

## ANALYZING THE RELATIONSHIP BETWEEN RED CELL DISTRIBUTION WIDTH AND MYOCARDIAL INFARCTION

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### ABSTRACT

Myocardial infarction (MI) is a prominent contributor to global illness. The Red Cell Distribution Width (RDW), holds promise as a viable biomarker for these purposes. The objective of this study was to analyze the relationship between red cell distribution width and myocardial infarction. A cross-sectional study was conducted at Cheema Heart Complex and Siddique Sadiq Hospital Gujranwala. In this study, 137 patients of Myocardial Infarction, both males and females, above the age of 18 years were included. Blood sample from the patients was collected in EDTA vials for complete blood count (CBC) and the results obtained were analyzed on SPSS version 27. Among these 137 patients, the frequency of male patients was 59 (43.1%) and female patients were 78 (56.9%). All the patients were divided into different age groups. The highest number of patients were seen between age group 59-68 (n=41), among them 23 were male and 18 were females. The results of red cell distribution width obtained by the complete blood count were categorized into four levels normal, slightly elevated, moderately elevated, and significantly elevated. Out of the total 137 patients, 26 (19%) had normal RDW levels, 27 (19.7%) had slightly elevated levels, 76 (55.5%) had moderately elevated levels and 8(5.8%) had significantly elevated levels. The highest number of patients were seen with a moderately elevated RDW level (n=76). In conclusion, the examination of the relationship between RDW and Myocardial Infarction (MI) has revealed intriguing insights into the potential utility of RDW as a biomarker in cardiovascular risk assessment.

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### INTRODUCTION

Myocardial Infarction (MI), also known as heart attack, is a condition in which there is a partial or complete loss of blood flow to the portion of the myocardium (1). It leads to cardiac necrosis which is the result of ischemia in heart muscles (2). The main cause of myocardial infarction is atherosclerosis, which is thickening or hardening of arteries by the development of atherosclerotic plaques (3). The term "cardiovascular disease" (CVD) refers to all conditions affecting the heart and blood vessels. The expression covers disease entities such as arrhythmia, heart valve issues, and venous thrombosis as well as diseases connected to the progression of

atherosclerosis, such as heart attack, stroke, and peripheral arterial disease (4).

The symptoms of myocardial infarction can vary from person to person but the most common are feelings of pain, pressure, tightness or discomfort in the chest, pain spreading to the arm, neck, jaw, and even back, shortness of breath, nausea or vomiting, cold sweats, dizziness and fatigue (5).

Risk factors for myocardial infarction can be divided into three categories which include non-modifiable risk factors (age, gender, and family history), modifiable risk factors (smoking, alcohol consumption, obesity, diabetes, physical inactivity, poor diet, etc.),

and emerging risk factors (C-reactive protein, coronary artery calcification, fibrinogen, homocysteine, lipoprotein) (6). Cardiovascular diseases are a leading cause of death and disability worldwide. Only a few high-income countries have declined the rates of cardiovascular disease-related mortality over the past few decades, but low and middle-income countries have observed an increase, bearing around 80% of the burden (7). Despite the significance of cardiovascular diseases in low and middle-income countries, South Asia, notably Pakistan, pays very little attention to the prevention of cardiovascular disease risk factors. According to the most recent data, cardiovascular disease (CVD) is the leading cause of mortality worldwide and accounts for 80% to 86% of all fatalities in low and middle-income countries (LMICs). Out of 82% of the 16 million fatalities caused by non-communicable diseases (NCDs) that occur each year in low and middle-income countries (LMICs), 37% are caused by cardiovascular diseases (8). Scientific research has now demonstrated that RDW may provide important information for the diagnosis of various disorders and variation in red cell distribution width can serve as a predictive marker of morbidity and mortality in cardiovascular diseases. It is unknown if red width distribution is merely a biomarker or also a pathogenic mediator for some cardiovascular diseases and pathologies (9, 10).

## **MATERIALS AND METHOD**

### **Study design**

An Observational, Cross-sectional study was done to analyze the relationship between red cell distribution width and myocardial infarction. The study was conducted at Cheema Heart Complex and Siddique Sadiq Memorial Trust Hospital. The study was completed in 6 months from April 2023 to September 2023. Simple convenience sampling was used.

### **Sample size**

A sample size of 137 myocardial infarction patients was calculated by the average method from the relevant articles (Sangoi *et al.*, 2014; He *et al.*, 2014; Liu *et al.*, 2016).

$$\bar{x} = \frac{\sum X}{N}$$

Where;

$\bar{X}$  = Mean,  $\sum x$  = Sum of all values,  $N$  = Number of all values

### **Inclusion criteria**

- Patients with Myocardial Infarction
- All patients above 18 years old
- Both genders (male and female)

### **Exclusion criteria**

Patients without Myocardial Infarction.  
Patients less than the age of 18 years

### **Sample Collection**

A blood sample of about 2-3 ml was collected in a Lavender top Ethylenediamine tetraacetic acid (EDTA) vial by using an aseptic technique.

### **Sample Transport**

All the samples were delivered to the hematology laboratory with a properly filled request form as soon as possible after collection. The samples were transported at room temperature in leakproof vials.

### **Processing**

Blood samples were analyzed in laboratory specialized equipment such as an automated hematology analyzer. Results were calculated through a complete blood count (CBC).

### **Data Collection Procedure**

- The data of 137 patients was obtained on a data collection sheet, used to collect various information
- The variables were age, gender, the status of the patient (cardiac patient or non-cardiac), value of red cell distribution width (RDW)

- All the patients were evaluated based on their eligibility for the inclusion criteria

### **Data Analysis Procedure**

- The collected data was analyzed through SPSS software version-27
- The variables such as age, gender, and level of red cell distribution width (RDW) were entered on the SPSS-27 spreadsheet
- The analyzed data was presented in the form of graphs, charts, or tables

### **RESULTS**

A cross-sectional study was conducted at Cheema Heart Complex and Siddique Sadiq Hospital to analyze the relationship between Red cell distribution width and Myocardial infarction. A total of 137 patients of myocardial infarction, both males and females, were included in this study above the age of 18 years. The frequency of males was 59 (43.1%) and females were 78 (56.9%). All the patients were divided into age groups. The highest number of patients were seen between age group 59-68 (n=41), among them 23 were male and 18 were females.

The results of red cell distribution width obtained by the complete blood count were categorized into four levels normal, slightly elevated, moderately elevated, and significantly elevated. Out of the total 137 patients, 26 (19%) had normal RDW levels, 27 (19.7%) had slightly elevated levels, 76 (55.5%) had moderately elevated levels and 8(5.8%) had significantly elevated levels.

The highest number of patients were seen with a moderately elevated RDW level (n=76) and among them, the majority of patients were between the age group 59-68. While comparing the patients of both genders who had elevated RDW levels it was found that the highest number of

females (38.69%) was seen with elevation in moderately elevated RDW levels while males had the highest percentage of 16.9% in moderately RDW levels and least number of patients, both male and female, were seen in the significantly elevated RDW level group. The mean and standard deviation of the age were (59.31 ± 16.316) and the mean standard deviation of RDW % was (16.54 ± 2.56).

### **DISCUSSION**

The current study found a statistically significant association between elevated RDW levels and the occurrence of MI. The data indicated that individuals with higher RDW values were at an increased risk of experiencing a myocardial infarction. This aligned with previous research suggesting that RDW is a potential marker of cardiovascular disease. To understand this relationship better, it's essential to consider the underlying biological mechanisms. Elevated RDW is often indicative of variations in red blood cell size and shape, which can reflect chronic inflammation, oxidative stress, and impaired erythropoiesis which was also demonstrated by Akboga et al., in the year 2015 (11).

These factors can contribute to the development and progression of atherosclerosis, a primary precursor to MI. The clinical significance of our findings is noteworthy. Monitoring RDW levels as part of routine blood tests could provide clinicians with an additional tool for identifying individuals at higher risk of MI. This might enable earlier interventions, lifestyle modifications, or more aggressive treatment strategies for those at greater risk.

The current study has shown that there is a significant relationship between red cell distribution width and myocardial infarction. As, out of a total of 137 patients, the majority of the patients showed elevated RDW levels, this was by the study undertaken by Li et al., (2017). They concluded in their study that

participants with acute myocardial infarction had elevated RDW levels and further stated that elevated RDW levels were also found to be associated with increased inflammation markers and adverse cardiovascular outcomes (12). Similar results were seen in the study carried out by Akin et al., in 2023 in which they analyzed the relation between red cell distribution width and severity of coronary artery disease in patients with acute myocardial infarction. They observed that increased RDW had been associated with adverse outcomes in acute myocardial infarction (AMI) and remained a significant predictor of the severity of the disease (13). In the present study, it was seen that the highest number of patients of MI lies between the age group 59-68 and have high RDW levels. The mean and standard deviation of age in the study was  $(59.31 \pm 16.316)$ . In a study carried out by Yang et al., in the year 2021, the age group with the highest RDW percentage was 56-74 years of age. In the study by Huang et al, RDW% was higher in the patients above 65 years and their mean and standard deviation was  $69.4 \pm 13.5$ .

### Recommendations

- One should consider RDW measurements in routine clinical screenings for patients at risk of MI, especially those with established cardiovascular risk factors. Elevated RDW levels can serve as an additional marker for risk assessment
- Utilize RDW as a risk assessment tool alongside established cardiovascular risk factors such as age, gender, cholesterol levels, and blood pressure. Patients with high RDW values may warrant closer monitoring and more aggressive preventive measures
- Educate patients about the potential significance of elevated RDW levels as a cardiovascular risk factor.

Increased awareness can encourage patients to engage in lifestyle modifications and adhere to prescribed medications.

### CONCLUSION

In conclusion, the current research has shown an interesting relationship between RDW (Red Cell Distribution Width) and myocardial infarction (MI), shedding light on its significance as a potential diagnostic and prognostic marker in this critical cardiovascular condition. Our study encompassed a comprehensive analysis of a substantial patient of MI and has yielded valuable insights. It was found that elevated RDW levels were consistently associated with an increased risk of MI. Moreover, the current research highlighted the utility of RDW as an independent predictor of adverse outcomes in MI patients, including in-hospital mortality and other clinical endpoints. Importantly, the ability of RDW to predict outcomes remained strong even when accounting for different influencing variables, confirming its potential importance in a clinical context. The incorporation of RDW into existing risk assessment models could enhance their accuracy, ultimately leading to more precise and timely interventions for MI patients. Its association with MI risk, prognosis, and its dynamic nature make it a promising biomarker worthy of further exploration. As we delve deeper into understanding the complexities of this connection, we expect that RDW could establish itself as a valuable asset for healthcare professionals working to combat this life-threatening condition, ultimately contributing to improved patient outcomes and quality of care.

### DECLARATION

All authors contributed equally.

### COMPETING INTERESTS

There is no conflict of interest among the authors.

## CONSENT FOR PUBLICATION

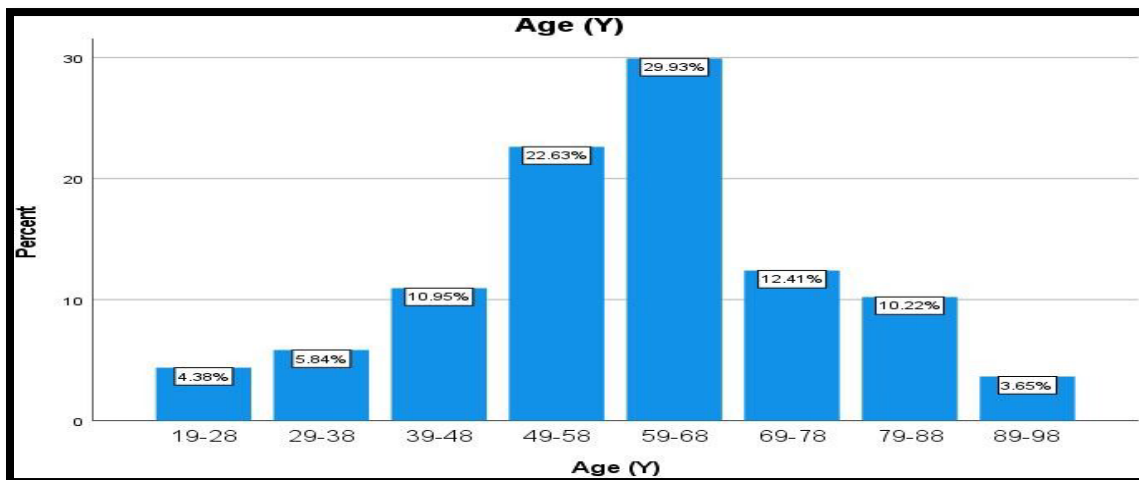
All authors are agreed for Publication.

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**Table 1:** Possible Clinical Interpretation

RDW (%)	Range	Severity Level	Possible Clinical Interpretations
11.5% - 14.5%		<b>Normal</b>	Red blood cells are relatively uniform in size.
14.6% - 15.5%		<b>Slightly Elevated</b>	Mild variation in red blood cell size; may indicate early or mild stages of certain conditions.
15.6% - 20%		<b>Moderately Elevated</b>	Greater variation in red blood cell size; may be associated with mixed nutritional anemia, vitamin deficiencies, or certain chronic diseases.
> 20%		<b>Significantly Elevated</b>	High variation in red blood cell size; may suggest megaloblastic anemia (linked to vitamin B12 or folic acid deficiency), hemolytic anemia, or serious underlying health issues.



**Figure 1:** Frequency distribution of age in the form of a bar chart

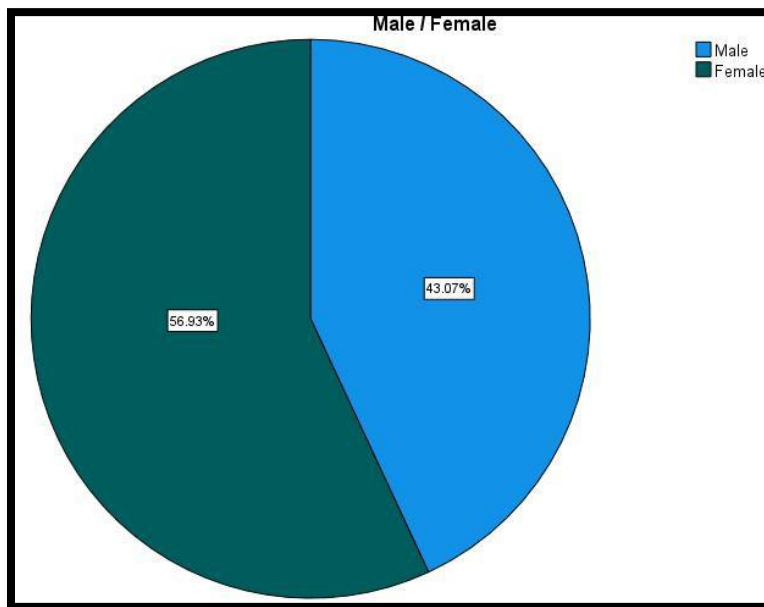


Figure 2: Frequency distribution of genders in the form of a Pie chart

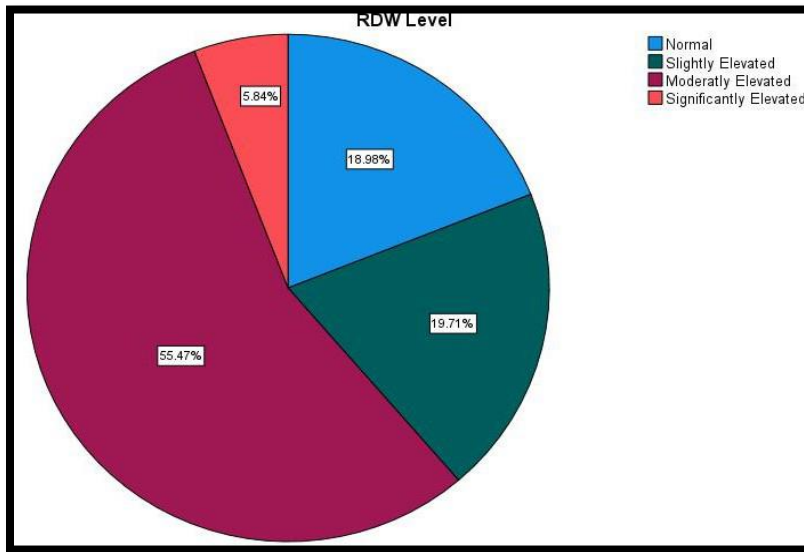


Figure 3: Percentage distribution of RDW levels in the form of a Pie chart

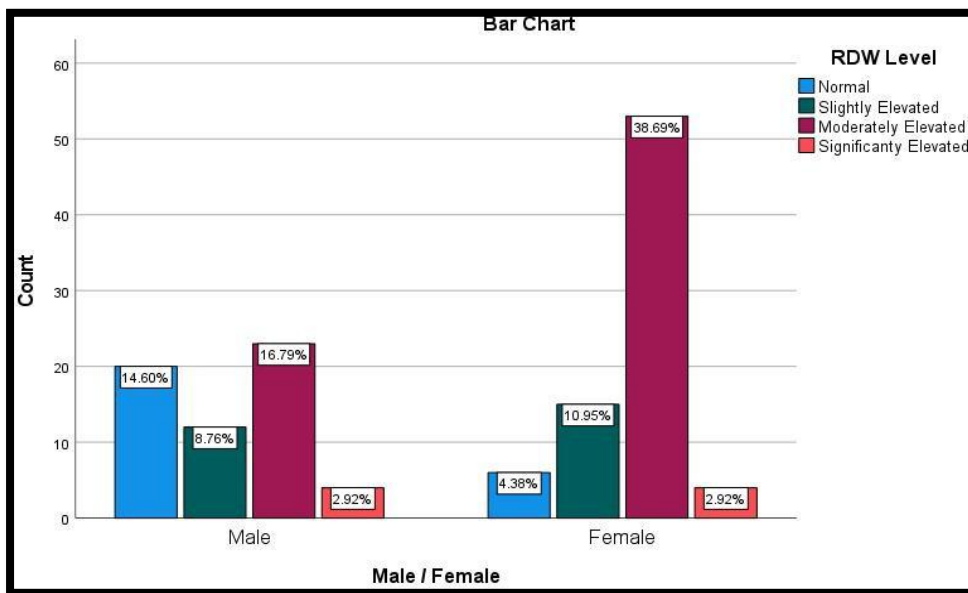


Figure 4: RDW level in both gender

**Table 2: Age groups of a total of 137 patients**

Age (Y)		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	19-28	6	4.4	4.4	4.4
	29-38	8	5.8	5.8	10.2
	39-48	15	10.9	10.9	21.2
	49-58	31	22.6	22.6	43.8
	59-68	41	29.9	29.9	73.7
	69-78	17	12.4	12.4	86.1
	79-88	14	10.2	10.2	96.4
	89-98	5	3.6	3.6	100.0
	<b>Total</b>	137	100.0	100.0	

This table shows the frequency distribution of all the 137 patients into different age groups. The highest number of patients were seen between the age group 59-68 (n=41) with a percentage of 29.9%.