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Blood pressure parameters and the development of congestive heart failure among hypertensive patients at Kiambu County Hospital, Kenya.

Isabell Mac'oduol*[1], Joseph Thigiti[1], Lydia Maingi[2]

Affiliations:

1. *Department of family medicine, Kenyatta University*
2. *Department of psychology, Kenyatta University*

Corresponding author:
Name: Isabell Mac'oduol
P.O.Box 66905-00200, Nairobi, Kenya.
Email: isabelladhiambo@yahoo.com

ABSTRACT

Introduction:

Global incidence of heart failure is on increase. Heart failure has been shown to be on the increase with 1-3% admission rates globally and a 3-7% admission rate in the African hospitals. Hypertension (HTN) has been shown to play a pivotal role in the evolution and syndrome of heart failure where it is mostly non- ischemic in origin yet there are few studies on the association of the individual blood parameters and heart failure.

Objective: The study assessed the individual blood pressure parameters as prognosticators of congestive heart failure (CHF) in hypertensive patients.

Method: A retrospective study was carried out at Kiambu County Hospital, on 205 heart failure patients who met the Framingham Criteria. The parameters observed included the time of onset of CHF, systolic/ diastolic blood pressure, pulse pressure and their duration to the development of CHF. Multivariable cox proportional hazard regression models were used to determine the effects of individual blood pressure parameters relative to the onset of CHF.

Results: Overall, 205 patients were eligible for the study. Median time to CHF was estimated to be 4 years (range: 1-18), median age of CHF development was 65.7 years with a 68.8% female preponderance. Pulse pressure of 55-60 mm Hg (AHR: 2.21; 95%CI: 1.16-4.21), hypertension duration of 5-10 years (AHR: 0.14; 95%CI: 0.088-0.223) and over 10 years (AHR: 0.023; 95%CI: 0.010-0.050) were significantly associated with the development of CHF.

Conclusion: Pulse pressure is a better prognosticator of CHF in hypertensive patients with a hazard ratio of 2.2 times more likely in patients with a pulse pressure of 55-60 mmHg than those below 55mm Hg.

Keyword: Congestive heart failure, hypertension, hazard

Introduction

Cardiovascular diseases especially congestive heart failure and hypertension contribute significantly to deaths resulting from non-communicable diseases (NCD) [1]. Obesity, cigarette smoking, hypertension and diabetes are known risk factors which highly predispose patients to CHF. The global status report projects an increase in NCD deaths from 38 million in 2012 to 52 million by 2030. Globally there are 26 million patients with heart failure with 1-3% hospital admissions in US and Europe [4]. In Sub Saharan Africa, more than 3% of hospital admissions were attributed to heart failure with over 30% hospitalized for cardiovascular diseases[]. In Kenyatta National Hospital CHF accounts for 3.3% of all medical admissions [6]. The cause of heart failure in Africa was recorded as non-ischaemic as opposed to the Western world where it is predominantly ischaemic [7, 8] .
A study done in Ghana, showed a 76% prevalence of CHF, with 45% of patients diagnosed with CHF secondary to hypertention [9]. The prevalence in the African Region of hypertension was at 46% in adults older than 25 years, while Americans showed a lower prevalence of 35%[1]. In a Kenyan study conducted in one of the largest urban slums (Kibera), the prevalence of HTN was 23% with 60% being pre-hypertensive [10]. The Framingham heart study associated widening of the pulse pressure at cited levels of systolic BP, with an increased risk of developing heart failure [11].

There is conflicting data in the literature on which blood pressure parameter confers higher risk of developing CHF. The current study aims to examine y the systolic, diastolic, pulse pressure and correlates of CHF among HTN patients in Kiambu County Hospital.

Materials and Methods

This was a retrospective cross-sectional study among patients who developed CHF between the periods 2011 and 2018 in Kiambu County Hospital,in Central Kenya. Simple random sampling method was used to select the number of files to be retrieved. Adult patients (≥18 years) who met the Framingham Criteria for heart failure and

had developed CHF were eligible to participate. Pregnant women, critically ill patients, patients with ischemic heart disease, valvular heart disease and other non-ischemic cardiomyopathies were excluded from the study. The outcome variable was time to development of CHF as measured from the time of diagnosis with hypertension. Hypertension stage was defined following current guidelines (≥140/90mm Hg) [12]. Time to development of heart failure from diagnosis of hypertension was collected. CHF was reported based on history, clinical examination findings and or radiological findings (echocardiogram & electrocardiogram). Diabetes was defined as fasting blood sugar above 7.7mmol/l and random blood sugar above 11.1mmol/l .

The Statistical Package for Social Science version (SPSS) program version 20.0 was used for analysis of data. An average of one blood pressure reading per year (2011-2018) was taken from each of the 205 files, excluding the blood pressure on the day the patient developed CHF. Descriptive statistics was applied to test distribution differences of age, sex, marital status, BMI, smoking and history of diabetes. Multivariable cox proportional hazard regression models were used to show relations between the blood pressure parameters with time to the onset of CHF. `

This study was conducted after signed consent was sought from the patients and permission obtained from Kenyatta University Ethics Review Committee, National Council of Science and Technology and Kiambu County Hospital management.

Results

\In the analysis of the demographic characteristics of the patient (Table 1). , the mean age of the participants was 65.7 years (SD=15.6) where females were (6.8%) more than males. Majority (51.7%) of the participants were married and about 47.8% had no formal education.

Table 1: Demographic characteristics of Patients (n = 205)

Vriable	Freq.	%
Mean age in years (Sd)	65.7	
Gender		
Female	141	31.2
Male	64	68.8
Marital status		
Married	106	51.7
Single	17	8.3
Divorced	3	**1**.6
Separated	4	1.7
Widowed	**75**	36.6
Level of education		
No formal education	98	47.8
Primary education	56	27.3
Secondary education	48	23.4
Tertiary education	3	1.5

Figure.1 **is the distribution of the blood pressure parameters among the patients where most (53.7%), of the participants recorded SBP above 160mmHg, 55.1% had DBP above 90mmhg 113 and PP >60mmHg in 64.4% of the patients and there were few patients with pulse pressure 55-60mm Hg.**

Majority (58%) of the participants had hypertension duration of less than 5 years whereas 29.3% of the cases had suffered .hypertension duration of between 5-10 years. Period of development of CHF varied but this was within five years of diagnosis with hypertension in most of the patients (Table 2).

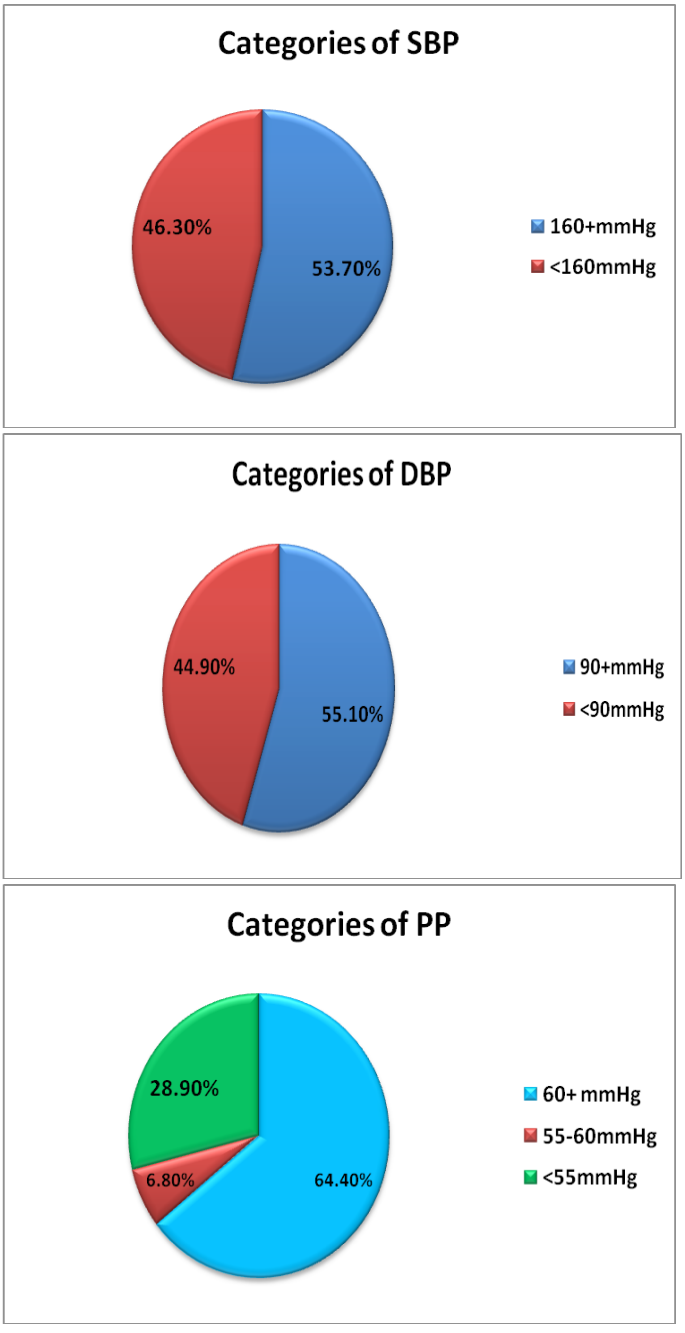

Figure 1: Distribution of the blood pressure parameters in hypertensive patients'

SBP = systolic blood pressure, DBP= diastolic blood pressure, PP= pulse pressure

Table 2: Blood pressure duration to the development of CHF in patients (n=205)

Blood parameters	Total	<5 yrs	5-10 yrs	>10yrs
Blood parameters	(%)	(%)	(%)	%
SBP group				
< 160 mm Hg	46.3	64.2	26.3	9.5
160+ mm Hg	53.7	52.7	31.8)	15.5
DBP group				
< 90 mm Hg	44.9	57.6	29.4	13.6
90+ mm Hg	55.1	58.4	29.2	12.4
PP Class				
< 55 mm Hg	28.9	64.4	27.1	8.5
55-60 mm Hg	6.8	64.3	35.7	0.0
60+ mm Hg	64.4	54.6	29.3	15.9

The mean duration from the time of the onset of hypertension in the patients to the time of the development of CHF was 4.76 years. Nearly all participants (94.6%). were on anti-ypertensive drugs. However up to 68.3% were not on regular follow up.

Table 3: Clinical characteristics and risk factors in the participants (n=205)

Variable	Mean	%
Clinical characteristics		
Mean duration HF	4.76	-
BMI	27.9	-
Risk factors	**Frequency**	
Patients on medication		
No	11	5.4
Yes	194	94.6
Smoker		
Current	14	6.8
Past	22	10.7
Never	169	82.4
Diabetic		
Yes	36	17.6
No	169	82.4
Regular follow up		
Yes	65	31.7
No	140	68.3

In the factors associated with Congestive heart failure in the bivariate analysis gender, hypertension for <5 years, patients not on follow-up, and 55-60 mm Hg of pulse pressure were significantly associated with development of CHF. The risk of females developing CHF was 36% greater than in males. Participants on follow-up faced a lower hazard of 74% than those who were not on follow-up. Those with pulse pressure of 55-60 mm Hg were 2.1 times more likely to face CHF (Table 4).

Pulse pressure of 55-60 mm Hg and having hypertension for <5 years were identified as predictor variables in the multivariate analysis . Majority of patients developed CHF within 5 years of diagnosis with hypertension, participants with hypertension that had lasted between 5-10 years faced a hazard rate that was only 14% of the hazard faced by the participants that had been hypertensive for < 5 years (AHR=0.14; 95%CI=0.088-0.223).

Table 4: Bivariate Cox proportional hazard models for patients' information

Variable	HR	95% CI	P-Value
Body Weight	1.01	0.99-1.02	0.095
BMI	1.003	0.98-1.03	0.782
Age	0.997	0.99-1.01	0.451
Sex			
Female	Ref		
Male	1.36	1.01-1.83	0.046
Marital Status			
Single	Ref		
Married	1.13	0.85-1.48	0.401
Education Level			
None	Ref		
Primary education	1.36	0.98-1.90	0.067
Secondary	1.29	0.92-1.81	0.144
Hypertension Duration			
<5 years	Ref		
5-10 years	0.16	0.101-0.24	< 0.0001
>10 years	0.03	0.012-0.055	< 0.0001
Regular Follow-up			
Yes	0.74	0.55-0.99	0.049
No	Ref		
Diabetic			
Yes	0.97	0.68-1.40	0.889
No			
Smoker			
Current	Ref		

Past	1.01	0.52-1.98	0.97
Never	0.60	0.35-1.04	0.068
Categories of DBP			
< 90 mm Hg	Ref		
90+ mm HG	1.10	0.83-1.45	0.511
Categories of SBP			
< 160 mm Hg	Ref		
160+ mm Hg	0.91	0.69-1.20	0.493
Categories of PP			
< 55 mm Hg	Ref		
55-60 mm Hg	2.10	1.16-3.80	0.014
> 60 mm Hg	0.91	0.67-1.24	0.557

Multivariate cox regression model in the development of CHF:

Patients with Pulse pressure between 55-60 mm Hg had a hazard of 2.2 times more than those with pulse pressure < 55 mm Hg (AHR=2.21; 95%CI=1.160-4.213). Diastolic and systolic blood pressure were not significantly associated with CHF (Table 5).

Table 5: Multivariate Cox regression estimates

Variables		**P-value**	**95% CI**
Gender			
Male	Ref		
Female	1.013	0.949	0.679-1.511
DBP	1.004	0.614	0.99-1.012
< 90 mm Hg	Ref		
90+ mm Hg	1.267	0.158	0.912-1.760
SBP	0.998	0.693	0.99-1.010
< 160 mm Hg	Ref		
160+ mm Hg	1.043	0.812	0.733-1.487
Pulse pressure			
< 55 mm Hg	Ref		
55-60 mm Hg	2.210	0.016	1.160-4.213
> 60 mm Hg	0.995	0.979	0.668-1.481
Hypertension Duration			
< 5 years	Ref		
5-10 Years	0.140	<0.0001	0.088-0.223
>10 Years	0.023	<0.0001	0.010-0.050
Regular follow-up			
No	Ref		
Yes	1.048	0.789	0.745-1.472

Discussion

The chief hazard of hypertension is often believed to be stroke. Framingham Study established that although its risk ratio is smaller than the one for stroke or heart failure, coronary disease is the most common hazard for hypertensive patients of all ages [2]. In the current study majority of patients (53.7%) had uncontrolled hypertension; systolic blood pressure above 160mmhg, diastolic above 90mmHg (55.1%) and 64.4% for the cases with pulse pressure above 60mmHg. This implied that hypertension was a major predictor of developing CHF, an observation which was also reported in a multicentre prospective study in nine countries in Sub Saharan Africa where the cause of CHF was non-ischemic in origin/ also attributed the condition mainly to hypertension [8].

The mean age of the participants was 65.7 years. Framingham's prospective heart study conducted in the U.S recorded a mean age of 61 years for patients who developed CHF[13]. The mean age of our study was higher than in the studies carried out in Sub Saharan Africa and in another study in Kenya where the median was 55 years and 52.2 years respectively [8, 14]. This difference in age could be due to the fact that the above studies drew their participants from diverse populations compared to our study which was mainly a representative of Kiambu County. Majority of the participants in this study were females, an observation which was also made in a matched prospective population study in the United States of America where 60% of the patients with uncontrolled hypertension who developed CHF were women [15] and in Ghana. A prepondence of females was also reported in a similar study in Ghana where the hazard of developing heart failure was higher in women than in men [9].

The hazard of females getting CHF was 36% greater than males in the current study (Bivariate analysis- p value 0.046). Similar findings were made in a multivariate analysis in the Framingham study in which hypertension was associated with 59% of heart failure cases in women ,and a 2-3 fold increased hazard of CHF after adjusting for age [16].

In the multivariate analysis, pulse pressure of 55-60 mmHg and hypertension for a duration of less than 5 years were identified as predictors in the development of CHF. The Patients with pulse pressure between 55-60mmHg faced a hazard of 2.2 times more likely to develop CHF than those with pulse pressure of <55mmHg (AHR=2.21; 95%CI=1.160-4.213). Pulse pressure was reported to rise blatantly after the fifth decade as a result of stiffening of the arteries with age[17] . Similarly, being elderly and post-menopausal was reported to cause increased pulse pressure which is in line with the findings in this study where most of the patients were female and above 65 years[18].

In conclusion, pulse pressure is a better prognosticator of CHF in hypertensive patients and there is with a hazard ratio of 2.2 times more likely in patients with a pulse pressure of 55-60 mHg than in those recording pressure below 55mm Hg. Pulse measurement could therefore be adopted as a useful tool in identification of the hazard of developing CHF in the elderly as the test points out to the onset of atherosclerosis and poor arterial compliance. Blood pressure control needs to be optimized by adequately training the health workers and actively screening the public for hypertension in an attempt to capture more males was mitigated by random sampling of the files with complete information. It is also noted that causality could not be determined in this type of study. The study setting used could only allow for internal validity of the research findings. These study findings were limited to CHF patients attending the Kiambu county hospital.

Disclosure:

No author expressed any potential of conflict of interest.

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