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# A Study on Red Cell Indices in Patients Having Heart Failure with Reduced Ejection Fraction

Authors
**Dr Indhuja.K[*1], Dr N.Chidambaram[2], Dr Periasamy[3], Dr Nanjilkumaran[4] Dr Gopathiraj.R[5]**

[*1],[5]General Medicine Postgraduate, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University, Annamalai Nagar - 608002

[2]Professor of General Medicine, Cardiologist & Dean, Rajah Muthiah Medical College and Hospital, Annamalai University, Annamalai Nagar – 608002

[3]Reader, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University, Annamalai Nagar – 608002

[4]Lecturer, Department of General Medicine, Rajah Muthiah Medical College and Hospital, Annamalai University, Annamalai Nagar – 608002

**Abstract**
*Heart failure (HF) is a burgeoning problem worldwide with more than 20 million people affected. Search for a cost effective marker is ongoing to stratify the risks and outcome of heart failure. In this aspect this study aims to show that Red cell distribution width (RDW) when elevated is a predictor of all cause morbidity and low ejection fraction in a patient with left ventricular (LV) dysfunction.*
**Keywords**: *Heart failure, ejection fraction, red cell distribution width.*

## Introduction

Heart failure follows an exponential pattern rising with age, and affects 6-10% of people over 65 years. Anemia is a frequent concomitant factor & there is associated diabetes and hypertension often. Coronary artery disease is a predominant cause & along with diabetes and hypertension it augments the risk of heart failure.[1]

Optimizing management of patients with heart failure remains quite challenging despite many significant advances in drug and device therapy for this syndrome. Although a large body of evidence from robust clinical trials supports multiple therapies, utilization of these well-established treatments remains inconsistent and outcomes suboptimal in "real-world" patients with heart failure. Disease management programs may be effective, but are difficult to implement due to cost and logistical issues. Another approach to optimizing therapy is to utilize biomarkers to guide therapeutic choices. Given the immense and growing public health burden of heart failure, identification of cost-effective ways to decrease the morbidity and mortality due to this syndrome is critical.[2] This study compares the cost effective parameter RDW in cases of cardiac failure and analyse RDW with severity of heart failure based on NYHA functional class as well as LV ejection fraction.

## Materials and Methods

100 patients with heart failure admitted to department of Medicine, Rajah Muthiah Medical College and Hospital, Chidambaram were studied. Informed consent was obtained from the study population. A detailed history including duration and treatment along with examination of cardiovascular system was carried out. NYHA functional class was applied and patients were classified into 4 classes of heart failure.

Patients with primary valvular heart disease, congenital heart disease, cardiomyopathies, chronic kidney disease and alcoholics were excluded from this study. Complete hemogram, blood glucose, fasting lipid profile, blood urea, serum creatinine, serum electrolytes and liver function tests were measured in all these patients. ECG, chest X – ray and 2-D echo were taken for all of them.

For complete blood count including red cell distribution width, blood samples were collected from antecubital vein, transferred to an EDTA test tube and analysed in an automated cell analyser. RDW is expressed in two forms: RDW- SD & RDW- CV. RDW-SD is not influenced by the MCV and accurately reflects the variation in red cell size. The normal RDW-SD range for adults is 40.0 - 55.0 fL. Hence this study uses RDW-SD for comparison purposes.

## Results

Among the 100 patients studied, most of them belonged to the age group of 41 – 60 years. Incidence among males was higher when compared to females. Most of the males were in the age group of 41 – 50 years. Comparatively the incidence in females was higher in the age group in 51-60 years. The male – female ratio was 2:1. The two major etiologies after applying exclusion criteria were coronary artery disease (68%) and cor pulmonale (32%). The mean value of RDW-SD was elevated in all cases of LV dysfunction irrespective of the etiology.

Statistical relevance was seen more in cases with obesity and smoking /tobacco than those with co-morbidities like systemic hypertension, diabetes mellitus or dyslipidemia. It was seen that cases under NYHA class IV had higher mean RDW values compared to those under NYHA class II and class III and cases with severe LV dysfunction had a higher mean RDW value (55.6) than those with moderate and mild dysfunction. However, the study failed to prove any significant correlation between hemoglobin and LV dysfunction.

**Figure 1:** Age & Gender Incidence

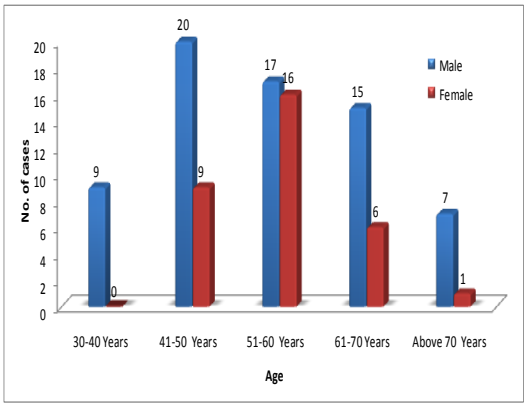



**Figure – 2:** Incidence of Etiology

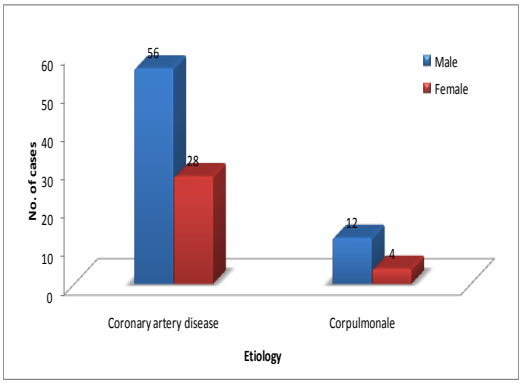



**Figure 3:** Mean RDW OF Each Etiology

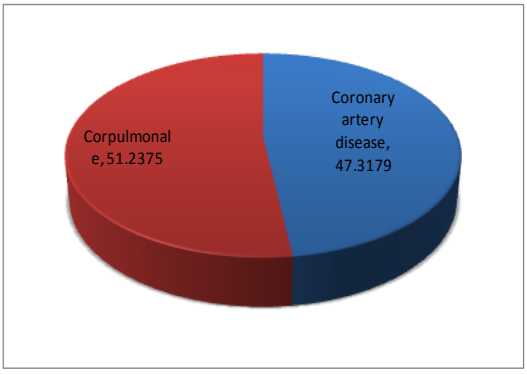


**Figure 4:** Mean RDW OF Risk Factors

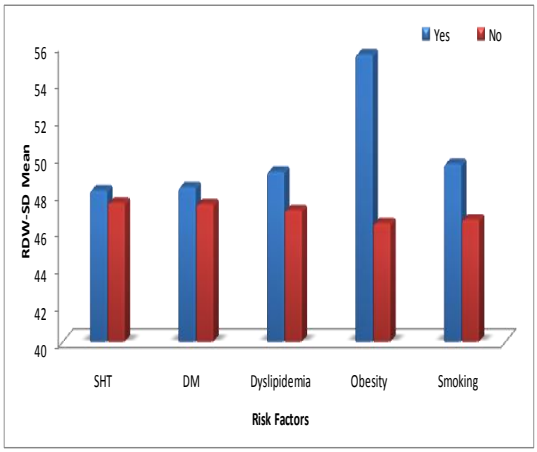



**Figure 5:** Mean RDW OF Each NYHA Class

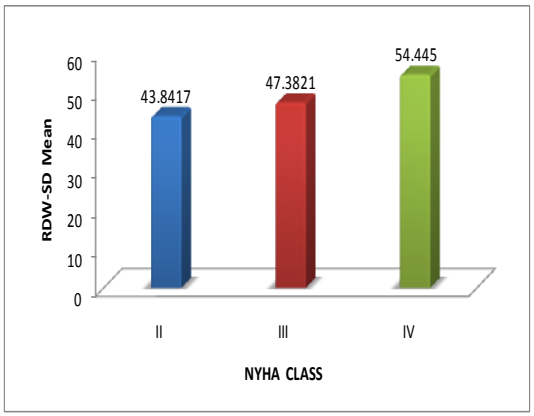



**Figure 6:** Mean RDW OF LVEF Range

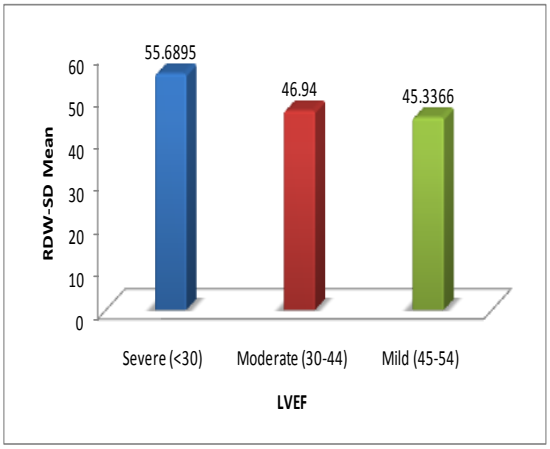



**Figure 7:** NYHA Class and Mean Hemoglobin

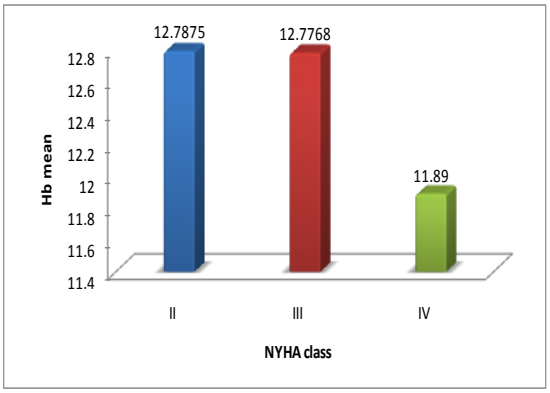
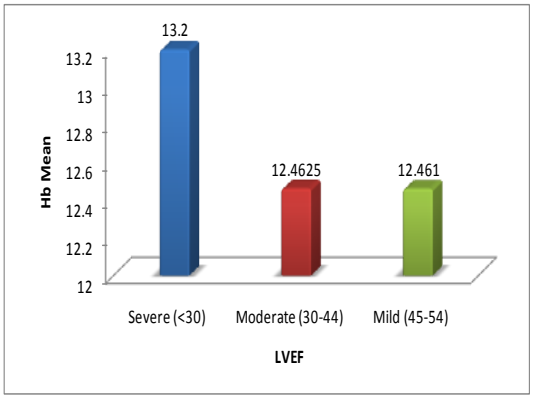



**Figure 8:** LVEF and Mean Hemoglobin




## Discussion

The results of the study indicate that severe LV dysfunction is associated with high RDW values, irrespective of etiology. Mean RDW values were found to be significantly increased in patients who were obese (55.5). Laufer Per et al. (2016) observed in their study that elevated RDW was an independent marker of metabolic syndrome and a predictor of long term mortality.[3]

RDW values were significantly higher in patients who smoked or took tobacco (49.6). Kurtoğlu et al., 2013 observed that elevated RDW is associated with cigarette smoking[4] and may be a useful indicator of inflammatory activity and pulmonary disease in smokers.[5] In this study, higher RDW values were associated with increasing severity of LV dysfunction. Bozorgi et al., 2016 discovered in their study that levels of RDW were associated with the presence of severe LV dysfunction, with an accuracy of 61.4% and 66.9% using cut-off values of higher than 13.5 and 13.8, respectively.[6]

On the other hand, when hemoglobin was compared with both NYHA class and LV ejection fraction, it was found to be not significant. Dai, Konishi, Takagi, Miyauchi & Daida, 2014 found that RDW has a better prognostic value than hemoglobin for both short- and long-term outcomes in patients with heart failure and the prognostic value in long-term outcomes remains significant regardless of anemia or BNP levels. Thus, RDW carries prognostic information regarding states other than anemia.[7]

Although many studies have successfully elucidated the prognostic role of RDW in heart failure, no clear insights into the mechanisms behind the same have been arrived till date. CHARM data and Duke Databank were used to study the role of RDW as a prognostic marker in heart failure.[8] One of the main mechanisms proposed is inflammation. Inflammation affects RDW by causing impaired iron metabolism, inhibiting erythropoietin and shortening RBC survival.[9] Other methods by which heart failure impacts on RDW are: decreased kidney function[10], level of complexity of coronary artery disease[11], high inflammatory & neurohumoral markers[12], low anti oxidative indices like selenium[13], high oxidative stress[14], anemia of chronic disease[15] and hemodilution.

**Conclusion**

All our observations revealed that RDW can be used as a cheaper and easily available marker in patients with LV dysfunction. This was in concordance with several studies done in various centres globally and in India. In the future, the inclusion of RDW in a combined model for the risk stratification of patients with heart failure is recommended. Further study is required to clarify the elaborate mechanisms of the effect of elevated RDW in heart failure.

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