

## A RETROSPECTIVE LOW HEART RATE VARIABILITY OVERVIEW IN JOS, NIGERIA.

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### ABSTRACT

**Background;** Heart Rate Variability (HRV) describes the variations of both instantaneous heart rate and R-R intervals in an electrocardiogram. Low HRV is considered to be a non-invasive measurement of autonomic inactivity and propensity lethal arrhythmias.

**Methodology:** This was a retrospective study of patients with Low HRV over a 2 year period seen at the Jos University Teaching Hospital from January 2013 to December 2015.

**Result:** Subjects with low HRV were older (51 vs 42,  $p < 0.05$ ) years with low mean heart rate  $p < 0.05$ , compared to those with normal HRV. They all had severe features of cardiac dysfunction. Females with low HRV had decreased frequency of premature atrial contraction (PACs) (52% vs 78%). Only 5 (28%) cases out of 18 retrievable cases were still attending the out-patient department 6 months after the test.

**Conclusions:** Low HRV is common among patients who had Holter monitoring in our centre and was associated with poor patient outcome. The few incidence of atrial ectopics among females with low HRV suggests poor sympathetic autonomic function.

**Keywords;** Holter, retrospective, low heart rate, variability, Jos

### Introduction

Heart Rate Variability (HRV) is considered by scientists and physicians to be an excellent non-invasive measurement of autonomic activity and propensity to lethal arrhythmias [1]. It refers to the tiny beat-to-beat variations in individual's heart rate. There are different ways of analyzing this variation, but in its simplest form, HRV is calculated by taking the standard deviation of the differences in the inter-beat-interval. These differences are called SDNN, which stands for Standard Deviation of Normal to Normal intervals. Normally heart rate varies slightly due to physiological autonomic response, as we grow older these responses become diminished. HRV progressively decreases with worsening of heart failure [2].

It is only in the past 50 years that doctors have come to understand the variable nature of how the heart beats. Specifically, interest in HRV began in 1965 when researchers found that reduced beat-to-beat intervals indicated fetal distress prior to any meaningful change in actual fetal heart rate [3]. In 1977 doctors found that people who had had a myocardial infarction (heart attack) and had reduced

HRV were at a much greater risk for “post-infarction mortality” [4]. A lot of other additional studies have found similar results.

Diminished heart rate variability is associated with high sympathetic tone and an increased mortality rate in heart failure cases. [5] There is a relationship between HRV, high cholesterol, and cardiovascular health risk. [6] Diabetes researchers have found a similar pattern. Cardiac autonomic impairment was observed to be present at early stages of diabetic metabolic impairment and progressive worsening of autonomic cardiac function over 9 years was also observed in diabetic subjects. [7]

While research looking at the relationship of HRV and cancer seems to be more limited, there have been studies using HRV as a way to estimate remaining lifespan in terminally ill cancer patients [9,10].

**Of the HRV modify factors,** vigorous exercise appears to be the single biggest factor in improving (increasing) HRV. For men, total leisure-time

physical activity and both moderate- and vigorous-intensity activity were associated with higher HRV independent of age. [11] In sedentary, healthy young adults, aerobic conditioning but not strength training enhances autonomic control of the heart. [12] A study suggests that vagal modulation is enhanced with high levels of Physical Activity (PA) and that it is the number of bouts of vigorous PA that is most closely associated with central autonomic nervous system function.” [13]

Stress, especially chronic stress, can be a significant cause of low HRV, significant overtraining /exercising (think chronic cardio) will present itself similarly to chronic stress. Tracking daily changes in HRV can be a great indicator of an over-trained or stressed condition. So, exercise, but don't over train, and make sure to get plenty of sleep [18].

In this study we retrospectively looked at patients that had low HRV during a period of two years, observed how common it was, observed heart rates (mean, maximum and minimum) and rhythm abnormalities (PAC, PVC, and MVC). We then retrieved suitable available clinical notes to have a general clinical overview of clinical state of the patients.

## Methodology

The study was done at the Jos University Teaching Hospital (JUTH) from January 2013 to December 2015. It was a retrospective descriptive study among patients that had holter study using the *cardionetics c.net500* (holter machine) in the cardiology unit.

One hundred and thirteen (113) patients had Holter study during the period out of which fifty two (46%) had low HRV. Eighteen retrievable and suitable clinical folders of patients with low HRV were observed/analysed considering demographic data,

clinical diagnosis and co-morbidities. The *cardionetics C.Net500* (Holter machine) examined extend of heart rate fluctuation and if the variation was less than 1% over a 30 second period, an event is recorded.

Data examined from the Holter registry were the heart rates (minimum, mean & maximum) and heart rhythm abnormalities [premature atrial contraction (PAC), premature ventricular contractions (PVC) and multi-ventricular contractions (MVC)]

Those patients that had incomplete records, seen outside the 2 year period and those than had the test less than 6 months before the study were not included in the study.

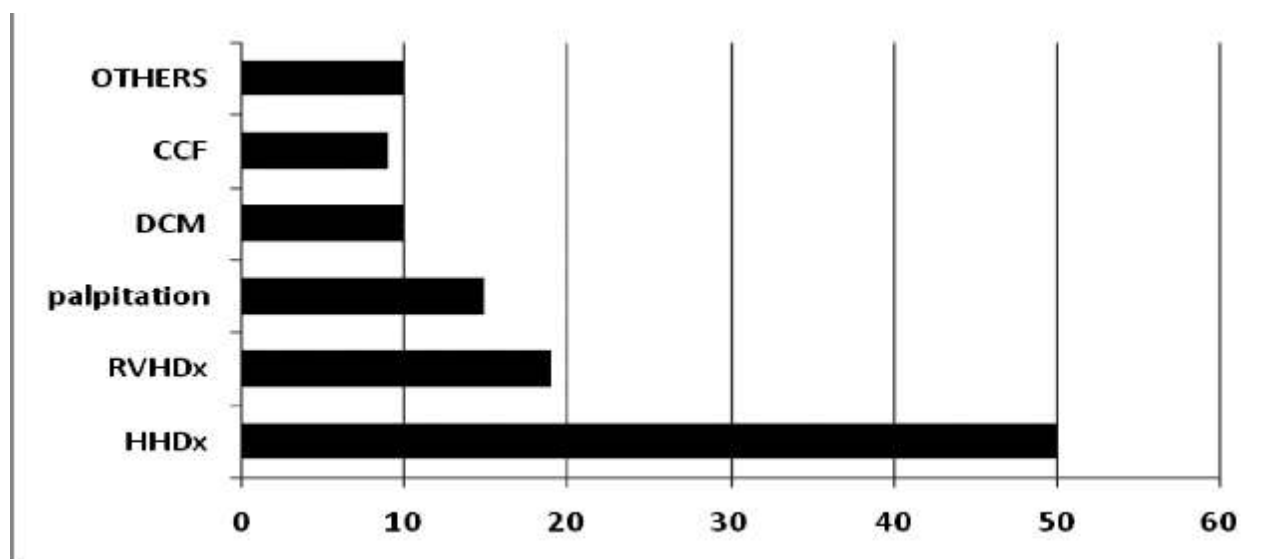
From the data obtained categorical variable were represented as mean and standard deviation while proportions were represented as percentages. Statistical analysis was with Epi-info version 3.5.1. Comparison between the two groups was with the students T-test (Simple Stat by Enrico Susatyo). Severe case was considered in symptomatic patient with co-morbidities and ejection fraction less than or equal 45% on echocardiography.

## Results

From the register of Holter monitoring, the most frequent indication for the Holter test which showed low HRV was hypertensive heart disease 20 (39.6%). Rheumatic valvular heart disease 9 (17.4%), palpitations 7 (14.3%), cardiomyopathy 6 (11.1%), congestive heart failure 4 (7.9%) and others 5(9.5%) [figure 1]. The male to female ratio was 1.2:1, and the age (mean  $\pm$  standard deviation) were  $50 \pm 15$  and  $53 \pm 14$  for female and male respectively p-value 0.12.

**Figure 1** shows the different diagnosis at the time Holter test was done of the 113 subjects recorded. About 90% are of cardiac origin.

**Figure 1** causes of illness of all subjects that had Holter test.



CCF-congestive cardiac failure; DCM-dilated cardiomyopathy; RVHDx-rheumatic valvular heart disease; HHDx- hypertensive heart disease

One hundred and thirteen subjects underwent Holter test during a two year period and fifty two of them were observed to have a low HRV. Subjects with low HRV were significantly older (51 vs 42, t-value 3.01  $p < 0.05$ ) years and had low mean heart rate (t-value -7.74  $p < 0.05$ ), [figure 2].

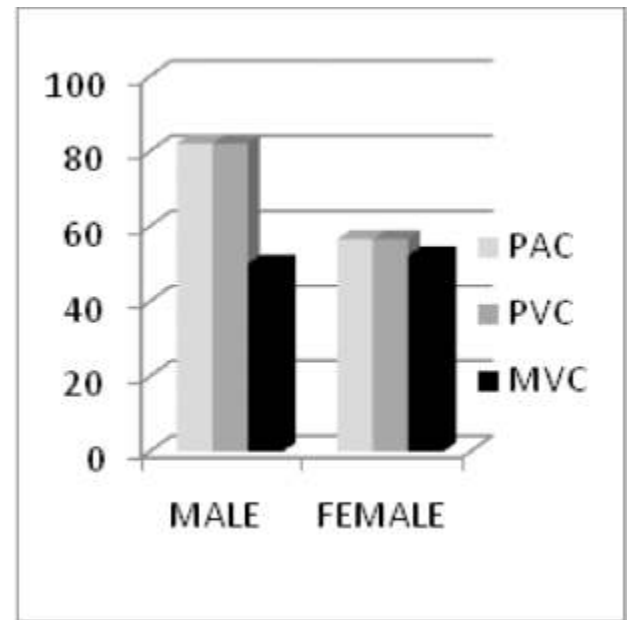
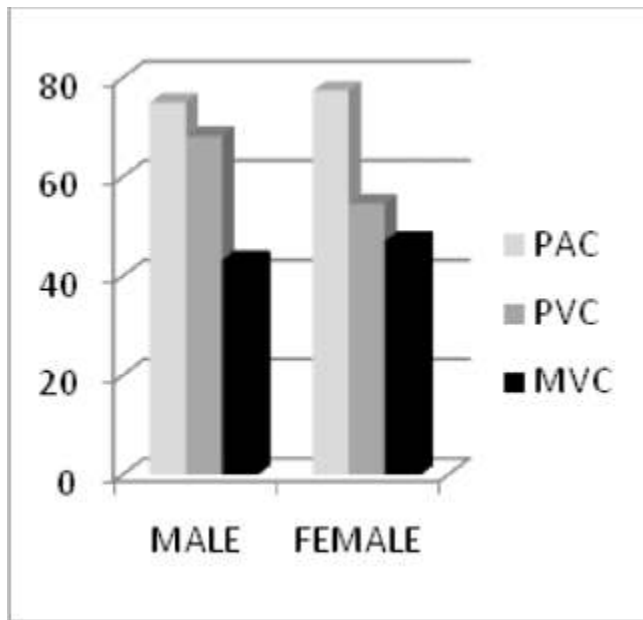
**Figure 2** compares the age and heart rates (minimum, mean maximum) of subjects with low HRV to the whole of the patients that had Holter test done.

	Low HRV n=52		Normal HRV n=61		t-value	p-value
	mean	SD	mean	SD		
<b>Age</b>	52.1	14.9	42.7	17.8	3.01	<0.05
<b>Min. HR</b>	58.1	11.8	59.9	10.7	-0.85	>0.05
<b>Mean HR</b>	80.0	14.2	98.7	12.4	-7.47	<0.05
<b>Max. HR</b>	144.3	23.4	139.7	17.3	1.20	>0.05

HRV-heart rate variability; SD-standard deviation; Min-minimum; Max-maximum; HR-heart rate;

All the retrieved clinical case had severe features of cardiac dysfunction. Females with low HRV had decreased frequency of premature atrial contraction (PACs) compared to normal HRV females studied (52% vs 78%) [figure 3]. Only 5 (28%) cases out of 18 retrievable cases were still attending the out- patient department 6 months after diagnosis [figure 4]

Figure 3 shows the relative frequencies of premature atrial contraction (PAC), premature ventricular contraction (PVC) and multiple ventricular MVA in the whole subjects that had echo and those with low HRV with respect to gender. What was striking was the relatively low frequency of PAC in female with low HRV.



PAC-premature atrial contraction; PVC-premature ventricular contraction; MVA-multiple ventricular contractions

Figure 4 shows a summary of the record of the 18 retrievable files , observation done at least 6 month after the last Holter test.

S. NO.	AGE	SEX	DIAGNOSIS	SYMPTOMS	SIGN	ECG	ECHO	STATUS	REMARKS
1	56	M	DM, COPD	DOE		RAE, RVH		DEATH	
2	52	M	HHDx/, CCF	CCUGH, DOE	TACHYCARDIA,	RAD, RVH	PUL HTN, EF 32%	DEATH	
3	50	F	?EMF CCF	COUGH DOE			PUL. HTN EF 52%	DEATH	
4	40	f	DCM/CCF	DOE,	EDEMA	-	EF29%	DEFAULTED	
5	24	F	RVHD, CC <sup>2</sup>	DOE	EDEMA	-	-	DEFAULTED	
6.	30	M	DCM/CCF	DOE	-	-	EF38%	DEFAULTED	
7	60	F	HHD/SHOCK	DOE	-	VE	EF25%	DEFAULTED	
8	26	F	HHD/DM/CCF	-	-	-	-	DEFAULTED	
9	45	M	CLD/DCM/CCF	DOE, COUGH	FOOT ULCER	VE,LAHB	EF 22%	DEFAULTED	
10	56	M	CCPD/CCF/SHOCK	DOE, COUGH	CYANOSIS	RAE	EF20%	DEFAULTED	
11	52	F	DCM/CCF	DOE	-	-	EF38%	DEATH	
12	52	M	DCM/CVA	DOE	-	-	-	DEATH	
13	61	F	HHD/CCF	DOE, DIZINESS	BRADYCARDIA	3 <sup>rd</sup> HB	-	ALIVE	HTNX30YRS
14	21	M	HHD	DOE,DIZINESS	BRADYCARDIA	-	-	ALIVE	HTNX4YRS
15	67	M	HHD/CKD/BPH	PAL, DIZINESS	BRADYCARDIA	-	-	ALIVE	HTNX25YRS
16	43	M	HHD/CCF	DOE	-	-	EF34%	ALIVE	
17	38	F	HHD/DM	PAL	-	-	-	DEFAULTED	
18	54	F	DCM/CCF	DOE	-	-	EF23%	ALIVE	

DM-diabetes mellitus; COPD-chronic obstructive pulmonary disease; HHDx-hypertensive heart disease; CCF-congestive cardiac failure; EMF-endomyocardial fibrosis; DOE-dyspnoea on exertion; DCM-dilated cardiomyopathy; RVHD-rheumatic valvular heart disease; CLD-chronic liver disease; CVA-cerebro-vascular accident; CKD-chronic kidney disease; BPH-benign prostrate hypertrophy; pal-palpitation; RAE-right atrial enlargement; RAD-right axis deviation; RVH-right ventricular hypertrophy; VE-ventricular ectopics; LAHB-left anterior hemiblock; 3<sup>rd</sup> HB-third degree heart block; PUL.HTN-pulmonary hypertension; EF-ejection fraction;

### Discussions

Considering that Holter test is mainly requested for cardiovascular risk evaluation, it was not surprising to observe that over 90% of cases studied were cardiovascular disorders. Low HRV event indicating some degree of autonomic CNS abnormality in cardiovascular disorders was seen in as much as 46% of cardiac cases in this centre. Out of all non-modifiable cardiovascular risk, age tends to be more conspicuous. In this study there was an expectant higher mean age in patients with low HRV compared to those with normal HRV. Furthermore a positive correlation (not shown in the results) was observed between age and low HRV in the study. Documented studies had shown that age independently was associated with low HRV [4].

We also observed that the mean heart rate in patients with low HRV was lower, collaborating with the fact that sympathetic autonomic activity is reduced in patient with low HRV. This picture was not glaring when we looked at minimum and maximum heart rates. These two rates are greatly influenced by the clinical state of the patient.

It is not clear why atrial ectopics was found more markedly low in females with low HRV. Cardiovascular risk has been shown to increase at post-menopause due to the absence of the protective effect of oestrogen. On the average, low HRV patients were older and were more likely to be at post-menopausal stage. Similar observation was made by Tushuizen et al when they studied two hour postprandial dysmetabolism in DM patients. They found a higher relative cardiovascular risk in female gender due to higher triglyceride level[19].

Looking at the retrospective clinical notes, subjects

showed generally severe state (multiple diagnoses/complications, symptomatic and poor cardiac functions). All factors associated with poor clinical outcome. It was not surprising then that out of the eighteen only five were up to date in follow-up clinic visit as at time of study, others were reported certified death while others by defaulting for over six months with severe symptoms were most likely to be death. This could straighten the perception that low HRV was associated with poor prognosis.

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