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ORIGINAL RESEARCH

Incidence and Predictors of Congestive Heart Failure Among Hemodialysis Patients at Felege Hiote Referral Hospital, Northwest Ethiopia, 2020: Retrospective Cohort Study

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Background: Heart failure is the cumulative and progressive result of conditions that cause structural defects and functional abnormalities in the heart. It is affects at least 26 million people worldwide and is increasing in prevalence especially among hemodialysis patients with severe renal failure.

Objective: To assess the incidence and predictors of congestive heart failure among hemodialysis patients at Felege Hiote Referral Hospital, Northwest Ethiopia.

Methods: This institutionally based retrospective cohort study was undertaken among 205 hemodialysis patients of Felege Hiote Referral Hospital from January 1, 2016 to February 29, 2020. All eligible hemodialysis patients who fulfilled the inclusion criteria were included in the study. Data were entered using Epi-data Version 4.1 and analyzed using STATA Version 14. The survival time of hemodialysis patients was estimated using the Kaplan–Meier survival curve, and the survival time between different categorical variables was compared using the log rank test. Both bivariable and multivariable Cox-proportional hazard regression models were fitted to identify independent predictors of congestive heart failure among hemodialysis patients.

Results: Among a cohort of 205 hemodialysis patients at Felege Hiote Referral Hospital, 12 (5.9%) developed congestive heart failure during the follow-up time. The overall congestive heart failure incidence rate was 2.9 per 100 person-years (PY) with 95% CI. The total time allotted to follow up the study participants was 4968 PY. Using multivariable Cox-regression analysis, we found that male sex, rural residence, no formal education, low body mass index (<18.5), presence of comorbidity, and anemia during dialysis initiation significantly increased the risk of heart failure.

Conclusion: In this study, we found a high rate of congestive heart failure among hemodialysis patients. Factors significantly linked with increased risk of heart failure included male sex, rural residence, no education, low body mass index (<18.5), presence of comorbidity, and anemia during dialysis initiation. Early screening and treatment for heart failure are highly recommended at hemodialysis follow-up for patients with the above risk factors.

Keywords: incidence, heart failure, predictors of congestive heart failure

Background

Heart failure (HF) is the cumulative and progressive result of conditions that cause structural defects and functional abnormalities in the heart. It is a clinical syndrome characterized by dyspnea, fatigue, and clinical signs of congestion leading to

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frequent hospitalizations, poor quality of life, and shortened life expectancy.[1] It is a life-threatening syndrome with substantial morbidity and mortality and its burden to patients, their careers, and health systems is high.[2] HF is a global phenomenon affecting at least 26 million people worldwide and is increasing in prevalence. The resulting health expenditures are considerable and increase dramatically with renal failure patients. Despite the significant advances in therapies and prevention, mortality and morbidity are still high and quality of life is poor among renal patients.[3]

A variety of strategies has been proposed to support patient self-management, such as early and targeted screening of patients to identify and resolve capacity deficits (limited literacy, cognitive and physical impairment) and psychosocial obstacles (depression and anxiety) that may undermine self-care. As a result self-management engagement training involves an assessment of patient needs, motivation and capacity, shared decision making and agreement on a management plan to support patient self-care to improve patient outcomes in chronic disease settings such as chronic kidney disease (CKD).[4]

The disease burden and health deterioration undermine adherence, so although self-management behaviors are commonly recommended in congestive heart failure (CHF) patients, 60% of patients do not adhere to their medication regimens as prescribed and up to 80% do not adhere to lifestyle recommendations.[5] The disease prevalence is between 2–3% of the population and 6.5 million people are hospitalized as a result of CHF annually, with 1–2% of the health-care budget being spent on this disease. Heart failure is a challenge for health-care teams and the effects on physical, psychological, social functions and daily living activities are high for patients. The treatment of CHF mainly focuses on self-care activities that have a major role in disease management, reducing re-hospitalization and improving quality of life, although self-care is not addressed yet.[6,7] This study aimed to investigate the incidence and predictors of CHF among hemodialysis patients.

Methods

Study Area and Period

The study was conducted at Felege Hiote Referral Hospital in Amhara region from February 1 to May 30, 2020. Felege Hiwot Referral Hospital is in the capital city of Amhara Regional State, which is 565 km away from the capital city of Ethiopia, Addis Ababa. It was established in 1963 as the district hospital, and it was upgraded to a referral hospital in 1994. The hospital has Surgery, Medical, Pediatrics, Obstetrics and Gynecology, Psychiatry, Dental, Orthopedics and Oncology units with outpatient, inpatient and follow-up departments. The hospital has a total of 415 health professionals (Minyichil Birhanu, 2018).

Study Design

Retrospective cohort study design was used.

Study Population

The study population was all dialysis patients who were registered at Felege Hiote Referral Hospital dialysis center from January 1, 2016 to February 29, 2020.

Inclusion Criteria and Exclusion Criteria

All hemodialysis patients who were registered at Felege Hiote Referral Hospital dialysis centers from January 1, 2016 to February 29, 2020 were included in the study. However, patients with incomplete data, with lost medical records, patients who developed CHF at the initiation of hemodialysis or were transferred in were excluded from the study.

Study Variables

The dependent variable for this study was incidence of CHF among hemodialysis patients. The independent variables were: socio-demographic factors (age, sex, marital status, educational status, employment), personal behaviors (smoking, alcohol use and both smoking and alcohol use) and clinical characteristics (time since CKD diagnosed, time since first dialysis started, presence of comorbidity, BMI (kg/m^2), re-hospitalizations (in last year), family history of CHD, heart rate, systolic blood pressure, diastolic blood pressure, history of kidney transplantation, medication at admission for CKD, hemoglobin, creatinine, HDL cholesterol, LDL cholesterol, BUN and triglycerides).

Operational Definition

Congestive Heart Failure

Hemodialysis patients who were recorded as having CHF among hemodialytic patients.[8]

Dialytic Congestive Heart Failure (DCHF)

Hemodialysis patients who were diagnosed for CHF after the initiation of hemodialysis procedure.

Event

Hemodialysis patients who developed CHF within the study period.

Censored

Hemodialysis patients who did not develop CHF because of death, being transferred out or loss to follow up before CHF development.

Transfer Out

Hemodialysis patients who moved by taking their full medical records before completion of the study from the hospital to other health institutions for care and treatment.

Transfer in

Hemodialysis patients who came from other health institutions to the hospital by transfer for care and management purposes.

Data Collection Procedures

A five-year institution-based retrospective follow-up study was conducted using chart review at Felege Hiote Referral Hospital dialysis care follow-up clinic among hemodialysis patients who had been registered from January 1, 2016 to February 29, 2020. All eligible hemodialysis patients were included in the study (census method) after ethical clearance was received from the Institutional Review Committee of the College of Health Sciences, Debre Markos University (Ref. Res/Com/ser/andPost gra/Coor/Off: 781/11/10) and verbal informed consent was obtained from the patients. The medical record number (MRN) of the patients was identified from electronic database and health management information system (HMIS) registry books that had been used for the routine care of patients from January 1, 2016 to February 29, 2020. Then by using the MRN of the hemodialysis patients their medical records were identified and their status was assessed for the development of CHF starting from the date of hemodialysis initiation (first follow-up visit) to the end of the study period using validated data collection checklists.

Data Processing and Analysis

Data collection checklist tools adapted from previous studies in Ethiopia were used for the data collection. We used Epi-data Version 4.1 for data entry and STATA Version 14 statistical software for data analysis. The necessary assumption of Cox-proportional hazard regression model was checked using the Schoenfeld residual test and the Log-Log plot. The hemodialysis cohort characteristics of continuous data were described in terms of central tendency (mean or median), dispersion (standard deviation or interquartile range) and in the frequency distribution for categorical data. Finally, the outcomes of hemodialysis patients were dichotomized into censored or event categories. The Kaplan–Meier survival curve was used to estimate survival time, and log rank test was used to compare the survival curves. Bivariable Cox proportional hazard regression model was fitted for each explanatory variable and those variables having p-value ≤ 0.25 in bivariate analysis were fitted into the multivariable Cox proportional hazard regression model. Hazard ratio with 95% confidence interval and p-values were used to measure the strength of association and to identify statistically significant predictors. In the multivariable analysis, variables having P-value <0.05 were considered as significant predictors of congestive heart failure.

Ethical Considerations

The study was conducted after getting ethical clearance from the research and ethical committee of the Health Science College of Debre Markos University. Permission was taken from Felege Hiote Referral Hospital. The information collected from the medical records was used only for research purposes and kept confidential. In addition to this in order to maintain confidentiality, study subjects are not identified by name.

Result

Socio Demographic Characteristics of Study Participants

In this retrospective cohort study, a total of 205 hemodialysis patients at Felege Hiote Referral Hospital from the period of January 1, 2016 to February 29, 2020 were included. From the total respondents more than half, 115 (56.1%) of them were males and 143 (69.8%) were rural residents. Regarding their occupation about 107 (52.2%) were merchants followed by farmers (46, 22.44%) (see Table 1).

Clinical Characteristics of Study Participants

This study revealed that about 20 (9.76%) of the study participants had comorbidities (40% COPD followed by 35% hypertension) and 16 (7.80%) had a history of hospitalization after the initiation of dialysis. In addition to this 19 (9.27%) participants had a family history of CHF and 124 (60.49%) of them were taking prescribed medication

Table 1 Baseline Socio Demographic and Behavioral Characteristics of Dialysis Patients at Felege Hiote Referral Hospital, Ethiopia .

Variables	Characteristics	Frequency	Percent (%)
Sex			
	Male	115	56.1
	Female	90	43.90
Age			
	18–35	136	66.34
	36–50	38	18.54
	>50	31	15.13
	Mean	39.9	
Place of residence			
	Urban	62	30.24
	Rural	143	69.76
Occupation			
	Farmer	46	22.44
	Employer	32	15.61
	Merchant	107	52.20
	Driver	14	6.83
	Other	6	2.93
Educational status			
	Unable to read and write	44	21.46
	Primary school	117	57.1
	Secondary school	23	11.22
	College and above	21	10.24
Marital status			
	Single	51	24.88
	Married	123	60.00
	Divorced	21	10.24
	Widowed	10	4.88
History of smoking			
	Yes	28	13.66
	No	177	86.34
History of alcohol use			
	Yes	30	14.63
	No	175	85.37
History of alcohol use and smoking			
	Yes	20	9.76
	No	185	90.24

(58.4% diuretics followed by 27.2% beta blockers) at dialysis initiation (see Table 2).

Incidence of CHF Among Dialysis Patients

The patients were followed for 4968 person years (PY). The mean, median and range of the follow-up time was

Table 2 Baseline Clinical Characteristics of the Dialysis Patients at Felege Hiote Referral Hospital, Ethiopia

Variables	Characteristics	Frequency	Percent
Time since initiation for dialysis			
	1–2 years	184	89.76
	2–4 years	21	10.24
History of hospitalization after dialysis			
	Yes	16	7.80
	No	189	92.20
Possible etiology of CKD (underlined causes)			
	Anemia	19	9.27
	RHD	174	84.88
	Hypertension	5	2.44
	Diabetes mellitus	2	0.98
	Other	5	2.44
Re-hospitalization in the last year			
	Yes	18	8.78
	No	187	91.22
Presence of comorbidity other than CHF			
	Yes	20	9.76
	No	185	90.24
Anemia during dialysis therapy			
	Yes	24	11.71
	No	181	88.29
Atherosclerosis			
	yes	30	
	No	175	85.37
BMI			
	<18.5	47	22.93
	18.5–25	147	71.71
	≥ 25	11	5.37
Family history of CHF			
	Yes	19	9.27
	No	186	90.73
Missing of appointment for dialysis			
	Yes	18	8.78
	No	187	91.22
History of cardiac surgery			
	Yes	5	2.44
	No	200	97.56
Medication at dialysis initiation			
	Yes	124	60.49
	No	81	39.51

(*Continued*)

Table 2 (Continued).

Variables	Characteristics	Frequency	Percent
Hemoglobin			
	<10	35	17.07
	10–15	143	69.76
	≥15	27	13.17
Hematocrit			
	<34	75	36.59
	34–42	101	49.27
	>42	29	14.15
HDL			
	<40	44	21.46
	40–50	42	20.49
	>50	119	58.05
LDL			
	<50	30	14.93
	50–130	140	69.65
	>130	31	15.42
Triglyceride			
	<150	171	83.41
	150–200	31	15.12
	>200	3	1.46
Serum albumin			
	<3.4	39	19.02
	3.4–5.4	100	48.78
	>5.4	66	32.20
Diastolic blood pressure			
	<60	29	14.15
	60–80	79	38.54
	≥80	97	47.32
Systolic blood pressure			
	<90	10	4.88
	90–120	101	49.27
	≥120	94	45.85
Heart rate			
	<72b/min	26	12.68
	≥72b/min	179	87.32
Serum calcium level			
	<8.5mg/dl	147	71.71
	8.5–10.5 mg/dl	25	12.20
	≥10.5 mg/dl	33	16.10
Serum potassium level (mg/dl)			
	<3.5	31	15.12
	3.5–5	42	20.49
	≥5	132	64.39
Serum urea level (mg/dl)			
	<5	30	14.71
	5–20	140	68.63
	≥20	34	16.67

found to be 2.1, 2 and 4 years (IQR=3) respectively. During the follow-up period, about 12 (5.9%) of the patients were CHF cases (events). The overall incidence rate ratio of CHF was found to be 2.9 per 100 PY with 95% CI. Among the 12 individuals reporting CHF 8 (66.7%) of them were males, 9 (75%) were from urban residences and about 5 (42%) of them were employers. Moreover, a relatively higher proportion of CHF, 6 (50%) was diagnosed among the age group of 18–35 years. In addition, the incidence rate was higher among patients with comorbidities (9; 75%) and who had a duration of 1–2 years (8; 66.7%) follow-up. In this study more than half (10; 83.3%) of the dialysis-congestive heart failure patients started medication during admission, commonly diuretics (58.4%) (Figure 1).

CHF Incidence Density

Two hundred and five study participants who were followed for different periods in 5 years produced 4968 PY of observation. Within the follow-up period, 12 patients were found to have post hemodialysis CHF. The overall CHF incidence density (ID) was 2.9 per 100 PY (12/418) and the mean survival time was 2 years (see Tables 3 and 4).

Predictors of Time to CHF Occurrence Among Dialysis Patients

In the bivariable Cox-regression analysis, significant predictors with p-value ≤0.25 of CHF were included: place of residence, occupation, presence of comorbidity, BMI, history of hospitalization, education, age, history of alcohol anemia during dialysis initiation, and medication at admission. To determine the independent predictors of CHF a multivariable Cox-proportional hazard adjusted model was fitted after the proportional hazard assumptions were checked with global test = 0.94, log rank test for significantly associated variables at the multivariable analysis (sex = 0.04, place of residence = 0.03, education = 0.001, BMI = 0.001, presence of comorbidity = 0.02, anemia during dialysis initiation = 0.03) and by graphical assessment method for categorical variables. Finally, sex, place of residence, education, BMI, presence of comorbidity, and anemia during dialysis initiation time were predictors of CHF among dialysis patients. Accordingly, male hemodialysis patients have 1.5 times higher risk of developing CHF compared with female patients (incidence rate ratio (95% CI: 1.5 (1.8 −12.1), p= 0.04) (Figure 2).

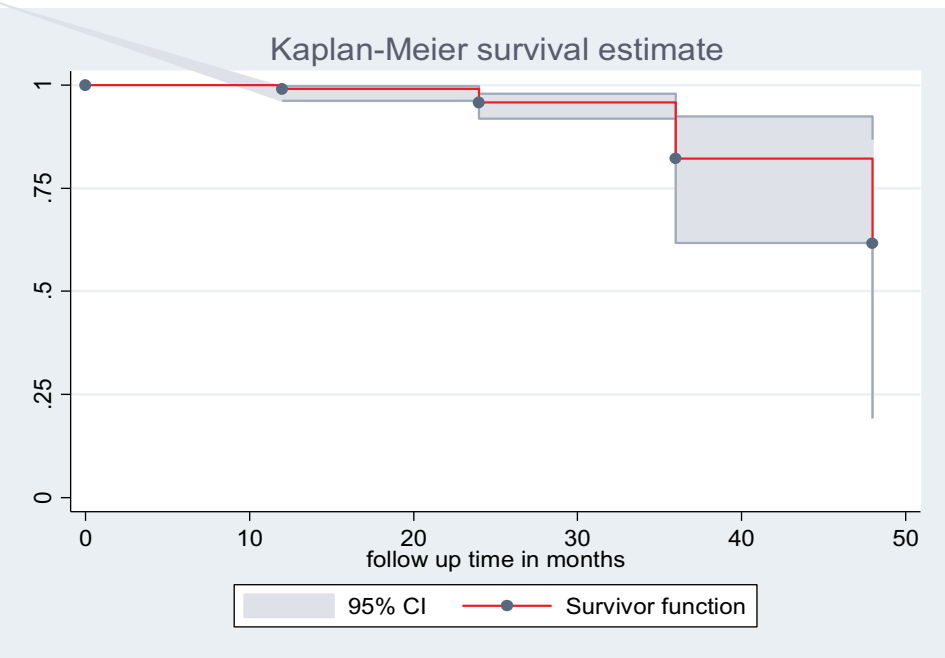

Figure 1 The overall Kaplan–Meier survival curve with 95% confidence interval showing the survival time of patients with CHF at Felege Hiote Referral Hospital, Northwest Ethiopia, 2020.

In addition to sex, type of residence was significantly associated with CHF. Accordingly, patients from rural areas had 2.5 times higher risk of developing CHF compared with urban residents (95% CI: 2.5 (2 −14.4), p= 0.01) (Figure 3).

Body mass index is another determining factor for CHF. Accordingly, underweight patients (BMI < 18.5) are 1.6 times more likely to develop CHF than those with normal body weight (BMI 18.5–25) (95% CI: 1.6 (8 −16), p = 002) (Figure 4).

On the other hand, patients with comorbidity are 6.9 times more likely to develop CHF than those without (95% CI: 6.9 (2.1 −12), p = 0.02) (Figure 5).

Moreover, hemodialysis patients with anemia at the time of hemodialysis initiation are 2.2 times more likely

Table 3 Baseline Socio-Demographic, Clinical and Behavioral Characteristics of Dialysis Patients at Felege Hiote Referral Hospital from January 1, 2016 to February 29, 2020

Variables	Characteristics	Frequency	Percent (%)	PY	CHF	CHFID
Sex						
	Male	115	56.1	2820	8	0.003
	Female	90	43.9	2148	4	0.002
Age						
	18–35	136	66.34	3240	6	0.002
	36–50	38	18.54	924	5	0.005
	>50	31	14.13	804	1	0.001
Place of residence						
	Urban	65	1536	441.3	9	0.01
	Rural	140	68.29	3432	3	0.001
BMI	< 18.5	47	22.93	1104	7	0.006
	18.5–25	147	71.71	3432	5	0.001
	≥ 25	11	5.37			

(*Continued*)

Table 3 (Continued).

Variables	Characteristics	Frequency	Percent (%)	PY	CHF	CHFID
Occupation						
	Farmer	46	22.44	1128	2	0.002
	Merchant	107	52.20	2580	3	0.001
	Employer	32	15.61	780	5	0.006
	Driver	14	6.83	348		
	Others	6	2.93	132	2	0.015
Educational status						
	Unable to read and write	44	21.46	1104	4	0.003
	primary school	117	57.07	2796	2	0.001
	Secondary School	23	11.22	564	2	0.004
	College and above	21	10.24	504	4	0.001
Marital status						
	Single	51	24.88	1260	3	0.002
	Married	123	60	2988	8	0.003
	Divorced	21	10.24	480	1	0.002
	Widowed	10	4.88	240		
History of smoking						
	Yes	28	13.66	720	1	0.001
	No	177	86.34	4248	11	0.002
History of alcohol use						
	Yes	30	14.63	732	4	0.005
	No	175	85.37	4236	8	0.001
History of alcohol use and smoking						
	Yes	20	9.76	492	1	0.002
	No	185	90.24	4476	11	0.002
Time since diagnosis of CHF						
	1–2 years	184	89.76	4164	8	0.001
	2–4 years	21	10.24	804	4	0.004
History of hospitalization after dialysis						
	Yes	16	7.80	420	2	0.004
	No	189	92.20	4548	10	0.002
Possible etiology for CKD (underlined causes)						
	Anemia	19	9.27	408	5	0.012
	RHD	174	84.88	4272	2	
	Hypertension	5	2.44	108		0.018
	DM	2	0.98	48	1	0.02
	Other	5	2.44	132	4	0.03
Re-hospitalization in the last year						
	Yes	18	8.78	432	4	0.009
	No	187	91.22	4536	8	0.002
Presence of comorbidity						
	Yes	20	9.76	528	6	0.011
	No	185	90.24	4440	6	0.001

(*Continued*)

Table 3 (Continued).

Variables	Characteristics	Frequency	Percent (%)	PY	CHF	CHFID
Anemia during the initiation of dialysis therapy						
	Yes	24	11.71	636	5	0.007
	No	181	88.29	4332	7	0.001
Atherosclerosis						
	Yes	30	14.63	756	2	0.002
	No	175	85.37	4212	10	0.002
Family history of CHF						
	Yes	19	9.27	480	2	0.004
	No	186	90.73	4488	10	0.002
Missing of appointment for dialysis						
	Yes	18	8.78	480	3	0.006
	No	187	91.22	4488	9	0.002
Medication at admission						
	Yes	124	60.49	3012	10	0.003
	No	81	39.51	1956	2	0.001
Hemoglobin						
	<10	35	17.07	960	4	0.004
	10–15	143	69.76	3396	8	0.002
	≥15	27	13.17	612		
Hematocrit						
	<34	75	36.59	1812	2	0.001
	34–42	101	49.27	2496	8	0.003
	>42	29	14.15	660	2	0.003
HDL						
	<40	44	21.46	1080	5	0.004
	40–50	42	20.49	1032	3	0.002
	>50	119	58.05	2856	4	0.001
LDL						
	<50	30	14.93	696	1	0.001
	50–130	140	69.65	3456	7	0.002
	>130	31	15.42	732	4	0.005
Triglyceride						
	<150	171	83.41	4128	5	0.001
	150–200	31	15.12	768	7	0.009
	>200	3	1.46	72	0	
Serum albumin						
	<3.4	39	19.02	948	4	0.004
	3.4–5.4	100	48.78	2520	5	0.001
	>5.4	66	32.20	1500	3	0.002
Diastolic blood pressure						
	<60	29	14.15	720	1	0.001
	60–80	79	38.54	1908	2	0.001
	≥80	97	47.32	2340	9	0.003

(*Continued*)

Table 3 (Continued).

Variables	Characteristics	Frequency	Percent (%)	PY	CHF	CHFID
Systolic blood pressure						
	<90	10	4.88	240	1	0.004
	90–120	101	49.27	2460	3	0.001
	≥120	94	45.85	2268	8	0.003
Heart rate						
	<72b/min	26	12.68	696	5	0.007
	≥72b/min	179	87.32	4272	7	0.001
Serum calcium level						
	<8.5mg/dl	147	71.71	3528	5	0.001
	8.5–10.5 mg/dl	25	12.20	624	2	0.003
	≥10.5 mg/dl	33	16.10	816	5	0.006
Serum potassium level(mg/dl)						
	<3.5	31	15.12	768	2	0.002
	3.5–5	42	20.49	1092	7	0.006
	≥5	132	64.39	3108	3	0.001
Serum urea level(mg/dl)						
	<5	30	14.71	768		
	5–20	140	68.63	3360	9	0.003
	≥20	34	16.67	816	3	0.003

Abbreviations: BMI, body mass index; CHF, congestive heart failure; DCHF, dialytic congestive heart failure.

Table 4 CHF Incidence Density Rate Stratified by Socio-Demographic, Clinical and Behavioral Characteristics of Dialysis Patients at Felege Hiote Referral Hospital from January 1, 2016 to February 29, 2020

Variables	Frequency	PY	CHF	CHF IDR	CHR (95% CI)	p-value	AHR (95% CI)	p-value
Sex								
Male	115	2820	8	0.003	0.7(0.22–2.45)	0.61	1.5(1.8 −12.1)	0.04*
Female	90	2148	4	0.002	1.00		1.00	
Age								
18–35	136	3240	6	0.002	1.00			
36–50	38	924	5	0.005	2.4(0.75–8.2)	0.13	4(0.23–11)	0.71
>50	31	804	1	001	0.49(0.06–4.17)	0.52	2.1(0.01–17)	0.66
Place of residence								
Urban	65	441.3	9	0.01	1.00		1.00	
Rural	140	3432	3	0.001	0.16(0.04 −0.60)	0.01	2.5(2 −14.4)	0.01*
Educational status								
Unable to read and write	44	1104	4	0.004	0.33(0.08–1.39)	0.13	1.9(5–16.9)	0.04*
Primary school	117	2796	2	0.001	0.1(0.01–0.48)	0.01	3(0.5–9.9)	0.09
Secondary school	23	564	2	0.004	0.36(06 −2.11)	0.261	9(0.4–21)	0.16
College and above	21	504	4	0.008	1.00			
BMI								
< 18.5	47	1104	7	0.006	0.26(0.08 −.86)	0.03	1.6(8 −16)	002*
18.5–25	147	3432	5	0.001	1.00		1.00	
≥ 25	11	1104			2.33(0.91–4.3)	0.62	3.3(0.91–4.3)	

(*Continued*)

Table 4 (Continued).

Variables	Frequency	PY	CHF	CHF IDR	CHR (95% CI)	p-value	AHR (95% CI)	p-value
Occupation								
Farmer	46	2580	2	0.002	1.1(0.72–6.86)	0.09	0.1(7.2–8.6)	0.59
Merchant	107	780	3	0.001	4.5(1.1–19.57)	0.04	2(0.5–19.57)	0.9
Employer	32	348	5	0.006	3.14(0.01–1.5)	1.00	4(0.2–2.4)	1.00
Driver	14	132			11(1.77–68.72)	0.01	2.4(0.3–6.8)	0.86
Others	6	1128	2	0.015	1.00		1.00	
History of hospitalization								
Yes	16	420	2	0.004	1.00		1.00	
No	189	4548	10	0.002	1.2(0.23 −6.00)	0.83	0.8(0.04 −14.8)	0.87
Presence of comorbidity								
Yes	20	528	6	0.011	6.1(1.77–20.88)	0.01	6.9(2.1 −12)	0.02*
No	185	4440	6	0.001	1.-00		1.00	
Anemia during dialysis initiation								
Yes	24	636	5	0.007	3.3(0.92–11.56)	0.07	2.2(2–11)	0.04*
No	181	4332	7	0.001	1.00			
Atherosclerosis	9							
Yes	30	480	2	0.002	1.3(0.27–6.32)	0.34	4(0.7–7.7)	0.67
No	175	4488	10	0.002	1.00		1.00	
Family history of CHF								
Yes	19	480	2	0.004	1.3(0.26–6.11)	0.75	0.23(0.02 −4.7)	0.34
No	186	4488	10	0.002	1.00		1.00	
Medication at admission								
Yes	124	3012	10	0.003	3.11(0.68–14.25)	0.14	2.3(0.26 −12)	0.71
No	81	1956	2	0.001	1.00		1.00	
History of smoking								
Yes	28	720	1	0.002	0.36(0.05–2.9)	0.34	6(0.01–9)	0.82
No	177	4248	11	0.003	1.00		1.00	
History of alcohol use								
Yes	30	732	4	0.005	2.2(0.64–7.72)	0.2	3(4–7.7)	0.01*
No	175	4236		0.002	1.00		1.00	
History of smoking and alcohol use								
Yes	20	492	1	0.002	0.66(0.08–5.32)		7(0.01–32)	0.9
No	185	4476	11	0.002	1.00		1.00	
History of hospitalization								
Yes	16	420	2	0.005	1.2(1.3–6.00)	0.21	2(3–8.00)	0.65
No	189	4548	10	0.002	1.00		1.00	
Hgb1								
< 7	35	960	4	0.004	4.8(0.37–56)	0.34		0.76
7–10	143	3396	8	0.002	2(0.2–5)	0.9	3.2(0.4–9)	0.88
≥10	27	612			1.00		1.00	
HDL								
≤40	44	1080	5	0.005	1.00		1.00	
40–60	42	1032	3	0.003	2.1(0.23–18.38)		4(0.3–1.4)	0.4
≥60	119	2856	4	0.002	0.2(0.02 −1.4)		2(0.08 −11)	0.81

Note: *Significantly associated variables.

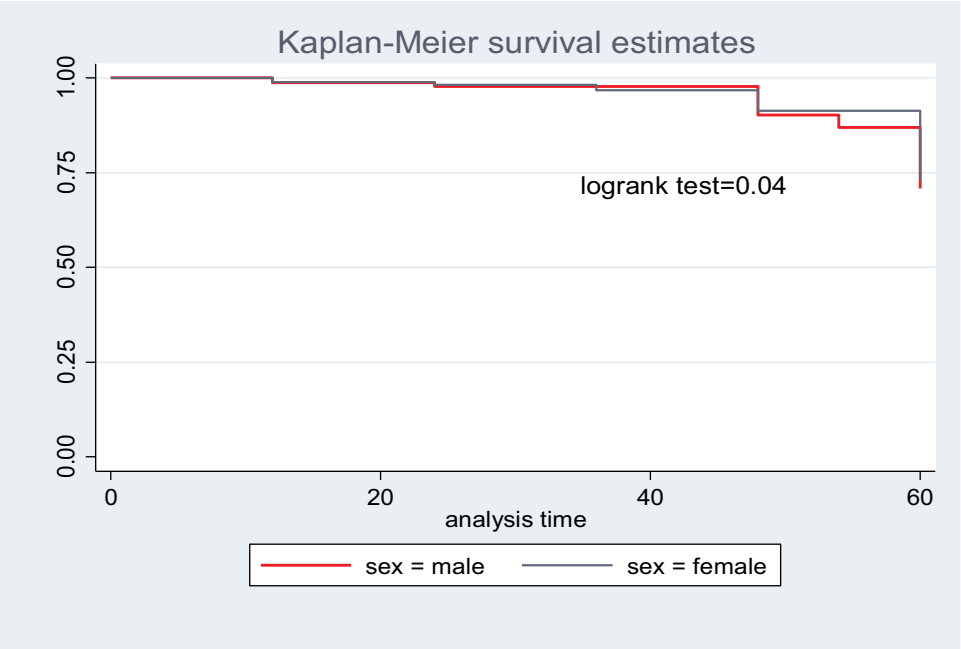

Figure 2 The Kaplan–Meier survival curves comparing the CHF incidence probabilities of hemodialysis patients based on their sex.

to develop CHF than those without (95% CI: 2.2 (2–11), p = 0.04) (Figure 6).

Discussion

Despite numerous interventions made to prevent CHF, it remains a serious global public health concern, especially in low- and middle-income countries. Therefore, we conducted this retrospective cohort study to determine the incidence of CHF among dialysis patients at Felege Hiote Referral Hospital, Ethiopia. The overall incidence rate of CHF at Felege Hiote Referral Hospital was found to be 2.9 per 100 PY. This finding is lower than the results of studies conducted in America (7.9/100 PY, 22 per 1000 PY).[9,10] However, this finding is higher than findings

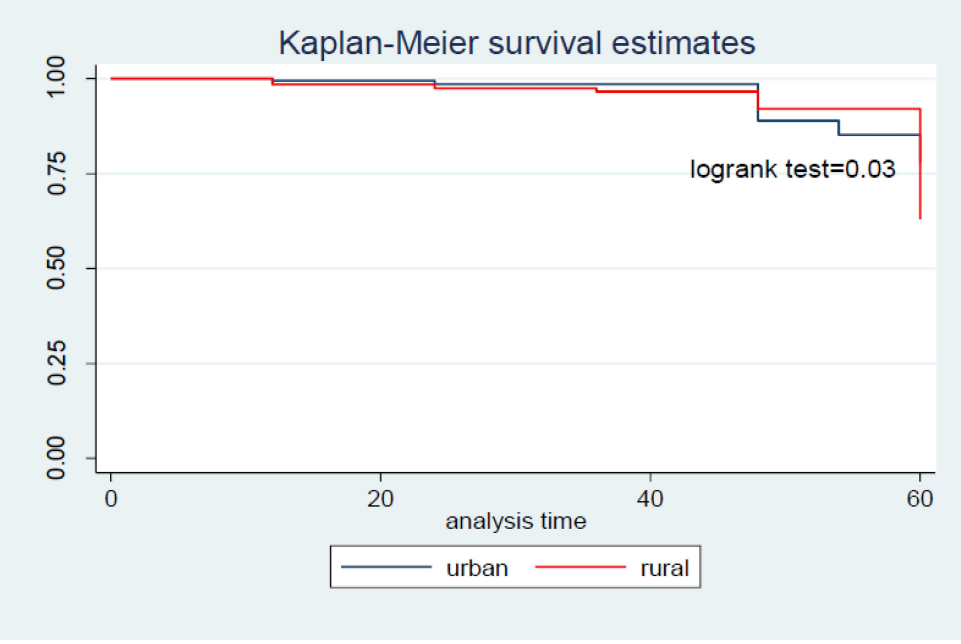

Figure 3 The Kaplan–Meier survival curves comparing the CHF incidence probabilities of hemodialysis patients based on their place residence.

reported from Spain (0.17 to 0. 21)[11] and America (0.38).[12] The above variations between studies could be explained, in part, by the differences in sample size, study settings, follow-up period, and socio-demographic characteristics of study participants. In addition, geographic differences might explain in part the differences in age expectancy and prevalence of comorbidities (diabetes, CAD and other cardiovascular diseases), as could the different criteria for diagnosing and defining CHF.

In this cohort study, male sex is significantly associated with CHF. Accordingly, male hemodialysis patients are 1.5 times at higher risk of developing CHF compared with female patients (95% CI: 1.5 (1.8 −12.1), p = 0.04). This study finding is consistent with other findings reported from the UK,[13] Australia,[14] China,[15] Canada[16] and Nigeria[17] which showed that male sex is a predictor for onset of CHF and its survival rate. On the other hand, patients who are rural residents are 2.5 times at higher risk of developing CHF compared with urban residents (95% CI: 2.5 (2 −14.4), p = 0.01). However, a study in Brazil reported that differences between urban and rural residency.[18] The variations between studies could be explained, in part, by the differences in sample size, study settings, follow-up period, and socio-demographic characteristics as well as socio-economic characteristics of study participants.

Hemodialysis patients having comorbidity were 6.9 times more likely to develop CHF than those with no other diagnoses (95% CI: 6.9 (2.1 −12), p = 0.02. The finding of this study is consistent with studies conducted in America,[12,19] Australia,[14] New Zealand,[20] Germany[21] and Tanzania.[12]

Anemia during dialysis initiation was significantly associated with CHF. Accordingly, patients with anemia at the time of dialysis initiation are 2.2 times more likely to develop CHF than non-anemic patients (95% CI: 2.2 (2–11), p = 0.04). This is consistent with studies in the USA[9] and Tanzania.[22] In this study level of education is an important predictor for CHF. Accordingly patients who are unable to read and write were 1.9 times more likely to develop CHF than those who are educated to college level and above (95% CI: 1.9 (5–16.9), p = 0.04). It is already known that as levels of education increase so do patients' awareness of their illness and self-management. A similar study in Ethiopia reported statistically significant positive associations between self-management and education.[23]

In addition, our study demonstrated that underweight patients (BMI <18.5) are 1.6 times more likely to develop CHF than those who have normal weight (BMI 18.5–25). This finding is in line with a systematic review in Asia,[24] the USA[25,26], Sweden[25] and Germany.[27] According to the above studies extremely low BMI may continue to pose greater hemodynamic stress on the heart that could be deleterious and compromise the pumping ability of the heart. This situation highly compromises the blood perfusion of the body and

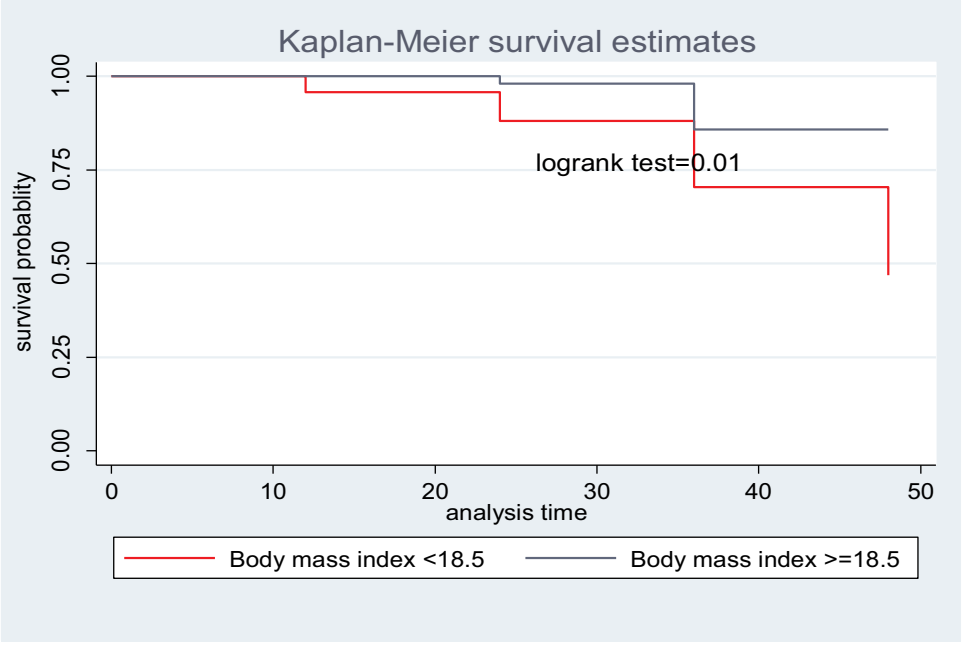

Figure 4 The Kaplan–Meier survival curves comparing the CHF incidence probabilities of hemodialysis patients based on comorbidity status.

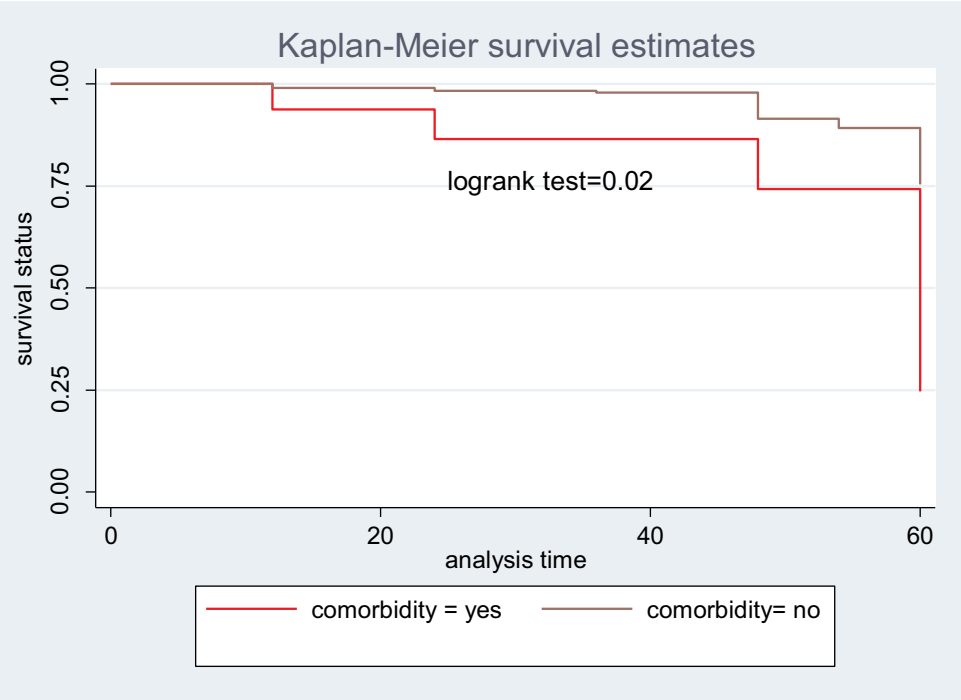

Figure 5 The Kaplan–Meier survival curves comparing the CHF incidence probabilities of hemodialysis patients based on their anemic status at the time of hemodialysis initiation.

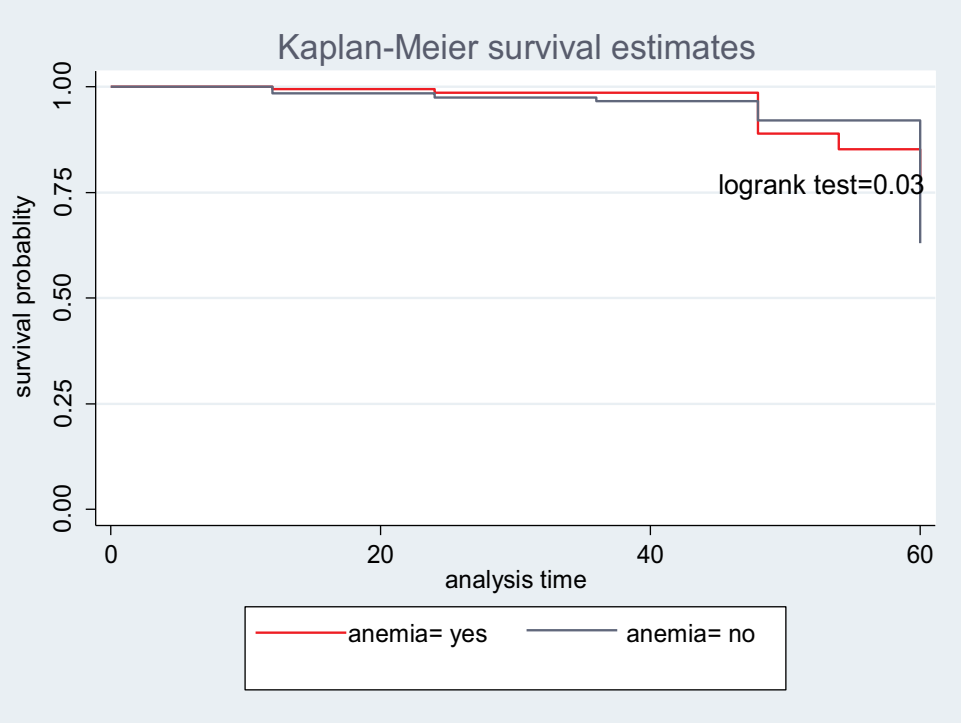

Figure 6 The Kaplan–Meier survival curves comparing the CHF incidence probabilities of hemodialysis patients based on body mass index.

the heart itself and can cause heart failure. However, this study finding is inconsistent with some findings reported from Denmark[28] and the USA.[29] The variations between studies could be explained, in part, by the differences in sample size, study settings, follow-up period, and socio-demographic characteristics as well as socio-economic characteristics of study participants.

Limitations of the Study

This study has a number of limitations. Firstly, secondary data were used, consequently important variables could be missed. Furthermore, the impact of providers' training, supplies, equipment, and hospital service contexts has not been explored.

Conclusion

In five years of a hemodialysis cohort, the overall incidence of CHF was high among patients at Felege Hiote Referral Hospital. Finally, male sex, place of residence, education (unable to read and write), BMI, presence of comorbidity and anemia during dialysis initiation time were predictors of CHF among hemodialysis patients.

Special attention should be given for male patients, rural residence, patients who cannot read and write, with low BMI (≤18.5), with comorbidities, and anemic during dialysis initiation time to reduce the risk of CHF incidence by improving modifiable risk factors. Furthermore, a prospective cohort study should be conducted to make clear relations between predictors and CHF incidence among hemodialysis patients.

Abbreviations

ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin receptor blockers; CKD, chronic kidney disease; HF, heart failure; CHF, congestive heart failure; MICU, Medical Intensive Care Unit; NCD, non communicable disease.

Data Sharing Statement

The dataset will not be shared in order to protect the participants' identities but it is available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Institutional Review Committee of the College of Health Sciences, Debre Markos University. Oral permission was obtained from the hospital administrations. To ensure confidentiality, all collected data were coded and locked in a separate room prior to the data entry process. After entering of data into the computer, all data were locked by password. Participant names were not included in the data collection format, and the data were not disclosed to any person other than principal investigators.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest for this work.

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