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Survival of heart failure patients in a low-resource setting: a 3-year prospective cohort study from Eastern DR Congo

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Abstract

Background

Heart failure (HF) remains a major cause of morbidity and mortality worldwide, particularly in low-resource settings where survival data remain limited. This study aimed to identify factors associated with survival among heart failure patients followed in Butembo, Democratic Republic of Congo.

Methods

We conducted a prospective cohort study including 235 adult patients diagnosed with HF at the University Clinics of the Graben between January 2022 and February 2022 and followed for up to 36 months. Mortality was defined as all-cause mortality (not limited to cardiovascular causes, due to limited diagnostic resources for cause-of-death adjudication) occurring during the follow-up period. It was ascertained through hospital records, family contact, and community follow-up when necessary. Survival analysis was performed using the Kaplan–Meier estimator and Cox proportional hazards regression. Hazard ratios (HR) with 95% confidence intervals were reported. Statistical significance was set at $p < 0.05$.

Results

During the 3-year follow-up, 23 deaths (9.8%) were recorded among the 235 patients. Mean survival time was 30.2 ± 0.6 months. Kaplan–Meier analysis showed significantly lower survival among patients aged > 70 years, those with severe HF (NYHA III–IV), and those reporting the use of indigenous anti-poison products. Indigenous product, alcohol consumption, heart failure severity, renal failure, and age are significant independent predictors of survival in patients with heart failure ($p < 0.05$), with IP showing the strongest association with mortality (HR = 12.4; 95% CI: 3.94–39.05).

Conclusion

In this prospective cohort from eastern DR Congo, survival of HF patients was significantly influenced by disease severity, age, and certain cultural treatment practices. These findings highlight the need for earlier diagnosis and improved management strategies in low-resource settings.

Background

Heart failure (HF) is an inability of the heart to meet the body's needs. It is becoming increasingly prevalent and common worldwide, particularly in developing countries. It is estimated that its prevalence worldwide ranges from 1 to 3% [1]. There is little data on the prevalence and incidence of HF in sub-Saharan Africa. In this region, it is estimated that HF affects millions of people [2]. Studies conducted in

hospitals in sub-Saharan Africa have indicated that the rate of admission to hospital for heart failure ranges from 9.4% to 42.5%, with around 30% of admissions being to cardiology departments. Several studies in sub-Saharan Africa (SSA) have found that heart failure patients tend to be young.

Heart failure is a chronic, progressive condition. In the advanced stages (NYHA III and IV), it is life-threatening. The estimated 5-year life expectancy is 50% [1]. It is believed that the majority of known heart failure patients are in the advanced stages of the disease [3].

HF is a disease with a high risk of mortality within one year. In 2022, its in-hospital mortality rate in Africa ranged from 3.8% to 26.2%. In SSA, mortality related to HF at 6 months of survival was around 18%, and this mortality was even higher (around 50%) at three years.

Life expectancy and quality of life seem to have improved with the arrival of new pharmaceutical products and new policies for managing heart failure. Improved quality of life is thought to be a strong predictor of all-cause mortality. The goal of HF management is to reduce mortality and improve quality of life [4]. The latter is thought to be poor in Africa, at 39.5 ± 0.3 [3]. The quality of life of HF patients is also poor in several other regions with low annual income [3].

As heart failure patients in sub-Saharan Africa are often not affiliated with health insurance services, compared to other regions of the world [5], new management policies would seem difficult to implement. In addition, guidelines defined by major cardiology societies take little account of the cultural reality in Africa.

In various regions of sub-Saharan Africa, heart failure is often diagnosed late. This is thought to be due to ignorance of the symptoms, choices of treatment pathway, and inadequate healthcare facilities equipped to diagnose heart failure [6].

Cardiovascular risk factors known to have harmful effects on the myocardium are on the rise in low-income regions such as sub-Saharan Africa. Poor management of these factors in heart failure patients reduces their survival [7].

Studies on the survival of heart failure patients have been conducted in several regions of the world [3, 8, 9]. However, studies in sub-Saharan Africa, particularly those conducted in the Democratic Republic of Congo, are rare and difficult to access.

Material and methods

Setting and type of study

This prospective, analytical study was conducted between January 5, 2022, and December 31, 2024, at the University Clinics of the Graben (UCG). The last patients were recruited in February 2022. The UCG is a healthcare facility in the city of Butembo, located in the eastern part of the Democratic Republic of Congo. It was the only facility with a cardiology center.

Materials

This study included 235 symptomatic and pauci-symptomatic heart failure patients whose diagnosis was confirmed by the presence of functional and structural cardiac abnormalities on echocardiography. These patients were over 18 years of age. Their average age was 63 ± 14 years. Among these patients, 51% were male. Each of these patients was followed for at least 30 months. Evaluations were performed every three months.

Methods

Data collection

The data for this study were collected from patients with heart failure and suspected heart failure who had agreed to participate in the study according to a pre-established research protocol. All of these patients underwent echocardiography to confirm HF, identify cardiac lesions, and determine HF phenotypes.

Each patient was interviewed to identify socio-professional parameters (age, gender, level of education, marital status, occupation, religion, and residence), personal medical history (high blood pressure, diabetes mellitus, dyslipidemia, chronic obstructive pulmonary disease, renal failure, and obliterative arteriopathy), behavioral history (passive and active cigarette smoking, alcoholism), use of indigenous anti-poison products (substances produced by traditional healers to treat supposed intoxication), level of dyspnea as defined by the New York Heart Association [6], and duration of heart failure.

A physical examination was performed on each patient. The following parameters were recorded: blood pressure, heart rate, respiratory rate, weight, and height (the latter two being used to calculate body mass index). For patients with oedema, weight was only considered after weight loss under diuretic therapy.

Information on prescribed heart failure therapies was collected when available. Standard treatment typically included loop diuretics, angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs), mineralocorticoid receptor antagonists, and, when accessible, SGLT2 inhibitors. However, treatment adherence and dosage optimization were not systematically assessed due to financial constraints.

The data from our study were recorded in an Excel spreadsheet.

Outcome Definition

The primary outcome of this study was all-cause mortality during the follow-up period. Due to limited access to advanced diagnostics and post-mortem investigations, cause-specific mortality (cardiovascular vs non-cardiovascular) could not be reliably determined; therefore, all-cause mortality

was used. Deaths were identified through hospital records, direct contact with patients' families, and community verification when patients failed to attend scheduled visits.

Patients who were alive at the end of the study period or lost to follow-up were censored at the last known contact date.

Follow-up

Patients were followed every three months for a maximum of 36 months. Loss to follow-up was minimized through telephone contact and community tracing when necessary.

Variable definitions

Severe HF was defined as New York Heart Association (NYHA) functional class III or IV at baseline evaluation.

Indigenous anti-poison products (IP) are traditional remedies used to treat presumed poisoning or spiritual illness, widely used in parts of sub-Saharan Africa.

No patients had implantable cardioverter-defibrillators (ICDs) or cardiac resynchronization therapy devices, as these technologies are not available in the study setting. Coronary artery disease was assessed based on clinical history, electrocardiographic findings, and echocardiographic features suggestive of ischemic cardiomyopathy. Coronary angiography was not performed due to limited availability and cost constraints.

Data analysis and processing

The data recorded in Excel were transferred to SPSS version 23 for analysis. The Kaplan-Meier estimator and Cox proportional hazards regression were used to assess survival. We used the Log-Rank test at a significance level of 0.05 to compare the different variables related to survival. We rejected the null hypothesis for a P value less than or equal to 0.05. We used Cox proportional hazards regression analysis to study the differences in survival of various parameters that had shown an influence on survival using the Kaplan-Meier estimator. Statistical significance was defined as a p-value ≤ 0.05 and a 95% confidence interval that does not include 1. We also calculated various proportions with regard to mortality.

Given the limited number of events (23 deaths), we carefully addressed the risk of model overfitting. Following the rule-of-thumb of at least 10 events per variable (EPV), the number of variables included in the multivariable Cox model was restricted. Variable selection was performed using a two-step approach: (1) preselection based on clinical relevance and prior literature, and (2) inclusion of variables with $p < 0.20$ in univariable analysis.

To improve model stability, we limited the final model to five variables (EPV ≈ 4–5), acknowledging this remains below ideal thresholds. Therefore, results from the multivariable analysis should be interpreted cautiously as exploratory. No automated stepwise procedures were used to avoid data-driven overfitting.

Limitations of the study

This study only involved patients who had visited the University Clinics of the Graben and did not report cases in the community. Due to a lack of funding, paraclinical examinations were limited to the bare minimum. The relatively small number of events (n = 23) may have led to model overfitting and reduced statistical power. Consequently, the identified predictors, particularly those with large effect sizes, should be interpreted with caution and require external validation. Differentiation between sudden cardiac death and death due to pump failure was not feasible due to limited monitoring and lack of autopsy data.

The possibility of underestimation of mortality due to incomplete capture of out-of-hospital deaths and loss to follow-up should also be considered.

Long-term follow-up of this cohort is ongoing and may provide additional insights into long-term survival trends.

Results

Baseline characteristics and follow-up

A total of 235 patients with heart failure were included in this 3-year prospective cohort study conducted at the University Clinics of the Graben, eastern Democratic Republic of Congo. The mean age was 63 ± 14 years and 51% were male. Patients were followed every three months for up to 36 months.

During follow-up, 23 deaths occurred, corresponding to a cumulative all-cause mortality of 9.8%. Patients alive at the end of follow-up or lost to follow-up were censored at the last known contact date. The mean survival time was 30.2 ± 0.6 months (95% CI: 29.0–31.0).

Survival according to heart failure severity (NYHA class)

Kaplan–Meier analysis showed a statistically significant difference in survival according to NYHA functional class (log-rank $p < 0.001$). Patients with NYHA III–IV heart failure had significantly lower survival compared to those in NYHA I–II (Table 1). No crude deaths were recorded in NYHA I–II; however, Kaplan–Meier estimates demonstrated reduced survival over time in this group.

Table 1
Survival according to NYHA functional class

NYHA class	Mean survival time (months)	95% CI	Interpretation
I–II	34.0 ± 0.3	33–35	Better prognosis
III–IV	24.0 ± 1.1	22–26	Poor prognosis
(p < 0.001, log-rank test)			

Kaplan–Meier analysis estimated survival probability at 36 months of approximately 75% in NYHA I–II patients.

Survival according to demographic and cardiovascular factors

Frome Table 2, age significantly influenced survival (log-rank p < 0.001), with decreasing survival observed in older age groups. Patients over 70 years had the lowest survival. From the same Table, no significant differences in survival were observed according to sex, hypertension, diabetes mellitus, dyslipidemia, or family history of cardiopathy (all p > 0.05).

Table 2
Survival according to demographic and cardiovascular risk factors

Variable	Category	Mean survival (months)	p-value
Age	≤ 40	33.2 ± 1.3	< 0.001
	41–55	32.0 ± 1.2	
	56–70	31.7 ± 1.0	
	> 70	27.0 ± 1.0	
Sex	Male	30.6 ± 0.8	0.081
	Female	29.8 ± 0.9	
Hypertension	Yes	29.4 ± 1.0	0.423
	No	30.8 ± 0.8	
Diabetes	Yes	28.3 ± 1.9	0.417
	No	30.5 ± 0.6	

Survival according to comorbidities

From Table 3, renal failure was significantly associated with reduced survival (log-rank p < 0.001).

Table 3
Survival according to comorbidities

Comorbidity	Category	Mean survival (months)	p-value
Renal failure	Yes	20.4 ± 2.3	< 0.001
	No	31.5 ± 0.6	
COPD	Yes	29.0 ± 4.9	0.595
	No	30.2 ± 0.6	

Legend: COPD = Chronic obstructive pulmonary disease.

Survival according to behavioral and cultural factors

Alcohol consumption and use of indigenous anti-poison products (IP) were strongly associated with reduced survival (both $p < 0.001$) (Table 4).

Table 4
Survival according to behavioral exposures

Exposure	Category	Mean survival (months)	p-value
Indigenous products	Yes	17.6 ± 4.1	< 0.001
	No	30.6 ± 0.6	
Alcohol use	Yes	16.5 ± 3.7	< 0.001
	No	30.9 ± 0.6	

Survival according to cardiac abnormalities

From Table 5, reduced ejection fraction and structural heart disease were associated with worse survival in univariate analysis.

Table 5
Survival according to echocardiographic findings

Cardiac abnormality	Category	Mean survival (months)	p-value
EF ≥ 50%	Yes	33.8 ± 0.4	< 0.001
40 ≤ EF≤-49	Yes	29.9 ± 1.1	
EF < 40%	Yes	24.3 ± 1.4	
Dilated cardiomyopathy	Yes	27.7 ± 1.0	0.010
Valvular disease	Yes	28.8 ± 0.8	0.012
Conduction disorder	Yes	27.6 ± 1.3	0.038

Legend : EF = ejection fraction.

Multivariable Cox proportional hazards model

In the multivariable Cox regression model, five variables were associated with survival (Table 6).

Table 6
Cox regression analysis

Variable	HR	95% CI	p-value
Indigenous products	12.4	3.94–39.05	< 0.001
Alcohol use	2.84	1.50–5.37	0.001
Heart failure severity	1.95	1.40–2.71	< 0.001
Renal failure	1.63	1.01–2.63	0.045
Age	1.36	1.12–1.65	0.002

Legend: HR = hazard ratio; CI = confidence interval.

Note

This model is exploratory due to limited number of events (n = 23) and potential risk of overfitting.

Survival curves

Patients with NYHA III–IV showed significantly lower survival compared to NYHA I–II (log-rank p < 0.001). Estimated survival at 36 months was approximately 75% in NYHA I–II and substantially lower in NYHA III–IV.

Discussion

Overall survival and interpretation of mortality

In this prospective cohort of 235 patients with heart failure followed over 36 months in eastern Democratic Republic of Congo, the observed all-cause mortality was 9.8%, with a mean survival time of 30.2 months. This mortality is lower than that reported in many international and sub-Saharan African cohorts, where 3-year mortality often exceeds 20–50% [5, 8].

This discrepancy may be explained by differences in case-mix, as a substantial proportion of patients in this study presented with early-stage heart failure (NYHA I–II), which is associated with better prognosis [4]. Additionally, structured follow-up in a single tertiary cardiology center may have improved continuity of care and clinical monitoring, potentially contributing to better outcomes.

However, the relatively low mortality may also reflect under-ascertainment of out-of-hospital deaths, a recognized limitation in low-resource settings [2]. Therefore, mortality estimates should be interpreted cautiously.

Heart failure severity and prognosis

Heart failure severity was a strong determinant of survival. Patients with NYHA III–IV had significantly lower survival than those in NYHA I–II ($p < 0.001$), consistent with established evidence that functional class is a key prognostic marker [4].

Although no deaths were recorded in crude tabulation among NYHA I–II patients, Kaplan–Meier analysis demonstrated reduced survival over time, with an estimated 36-month survival of approximately 75%. This illustrates the importance of time-to-event methods in capturing risk that may not be visible in crude mortality proportions.

These findings are consistent with large cohort data showing a progressive increase in mortality with worsening NYHA class [3].

Age and traditional cardiovascular risk factors

Age was independently associated with survival, with progressively worse outcomes observed in older patients. This is consistent with established heart failure epidemiology, where aging is strongly associated with increased mortality risk [4].

In contrast, hypertension, diabetes mellitus, dyslipidemia, and family history of cardiovascular disease were not significantly associated with survival. This finding differs from large registry studies but may be explained by limited statistical power due to the small number of events, as well as possible underdiagnosis or misclassification of comorbid conditions in low-resource settings [8].

Renal dysfunction and comorbidity burden

Renal failure was significantly associated with reduced survival. This is consistent with the well-established cardiorenal interaction in heart failure, where renal dysfunction contributes to neurohormonal activation, fluid overload, and reduced therapeutic tolerance [7].

Similar findings have been reported in African cohorts, where renal dysfunction is a strong predictor of poor outcomes in heart failure patients [8].

In contrast, chronic obstructive pulmonary disease was not significantly associated with survival differences, possibly due to limited sample size or diagnostic constraints.

Behavioral and socio-cultural determinants

A major finding of this study is the strong association between survival and behavioral and culturally rooted exposures, particularly alcohol consumption and use of indigenous anti-poison products.

Alcohol consumption was independently associated with increased mortality risk. This is consistent with evidence showing that chronic alcohol exposure contributes to dilated cardiomyopathy, arrhythmias, and progressive myocardial dysfunction [14, 15]. Excessive alcohol intake is a recognized contributor to worsening heart failure prognosis [12, 13].

More importantly, the use of indigenous anti-poison products (IP) was the strongest predictor of mortality in this cohort. These substances, often used in the context of presumed poisoning or spiritual illness, may delay access to effective medical care and expose patients to unknown toxic effects. Similar associations between traditional remedies and adverse heart failure outcomes have been reported in sub-Saharan African studies [16].

These findings highlight the importance of socio-cultural determinants of health, which are often underrepresented in cardiovascular research but highly relevant in low-resource settings.

Cardiac structure and univariate prognostic markers

Several echocardiographic abnormalities, including reduced ejection fraction, dilated cardiomyopathy, valvular disease, and conduction disorders, were associated with worse survival in univariate analysis.

These findings are consistent with global heart failure data showing poorer outcomes in patients with reduced ejection fraction and structural heart disease [1, 4]. However, these variables were not retained in multivariable analysis, suggesting that their effects may be mediated by overall disease severity or overlapping risk factors.

Multivariable analysis and interpretation

In the exploratory Cox regression model, five variables were associated with survival: age, renal failure, heart failure severity, alcohol consumption, and indigenous product use. Indigenous product use showed the strongest association with mortality.

However, given the limited number of events (n = 23), these findings must be interpreted cautiously due to the risk of model overfitting (EPV < 10). Therefore, these results should be considered hypothesis-generating rather than confirmatory.

Clinical and public health implications

These findings suggest that heart failure outcomes in low-resource settings are influenced by a combination of biomedical and socio-cultural factors. Improving outcomes will require:

- Earlier diagnosis of heart failure
- Improved management of renal dysfunction

- Strengthening access to guideline-directed medical therapy
- Reduction of harmful alcohol consumption
- Community-based education addressing traditional medicine practices
- Integration of cultural beliefs into referral systems

Such integrated strategies are essential to improve survival in similar settings [7].

Limitations

This study has several limitations. The small number of events limits statistical power and increases the risk of overfitting in multivariable analysis. In addition, despite follow-up efforts, some deaths occurring outside hospital settings may have been missed, potentially leading to underestimation of mortality.

Cause-specific mortality could not be determined due to limited diagnostic resources. Furthermore, alcohol exposure was measured only as a binary variable, limiting dose–response interpretation. Finally, residual confounding cannot be excluded.

Conclusion

This study highlights the complex interplay between clinical, socio-cultural, and healthcare system factors influencing heart failure outcomes in a low-resource setting. Beyond traditional biomedical predictors, culturally rooted practices such as the use of indigenous products significantly impact survival. Addressing these challenges requires context-specific, culturally sensitive interventions integrating modern cardiology with community-based strategies.

Declarations

Funding

No funding.

Data availability

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

Ethics approval and consent to participate

The protocol for this study was previously approved by the UNIGOM Ethics Committee on January 5, 2022, under approval number UNIGOM/CEM/003/2022. All methods were performed in accordance with relevant guidelines and complied with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. We ensured respect for the individual's privacy by anonymizing the data.

Informed consent was obtained from the patient. All patients' information was treated confidentially under ethical guidelines.

Not a clinical trial.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used ProWritingAid to detect and correct language mistakes. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Consent for publication

Not applicable.

Code availability

N/A

Conflict of interest

There are no conflicts of interest to report for this study. Except for certain paraclinical tests (electrocardiography and echocardiography), which were provided free of charge by the CUG, the study was funded by our own resources. Medications (angiotensin-converting enzyme inhibitors/angiotensin receptor blockers, Aldosterone receptor antagonists, SGLT2 inhibitors, and furosemides) were prescribed by a physician at the CUG and paid for by the patients themselves. For those who were indigent, we used our own resources to purchase the medications.

Author Contribution

JP.M.P.: conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, and writing– review & editing.L.P.S., Z.T.K., JP. M.M., and C.K.M.: conceptualization, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, and writing– review & editing.R.M.M., JP.M.M., A.N.K., S.M.S., F.N.A., D.K.N., and J.K.W.: methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, and writing– review & editing.

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Data Availability

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

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Figures

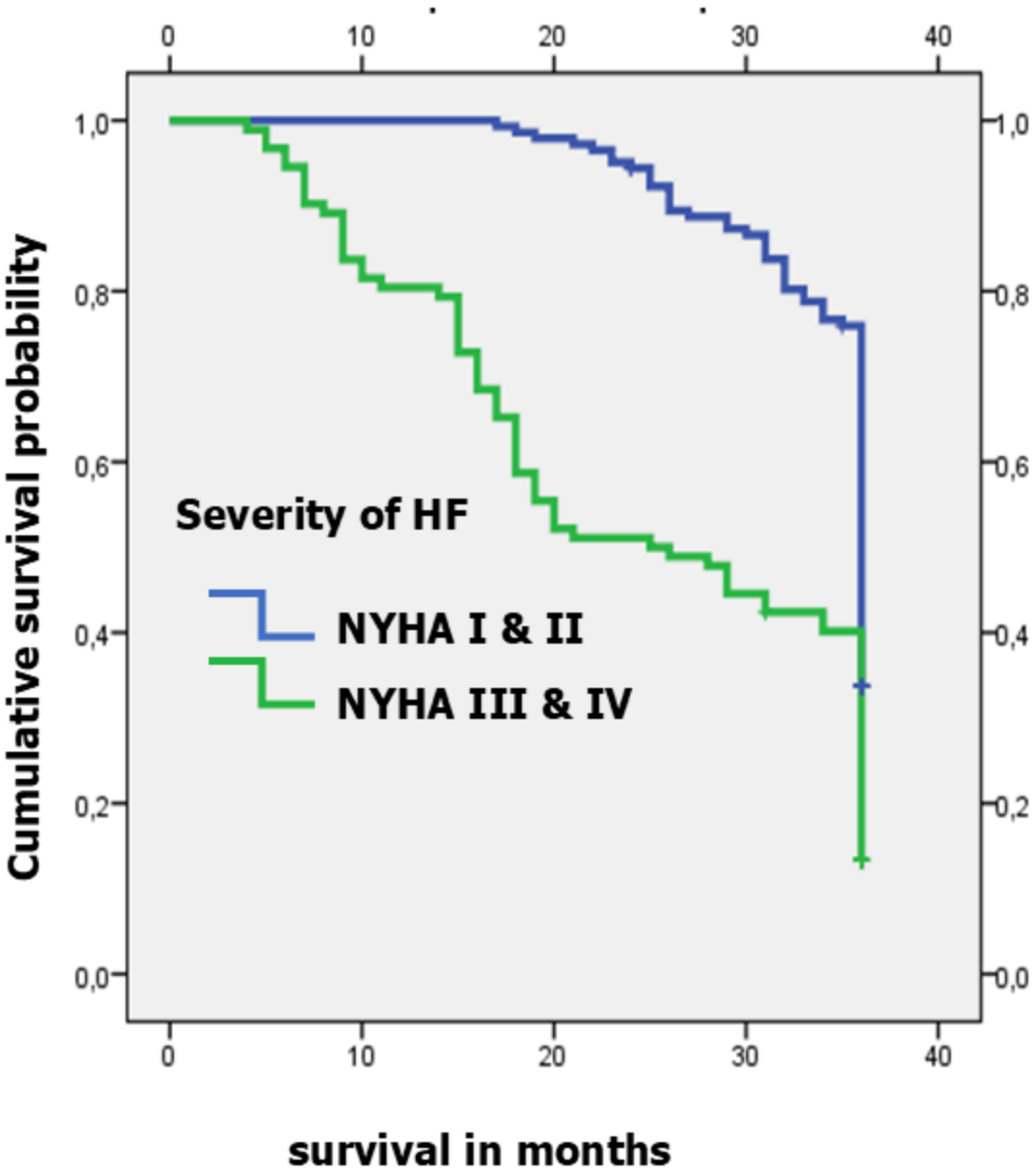


Figure 1

Kaplan–Meier survival curves according to NYHA class