

# Time to death from chronic heart failure among outpatient Treatment: a retrospective cohort study

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## Research note

**Keywords:** Chronic heart failure, Retrospective cohort study, Outpatient, treatment, Wollo, Ethiopia

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# Abstract

**Abstract Objective:** Chronic heart failure is a complex clinical syndrome of functional or structural impairment in the heart. Even though the occurrences of heart failure is increasing in the world, there has been limited researches on the management of chronic heart failure in outpatient, particularly in the study area. Therefore, this study was aimed for the management of outpatients with chronic heart failure. A Retrospective cohort study was conducted from January 1, 2010, to December 30, 2016, on outpatient's follow-up at Wollo governmental hospitals. A required sample of 487 patients were selected by using a simple random sampling method. Proportional hazard with weibull distribution was modelled since its coefficients more precise than other parametric Cox models. Result: Weibull proportional hazard model result showed that risk factors related to mortality were Age (HR=1.04, p=0.000), Rural in residence (HR=1.74, p=0.003), having poor Nutritional status (HR=3.12, p=0.000), Systolic blood pressure (HR=1.01, p=0.037), having Coronary Artery disease (HR=3.70, p=0.006), having Pneumonia (HR=1.91, p=0.015 and infection with Tuberculosis bacillus (HR=1.87, p=0.000) were found statistically significant. Hence, early identifying and treating of Chronic heart failure and improving a strategies of frequent monitoring and follow up for outpatients is highly recommended . Keywords: Chronic heart failure, Retrospective cohort study, Outpatient, treatment, Wollo, Ethiopia

## Introduction

Chronic Heart Failure (CHF) is a complex clinical syndrome in which there is a functional or structural impairment in the heart[1]. Heart failure (HF) is progressive and irreversible which occurs more slowly because of damage to the heart muscle, building up through time due to disease of the heart or a blood vessel leading from the heart as a result of various diseases, accordingly it is a serious clinical condition which represents the end-stage of numerous other cardiac disease[2]. Now a day's heart failure become a major clinical problem worldwide, reaching an epidemic level in the developed world with no known cure at this time[2]. Approximately 26 million people worldwide are living with heart failure, and nearly 1 million new cases are diagnosed annually worldwide and in economically developed countries, up to one person in five is expected to develop heart failure at some point in their life[2] and it affects one to three percent of the overall population[3,4]. Thus, the prevalence of heart failure has been shown to follow an exponential pattern, which rises with age and affects 6% to 10% of people over age 65[3–7]. Compared to studies from other parts of the world, heart failure in Africa tends to occur at a much younger age with most cases recorded around the 5th and 6th decade and it is not a disease of the elderly in sub-Saharan Africa[2]. This young age reflect the major contribution of rheumatic valvular disease to heart failure, but could also be accounted for infections as it remain a common cause of heart failure in many parts of the world including Africa and can strike at any age.. Hospital case fatality among those with heart failure in Africa ranges from 9% to 12.5%. This consistent death rate ranks heart failure among the major causes of death of cardiovascular origin in Africa [5,6]. In a study conducted in Ghana, HF had 76% prevalence for contributing to cardiovascular disease burden in sub-Saharan Africa[8].

The prevalence and mortality associated with major non-communicable diseases in Ethiopia found cardiovascular disease accounted for 3%–12.6% hospital admission and found to have increased between 1970s and 2000s and congestive heart failure reported to have caused 2.5% of deaths among all age-groups in a sampled hospital-based mortality study[9]. According to the 2017 Wollo Zonal Health Administrative Office report, on causes of death in found that, the leading cause of death was cardiovascular disease causing 2.4% of all death.

However, the limited work on the area especially for outpatient's management for long-term prognosis associated with CHF has initiated the researcher by fitting a statistical model that can explain the data in the most meaningful manner.

## **Methods**

### **Study design and Setting**

An institution based retrospective cohort study was conducted on 487 chronic heart failure patients from January 1, 2010 to December 30, 2016. Wollo is found 253.7 Km from Addis Ababa, the capital of Ethiopia. It has a total of one general and one referral hospitals but both Woldia general and Dessie referral governmental hospitals provide CHF treatment services. Those hospital serves as a teaching and referral hospital with a catchment of 7.5 million people[10]. According to the 2017 Zonal Health Administrative Office report, only these two hospitals gave CHF treatment services to 1200 patients.

### **Source population**

All chronic heart failure patients attend at Woldia general and Dessie referral hospitals during January 1, 2010 to December 30, 2016.

### **Sample size and sampling procedures**

All chronic heart failure patients who follow up both at Woldia general and Dessie referral hospitals were included in the study. However, patients died with other than CHF, a patients first seen department is not CHF case and patients or who had no a reliable results and severely ill(patients in intensive care unit) were excluded. ie required sample size was calculated using the single population formula by considering the proportion of death in CHF as 12.5% taken from a previous study in Gonder[5],a 95% confidence interval(CI) and 3% margin of error(d);the final sample was 487patients chart were reviewed. First, the hospitals were stratified into General and Referral hospitals. Then, by the random sampling method, 1 general and 1 referral hospital were selected. Finally, using systematic random sampling method and proportional allocation to each selected hospitals,487 out of 1160 CHF patients were selected and reviewed their charts.

# Measurements

The outcome variable is time to death measures the time from a defined starting point to the occurrence of a given event and actually the event of interest is death, however if the event of death is not occurred within or more than the defined study period, we considered the event as censored.

## Data collection tools and techniques

From the patient's chart, the length of treatment from outward entry to event or censoring and the event of interest is death up to the defined study period and risk factors such as a baseline age, Sex, Residence, Marital status, Educational status, religion, weight, Baseline heart rate, Systolic blood pressure(Sbp), Nutritional status(Nut), Smoking, Alcoholism, and Presence of Diabetes mellitus(DM), Hypertension(HTN), Stroke, Coronary Artery Diseases(CAD), Tuberculosis Bacillus(TB), Human immune Virus(HIV), Pneumonia and Coronary Kidney Disease (CKD) as a comorbidity were reviewed retrospectively. A total of 6 trained data collectors(BSc.in Nurse) and two supervisors(Msc. in biostatistics) were involved in the data collection process. i.e. purposes and objectives of the study were clearly explained to participants before data collection

## Data quality controls

One supervisor and three data collectors were selected from each hospital and they were trained how they collect data from chart and supervise accordingly for 3 days. Also they were practice how they review documents before the data collection. Then, the supervisors and investigators were closely follow the data collection process and ensure completeness and consistency of the collected information daily until data collection ends. During document review, any personal identifiers were not included.

## Data processing and analysis

After data collection data was cleaned and entered in SPSS version 20 and exported to STATA version 12 for analysis was used. First, both Kaplan-Meier (KM) [11] and Log-rank test (12)] were carried out to see the survival experience of factors along with its categories. Then, both bivariate and multivariable Cox proportional hazards model were carried out to identify factors associated with accelerating and decelerating time of death of a patient with CHF. In bivariate Cox proportional hazards model, variables with p-value less than 25% were considered into the multivariable analysis to control the possible effect of confounders. Hazard ratio with a 95% confidence interval(CI) was calculated to see the strength and significant associations. Variables having a p-value less than 0.05 in the Multivariable Cox proportional hazards model were considered as statistically significant.

## Results

# Sociodemographic,behavioral and health characteristics

A total of 487 Patients chart were reviewed, which makes a completeness of 100%. The overall death proportion was 42.1%, while 58.9% were centered. The majority(71.7%) of the patients were in the age range of 16–64 years. About 40.9% and 47.74% of patients were Males and died, While 59.1% and 38.19% were females respectively. About 56.7% and 43.11% of patients lived in urban areas and died, respectively. Likewise 13.3% and 91.23% of the patients were smoker and died. Moreover, 11.7% of patients had Diabetes mellitus as a co morbidity and 74.51% were died presented in (Table 1).

Table 1 Sociodemographic,behavioral and Health characteristics of patients in Woldia general and Dessie referral hospitals, Ethiopia, from January 1, 2010, to December 30, 2016(n = 487).

Variables	Status		
	Event/Death	Censored	Percentage of Death
<b>Sex</b>			
Male	95	104	47.74
Female	110	178	38.19
<b>Residence</b>			
Urban	119	157	43.11
Rural	86	125	40.76
<b>Nutritional status</b>			
Poor	157	148	51.48
Good	48	134	26.37
<b>Weight</b>			
Under	97	105	48.02
Normal	72	159	31.17
Over	36	18	66.67
<b>Marital Status</b>			
Single	31	84	26.96
Married	128	166	43.54
Others	46	32	41.03
<b>Smoking Status</b>			
No	153	277	35.58
Yes	52	5	91.23
<b>Religion</b>			
Orthodox	84	153	35.44
Muslim	121	129	48.4
<b>Educational status</b>			
Illiterate	70	98	41.67
Literate	135	184	97.12
<b>Alcoholism</b>			
No	177	267	39.86
Yes	28	15	65.12
<b>DM</b>			
No	167	269	38.3
Yes	38	13	74.51
<b>CKD</b>			

No	168	271	38.27
Yes	37	11	77.08
<b>Pneumonia</b>			
No	178	178	39.12
Yes	27	27	84.38
<b>CAD</b>			
No	188	279	40.26
Yes	17	3	85.0
<b>HTN</b>			
No	100	227	30.58
Yes	105	55	65.62
<b>Stroke</b>			
No	152	277	35.43
Yes	53	5	91.38
<b>TB</b>			
No	116	272	29.90
Yes	89	10	89.90
<b>HIV</b>			
No	147	262	36.48
Yes	64	20	76.19

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## Survival experience of the patient along with categorical factors

Both the log rank test and the Kaplan Meier curve result suggests that Sex, Religion, Residence, Nutritional status, smoking status, Weight, Diabetic Mellitus, presence of Hypertension, Chronic kidney disease, Stroke, pneumonia, coronary artery disease, Tuberculosis, and HIV status are significant covariates whose different levels have an impact in the survival longevity of patients, while Alcoholism, Marital status and Educational status have no effect along with its different levels.

## Comparison model estimate

According to [13], a model with more precise coefficients can be considered as a more precise model, which expected to better explains the effect of predictors on outcome or the smaller the better Akaike information criteria (AIC) and Bayesian information criteria (BIC) were Weibull Cox PH model, since it have the minimum AIC value of 735.4757 presented in (Table 2).

Table 2 Comparison model estimate through AIC&BIC

Cox Proportional hazards models baseline distribution assumptions	AIC	BIC
Free	1934.25	1992.89
Weibull	735.4757*	827.6175*
Log logistic	758.1743	850.3162
Exponential	758.6276	846.5812

\*the best model which explains the factors effect on outcome, AIC&BIC was minimum.

## Factors contributing to shorten or longevity the survival time of the patient

Both bivariable and multivariable Weibull Cox proportional hazards regression analysis were done to see the effects of the selected variables on time to death of a patients with CHF. As it is shown Sex, Age, Residence, Nutritional Status, Heart Rate, Systolic Blood Pressure, Presence of Diabetes Mellitus, Hypertension, Pneumonia, Tuberculosis, Stroke and Coronary Artery Disease as co morbidity had significant associations with time to death in the bivariable analysis. However, in the multivariable Weibull Cox proportional hazards regression analysis Sex, Age, Residence, Nutritional status, Sbp, DM, Pneumonia, CAD and TB had significant associations with time to death. About urban resident patients had 3 times (HR = 3.1, 95% CI 1.9, 4.94) more likely to die than rural resident patients. Likewise patients had good nutrition were 3.12 times (HR = 3.12, 95% CI 1.8, 5.42) less likely to die than who had poor nutrition. Moreover, the presence of diabetes mellitus as a co morbidity were 0.12 times (HR = 0.12, 95% CI 0.205, 0.73) more likely die the their counterparts (see Table 3).

## Discussion

This study was intended to identify risk factors and compare semi parametric and parametric models to recommend the most parsimonious model that find the real effect of predictors on the survival time of patients with CHF at WGH and DRH, Wollo, Ethiopia from January 1, 2013 to December 30, 2017 medical ward outpatient follow up data. The survival time is measured in month. Accordingly, Cox PH model and parametric PH model and then the best model was selected using AIC&BIC, which is weibull Proportional model model explains better than other models so that the discussion was all about on the weibull PH model results. The total number of patients covered in the present study was 487, for which 202 were censored data and 285 were the event of death.

Sex is a prognostic factor in this study. The hazard of death (HR = 0.59, 95% CI, 0.371, 0.94) for female patient were 0.59 times less than men patients. This finding is consistent with the previous studies [14, 15], While [16] a multicenter Italian study suggests Females have more advanced disease than men even though sex is not statistically significant factor in regard to mortality. Since the subject's outpatients, Weibull PH model and the natural history of the disease or if it results from the influence of the underlying

etiology or from gender-dependent response to treatment as compared to the above studies might have contributed for the significance. As the age of the patient increase in years (HR = 1.04,P = 0.000), the hazard of death of outpatients with CHF was increased by 4%. This finding is consistent with the previous studies [2- 5],While[9,10]suggests age not significantly associated with CHF complications since the subject's outpatients and Weibull PH model as compared to the above studies might have contributed for the significance. The Hazard of the death of rural outpatients was 74% times longer life than urban outpatients(HR = 0.74,P = 0.003). This might be due to the different poisoning chemicals from the vehicles, industries, and suffocations.

As the Sbp of the patient increases in parts per second (HR = 1.01,95%CI,1.001,1.02) the survival rate of the patient were less by 1%. Also Patients had poor nutrition were 3.12 times (HR = 3.12, 95%CI,1.8,5.42) less survival rate than having good nutrition. This finding is consistent with the previous studies [10]. About the hazard of death for outpatients had Coronary artery disease as a comorbidity were higher than patients without Coronary artery disease by 2.7 (HR = 3.7,p = 0.006). This study Consistent with[19]suggests that the survival rate of patients had CAD as a co are worse. Likewise the survival rate of patients had DM (HR = 0.39,95%CI,0.205,0.73) as a co morbidity were 61% higher than its counterpart. While,[20] suggests that Debits mellitus as a co morbidity on CHF patients make more complex. as compared to the previous studies may be the physician give more care for patients had DM as co morbidity for getting better survival rate outcome. Finally, Patients had TB as a comorbidity had a worse survival rate (HR = 1.87,P = 0.000).

## Conclusion

Sex, Age, Residence, Nutritional status, Sbp, DM, Pneumonia, CAD and TB as a comorbidity were contributing factors for death. Since CHF is incurable disease, due attention must be given to those contributing factors by a strategy of a frequent follow up of a patient. Medicare coverage for home testing of CHF should be explained. Finally, modelling time varying factors will give better result to explain its effect on the patient survival time.

## Limitations Of The Study

Being missing some of important clinical variables attempt to our work did not establish the possible temporal relationship between dependent variables and independent variables. Besides, time varying factor effects were not addressed.

## List Of Abbreviations

The HIV-human immune virus, STATA- Statistical Data Analysis, CHF- Chronic heart failure, AIC-Akavian information criteria, BIC-Bayesian information criteria, ICU- Intensive Care Unit, HR- Hazard ratio, CKD- Coronary Kidney disease, CAD-Coronary Artery Disease, HTN-Hypertension, TB-Tuberculosis Bacillus, Sbp- Systolic blood pressure, Dm- Diabetes mellitus and Nut.-Nutritional status

## Declarations

We, declare that this study entitled "Time to death from chronic heart failure among outpatient Treatment: a retrospective cohort study." is our own work and has not been submitted in any form for any degree or diploma in this or another university

## Ethics approval and consent to the participant

Not applicable

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This study was funded by Woldia University which was not involved in the design of the study,data collection,analysis,and interpretation.

## Authors Contributions:

Authors Contributions: Conceptualization:HDM,YWB,BAW,EAK

Authors Contributions: Methodology:HDM,YWB,BAW

Authors Contributions: software:HDM

Authors Contributions: validation:HDM,YWB,BAW

Authors Contributions: formal analysis:HDM,YWB,BAW

Authors Contributions: investigation:HDM,YWB,BAW

Authors Contributions: resources:HDM,YWB,BAW,EAK

Authors Contributions: data curation:HDM,YWB,BAW

Authors Contributions:writing (original draft preparation):HDM,YWB,BAW

Authors Contributions: writing (review and editing):HDM,YWB,BAW

Authors Contributions: Visualization;HDM,YWB,BAW

Authors Contributions: supervision:HDM,YWB,BAW

Authors Contributions: project administration:HDM,YWB,BAW

Author Contributions: funding acquisition: HDM

# Availability of data and materials

Due to privacy concerns, a dataset is available upon request from the author Habtamu Dessie: [habtamudessie54@gmail.com](mailto:habtamudessie54@gmail.com)

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## Consent for publication

Not applicable

## Competing interests:

The authors have declared there is no competing interest.

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## Tables

Table 3: Weibull PH model result under the follow up of treatments in Woldia general and Dessie Referral Governmental Hospitals, from January 1, 2010, to December 30, 2016.

Factors	HR	S.E	Z	P-value	95% CI	
					Lower	Upper
<b>Sex(Ref.=Male)</b>						
<b>Female</b>	0.59	0.14	-2.23	0.026*	0.371	0.940
<b>Age</b>	1.04	0.01	4.40	0.000**	1.02	1.05
<b>Residence(Ref.=Urban)</b>						
<b>Rural</b>	0.74	0.33	0.94	0.003**	0.58	0.98
<b>Nut (Ref.=Good)</b>						
<b>Poor</b>	3.12	0.88	4.04	0.000**	1.80	5.42
<b>Smoking status (Ref.=No)</b>						
<b>Yes</b>	0.86	0.19	-0.71	0.479	0.560	1.31
<b>Alcoholism (Ref.=No)</b>						
<b>Yes</b>	1.24	0.38	0.70	0.482	0.68	2.27
<b>Baseline Heart rate</b>	1.005	0.006	0.79	0.431	0.993	1.02
<b>Sbp</b>	1.01	0.005	2.08	0.037*	1.001	1.02
<b>Dm(Ref.=No)</b>						
<b>Yes</b>	0.39	0.12	-2.95	0.003**	0.205	0.73
<b>CAD(Ref.=No)</b>						
<b>Yes</b>	3.7	3.18	2.75	0.006**	2.73	4.28
<b>CKD( Ref.=No)</b>						
<b>Yes</b>	1.294	0.343	0.97	0.331	0.77	2.18
<b>HIV (Ref.=No)</b>						
<b>Yes</b>	1.23	0.30	1.13	0.257	0.83	2.04
<b>HTN (Ref.=No)</b>						
<b>Yes</b>	1.43	0.281	1.82	0.069	0.973	2.51
<b>Stoke(Ref.=No)</b>						

<b>Yes</b>	1.14	0.28	0.52	0.600	0.71	1.83
<b>Pneumonia (Ref.=No)</b>						
<b>Yes</b>	1.91	0.51	2.43	0.015*	1.13	3.23
<b>TB (Ref.=No)</b>						
<b>Yes</b>	1.87	0.51	2.11	0.000**	1.06	2.08
<b>Constant</b>	0.00007	0.0001	-11.79	0.000**	0.000014	0.00033
<b>/ln_p</b>	0.31	0.06	5.32	0.000	0.19	0.42
<b>P</b>	1.36	0.08		1.21	1.52	
<b>1/p</b>	0.73	0.04		0.66	0.82	
<b>AIC</b>						<b>735.4757</b>
<b>BIC</b>						<b>827.6175</b>

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\*and \*\* significantly associated factor at a P value < 0.05 and < 0.01, respectively.

Log likelihood = -345.7385      LR chi2(21) = 273.09      Prob > chi2 = 0.0000