Predicting Factors to 30-Day Hospital Readmission in Patients with Acute Heart Failure
ปัจจัยทำนายการกลับมารักษาซ้ำในโรงพยาบาลภายใน 30 วัน จากภาวะหัวใจล้มเหลวเฉียบพลัน

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Abstract

This prospective cohort study aimed to investigate the readmission rate of 30-day readmission with acute heart failure (AHF) and the predicting factors including comorbidity severity, malnutrition, family support, self-care, and post-discharge follow-up methods. Andersen's behavioral model of health service was employed as a framework guiding this study. The sample comprised 163 hospitalized patients with heart failure, both male and female, aged 18 years and older, who had discharge plans from two super tertiary hospitals in Bangkok. Data were collected between February and September 2022 using a general profile questionnaire, the Charlson Comorbidity Index (CCI), Controlling Nutritional Status (CONUT), the Family Adaptation, Partnership, Growth, Affection, and Resolution Questionnaire (APGAR), the

Received: February 20, 2024 Revised: April 16, 2024 Accepted: April 17, 2024

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Self-Care of Heart Failure Index (SCHFI), and a post-discharge questionnaire. The instruments were validated, and the reliability testing results ranged from 0.86 to 1.0. The data were analyzed using descriptive statistics, Chi-square test, and Point-biserial correlation. Logistic regression analysis was employed to examine the predictive power of 30-day readmission risk, with the statistical significance level set at .05.

The study's results revealed that the average age of participants was 66.23 years old (SD = 15.53). Among the participants, 53.4% were female, had a moderate level of comorbidity severity (Mean = 4.60, SD = 2.32), 50.3% had mild malnutrition, and had a high level of family support (Mean = 17.55, SD = 3.98). The level of self-care was found inadequate in all three aspects of self-care maintenance (Mean = 65.33, SD = 15.43), symptom perception (Mean = 61.13, SD = 17.83), and self-care management (Mean = 55.18, SD = 17.45). The follow-up methods were mainly hospital visit with a cardiologist (83.4%). The readmission rate was found to be 11.0% of the total sample. The comorbidity severity and malnutrition variables were significantly correlated with 30-day readmission with AHF (r_{pb} = .240, and r_{pb} = .204, respectively). The predictive factors of 30-day readmission with AHF included inadequate self-care maintenance (OR = 4.522, 95% CI = 1.083–18.885, p = 0.039), comorbid severity (OR = 1.331, 95% CI = 1.070–1.657, p = 0.010), and malnutrition (OR = 1.325, 95% CI = 1.033–1.700, p = 0.026).

Recommendations to effectively reduce the risks of 30-day readmission associated with AHF, nurses should develop a comprehensive discharge planning program by concerning the severity of comorbidities, assess and coordinate for patients to receive an appropriate diagnosis and management of malnutrition, and patient education specific to self-care for HF.

Keywords: heart failure, 30-day hospital readmission, self-care, nutrition status, comorbidity

บทคัดย่อ

การศึกษาแบบเปรียบเทียบไปข้างหน้านี้มีวัตถุประสงค์เพื่อศึกษาอัตราการกลับมารักษาซ้ำภายใน 30 วัน และศึกษาปัจจัยการทำนายการกลับมารักษาซ้ำในโรงพยาบาลภายใน 30 วัน จากหัวใจล้มเหลวเฉียบพลัน ได้แก่ ความรุนแรงโรคร่วม ภาวะโภชนาการ การสนับสนุนจากครอบครัว การดูแลตนเอง และวิธีการตรวจตามนัดภายหลังจำหน่ายออกจากโรงพยาบาล โดยใช้กรอบแนวคิดทฤษฎีพฤติกรรมการใช้บริการสุขภาพของ Andersen กลุ่มตัวอย่าง จำนวน 163 ราย เป็นผู้ป่วยหัวใจล้มเหลวทั้งชายและหญิง อายุตั้งแต่ 18 ปีขึ้นไป ที่เข้ารับการรักษาแผนกผู้ป่วยในของโรงพยาบาลตติยภูมิสองแห่งในจังหวัดกรุงเทพมหานคร คัดเลือกแบบเจาะจงตามเกณฑ์คัดเข้า เก็บรวบรวมข้อมูลระหว่างเดือนกุมภาพันธ์ถึงเดือนกันยายน พ.ศ. 2565 โดยใช้แบบสอบถามข้อมูลส่วนบุคคลและข้อมูลการเจ็บป่วย แบบบันทึกความรุนแรงโรคร่วม แบบบันทึกภาวะโภชนาการ แบบสอบถามการสนับสนุนจากครอบครัว แบบสอบถามการดูแล

ตนเอง และแบบสอบถามการติดตามการรักษา แบบสอบถามมีค่าความเชื่อมั่นระหว่าง 0.86-1.00 วิเคราะห์ข้อมูลโดยใช้สถิติเชิงบรรยาย สถิติไคสแควร์ สถิติสหสัมพันธ์พอยท์ไบซีเรียล และใช้สถิติวิเคราะห์ถดถอยลอจิสติกวิเคราะห์ อำนาจการทำนายกำหนดระดับนัยสำคัญที่ .05

ผลการศึกษาพบว่า กลุ่มตัวอย่างมีอายุเฉลี่ย 66.23 ปี (SD = 15.53) ร้อยละ 53.4 เป็นเพศหญิง มีความรุนแรงของโรคร่วมในระดับปานกลาง (Mean = 4.60, SD = 2.32) ร้อยละ 50.3 มีภาวะทุพโภชนาการระดับน้อย ได้รับการสนับสนุนจากครอบครัวในระดับสูง (Mean = 17.55, SD = 3.98) มีการดูแลตนเองอยู่ในระดับไม่เหมาะสมทั้ง 3 ด้าน คือ ด้านการดำรงพฤติกรรม (Mean = 65.33, SD = 15.43) ด้านการรับรู้อาการ (Mean = 61.13, SD = 17.83) และด้านการจัดการอาการ (Mean = 55.18, SD = 17.45) วิธีการติดตามภายหลังจำหน่ายออกจากโรงพยาบาลส่วนใหญ่ (ร้อยละ 83.4) มาพบอายุรแพทย์หัวใจที่โรงพยาบาล อัตราการกลับมารักษาซ้ำภายใน 30 วัน คิดเป็นร้อยละ 11.0 ตัวแปรความรุนแรงโรคร่วม และภาวะโภชนาการมีความสัมพันธ์กับการกลับมารักษาซ้ำ (r_{pb} = .240 และ r_{pb} = .204 ตามลำดับ) ปัจจัยทำนายการกลับมารักษาซ้ำในโรงพยาบาลภายใน 30 วัน จากหัวใจล้มเหลวเฉียบพลันได้อย่างมีนัยสำคัญทางสถิติ ประกอบด้วยการดำรงพฤติกรรมการดูแลตนเองไม่เพียงพอ (OR = 4.522, 95% CI [1.083–18.885], p = .039) ความรุนแรงโรคร่วม (OR = 1.331, 95% CI [1.070–1.657], p = .010) และภาวะทุพโภชนาการ (OR = 1.325, 95% CI [1.033–1.700], p = .026)

ข้อเสนอแนะ เพื่อลดอัตราการกลับมารักษาซ้ำจากหัวใจล้มเหลวเฉียบพลันได้อย่างมีประสิทธิภาพ พยาบาลควรพัฒนาโปรแกรมการวางแผนจำหน่ายที่ครอบคลุม โดยคำนึงถึงความรุนแรงโรคร่วม การประเมินและประสานให้ผู้ป่วยได้รับการวินิจฉัยและจัดการภาวะทุพโภชนาการอย่างเหมาะสม และให้ความรู้ทางด้านสุขภาพที่มีความเฉพาะกับผู้ป่วยแต่ละรายเพื่อส่งเสริมการดูแลตนเองที่เหมาะสม

คำสำคัญ: หัวใจล้มเหลว การกลับมารักษาซ้ำในโรงพยาบาลภายใน 30 วัน การดูแลตนเอง ภาวะโภชนาการ โรคร่วม

Background and significance

Heart failure (HF) poses a significant health crisis in both developed and developing countries, including Thailand.[1] Approximately 64 million people globally are estimated to be affected by HF, with 1 to 20 new cases per 1,000 person-years.[2] In Thailand, the rate of HF hospitalizations increased from 138 per 100,000 person-years in 2008 to 168 per 100,000 person-years in 2013, primarily due to acute heart failure (AHF).[3] AHF is defined as the rapid or gradual onset of symptoms or signs of HF, such as dyspnea, orthopnea, and edema of the lower extremities, which are severe enough to prompt urgent medical attention.[4]

A 30-day hospital readmission is a situation in which patients are discharged from the hospital and then readmitted within 30 days of their previous admission.[5] Hospital readmission within 30 days due to AHF is well recognized as an outcome and indicator of the quality of care for HF management.[4,6] Literature reviews have found that approximately 7.0%–12.5% of patients with HF experienced hospital readmissions within 30 days due to AHF.[7,8] Some studies

in Thailand reported hospital readmission rates within 30 days ranging from 14.1% to 34.0% for all causes.[3,9] However, the existing knowledge is a need for new data that integrates associated factors at both health service and patient levels to predict the risks of 30-day hospital readmission with AHF, particularly within the Thai context.

Comorbidities are commonly reported as associated factors inducing poorer or negative health outcomes such as readmission[5,8,10] and functional decline.[11] It refers to the simultaneous presence of two or more medical conditions in patients, often including hypertension, diabetes, cerebral diseases, and chronic kidney diseases.[1,12,13] The presence of multiple comorbidities is found to have an association with negative outcomes such as reduced physical functions,[11] morbidity, and mortality in patients with HF.[5,10] However, there are limited studies on predicting comorbidity severity and hospital readmissions due to AHF within 30 days in Thai studies.

The issue of malnutrition is well recognized as a serious condition influenced by poor intake and utilization of nutrients in patients with HF.[14] Evidence indicates both hospitalized[14,15] and outpatients[16] with HF suffered from malnutrition, with a higher incidence of AHF exacerbations and hospital readmission rate.[14,15] However, data on malnutrition in hospitalized Thai patients with HF, who are at greater risk, are currently unavailable.

In Thailand, the majority of patients with HF live with their families and receive care from family members.[11,13] Unlike in developed countries, where many patients live alone or in specialized care facilities.[17,18] The role of family support in assisting patients with HF and its relevance within the context of Thailand should be focused and it is worth investigating whether family support is utilized to maintain the health of patients with HF and reduce the readmission risks.

Self-care is addressed as a crucial behavioral component of HF management programs.[4,6] Studies in Japanese, Iran, and China patients with HF who reported having inadequate self-care found higher rates of hospital readmission within 3-6 months due to AHF compared to those with adequate self-care.[17,19,20] Similarly, self-care was reported as inadequate among Thai patients with HF.[11,21] However, the association between self-care behaviors and hospital readmission within 30 days due to AHF is unclear in Thai studies and remains gaps in knowledge.

Post-discharge follow-up methods refer to the approaches for accessing healthcare services after hospital discharge for patients with HF. In recent years, the health service system has been disrupted by the COVID-19 pandemic. As a result, many patients have been encouraged to use telehealth for their follow-up care, either in ambulatory HF clinics or in combination with hospital visits. A recent Thai study has reported that telehealth can reduce the likelihood of hospital readmission within 30 days, regardless of the cause.[22]

Based on the literature review above, the 30-day readmission rates among patients with HF and the predictive risk factors are unclear and require further investigation, especially with a comprehensive approach that encompasses patient, family, and health service delivery system factors. The updated 30-day readmission rates and the predicting factors identified from this study can be beneficial in guiding efforts to prevent and reduce the risks of readmission. These inquiries became research questions of this study.

Conceptual Framework

This study applied Andersen's behavioral model of health services utilization. The model was developed by the medical sociologist, Ronald M. Andersen, in 1968 and was subsequently revised and restructured to its phase 4.[23] The model provides a comprehensive framework for understanding health services accessibility and utilization, as well as recognizing the factors influencing an individual's decision to use or not use existing health services, subsequently affecting outcomes including health status.

This model consists of four major structures explaining logical expectations from the first structure of the environment, population characteristics, and health behaviors, to the endpoint of outcomes. The environment structure consists of two substructures: the health care system and the external environment. Population characteristics include three aspects: predisposing characteristics, enabling resources, and needs. Health behavior is explained in terms of personal health practices and the use of health services. Both substructures can directly affect outcomes. Regarding the outcome structure, perceived health status and evaluated health status, as well as consumer satisfaction, are addressed to determine.

As is known, patients with HF require comprehensive approaches and the 30-day readmission with AHF is an undesired outcome in need of prevention. The variables included from the model in this study are selected from knowledge gaps including post-discharge follow-up methods, comorbidity severity, malnutrition, family support, and self-care. The variables under the model structures are illustrated in Figure 1. Andersen clearly stated that applying this model required a longitudinal study approach.[23] The design of this research study was then approached with a prospective cohort study.

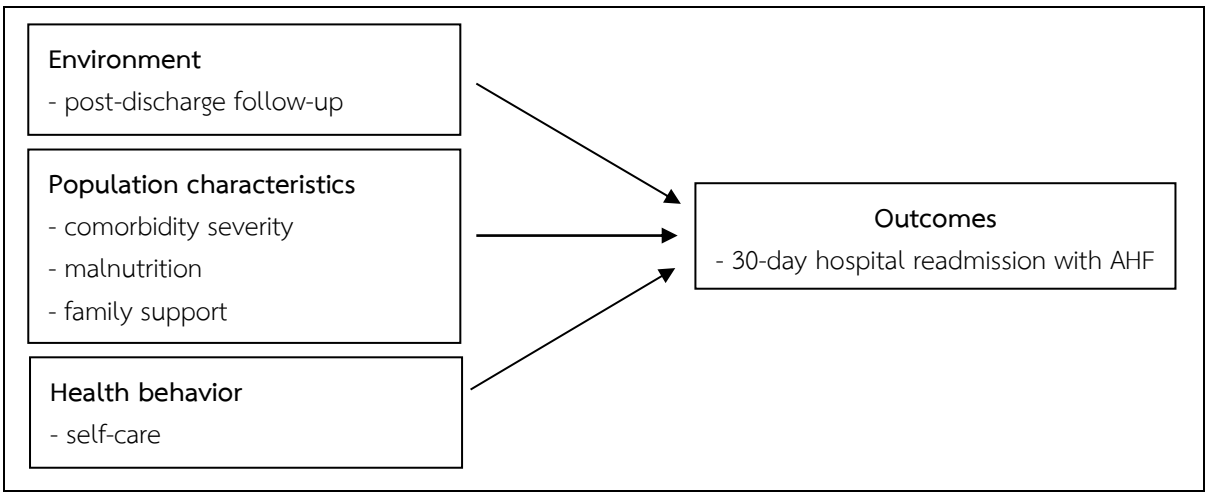

Figure 1 Conceptual Framework

Research objectives

This study aims to examine the 30-day readmission rate with AHF among patients with HF and identify the factors that predict readmission, including comorbidity severity, malnutrition, family support, self-care, and post-discharge follow-up methods.

Research hypothesis

Comorbidity severity, malnutrition, family support, self-care, and post-discharge follow-up methods can predict 30-day readmission with AHF among patients with HF.

Methods

Study design

This research is a prospective cohort study.

Population and Sample

The population in this study were patients with AHF from two super tertiary hospitals in Bangkok. Both hospitals utilize interdisciplinary care teams to provide care and management following heart failure disease management guidelines. The sample comprised 163 hospitalized patients with AHF admitted for treatment in the general medical ward, intermediate cardiac care unit, and cardiac care unit of the two super tertiary hospitals. The sample was purposively selected based on the study's inclusion and exclusion criteria. Inclusion criteria included 1) both male and female patients, 2) aged 18 years and older, 3) diagnosed with HF for at least three months, 4) admitted for treatment of AHF, 5) undergoing hospital discharge planning, 6) exhibiting stable symptoms at discharge or without the need for vasopressors, and 7) having no literacy problems in the Thai language and being capable of communicating via telephone contact post-discharge. Exclusion criteria included 1) patients

aged 60 years and older with Mini-Cog testing score less than 3, and 2) developing severe bacterial infections on the discharge date.

The sample size was calculated using G*Power 3.1[24] with logical regression statistics testing. A significance level of .05 and a statistical power of .80 were set. The calculation was based on the correlation between comorbidity severity and hospital readmission within 30 days from a previous study, which was a large retrospective cohort study in Korea. The effect size was determined with H_0 = 0.19 and H_1 = 0.402, and the estimated proportion (π) was set at 0.5.[5] The calculated odds ratio (OR) of 2.87 indicated the sample size required was 148 participants. A 10% attrition rate was added to the calculated sample size, resulting in a total of 163 sample cases in the study.

Research instruments

The research instruments used for data collection were as follows:

1) Mini-Cog developed by Borson et al.[25] and translated into Thai by Trongsakul et al.[26] It was utilized as a screening instrument to assess cognitive impairment in cases where patients were aged 60 years and older. The instrument consists of three items including word recall and clock drawing. The total score ranges from 0 to 5 points, where scores of 0 to 2 indicate cognitive impairment. [26]

2) A General Profile Questionnaire developed by the research team, consisting of 13-item general demographic data of the patients and their health profile.

3) The Charlson Comorbidity Index (CCI), developed by Charlson et al.[27] It comprises 23 comorbidities, each assigned a score of 1, 2, 3, or 6 depending on the associated risk of mortality. In this study, the researcher did not include the score of HF as the samples were HF cases. Therefore, the total scores of CCI ranged from 0 to 41, and the severity score is classified into four levels including: 0 = no severity, 1-2 = low severity, 3-4 = moderate severity, and >4 = high severity. [27]

4) The Controlling Nutritional Status (CONUT) was developed by Ignacio de Ulíbarri et al.[28] for evaluating malnutrition in hospitalized patients. It utilizes laboratory blood tests, including serum albumin (g/dl), lymphocytes (count/ml), and cholesterol (mg/dl). The total scores range from 0.00 to 12.00. The score evaluation includes: 0-1.99 normal nutrition; 2.00-4.99 mild malnutrition; 5.00-8.99 moderate malnutrition; and 9.00-12.00 severe malnutrition.[28] The inter-rater reliability (Cohen's kappa) of the instrument was reported at 0.67, with sensitivity and specificity at 92.3% and 85%, respectively.[28] In this study, the inter-rater reliability of the instrument was found to be 1.0.

5) Smilkstein's Family Adaptation, Partnership, Growth, Affection, and Resolution (APGAR) Questionnaire (Thai version) by Malathum.[29,30] This instrument comprises 5 items

that evaluate family functioning to support patients, including adaptation, partnership, growth, affection, and resolution, using a five-point Likert-type scale from 0 to 4, where 0 = never; 1 = almost never; 2 = sometimes; 3 = almost always; and 4 = always. Total scores range from 0 to 20. A score of 14.00-20.00 suggest highly satisfaction to family support. A score of 7.00 to 13.99 suggests moderate satisfaction to family support. A score of 0.00 to 6.99 suggests low satisfaction to family support representing a severely dysfunctional family.[30] The internal consistency of the instrument (Cronbach's alpha reliability) was reported at 0.91. In this study, Cronbach's alpha reliability was found to be 0.92.

6) The Self-Care of Heart Failure Index (SCHFI) version 7.2. The SCHFI (v7.2) was developed by Riegel et al.[31] In this study, the back translated Thai version by Damrongratnuwong[32] was utilized. The SCHFI consists of 29 items divided into three subscales measuring self-care maintenance, symptom perception, and self-care management,

The Self-Care Maintenance scale comprises 10 items measured in terms of frequency, rated using a five-point Likert scale type ranging from 1 (never) to 5 (always). The Symptom Perception scale includes 9 items assessing the frequency of behaviors, along with 2 items evaluating how quickly symptoms were recognized and identified as related to HF. The response choices for the 2 recognition items span from "not applicable" (indicating no symptoms) or 0 (indicating the symptom was not recognized) to 5 (indicating the symptom was recognized very quickly).

The Self-Care Management scale consists of 8 items. Seven items are behaviors commonly used to control HF symptoms (1, not likely, to 5, very likely). One item asks about the patient's confidence in the treatment they most recently used to manage their symptoms, which has helped them feel better. Response options for this item range from 0 (I did not do anything) or 1 (not sure) to 5 (very sure). The three subscale scores were calculated separately and then standardized from 0 to 100, with higher scores indicating better self-care.[31] A cut-off score of 70 or higher was used to indicate adequate self-care behavior on each SCHFI scale. The inter-rater reliability of the instrument was reported as 0.88[33] in the previous study and as 0.86 in this study.

7) A post-discharge questionnaire. The instrument, developed by the research team based on related literature, consists of two parts. Part 1 evaluates follow-up methods received after discharge, offering options: 1) a follow-up visits with a cardiologist, and 2) a follow-up visits with a cardiologist combined with telehealth, using communications technologies to provide health care at a distance. Part 2 records 30-day hospital readmission with AHF by the researcher, with dichotomous options (0 = no readmission, and 1 = readmission).

The content validity of the post-discharge questionnaire was validated by five experts, including nurses, nurse educators, and cardiologists. The Content Validity Index was

0.88. The other instruments reported were used in patients with HF.[5,8,11] The process of instrumental validation was then omitted. The reliability testing of each instrument was explained by the psychometric properties of the instruments.

Ethical considerations

This study was approved by the Institutional Review Board of the Faculty of Nursing and Faculty of Medicine, Siriraj Hospital, Mahidol University (MU-MOU CoA No. IRB-NS2021/647.2212 date of approval 22 December 2021), as well as from the Faculty of Medicine, Chulalongkorn University (COA No. 0208/2023 IRB No. 0023/65 date of approval 24 February 2022). All participants received a detailed explanation of the study procedures, their rights as participants, and potential risks and benefits of participation. Written informed consent was obtained from all participants prior to their enrollment in the study.

Data collection

This study collected data from February to September 2022, through questionnaires, medical records, and telephone interviews. The data were collected in 2 rounds by researcher. The first round of data collection was conducted in the in-patient department of the hospital on the day before the patients were discharged. The patients who aged 60 years and older were screening by Mini-Cog for assessing cognitive impairment. Participants were asked to complete the general profile questionnaire, the SCHFI version 7.2, and the family APGAR questionnaire. Subsequently, the CCI, CONUT, and patients' illness information were collected via medical records by the researcher. The second round was conducted 30 days post-discharge. Questionnaire responses were obtained through telephone interviews and cross-checked with patients' medical records.

Data analysis

This study utilized descriptive statistics to examine various factors, including general profile, clinical data, comorbidity severity, malnutrition, family support, self-care, post-discharge follow-up methods, and the 30-day hospital readmission rate of the patients in the study. Correlations between comorbidity severity, malnutrition, family support, and 30-day hospital readmissions were analyzed using Point-biserial correlations. The relationships between self-care and 30-day hospital readmissions were examined using the Chi-square test. Additionally, correlations between post-discharge follow-up methods and 30-day hospital readmissions were assessed using Fisher’s exact test. The predictive model was examined using binary logistic regression with statistical significance set at .05.

Results

All participants

A total of 163 participants were included in this study, with an average age of 66.23 years (SD = 15.32). The majority of the participants were female (53.4%), had primary school education or lower (80.9%), and were unemployed (64.4%). 82.2% of total participants lived with family and about 60.7% received health assistance from family support or caregivers. (See Table 1)

Their median duration of HF was 19 months (IQR = 56 [4–60]. 146 cases (89.6%) underwent testing for left ventricular ejection fraction (LVEF) within one year, with an average functioning of 45.13% (SD = 18.88). Of those, the average LVEF of the readmission group (18 cases) was about 49.5 % (SD = 21.68). Their heart functional class, using the New York Heart Association (NYHA) criteria, was predominantly in functional classes III (52.1%) and IV (41.7%) upon their first admission, shifting to NYHA functional class II (79.1%) upon discharge.

Table 1 General characteristics of the participants and the 30-day readmission rate (n = 163)

Variables	Total (n = 163)		30-day readmission (n = 18)		30-day readmission rate
	n	%	n	%	(%)
Age (years) (Mean ± SD)	66.23 ± 15.32		70.17 ± 17.78		
< 60	47	28.8	4	22.2	2.44
≥ 60	116	71.2	14	77.8	8.59
Sex					
Male	76	46.6	7	38.9	4.29
Female	87	53.4	11	61.1	6.74
Education					
High school or less	132	80.9	17	94.4	10.42
Greater than High school	31	19.1	1	5.6	0.61
Current occupation					
Unemployed/retired	105	64.4	15	83.3	9.2
Employed	58	35.6	3	16.7	1.84
Health insurance					
Universal health coverage	85	52.1	10	55.4	6.13
Civil servant medical benefit	53	32.5	6	33.4	3.68
Social security scheme	19	11.7	1	5.6	0.61
Self-paid	6	3.7	1	5.6	0.61
Living with					
Family	134	82.2	16	88.9	9.81
Alone	17	10.4	2	11.1	1.22
Relatives/friends	12	7.4	0	0.0	0.0

Table 1 General characteristics of the participants and the 30-day readmission rate (n = 163) (cont.)

Variables	Total (n = 163)		30-day readmission (n = 18)		30-day readmission rate
	n	%	n	%	(%)
Received health assistance from caregivers					
No	64	39.3	2	11.1	1.22
Yes*	99	60.7	16	88.9	9.81
Seeking medical care	94	94.9	15	93.8	9.2
Diet adherence	56	56.6	7	43.8	4.29
Medication adherence	41	41.4	6	37.5	3.68
Activity/exercise	19	19.2	5	31.3	3.06

* More than 1 answer

Table 2 The clinical profiles and 30-day readmission rate of the participants (n = 163)

Variables	Total (n = 163)		30-day readmission (n = 18)		30-day readmission rate
	n	%	n	%	(%)
Duration of HF (months) (Median [IQR])	19 (56 [4-60])		13.5 (34 [4-38])		
3-11	64	39.3	9	50.0	5.52
12-35	36	22.1	5	27.8	3.06
36-59	16	9.8	1	5.5	0.61
≥ 60	47	28.8	3	16.7	1.84
LVEF (n = 146) (Mean ± SD)	45.13 ± 18.88		49.5 ± 21.68		
≤ 40.00 %	64	43.8	5	35.7	3.06
40.01-49.99 %	19	13.0	1	7.2	0.61
≥ 50.00 %	63	43.2	8	57.1	4.91
NYHA functional class at admission date					
NYHA functional class II	10	6.2	0	0.0	0.0
NYHA functional class III	85	52.1	8	44.4	4.91
NYHA functional class IV	68	41.7	10	55.6	6.13
NYHA functional class at the discharge date					
NYHA functional class I	18	11.1	0	0.0	0.0
NYHA functional class II	129	79.1	15	83.3	9.2
NYHA functional class III	16	9.8	3	16.7	1.84
Comorbidity severity (Mean ± SD)	4.60 ± 2.32		6.17 ± 2.71		
Mild (1.00-2.99)	28	17.2	1	5.6	1.63
Moderate (3.00-4.99)	62	38.0	5	27.8	0.12
Severe (5.00-41.00)	73	44.8	12	66.6	7.36

Table 2 The clinical profiles and 30-day readmission rate of the participants (n = 163) (cont.)

Variables	Total (n = 163)		30-day readmission (n = 18)		30-day readmission rate
	n	%	n	%	(%)
Comorbid*					
Hypertension	124	76.1	15	83.3	9.2
Diabetes	95	58.2	14	77.7	8.59
Chronic kidney disease	74	45.4	10	55.6	6.13
Lung disease	45	27.6	3	16.7	1.84
Coronary artery disease	40	24.5	3	16.7	1.84
Cerebral disease	21	12.9	3	16.7	1.84
Malnutrition (Mean ± SD)	3.39 ± 2.11		4.61 ± 2.28		
Normal (0.00-1.99)	35	21.5	2	11.1	1.22
Mild malnutrition (2.00-4.99)	82	50.3	7	38.9	4.29
Moderate malnutrition (5.00-8.99)	44	27.0	8	44.4	4.91
Severe malnutrition (9.00-12.00)	2	1.2	1	5.6	0.61
Level of family support (Mean ± SD)	17.55 ± 3.98		17.11 ± 5.58		
Low (0.00-6.99)	6	3.7	2	11.1	1.22
Moderate (7.00-13.99)	14	8.6	1	5.6	0.61
High (14.00-20.00)	143	87.7	15	83.3	9.2

* More than 1 answer

From Table 2, the average length of hospital stay was 14.32 days (SD = 15.35). The top three comorbidities were hypertension, diabetes, and chronic kidney disease (76.1%, 58.2%, and 45.4%, respectively). Most participants (78.5%) experienced malnutrition, with 50.3% categorized as mild, 27.0% as moderate, and 1.2% as severe (See Table 2).

The readmission group

This study found that within 30 days after discharge, 18 cases (11.0%) of the total participants were readmitted to AHF. Their average age was 70.17 years (SD = 17.78), and females were 61.1% re-admitted cases were female (See Table 1). Half of the readmitted participants (50.0%) had been diagnosed with HF for at least 12 months, more than half were in NYHA Functional Class IV (55.6%) and 57.1% had an LVEF of 50.00% or higher.

The level of comorbidity severity in the readmission cases was found to be severe, with a mean severity score of 6.17 (SD = 2.71). About 88.9% had malnutrition at a mild to moderate level (38.9% mild, 44.4% moderate, 5.6% severe), with an average score of mild level (Mean = 4.61, SD = 2.28) (See Table 2). All the self-care scores were inadequate: self-care maintenance score (mean = 66.11, SD = 18.27), symptom perception (Mean = 62.53, SD = 19.34), and self-care management (Mean = 58.06, SD = 21.52) (See Table 3).

Table 3 The correlation between self-care, post-discharge follow-up methods, and 30-day readmission with AHF using Chi-square or Fisher's exact test (n = 163)

Variables	Total (n = 163)	30-day hospital readmission		p-value
		No (n = 145)	Yes (n = 18)	
Self-care maintenance	**65.33 ± 15.43**	**65.23 ± 15.11**	**66.11 ± 18.27**	.168
Adequate (≥ 70.00)	70 (42.9)	65 (92.9)	5 (7.1)	
Inadequate (< 70.00)	93 (57.1)	80 (86.0)	13 (14.0)	
Symptom perception	**61.13 ± 17.83**	**60.95 ± 17.69**	**62.53 ± 19.34**	.386
Adequate (≥ 70.00)	49 (30.1)	42 (85.7)	7 (14.3)	
Inadequate (< 70.00)	114 (69.9)	103 (90.4)	11 (9.6)	
Self-care management	**55.18 ± 17.45**	**54.83 ± 16.93**	**58.06 ± 21.52**	.368 [F]
Adequate (≥ 70.00)	33 (20.2)	28 (84.8)	5 (15.2)	
Inadequate (< 70.00)	130 (79.8)	117 (90.0)	13 (10.0)	
Post-discharge follow-up methods				.740[F]
Hospital visits with cardiologist	136 (83.4)	120 (88.2)	16 (11.8)	
Hospital visits with cardiologist with telehealth	27 (16.6)	25 (92.6)	2 (7.4)	

F = Fisher's exact test

Prior to the predicting power testing, the results of Chi-square and Fisher's exact tests indicated no significant association between self-care, family support, and post-discharge follow-up methods with 30-day readmission with AHF ($p > .05$), as shown in Table 3. Point-biserial statistical testing revealed significant and low levels of association between comorbidity severity and malnutrition with 30-day readmission with AHF ($r_{pb} = .240$, $p < .01$ and $r_{pb} = .204$, $p < .01$, respectively), as illustrated in Table 4.

Table 4 The correlation between comorbidity severity, malnutrition, family support, and 30-day readmission with AHF using Point-biserial correlation (n = 163)

Variables	1	2	3	4
1. Comorbidity severity	1			
2. Malnutrition	.205**	1		
3. Family support	.140	-.132	1	
4. 30-day readmission	.240**	.204**	-.039	1

** p-value < .01

Hypothesis testing for investigating the predicting factors of 30-day readmission with AHF was done. The binary logistic analysis showed that inadequate self-care maintenance (OR = 4.522, 95% CI [1.083–18.885], p = 0.039), severe comorbidity (OR = 1.331, 95% CI [1.070–1.657],

p = 0.010), and malnutrition (OR = 1.325, 95% CI [1.033–1.700], p = 0.026) were independent predictors for 30-day readmission with AHF in the model. Hence, when these three predictive variables increase, the probability of 30-day hospital readmission risks increases by 4.52, 1.33, and 1.32 times, respectively (See Table 5).

Table 5 Analysis results of multivariate predictors for 30-day readmission with AHF and their predictive power using logistic regression (n = 163)

Variables	B	S.E.	wald	df	p-value	OR	95% CI	
							lower	upper
1. Comorbidity severity	.286	.112	6.575	1	.010*	1.331	1.070	1.657
2. Malnutrition	.282	.127	4.926	1	.026*	1.325	1.033	1.700
3. Family support	-.040	.064	.387	1	.534	.961	.848	1.089
4. Self-care								
Self-care maintenance								
Adequate [ref]	ref	-	-	-	-	-	-	-
Inadequate	1.509	.729	4.280	1	.039*	4.522	1.083	18.885
Symptom perception								
Adequate [ref]	ref	-	-	-	-	-	-	-
Inadequate	-.668	.664	1.012	1	.314	.513	.139	1.885
Self-care management								
Adequate [ref]	ref	-	-	-	-	-	-	-
Inadequate	-.951	.756	1.585	1	.208	.386	.088	1.698
5. Post-discharge follow-up methods								
Hospital visits with cardiologist [ref]	ref	-	-	-	-	-	-	-
Hospital visits with cardiologist with telehealth	.273	.831	.108	1	.742	1.314	.258	6.705
Constant	-4.049	1.731	5.469	1	.019	.017		

* p-value < .05, [ref] = reference group

Discussion

The first objective was to examine the 30-day readmission rate with AHF among patients with HF. The results showed that 11.0% of the participants had a readmission rate with AHF, which is within the range of 7.0%–12.5% readmission rate reported in recent studies both in Thailand and other countries.[3,7-9] This study was conducted in two super tertiary hospitals with cardiologists and follow-up. The standard treatment guideline may help to control the severity of the disease when comparing the readmission rate with those of other countries. However, it is notable that the majority of the readmission cases were female and had family caregivers. Closer approaches to female patients as well as further investigation in more detail of each variable may help to better discussion in this group.

The second objective was to investigate the predictive risk factors of readmission. This study proposed seven variables to test their predictive risks. Only three predictive factors were found, including inadequate self-care, comorbid severity, and malnutrition (See Table 5). This needs to be discussed as evidence that can be confirmed from recent studies and why some proposed variables were not significant predictive risks.

It is known that self-care plays an important role in the home care of patients with HF.[4,6] The results revealed that self-care maintenance specific to HF in this study was inadequate. Congruently, the low level of self-care in Thai population was reported in a previous study[11,21] The Chi-square test results indicated that all three self-care subscales had no direct relationship with the readmission (See Table 4). However, when the variable of inadequate self-care maintenance was included in the analysis along with other predictive factors using the enter mode, it resulted in the highest odds ratio for this factor (OR = 4.522) compared to severe comorbidity score and malnutrition (See Table 5). This may indicate an increased risk of inadequate self-care when combined with several comorbidities. Additionally, the self-care being investigated in this study is specific to HF management, whereas the patients typically experience severe comorbidities (See Table 2). This implies that the self-care needs of the patients should be broader than HF alone. When self-care specific to HF was found to be inadequate, self-care for their comorbidities might also be insufficient.

To discuss the importance of comorbidity severity on 30-day readmission, this study found that participants had a high level of comorbidity severity, and the readmission group had a higher score of severity (See Table 2). This variable is also a significant predictive risk for readmission (r_{pb} = .240, $p < .01$ and OR = 1.331, 95% CI [1.070–1.657], p = 0.010), which is consistent with recent literature.[5,8] Studies in other countries have shown that HF patients with more comorbidities themselves are at a greater readmission risk compared to those with fewer comorbidities, more than 3 times (OR = 3.6).[12] Additionally, patients with HF with chronic kidney disease and diabetes were reported to be at a higher risk of readmission compared to patients who do not have these comorbidities.[5,18] This demonstrates how the complexity of a patient's comorbidities renders the management and monitoring of HF exacerbations more challenging.[4,6]

The presence of malnutrition in patients with HF is linked to increased rates of hospital readmission and mortality.[34] The cases of severe malnutrition can have higher risks of death about 9 times than the case with normal nutritional status.[34] In this study, where most of the participants (78.5%) suffered from malnutrition, and about half of the readmitted participants (50.0%) had moderate to severe malnutrition. This factor is found to be a predictive risk for 30-day hospital readmission significantly (OR 1.325, 95% CI [1.033–1.700], p = 0.026). The finding is consistent with the recent studies.[35] In explaining the possible causes

of malnutrition in individuals with poor functional heart status, all readmitted participants in this study (100.0%) had NYHA functional class III to IV, indicating dyspnea and increased energy expenditure for breathing. These conditions can result in poor appetite, muscle weakness, and low cardiac pumping to meet the body's requirements.[14,15] In considering proper long-term care approaches, this study focused only on a short period of 30-day readmission, and it is doubted for the long-term negative outcomes. The readmission rate may perhaps increase in malnourished cases. The high-risk cases should be intensively focused.

Two factors were found no significant risks to 30-day hospital readmission including family support, and post-discharge follow-up methods. The major group of participants informed living with family (82.2%) and both readmission and non-readmission groups informed had highly supported by their families, which is congruent with other studies in Thailand.[11,13] With these conditions, the supports provided should be expected to contribute to better self-care and reduce readmission outcomes. On the contrary, the result showed no association to the readmission. This inconsistent with a recent study.[36] This means that family supports may not directly contribute to self-care as expected and the health conditions of the patients with HF may be stronger predictive risks.

This study found that the readmission rate in the group that had a hospital visit with cardiologists combined with telehealth was lower than that of the general post-discharge follow-up with hospital visits. However, the analysis results presented in Table 3 and Table 4 revealed that this variable had no significant relationship with readmission. Logistic regression analysis also confirmed that there was no significant correlation in predicting 30-day hospital readmission with AHF ($p = .742$). The routine follow-up methods, supplemented with additional approaches via telehealth, did not support the hypothesis of the study in predicting the risk of readmission rate due to the complex health problems in this group of patients.

In a broader perspective, using Andersen's behavioral model of health services utilization to investigate the negative outcomes of readmission in patients with HF is appropriate. The four structures of the model were examined, revealing limited accessibility for patients with HF across all structures, especially the population characteristics. With the several potential risks of readmission and mortality readmission and mortality, the 11.0% readmission rate found in this study may represent only the initial wave of readmissions within 30 days after discharge. It is possible that more patients will require readmission in the near future if their complex health issues persist.

Limitations of this study

This study aims to focus on the accessibility and health services utilization of the patients with HF who are high risks to 30-day readmission. The variables related to health

conditions, especially heart functions of the patients were not included in the study aims which may contribute to the predicting factors under investigation from this study.

Conclusions and Nursing Implications

This study found that the variables of inadequate self-care maintenance, high comorbidity severity, and malnutrition were significantly associated with 30-day hospital readmission due to AHF. Implications to nursing are focused on how to prevent the readmission of the high-risk groups and how to maintain or improve better health status of the patients supported by their family.

The results of health delivery services towards post-discharge follow-up indicated only a certain level of routine accessibility to health services and care. To promote adequate self-care for the patients and prevent exacerbation of illness to readmission, the high-risk cases may require closer approaches, including severe comorbidity and malnutrition.

Furthermore, the structure of population characteristics showed that patients with HF are confronting with multiple health problems and home care services may need to be focused, due to their inadequate self-care specific to heart issues, as well as related comorbidities and malnutrition. Family support may require more intensive nursing approaches to provide better self-care assistance. Thus, well-plan and effective discharge planning specific to needs of the patients and family for better self-care. Multidisciplinary approaches with supportive consultation led by nurse-led case manager are suggested.

Recommendation for nursing research

1) Investigate the association between self-care and 30-day hospital readmission with AHF by collecting data at 30 days post-patient discharge from the hospital.

2) Conduct future studies with a larger sample size to explore specific variables associated with HF, including medical conditions.

3) Consider extending this longitudinal study to examine readmission in this participant group over longer follow-up periods, such as 60 days, 90 days, 6 months, and 1-year post-discharge from the hospital.

Acknowledgement

This research study acknowledges the contribution of The King Prajadhipok and Queen Rambhai Barni Memorial Foundation who provided funding support for the study.

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