Original article

Factors Affecting Mortality in Heart Failure Patients at Tha Luang Hospital, Lopburi Province

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Abstract

Introduction: Heart failure is a major global health problem, associated with impaired quality of life, frequent hospitalizations, and high mortality, particularly in advanced stages. Identifying risk factors for in-hospital mortality is essential to optimize management, improve outcomes, and reduce the burden on healthcare systems. **Materials and Method:** This retrospective cohort study analyzed patients admitted with heart failure to a community hospital. Competing risk regression analysis was employed to identify clinical and laboratory factors associated with in-hospital mortality. Variables included demographic characteristics, comorbidities, laboratory findings, and clinical parameters. **Results:** The analysis revealed that female sex, smoking, elevated serum hemoglobin levels, higher serum creatinine levels, and increased heart rate were significantly associated with an increased risk of in-hospital mortality. Conversely, a higher body mass index (BMI) was significantly associated with a lower risk of mortality. **Conclusions:** In this cohort of heart failure patients, female sex, smoking, higher hemoglobin, elevated creatinine, and increased heart rate emerged as significant predictors of mortality, while higher BMI demonstrated a protective effect. These findings underscore the importance of integrating clinical, laboratory, and lifestyle factors into risk stratification models.

Improved recognition of these predictors may support more tailored and effective management strategies for heart failure, particularly in community hospital settings where resources are limited.

Keywords ● *Heart failure* ● *In-hospital mortality* ● *Risk factors* ● *Lifestyle behaviors* ● *Community hospital*

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นิพนธ์ต้นฉบับ

ปัจจัยที่มีผลต่อการเสียชีวิตของผู้ป่วยโรคหัวใจล้มเหลวในโรงพยาบาลท่าหลวง จ.ลพบุรี

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บทคัดย่อ

บทนำ: โรคหัวใจล้มเหลวเป็นภาวะรุนแรงที่ส่งผลกระทบต่อคุณภาพชีวิตของผู้ป่วยและเป็นสาเหตุสำคัญของการเสียชีวิตทั่วโลก โดยเฉพาะในระยะท้ายของโรค การศึกษาปัจจัยที่มีผลต่อการเสียชีวิตในผู้ป่วยจึงมีความสำคัญต่อการวางแผนการดูแลรักษาอย่างมีประสิทธิภาพ วัตถุประสงค์ของการวิจัย เพื่อศึกษาปัจจัยที่มีผลต่อการเสียชีวิตของผู้ป่วยโรคหัวใจล้มเหลวที่เข้ารับการรักษาในโรงพยาบาลท่าหลวง จังหวัดลพบุรี **วัสดุและวิธีการ:** การวิจัยนี้เป็นการศึกษาแบบ retrospective cohort study โดยใช้วิธีการวิเคราะห์ถดถอยความเสี่ยงแข่งขัน (competing risk regression) เพื่อประเมินปัจจัยที่มีผลต่อการเสียชีวิตจากโรคหัวใจล้มเหลว **ผลการวิจัย:** พบว่าปัจจัยที่มีความสัมพันธ์กับความเสี่ยงการเสียชีวิตที่เพิ่มขึ้นอย่างมีนัยสำคัญ ได้แก่ เพศหญิง การสูบบุหรี่ ค่า hemoglobin ที่สูงขึ้น ค่า serum creatinine ที่สูงขึ้น และอัตราการเต้นของชีพจรที่เพิ่มขึ้น ในทางกลับกัน ค่าดัชนีมวลกายที่สูงขึ้นมีความสัมพันธ์กับความเสี่ยงการเสียชีวิตที่ลดลงอย่างมีนัยสำคัญ **สรุปผล:** เพศหญิง การสูบบุหรี่ ระดับ hemoglobin และ creatinine ที่สูง รวมถึงอัตราการเต้นหัวใจที่เร็วขึ้น เป็นปัจจัยเสี่ยงต่อการเสียชีวิตจากโรคหัวใจล้มเหลว ในขณะที่ค่าดัชนีมวลกายสูงอาจมีบทบาทในการปกป้องต่อความเสี่ยงการเสียชีวิต ข้อมูลนี้มีความสำคัญต่อการประเมินความเสี่ยงและการจัดการดูแลรักษาผู้ป่วยโรคหัวใจล้มเหลวในอนาคต

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ต้องการสำเนาต้นฉบับติดต่อ วิศิษฐ์ แก้วพุด ภาควิชาเวชศาสตร์ทหารและชุมชน วิทยาลัยแพทยศาสตร์พระมงกุฎเกล้า

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Introduction

Heart failure is a complex and life-threatening condition that significantly impacts patients' quality of life and contributes to increasing morbidity and mortality rates worldwide.[1] This is particularly evident in the late stages of the disease, where mortality rates rise significantly. Additionally, frequent hospitalizations may further deteriorate patients' quality of life and impose a substantial burden on the healthcare system.[2] Early detection and appropriate management of heart failure can help mitigate disease severity, slow its progression, and reduce hospitalization rates.[3]

Although heart failure is commonly encountered in clinical practice, patient prognosis and recovery rates depend on multiple factors. These include patient age, underlying comorbidities such as diabetes and hypertension, laboratory findings, and residual cardiac function (e.g. ejection fraction). Moreover, external factors such as smoking, alcohol consumption, and medication use, particularly diuretics, play a crucial role in predicting and evaluating treatment outcomes in heart failure patients.[4]

Given these challenges, the research team conducted the study entitled "Factors Influencing In-Hospital Mortality Among Heart Failure Patients" to investigate determinants of mortality among patients with heart failure at Tha Luang Hospital, Lopburi Province. Understanding these factors is essential for strengthening healthcare strategies and optimizing patient management. The findings from this study may contribute to improved patient outcomes, enhanced quality of life, and a reduced long-term burden on the public health system.

Material and methods

This study was conducted as a retrospective cohort study. After obtaining approval from the Institutional Review Board (IRB), data collection was carried out using patient records from the hospital database of Tha Luang Hospital, Lopburi Province, covering the period from 2018 to 2024. A total of 483 patients were included in the study to analyze the factors influencing clinical outcomes and disease prognosis among heart failure patients.

The study population was categorized into three groups based on patient status at hospital discharge: Discharge with approval – 420 patients, Referral to a higher-level hospital – 44 patients, Death – 18 patients. Since the primary outcome of interest was in-hospital mortality

(Death), the study employed a competing risk regression model (Fine & Grey model) to evaluate the factors influencing mortality risk in heart failure patients at Tha Luang Hospital, Lopburi Province **(Figure1)**. The competing events, which included discharge with approval and referral to a higher-level hospital, were considered in the analysis to ensure an accurate estimation of mortality risk while accounting for alternative outcomes.

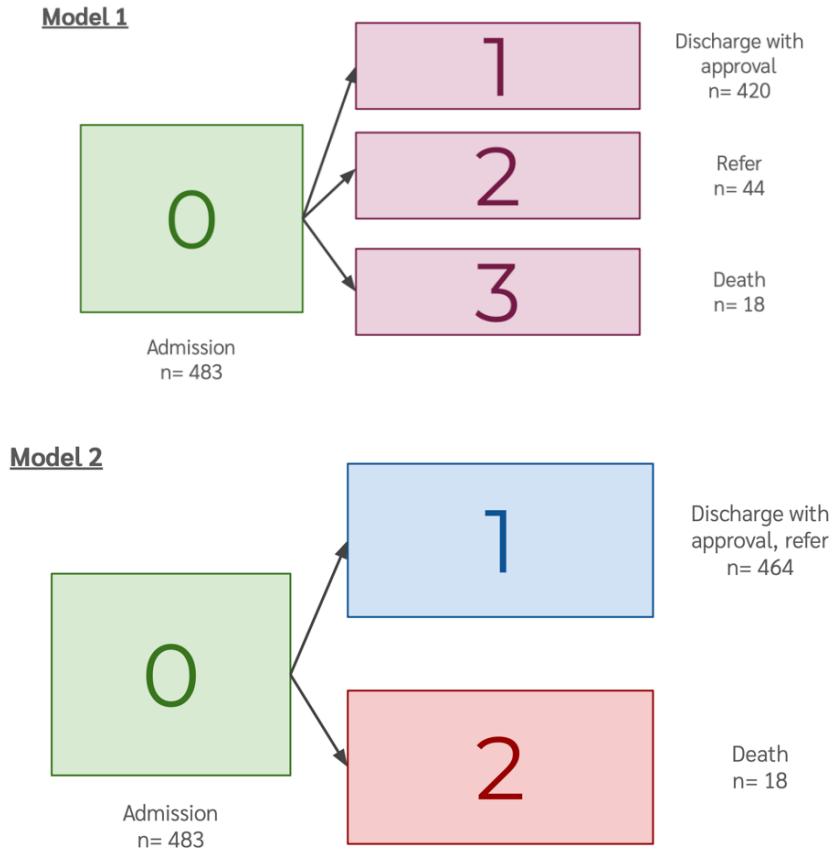

Figure 1 The study population was categorized into three groups based on patient status at hospital discharge

Operational definitions

1. Heart Failure is a clinical condition in which the heart is unable to pump blood sufficiently to meet the body's demands. The condition is caused by structural or functional abnormalities of the heart, including impaired contraction or relaxation. It can be assessed using biomarkers such as Natriuretic Peptides and evidence of elevated pulmonary or circulatory

pressure. Heart failure is classified based on Ejection Fraction (EF) and disease stage to guide treatment planning and risk prevention.[5]

2. Intubation is a medical procedure in which an endotracheal tube is inserted through the mouth or nose into the trachea to assist with breathing. It is typically performed in cases where the patient is unable to breathe adequately on their own, such as in respiratory failure, major surgery, or during intensive care unit (ICU) management**.** The procedure helps maintain respiratory function and enhances patient safety during treatment.[6]

3. Multi-organ failure refers to the dysfunction or failure of two or more vital organ systems.[7] It is commonly a consequence of a severe inflammatory response, such as sepsis (systemic infection) or major trauma. MOF can affect various organ systems, including the respiratory system, kidneys, liver, and cardiovascular system. Symptoms vary depending on the affected organs, with conditions such as acute respiratory distress syndrome (ARDS), Acute Kidney Injury (AKI), or hepatic dysfunction being common complications.[8,9]

Study population

The study included patients aged 25 years or older who had been diagnosed with heart failure and had their medical records documented in the hospital database of Tha Luang Hospital, Tha Luang Subdistrict, Tha Luang District, Lopburi Province. Data were collected from 2018 to 2024 to analyze patient outcomes and prognostic factors.

Data collections

This was a retrospective cohort study using secondary data from individuals aged 25 years or older, who had been diagnosed with heart failure. The data is collected from the medical records of Tha Luang Hospital, located in Tha Luang Subdistrict, Tha Luang District, Lopburi Province. The data covered from 2018 to 2024. The inclusion criteria for participants included all patients aged 25 years or older, diagnosed with heart failure, and whose records are available in the medical database of Tha Luang Hospital, Lopburi. In cases of recurrent heart failure, the most recent treatment episode was considered for the study. There were no exclusion criteria.

Outcome measurements

The study calculated the subdistribution hazard ratio (SHR), 95% confidence interval (95% CI) for each factor, and p-value to identify factors influencing mortality rates in heart failure patients. Data were collected retrospectively from the Tha Luang Hospital database in Lopburi Province from 2018 to 2024.

Statistical analysis

Continuous variables were summarized as means ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Baseline characteristics of the study population were described accordingly. The Elixhauser comorbidity index was calculated to assess the comorbidity burden.

To analyze factors associated with in-hospital mortality, the Fine and Gray subdistribution hazard model for competing risks regression was applied. This model accounts for competing events that may preclude the occurrence of the event of interest (death from heart failure) and provides a more accurate estimate of the cumulative incidence of the outcome. Both univariate and multivariate competing risk regression analyses were performed. In the univariate analysis, each variable was entered individually into the Fine and Gray model to estimate its association with mortality. Variables with a p-value < 0.20 in the univariate model, along with clinically relevant covariates, were subsequently included in the multivariate model to adjust for potential confounding factors.

Results from the regression analyses were expressed as subdistribution hazard ratios (SHRs) with 95% confidence intervals (CIs) and corresponding p-values. An SHR > 1 indicated an increased risk of mortality, whereas an SHR < 1 indicated a decreased risk. The level of statistical significance was set at $p < 0.05$. Model assumptions were verified, including proportionality of hazards, and sensitivity analyses were conducted where necessary. The cumulative incidence function (CIF) was estimated to illustrate the probability of mortality over time while accounting for competing risks. All analyses were conducted using Stata version 17.0 (StataCorp LLC, College Station, TX, USA). Additional factors were also analyzed.

Ethical considerations

This research study was approved by the Human Research Ethics Committee and the Department of Medicine, Royal Thai Army, with approval number M040h/67_Exp. The study utilized data from the database of Tha Luang Hospital, Lopburi Province, which may include personal identifiers or numbers that could potentially identify the study participants. Therefore, the data were stored in a password-protected file, accessible only to the research team, and were never disclosed to ensure patient privacy.

Results

In this study, 483 patients aged 25 years or older were diagnosed with heart failure. The majority were female (60.04%), with a mean age of 67 years. Most participants were employed as laborers (74.12%). Hypertension and hyperlipidemia were the most common comorbidities, observed in 77.91% and 69.15% of patients, respectively. There were 18 in-hospital deaths, accounting for 3.73% of the cohort **(Table 1).**

Table 1 Baseline demographic data of patients diagnosed with heart failure at Tha Luang Hospital, Tha Luang District, Lopburi Province (n=483)

		n	**%**
Sex			
	Male	193	39.96
	Female	290	60.04
Age			
	Mean±SD	67.35±14.58	
		68 (28-96)	
	Median (min-max)		
Occupation			
	Unemployed	125	25.88
	Employed	358	74.12
Healthcare entitlement			
	Universal coverage scheme	429	88.82
	Social security scheme	14	2.9
	Government office scheme	40	8.28

	n	%
Discharge status		
With approval	420	87.14
Refer	44	9.13
Death	18	3.73
BMI		
< 18.5	32	6.63
18.5-25	150	31.06
25-30	89	18.43
>30	212	43.89
Mean±SD	26.03±7.00	
Median (min-max)	24.87 (13.41-57.84)	
Smoking status		
Non-smoker	416	86.13
Ex-smoker	28	5.8
Active smoker	39	8.07
Alcohol drinking		
Non-drinker	400	82.82
Active drinker	83	17.18
Underlying disease		
Diabetes mellitus	216	44.72
Hypertension	385	77.91
Dyslipidemia	334	69.15
Chronic kidney disease	230	47.62
Atrial fibrillation	98	20.29
Chronic obstructive pulmonary disease	45	9.32
Myocardial infarction	61	12.63
Influenza vaccination status		
Not received	276	57.14
Received	207	42.86

	n	%
Bronchodilators use		
No	388	80.33
Yes	95	19.66
Intubation status		
No	340	70.39
Yes	143	29.61
Length of hospitalization		
Mean±SD	4.21±3.64	
Median (min-max)	3 (0-23)	
Vital signs		
Mean arterial pressure		
Mean±SD	101.57±21.29	
Median (min-max)	99.6 (54-183.66)	
Respiratory rate		
Mean±SD	23.51±5.98	
Median (min-max)	22 (15-46)	
Pulse rate		
Mean±SD	93.23±23.77	
Median (min-max)	92 (34-190)	
Lab investigations		
Serum sodium (mEq/L)		
Mean±SD	137.75±5.46	
Median (min-max)	138.2 (108.9-154.7)	
Serum creatinine (mg/dL)		
Mean±SD	1.49±1.67	
Median (min-max)	1.1 (0.31-18.38)	
Hemoglobin (g/dL)		
Mean±SD	11.21±2.49	
Median (min-max)	11.3 (3-18.5)	

Competing risk regression analysis revealed that higher body mass index (BMI) was significantly associated with a reduced risk of death (SHR 0.85, 95% CI 0.74–0.97, p = 0.02). Increased heart rate was significantly associated with a greater risk of death (SHR 1.02, 95% CI 1.01–1.04, p = 0.01). Serum creatinine showed a non-significant trend toward increased mortality risk (SHR 1.15, 95% CI 0.99–1.34, p = 0.07), while mean arterial pressure suggested a possible protective effect (SHR 0.97, 95% CI 0.95–1.00, p = 0.09) **(Table 2, 3).**

Table2 Bivariate analysis of cause-specific hazard ratio for heart failure patients

Parameter	SHR	*p*-value	95% confidence interval
Age	1.02	0.10	0.99 - 1.06
Sex (female)	2.29	0.15	0.75 - 7.00
Employment	2.84	0.16	0.66 - 12.32
Comorbidities	1.16	0.51	0.75 - 1.78
BMI	0.85	0.02	0.74 - 0.97
Received influenza vaccination	1.32	0.55	0.53 - 3.32
Smoking	0.63	0.47	0.18 - 2.19
Alcohol drinking	0.28	0.22	0.04 - 2.12
Respiratory rate	1.04	0.26	0.97 - 1.13
Pulse rate	1.02	0.01	1.01 - 1.04
Mean arterial pressure	0.97	0.09	0.95 - 1.00
Hemoglobin	0.96	0.65	0.82 - 1.13
Serum creatinine	1.15	0.07	0.99 - 1.34
Serum sodium	0.99	0.24	0.98 - 1.00
Intubation	1.94	0.16	0.77 - 4.91
Bronchodilator	0.51	0.37	0.12 - 2.20

Table 3 Multivariate analysis of cause-specific hazard ratio for heart failure patients

Parameter	Subdistribution hazard	*p*-value	95% confidence interval
Age	1.03	0.11	0.99-1.08
Sex (female)	9.64	0.02	1.45-64.09
Comorbidities	1.09	0.81	0.53-2.24
BMI	0.87	0.00	0.80-0.95

Parameter	Subdistribution hazard	*p*-value	95% confidence interval
Receive Influenza vaccine	0.97	0.97	0.18-5.19
Smoking	8.73	0.00	2.40-3.17
Respiratory rate	1.07	0.06	0.99-1.15
Pulse rate	1.02	0.04	1.01-1.05
Mean arterial pressure	0.98	0.56	0.94-1.03
Hemoglobin	1.4	0.01	1.10-1.79
Serum creatinine	1.69	0.00	1.35-2.11
Serum sodium	0.99	0.56	0.98-1.01
Intubation	1.1	0.86	0.34-3.51

Further analysis demonstrated that female patients had a 9.64-fold higher risk of death compared with male patients (95% CI 1.45–64.09, $p = 0.02$). Smoking was strongly associated with mortality, with smokers exhibiting an 8.73-fold higher risk compared with non-smokers (95% CI 2.40–31.7, $p < 0.001$). Increased BMI remained significantly protective (SHR 0.87, 95% CI 0.80–0.95, $p < 0.001$). Elevated serum hemoglobin ($p = 0.01$) and serum creatinine ($p < 0.001$) were also significantly associated with a higher risk of death.

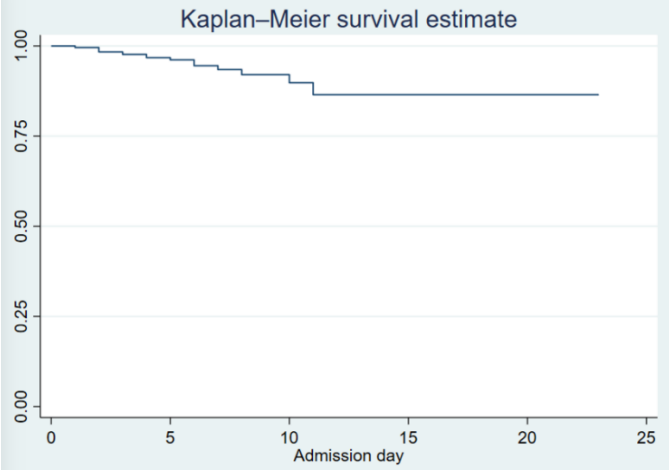

Figure 2 The Kaplan-Meier graph shows the survival rate over time. The X-axis represents the duration of survival following hospital admission. The Y-axis represents the probability of survival, expressed as a percentage.

Other variables, including age, comorbidities, respiratory rate, mean arterial pressure, serum sodium, intubation, and influenza vaccination, were not significantly associated with mortality. Survival curve analysis showed an initial steep decline in survival during the first 10 days of hospitalization, after which the curve stabilized **(Figure 2)**.

Discussion

This study identified several significant predictors of in-hospital mortality in patients with heart failure, including female sex, smoking, higher hemoglobin, elevated creatinine, and increased heart rate, while higher BMI was protective. Increased body mass index (BMI) was consistently associated with a reduced mortality risk. This finding supports the concept of the "obesity paradox," whereby patients with higher BMI may have greater metabolic reserve and enhanced production of adipose-derived cytokines, such as leptin and adiponectin, which exert anti-inflammatory and cardioprotective effects.[10] These mechanisms may help explain the lower mortality observed in patients with higher BMI compared with those with lower BMI.

In contrast, elevated heart rate was significantly associated with increased mortality, highlighting the prognostic importance of tachycardia in heart failure. This may reflect underlying pathophysiological conditions such as arrhythmia or systemic complications like sepsis, both of which warrant close clinical attention. Elevated serum hemoglobin and serum creatinine were also significantly associated with increased mortality risk, consistent with the established link between impaired renal function, hematologic abnormalities, and adverse outcomes in heart failure.[7,9]

Female sex was associated with a markedly higher risk of mortality compared with males. However, the wide confidence interval suggests variability within the female subgroup and the possibility of an insufficient sample size. Smoking was another strong predictor of mortality, reinforcing the detrimental impact of lifestyle-related risk factors on heart failure outcomes.

Other variables, including age, comorbidities, respiratory rate, mean arterial pressure, serum sodium, intubation, and influenza vaccination, did not show significant associations in this study. The survival curve further demonstrated that the highest risk of mortality occurred during the first 10 days of hospitalization, after which survival stabilized, suggesting that early

hospitalization is a particularly vulnerable period requiring intensified monitoring and intervention.

Several limitations should be acknowledged. First, this study was conducted at a small community hospital, which limited the overall sample size. This may explain the wide confidence intervals observed for certain variables, such as sex, despite their significant associations with mortality. Second, the transition to a paperless medical record system in 2020 resulted in missing data from earlier periods, which could have influenced data completeness. Third, the hospital's limited access to advanced cardiac investigations, such as echocardiography, restricted the analysis to basic laboratory results. Fourth, the relatively short study period prevented assessment of other clinically relevant outcomes, including ventilator requirements, hospital costs, or multi-organ failure. Finally, information on hospital management variables, such as the cost of care and procedural details, was insufficient and could not be analyzed.

Despite these limitations, the findings have several important implications for healthcare delivery. Public health interventions aimed at smoking cessation should be prioritized, both through patient education and supportive policies to sustain long-term behavioral change. Regular monitoring of renal function in patients with concomitant kidney disease is essential, alongside health promotion strategies such as dietary counseling, lifestyle modification, and avoidance of nephrotoxic agents. Hospital resource management could also benefit from these results, particularly in anticipating the need for ventilator support and optimizing ward capacity. Moreover, the findings support the ongoing role of nutritional education in patients with kidney disease, as many risk factors for kidney and cardiac conditions overlap. Finally, the development of a risk scoring system based on the identified predictors may facilitate early identification of high-risk patients and enable timely referral to higher-level hospitals, thereby improving outcomes in community settings.

Conclusion

A study on factors associated with the risk of mortality from heart failure using competing risk regression analysis found that significant factors associated with an increased risk of mortality from heart failure included female sex, smoking, higher serum hemoglobin levels, higher serum

creatinine levels, and increased heart rate. Conversely, a higher body mass index was significantly associated with a reduced risk of mortality from heart failure.

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Competing Interest

The authors declare that they have no competing interests.

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