenance.

Keywords: heart failure, economic problems, social frailty, social isolation, loneliness

INTRODUCTION

Heart failure（HF）is a major global health concern, and the increasing number of patients imposes a substantial burden not only on healthcare systems but also on national economies［1］. In the United States, the total medical cost related to HF reached approximately USD 46 billion in 2020 and is projected to rise to USD 142 billion by 2050［2］. In Japan, the annual hospitalization cost per HF patient is approximately USD 8,089, the highest among acute cardiovascular diseases, with adults aged ≥75 years accounting for about 70% of the USD 1.187 billion annual expenditure［3］. Therefore, addressing HF represents one of Japan's most pressing public health priorities.

In recent years, frailty has been recognized as an important prognostic factor in HF. Frailty is a multidimensional construct encompassing physical, psychological, and social domains［4–7］. Among these, social frailty（SF）, which involves reduced social participation, economic hardship, and social isolation

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(SI), has been increasingly highlighted as a critical determinant of adverse outcomes in HF patients.

In Japan, SF and SI are commonly evaluated using the Makizako questionnaire [8] and the Lubben Social Network Scale-6 (LSNS-6) [9]. Previous studies of hospitalized older adults with HF have reported a high prevalence of SF (66.5%) assessed by the Makizako questionnaire, which was significantly associated with increased risks of mortality and readmission [10]. However, because this questionnaire includes items related to physical activity, such as frequency of outings or visiting friends, it may partially overlap with physical frailty. In contrast, the LSNS-6 evaluates the size and quality of social networks independently of physical function and is therefore considered a more specific measure of SI. Reported prevalence of SI among HF patients ranges from 28% to 49% [11], and SI has been linked to increased risks of rehospitalization and mortality. Saito *et al*. further demonstrated that only objective SI, not perceived SI (loneliness), was associated with one-year mortality [12]. Nevertheless, neither of these measures includes economic hardship, an essential but often overlooked dimension of social vulnerability.

Economic hardship can delay treatment initiation, reduce adherence to guideline-directed medical therapy (GDMT) and device-based therapies, and increase psychological stress—collectively referred to as "economic toxicity"—which has been consistently associated with worse clinical outcomes and impaired quality of life (QOL) in Western countries [13,14]. Similarly, studies from Asian countries, including Japan, have shown that lower income and educational levels are linked to reduced use of β-blockers and device therapy, leading to poorer prognosis and lower QOL [15]. In Japan, financial hardship is primarily addressed through two public support mechanisms: the public assistance system and resident tax exemption. Public assistance provides financial and medical coverage for households experiencing severe poverty, and national statistics indicate that approximately 3% of households and 1.6% of individuals receive public assistance [16]. In contrast, resident tax exemption aims to reduce the burden on low-income households, with 23–25% of all households, corresponding to about 15–17% of the total population, falling under this category [17].

Furthermore, Japan's universal health insurance system guarantees affordable, high-quality care for all citizens, including those receiving public assistance [18]. Despite these systems, disparities remain. The Kyoto Congestive Heart Failure (KCHF) Registry reported that 5.8% of HF patients received public assistance and had significantly higher HF-related rehospitalization rates beyond 180 days. These patients were more likely to live alone, smoke, and exhibit poor medication adherence [19]. Such findings indicate that even within Japan's equitable healthcare structure, economic hardship continues to affect HF management and outcomes.

Importantly, many Japanese studies, including the KCHF Registry, have evaluated economic status solely based on receiving public assistance, potentially overlooking a substantial population experiencing financial hardship despite not qualifying for formal support. To better capture socioeconomic vulnerability among patients with HF, this study defined low-income status to include not only individuals receiving public assistance but also those exempt from resident tax. We then examined the economic status, SF, and SI of patients hospitalized for acute heart failure (AHF) in Japan and clarified the associations of these socioeconomic and psychosocial factors with clinical outcomes.

METHODS

Study Design and Patients

This single-center, retrospective study included patients hospitalized for AHF in Japan. The study was conducted at Matsue Red Cross Hospital and Shimane University between 2022 and 2023. A total of 88 consecutive patients diagnosed with AHF according to the Japanese guidelines [20] who survived to discharge were included. The study was approved by the ethics committees of Shimane University (No. 2021-12) and Matsue Red Cross Hospital (No. 523) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Data Collection

Clinical data, including demographics, comorbidities, medications, and New York Heart Association (NYHA) functional class and laboratory findings at admission, as well as echocardiographic results and physical, nutritional, and cognitive status, were collected from medical records. Left ventricular ejection fraction (LVEF) was measured by transthoracic echocardiography; HF with preserved ejection fraction (HFpEF) was defined as LVEF >50% [20]. Laboratory parameters included brain natriuretic peptide (BNP), estimated glomerular filtration rate (eGFR) and serum albumin. Nutritional status was assessed using the Geriatric Nutritional Risk Index (GNRI), with GNRI <92 indicating malnutrition [21]. Physical performance was evaluated using the Short Physical Performance Battery (SPPB) and handgrip strength, and functional status using the Barthel Index (BI). Cognitive function was assessed using the Mini-Cog, with scores ≤2 indicating cognitive impairment (CI) [22]. Physical, nutritional, and cognitive assessments were performed before discharge. Information on multidisciplinary inpatient care, including the involvement of nurses, physiotherapists, nutritionists, pharmacists, and medical social workers (MSWs), as well as the number of discharge prescriptions and self-management status, was also recorded.

Assessment of Social and Economic Factors

Low-income patients were defined as those receiving public assistance or exempt from resident tax. In Japan, public assistance eligibility is based on low income (approximately ≤130,000 yen/month), absence of family support, inability to work, and lack of financial assets. Resident-tax exemption was determined according to the high-cost medical care classification: Class I and II (for individuals ≥70 years) and Class O (for those <70 years). Employment and living status before and after discharge were also examined.

SF was assessed using the five-item Makizako questionnaire [8], which includes reduced frequency of going out, not visiting friends, not talking with someone every day, not feeling helpful to others, and living alone. Patients with two or more negative responses were classified as having SF. SI was assessed using the six-item LSNS-6 [9], which evaluates social network size, the frequency of contact, and the perceived availability of emotional and instrumental support from family and friends. The scale includes three family-related items (Q1–Q3) and three friendship-related items (Q4–Q6). SI was defined as a total score <12. In this study, we further distinguished objective SI, based on actual contact frequency (Q1, Q4), from subjective SI, based on perceived emotional support and connectedness (Q2, Q3, Q5, Q6) [12].

Clinical Outcomes

The primary outcomes were all-cause mortality and HF readmission within 6 months and 1 year after discharge. Outcome data was obtained from electronic medical records and confirmed through telephone interviews with patients or their families.

Statistical Analysis

Continuous variables are presented as mean ± standard deviation (SD) or median with interquartile range (IQR), and categorical variables as counts and percentages. For two-group comparisons between the low-income and non-low-income groups, the chi-square test or Fisher's exact test was used for categorical variables, and Student's t-test or the Wilcoxon rank-sum test was used for continuous variables, as appropriate. To evaluate the associations between low-income status, SF, and SI, regression analyses with propensity-score weighting were conducted. Covariates for weighting were selected based on the Meta-Analysis Global Group in Chronic Heart Failure (MAGGIC) risk score, a comprehensive risk model commonly used in HF research [23]. The MAGGIC model includes major clinical and demographic factors such as age, sex, NYHA class, LVEF, smoking status, diabetes mellitus, chronic obstructive pulmonary disease (COPD), prior HF hospitalization, systolic blood pressure, body weight, eGFR, heart rate, and the use of β-blockers and angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs). Statistical analyses were performed using StatFlex version 7 (Artech Co., Ltd., Osaka, Japan). Analyses were adjusted for these covariates, and a p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

Table 1 summarizes the baseline characteristics of the 88 patients (mean age 79 years; 70.5% male). Among them, 23 (26.1%) were classified as low-income. There were no significant differences between the low-income and non-low-income groups in age, sex, HF etiology, comorbidities, laboratory data, or nutritional status.

However, low-income patients exhibited significantly lower physical and cognitive function, as reflected by lower SPPB scores (5.7 ± 3.7 vs. 7.6 ± 3.7), grip strength (19.0 ± 8.7 vs. 24.7 ± 10.2 kg), and Mini-Cog scores (2.0 vs. 4.0) ($p < 0.05$). Cognitive impairment was also more frequent in the low-income group (60.9% vs. 36.9%, $p < 0.05$).

Social Frailty and Social Isolation

The distributions of Makizako questionnaire and LSNS-6 scores are shown in Figure 1. SF and SI were identified in 49 (55.7%) and 14 (15.9%) patients, respectively. Figure 2 illustrates their overlap with low-income status, with all three factors coexisting in six patients (6.8%).

As shown in Table 2, low-income patients demonstrated lower social engagement, although total Makizako and SF scores did not differ. While LSNS-6 total scores were similar, SI was more common in the low-income group (30.4% vs. 10.8%, $p < 0.001$), and perceived SI scores were lower (8 vs. 12, $p < 0.05$). Regarding financial background, 13.0% of low-income patients received public assistance, and they were less likely to be employed. The proportion of living as a couple was also lower (26.1% vs. 70.8%, $p < 0.001$), whereas post-discharge living arrangements were similar between groups.

Multidisciplinary care and discharge medications

As shown in Table 3, multidisciplinary interventions were common in both groups, but MSW involvement was more frequent among low-income patients (69.6% vs. 44.6%, $p < 0.05$). Although the number of discharge medications was similar, fewer low-income patients were able to self-manage them (42.1% vs. 75.4%, $p < 0.01$).

Independent Factors Associated with Low-Income Status

Table 4 shows the results of multivariate logistic regression analysis for factors associated with low-income status, adjusted for MAGGIC score, log-transformed BNP, SPPB, and CI. SI, but not SF, was independently associated with low-income status (odds ratio 5.30, 95% confidence interval 1.27–20.80; $p < 0.05$).

Clinical Outcomes

Regarding prognosis, there were no significant differences between the low-income and non-low-income groups in HF readmission within 6 months after discharge (30.4% vs. 30.8%, $p = 0.976$) or in all-cause mortality (8.7% vs. 9.2%, $p = 0.940$). Similarly, at 1 year, the rates of HF readmission (43.5% vs. 36.9%, $p = 0.579$) and all-cause mortality (17.4% vs. 16.9%, $p = 1.000$) were not significantly different between the two groups.

DISCUSSION

The main findings of this study were as follows: (1) Low-income patients comprised 26.1% of the study population, including 3.4% who were public assistance recipients. (2) They exhibited multiple vulnerabilities, including poorer physical and cognitive function and higher levels of perceived SI (loneliness). (3) Economic hardship, SF, and SI frequently overlapped, with economic hardship showing the strongest association with perceived SI. (4) Economic hardship was not significantly associated with all-cause mortality or HF readmission at 6 or 12 months.

Shimane Prefecture, where this study was conducted, had an aging rate of approximately 34% in 2024, which exceeds the national average of 29.3% and reflects an advanced aging population. Therefore, the findings should be interpreted in the context of these regional demographic characteristics [24].

HF is rapidly increasing with population aging, becoming a major public health concern. Frailty, encompassing physical, psychological, and social domains, is a key prognostic factor in HF [4]. SF, including economic hardship, living alone, lone-

Table 1. Baseline characteristics of the study population

	Overall (n = 88)	Low-income group (n = 23)	Non-low-income group (n = 65)	P value
Age, years	79 ± 12	82 ± 9	79 ± 12	0.285
Male, n (%)	62 (70.5)	15 (65.2)	47 (72.3)	0.522
BMI, kg/m^2	22.3 ± 5.3	21.7 ± 2.9	22.5 ± 6.0	0.531
NYHA III/IV, %	70.5	65.2	72.3	0.522
LVEF, %	39.6 ± 13.5	39.1 ± 14.3	39.7 ± 13.3	0.859
HFpEF, %	31.8	34.8	30.8	0.722
Prior HF hospitalization, %	19.3	26.1	16.9	0.366
Ischemic cardiomyopathy, %	28.4	34.8	26.2	0.430
Comorbidities, %				
Hypertension	52.3	60.9	49.2	0.337
Diabetes	35.2	34.8	35.4	0.959
Dyslipidemia	39.8	43.5	38.5	0.673
Laboratory data on admission				
BNP, pg/ml	581 (384-1,080)	773 (504-1,056)	532 (347-1,078)	0.159
eGFR, mL/min/1.73m^2	49.7 ± 21.9	49.6 ± 26.2	49.7 ± 20.4	0.988
Albumin, g/dl	3.5 ± 0.5	3.5 ± 0.4	3.5 ± 0.5	0.546
Nutritional status				
Malnutrition, %	64.0	78.3	58.7	0.620
Physical function				
SPPB, points	7.1 ± 3.8	5.7 ± 3.7	7.6 ± 3.7	0.038*
Hand grip strength, kg	23.2 ± 10.1	19.0 ± 8.7	24.7 ± 10.2	0.023*
Barthel index, points	83.4 ± 20.5	80.7 ± 20.0	84.3 ± 20.8	0.482
Cognitive function				
Mini-cog, points	4.0 (2.0-5.0)	2.0 (1.0-4.0)	4.0 (2.8-5.0)	0.026*
Cognitive impairment, %	43.2	60.9	36.9	0.047*

BMI: body mass index, BP: blood pressure, NYHA: New York Heart Association functional classification, LVEF: Left Ventricular Ejection Fraction, HFpEF: heart failure with preserved ejection fraction, BNP: brain natriuretic pepteides, eGFR: estimated Glomerular Filtration Rate, GNRI: Geriatric Nutritional Risk Index, SPPB: Short Physical Performance Battery

*P values indicate comparisons between the low-income and non-low-income groups.

*P < 0.05, **P < 0.01, ***P < 0.001

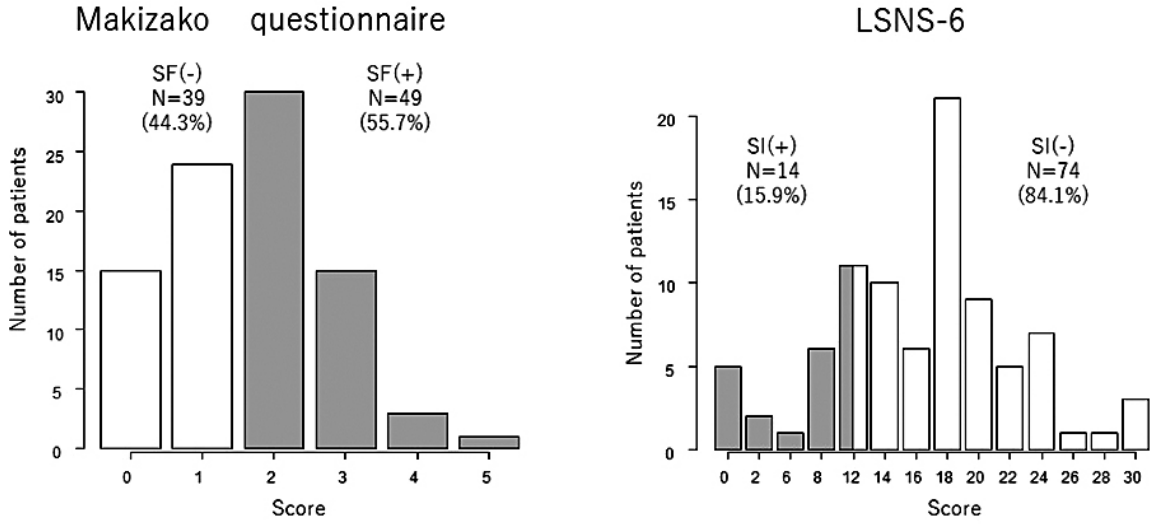

Figure 1. Distribution of scores for SF (Makizako questionnaire) and SI (LSNS-6).

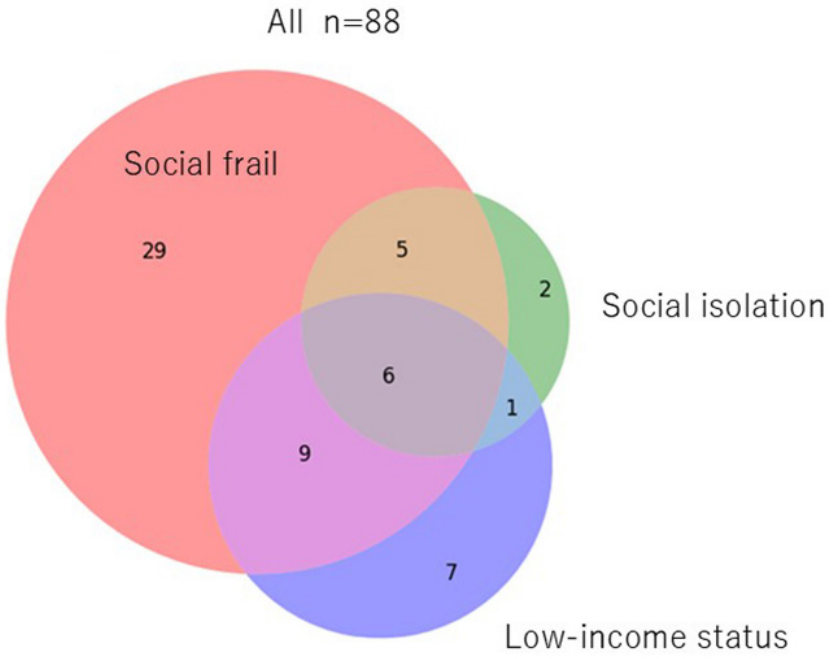

Figure 2. Venn diagram illustrating the overlap among SF, SI, and low-income status.

Table 2. Social factors by income groups

	Overall (n = 88)	Low-income group (n = 23)	Non-low-income group (n = 65)	P value
Makizako's questionnaire, points	2.0 (1.0-2.0)	2.0 (1.0-3.0)	2.0 (1.0-2.0)	0.138
Social frail, %	55.7	65.2	52.3	0.284
LSNS-6, points	18.0 (12.0-20.0)	14.0 (8.0-20.0)	18.0 (14.0-20.0)	0.206
Social isolation, %	15.9	30.4	10.8	<0.001***
Objective SI (Q1 + Q4)	6.0 (4.0-8.0)	6.0 (4.0-8.0)	6.0 (4.0-8.0)	0.945
Perceive SI (Q2 + Q3 + Q5 + Q6)	10.0 (8.0-12.0)	8.0 (4.0-12.0)	12.0 (8.0-12.0)	0.035*
Financial condition, %				
Receiving public assistance	3.4	13.0	0.0	0.002**
Currently working	14.8	4.3	18.5	0.170
Living status before hospitalization, %				
Living alone at home	13.6	17.4	12.3	0.504
Living someone at home	69.3	69.6	69.2	0.976
with husband/wife	59.1	26.1	70.8	<0.001***
with children	39.8	39.1	40.0	0.942
Living in nursing home	5.7	8.7	4.6	0.603
Living status after discharge, %				
Living alone at home	15.9	26.1	12.3	0.181
Living someone at home	64.8	52.2	69.2	0.141
Transfer to another hospital	12.5	17.4	10.8	0.468
Living in nursing home	6.8	4.3	7.7	1.000

BMI: body mass index, BP: blood pressure, NYHA: New York Heart Association functional classification, LVEF: Left Ventricular Ejection Fraction, HFpEF: heart failure with preserved ejection fraction, BNP: brain natriuretic pepteides, eGFR: estimated Glomerular Filtration Rate, GNRI: Geriatric Nutritional Risk Index, SPPB: Short Physical Performance Battery

*P values indicate comparisons between the low-income and non-low-income groups.

*P < 0.05, **P < 0.01, ***P < 0.001

Table 3. Rates of multidisciplinary interventions and medications at discharge

	Overall (n = 88)	Low-income group (n = 23)	Non-low-income group (n = 65)	P value
Multidisciplinary intervention, %				
Nurses	88.5	86.4	89.2	0.709
Physiotherapists	86.4	78.3	89.2	0.286
Nutritionists	78.4	78.3	78.5	1.000
Clinical pharmacists	94.3	87.0	96.9	0.110
Medical social worker	51.1	69.6	44.6	0.040*
Medications, %				
ACEI/ARB	42.0	52.2	38.5	0.252
ARNI	27.3	30.4	26.2	0.691
βBlocker	86.2	87.0	85.9	1.000
MRA	35.6	40.9	33.8	0.550
SGLT2	43.2	47.8	41.5	0.601
Number of medications at time of discharge	9.3 ± 3.3	8.7 ± 3.3	9.6 ± 3.2	0.240
Self-management of medications possible	67.1	42.1	75.4	0.007**

ACEI/ARB: Angiotensin-Converting Enzyme Inhibitor / Angiotensin II Receptor Blocker, ARNI: Angiotensin Receptor-Neprilysin Inhibitor, MRA: Mineralocorticoid Receptor Antagonist, SGLT2: Sodium-Glucose Cotransporter 2 Inhibitor
*P values indicate comparisons between the low-income and non-low-income groups.
*P < 0.05, **P < 0.01, *** P< 0.001

Table 4. Multivariate logistic regression analysis for predictors of low-income status

	Adjusted model		
	OR	95%CI	P
Social frail	1.160	0.343-3.950	0.807
Social isolation	5.300	1.270-20.800	0.019*

Adjusted for MAGGIC score, log BNP, SPPB, CI
OR: odds ratio, CI: confidence interval
*P < 0.05

liness, limited social support, and reduced social participation, has been associated with readmission and mortality [10]. However, due to heterogeneity in contributing factors and regional disparities [23], the standardization of SF assessment tools remains insufficient. In Japan, SF and SI are commonly evaluated using the Makizako questionnaire [8] and LSNS-6 [9]. The Makizako questionnaire is validated but includes items related to physical activity, such as the frequency of outings and visiting friends, which may partially overlap with physical frailty. In contrast, the LSNS-6 focuses on social relationships, and lower LSNS-6 scores have been associated with rehospitalization and mortality within 180 days [11,12]. Nevertheless, neither of these tools directly assesses economic hardship, an important yet often overlooked dimension of social vulnerability.

Economic hardship significantly affects health outcomes in HF [25, 26]. Financial constraints hinder adherence to GDMT and may worsen prognosis through malnutrition, sarcopenia, and psychological stress [26–28], therefore, this condition is often referred to as "economic toxicity" worldwide. In Japan, the high-cost medical care benefit system and standardized reimbursement ensure equitable access to treatment, while MSWs facilitate coordination with community resources. Nonetheless, the KCHF Registry reported higher 180-day readmission rates among public assistance recipients, possibly due to poor medication adherence, SI, and smoking [19]. These findings highlight the importance of addressing social determinants such as health literacy and loneliness in HF management.

First, in this study, low-income status was defined as including individuals exempt from resident tax

or receiving public assistance. While many previous studies have identified economic hardship solely based on the receipt of public assistance, this study adopted a broader definition to capture a wider range of individuals experiencing financial difficulties. Overall, 26.1% of patients were classified as low-income, including 3.4% who were receiving public assistance. This prevalence was comparable to national estimates—15–17% of the total population and 23–25% of households being tax-exempt, and 1.6% of individuals and 3% of households receiving public assistance [16, 17]. Even though the study population was older adults (mean age, 79 ± 12 years), the prevalence was similar to the national average, suggesting that it may actually be lower than expected. The prevalence of SF and SI was 55.7% and 15.9%, respectively, both lower than those reported in previous studies (66.5% and 38.4%) [10,12]. In addition, the proportion of individuals living alone was 13.6% overall and 17.4% in the low-income group, markedly lower than in earlier reports, which reported rates of 56% [19] and 76% [29] suggesting greater social integration in this population. These differences likely reflect the rural setting, characterized by close-knit community networks. National data also indicate that living alone is less common in rural areas [30], whereas loneliness tends to be higher in urban regions [31]. Therefore, although these findings may not fully represent urban HF populations, they provide a representative picture of HF patients in rural Japan, where social connectedness remains relatively strong.

Next, low-income patients showed greater physical and cognitive frailty, with lower SPPB, grip strength, and Mini-Cog scores. Consistent with previous large-scale cohort studies, patients with HF commonly exhibit coexisting physical, cognitive, and social frailty [7], which was also evident in this study. Low income may contribute to multidimensional vulnerabilities, including physical and cognitive frailty, via multiple interrelated pathways such as malnutrition, systemic inflammation (e.g., elevated Interleukin-6), activation of the hypothalamic-pituitary-adrenal axis with cortisol elevation due to chronic stress, reduced health literacy, and limited social participation [32–34]. In the present study, low-income status was strongly associated with perceived, but not objective, SI. Whereas objective SI reflects quantitative reductions in social contact, perceived SI represents subjective loneliness that does not necessarily correspond to the actual extent of social connections. This distinction is particularly important, suggesting that interventions should not merely aim to increase social interactions but rather focus on individualized support targeting subjective loneliness.

Although psychosocial differences by income level were evident, no significant differences were observed in HF-related or all-cause mortality at 6 or 12 months. Previous studies have demonstrated that structured multidisciplinary HF management, including discharge planning and social work-led support, can improve short-term outcomes and reduce readmissions, even among socially vulnerable patients [35]. In our institution, the active involvement of MSW may have contributed to attenuating differences in clinical outcomes between income groups. Nevertheless, the relatively small sample size and the rural study setting may also have influenced the results. Therefore, larger multicenter studies are warranted to clarify the long-term impact of socioeconomic vulnerability on HF outcomes.

This study has several limitations, including its single-center, retrospective design and limited sample size, which restrict generalizability and causal inference. Social vulnerabilities may also have been underestimated due to the rural context, and outcomes beyond one year were not assessed.

CONCLUSION

In conclusion, this study clarified the social determinants affecting HF patients in a rural area of Japan. Low-income patients faced multiple psychosocial challenges, including reduced physical and cognitive function and greater perceived isolation. Although these factors were not associated with short-term outcomes, comprehensive interventions addressing both economic hardship and perceived loneliness are essential to improving outcomes in this vulnerable population.

Ethics approval

The study was approved by the ethics committees

of Shimane University（No.2021-12）and Matsue Red Cross Hospital（No.523）, and the study was conducted in accordance with the Declaration of Helsinki. All patients gave informed consent to participate in the study. This study was registered retrospectively, so the clinical trial number is not applicable.

Author Contributions

SS contributed to study conception, data collection, statistical analysis, interpretation, and manuscript drafting. RS contributed to data collection. RT and TT contributed to study conception, data organization, and interpretation from a social public assistance perspective. MK contributed to manuscript drafting and supervised the study from a cardiology perspective. KS contributed to clinical data interpretation and supervised the study from a cardiology perspective. All authors read and approved the final manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

Data availability

The datasets used and analyzed during this study are available from the corresponding author on reasonable request.

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