



**ORIGINAL RESEARCH PAPER**

**General Medicine**

**STUDY OF RED CELL DISTRIBUTION WIDTH AS A NOVEL PREDICTIVE INDICATOR IN PRE-HYPERTENSIVE AND HYPERTENSIVE PATIENTS**

**KEY WORDS:** Red cell distribution width  
Hypertention  
Comparison of RDW Pre-hypertensive Hypertensive

**Dr. Gaurav Agarwal**

Jhalawar Medical College, Jhalawar Rajasthan.

**Dr. Megha S**

Jhalawar Medical College, Jhalawar Rajasthan.

**Dr. Karan Singh Charan**

Jhalawar Medical College, Jhalawar Rajasthan.

**Dr. Deepak Gupta**

Jhalawar Medical College, Jhalawar Rajasthan.

**ABSTRACT**

**Background:** An increased RDW mirrors a profound deregulation of erythrocyte homeostasis involving both impaired erythropoiesis and abnormal red blood cell survival, which may be attributed to a variety of underlying metabolic abnormalities such as shortening of telomere length, oxidative stress, inflammation, poor nutritional status, dyslipidaemia, hypertension, erythrocyte fragmentation and alteration of erythropoietin function. High blood pressure does damage to endothelial cells that leads to the secretion of inflammatory cytokines which suppresses erythropoiesis and inhibit red cell maturation and anisocytosis. Therefore, as a sensitive marker of inflammatory status in this process, RDW can be a potential predictor of hypertension in pre-hypertensive and normal individual. **Aim:** To provide general information about RDW and its routine assessment, to review the most relevant implications in prehypertensive and hypertensive patients and give some insights about its potential clinical applications. **Material and methods:** Current study was observational cross sectional study conducted at the Department of Medicine in SHRI RAJENDRA GENERAL HOSPITAL (SRGH), Jhalawar Medical College, Jhalawar Rajasthan. A total 100 newly diagnosed hypertensive and pre hypertensive patients were included in the study. Data were analysed in SPSS 21. Independent t-test and Chi-square test were applied. P value <0.05 was considered statistically significant. **Results:** In this study, mean age of study participants was 46.4±19.1 years and out of the 100 participants, maximum 40 were belongs to age <40 years followed by 37 in age of 41-60 years, 47 were male and 53 were female, 75 participants were diagnosed as hypertensive and 25 diagnosed as pre-hypertensive. In this study, mean RDW-CV and RDW-SD was 19.2±3.8 and 54.8±10.7 respectively and a statistically significant high RDW-CV and RDW-SD was found among hypertensive compare to pre-hypertensive patients. Also a statistically significant positive correlation of SBP and DBP was found with RDW-CV and RDW-SD. **Conclusion:** Our study concluded that RDW is significantly positively correlated with the blood pressure and increases as SBP and DBP increases. So RDW can be predictive marker for hypertension. This can be done routinely and easily in the laboratories, thereby giving the clinician a good supportive tool for diagnosing and preventing an adverse outcome.

**INTRODUCTION:**

Hypertension is the leading cause of global burden of disease. Hypertension increases the risk of CVD including CHD, CHF, ischemic and haemorrhagic cerebrovascular accident, renal failure and peripheral vascular disease.<sup>1</sup> Red cell distribution width (RDW) is a parameter that measures variation in red blood cell size or red blood cell volume. RDW is increased according to the variation in red cell size (anisocytosis), i.e., when elevated RDW is reported on CBC, increased anisocytosis (increased variation in red cell size) is expected on peripheral blood smear review.<sup>2</sup>

Red blood cell distribution width (RDW) is a numerical measure of the size variability of circulating erythrocytes and is routinely reported as a component of complete blood count in the differential diagnosis of anaemia. RDW has been very recently reported to be a strong and independent predictor of adverse outcomes in the general population.<sup>3-4</sup>

An increased RDW mirrors a profound deregulation of erythrocyte homeostasis involving both impaired erythropoiesis and abnormal red blood cell survival, which may be attributed to a variety of underlying metabolic abnormalities such as shortening of telomere length, oxidative stress, inflammation, poor nutritional status, dyslipidaemia, hypertension, erythrocyte fragmentation and alteration of erythropoietin function.<sup>5</sup> Several lines<sup>6</sup> of evidences found that inflammatory status is significantly related to ineffective erythropoiesis, and it has been suggested that inflammatory cytokines, such as interleukin (IL)-1 β, IL6, tumour necrosis factor (TNF)-α, desensitize bone marrow erythroid 2 progenitors to erythropoiesis, and inhibit

red blood cell maturation and in turn promote anisocytosis. Increased RDW may be due to an underlying inflammatory state.<sup>7</sup>

On the basis of above citation, we assume that high blood pressure does damage to endothelia cells that leads to the secretion of inflammatory cytokines which suppresses the erythropoiesis and inhibit red cell maturation and anisocytosis. Therefore, as a sensitive marker of inflammatory status in this process, RDW could be a potential predictor of hypertension in pre-hypertensive and normal individual.

So, the aim of this study was to provide general information about RDW and its routine assessment, to review the most relevant implications in prehypertensive and hypertensive patients and give some insights about its potential clinical applications.

**MATERIAL AND METHODS:**

Current study was observational cross sectional study conducted at the Department of Medicine in shri Rajendra general hospital (SRGH), Jhalawar Medical College, Jhalawar Rajasthan from February 2021 to December 2022. A total 100 newly diagnosed hypertensive and pre hypertensive patients were included in the study. History of systemic hypertension was verified by using previous records. Those patients with no previous history were diagnosed if there is elevation in the BP in more than one recording one week apart. Blood pressure was recorded without interindividual variation with the same automated BP apparatus. Smoking, intake of alcohol or/ and caffeinated drinks were avoided within 30 min of BP

measurement. RDW and other investigation were recorded and a detailed case record was prepared for each patient on the basis of specially designed proforma. Prehypertension was defined as SBP-121-139 mmhg and DBP-80-89mmhg and Hypertensive was defined as >139 and DBP >90mmhg.

Data were analysed in SPSS v- 24. Independent t-test and Chi-square test were applied. Pearson correlation coefficient was calculated between the BP (SBP and DBP) and RDW. p value <0.05 was considered statistically significant.

**RESULTS:**

In our study, mean age of study participants was 46.4±19.1 years and 53% were female participants, history of alcohol drinking was present in 44%, smoking history was present in 32%. In our study, out of the 100 participants, 75 participants were diagnosed as hypertensive and 25 diagnosed as pre-hypertensive. (Table 1)

In our study, mean RDW-CV and RDW-SD was 19.2±3.8 and 54.8±10.7 respectively. (Table 2)

A statistically significant high RDW-CV and RDW-SD was found among hypertensive compare to pre-hypertensive patients. (Table 3)

A statistically significant positive correlation of SBP and DBP was found with RDW-CV and RDW-SD. (Figure 1-4)

**DISCUSSION:**

Hypertension, or high blood pressure, is a prominent cause of morbidity and mortality in both developed and developing countries. The damage to the vascular endothelium in the blood arteries is the cause of such widespread problems. Renal hypertension exerts a lot of strain on the kidney, causing hypertensive nephropathy and kidney damage. RDW is a numerical measure of the size variability of circulating erythrocytes that is typically reported as part of a complete blood count in the differential diagnosis of anemia.

In our study, mean SBP and DBP was 154.4±15.4 mmhg and 91.9±5.6 mmhg respectively AND out of the 100 participants, 75 participants were diagnosed as hypertensive and 25 diagnosed as pre-hypertensive. In our study, mean RDW-CV and RDW-SD was 19.2±3.8 and 54.8±10.7 respectively. In our study, a statistically significant high smoking history and alcohol drinking history was found among hypertensive compare to pre-hypertensive patients. A statistically significant high weight and BMI was found among hypertensive compare to pre-hypertensive patients.

In our study, a statistically significant high RDW-CV and RDW-SD was found among hypertensive compare to pre-hypertensive patients and a statistically significant positive correlation of SBP and DBP was found with RDW-CV and RDW-SD.

Enawgaw B et al<sup>8</sup> also compared several hematological parameters of hypertensive persons with normotensive individuals and revealed that RDW demonstrated statistically significant positive correlations with systolic and diastolic blood pressure. Su D et al<sup>9</sup> did a cross-sectional study to determine if red blood cell distribution width (RDW) is related to the blood pressure (BP) reverse-dipper pattern in hypertensive patients. This study revealed that RDW was significantly higher in reverse dippers (13.52±1.05) than in dippers (13.25±0.85) with hypertension (p=0.012). Buyukkaya et al<sup>10</sup> assessed RDW as well as hs-CRP levels, retrospectively. The study revealed that patients with hypertension had greater RDW and hs-CRP levels than normotensive patients.

Reddy G et al<sup>11</sup> revealed that Significant difference was noticed in the RDW values also in the patients. It was

established that Hs-CRP levels and RDW levels are both equally useful as a prognostic marker for hypertension.

Ozcan F et al<sup>12</sup> found that the best cut-off value of RDW for predicting non-dipping patterns in receiver-operating characteristic curve analysis was > 13.8%, with 80% sensitivity and 75% specificity. RDW is considerably higher in non-dipper hypertension patients than in dipper hypertension patients. In non-dipper hypertensives, inflammatory activity was closely associated to RDW. RDW, as a simple and quick measuring measure, can indicate the absence of a dipping pattern in essential hypertension

Previously, the correlation between RDW and hypertension, especially the non-dipper pattern of hypertension, has been demonstrated in Wen Y et al<sup>13</sup> study. Furthermore, it showed that there was a close relationship between RDW levels and carotid artery atherosclerosis in patients with hypertension. Jithesh et al<sup>14</sup> also observed that both high-sensitive C reactive protein (hs-CRP) and RDW levels were higher in the hypertensive patient group compared with the control group. Tanindi et al<sup>15</sup> found that RDW was significantly higher in patients with prehypertension and hypertension than in healthy subjects.

**Table 1: Sociodemographic and clinical profile of study participants (N=100):**

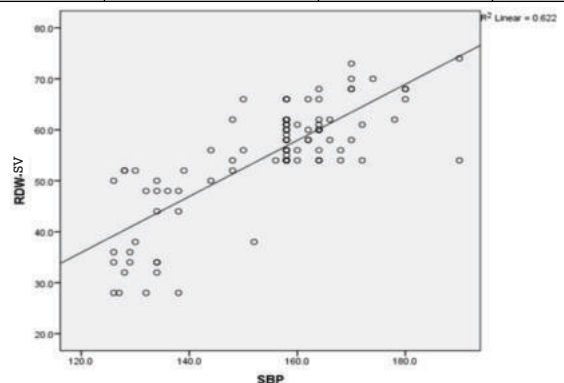
Variables	Frequency	Percent
Age (Mean±SD)	46.4±19.1	
Age:		
≤40 years	40	40.0
41-60 years	37	37.0
>60 years	23	23.0
Gender:		
Female	53	53.0
Male	47	47.0
History:		
Smoking	32	32.0
Alcohol drinking	44	44.0
Diagnosis:		
HTN	75	75.0
Pre-HTN	25	25.0

**Table 2: Distribution of clinical parameters:**

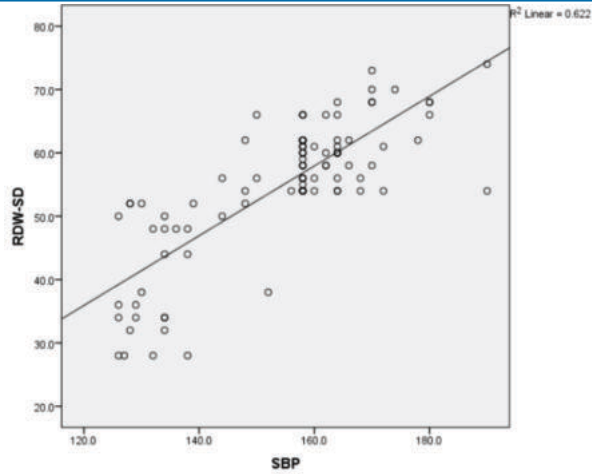
Variables	(Mean±SD)
BMI	25.4±5.3 kg/m2
SBP	154.4±15.4 mmhg
DBP	91.9±5.6 mmhg
RDW-CV	19.2±3.8
RDW-SD	54.8±10.7

**Table 3: Comparison of RDW between Pre-HTN and HTN patients:**

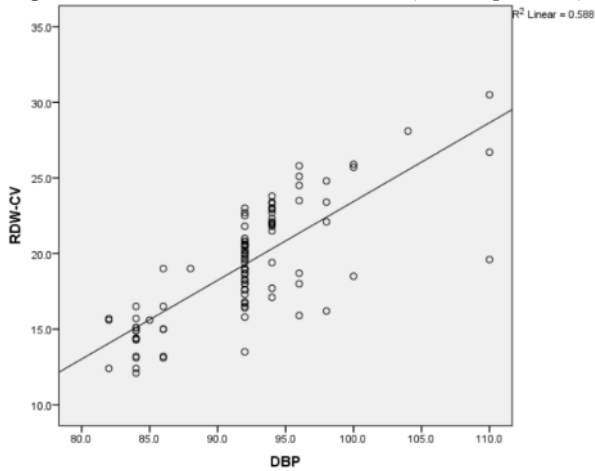
Variables	Pre-HTN (Mean±SD)	HTN (Mean±SD)	p-value
RDW-CV	14.8±1.8	40.4±9.0	0.0001
RDW-SD	20.7±3.1	59.6±5.9	0.0001



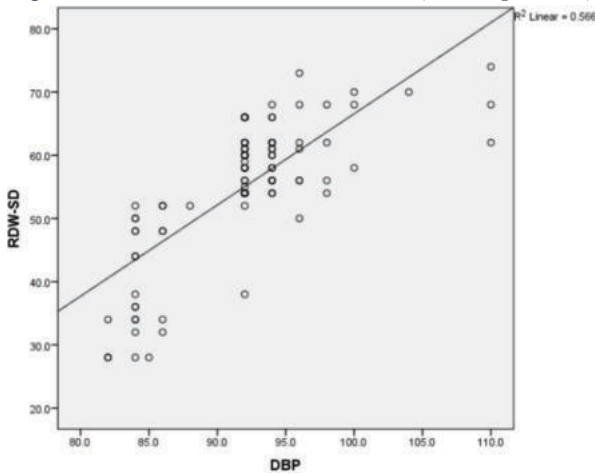
**Figure 1: Correlation of SBP with RDW-CV (r=0.790,p<0.0001)**



**Figure 2:** Correlation of SBP with RDW-SD ( $r=0.788, p=0.0001$ )



**Figure 3:** Correlation of DBP with RDW-CV ( $r=0.767, p=0.0001$ )



**Figure 4:** Correlation of DBP with RDW-SD ( $r=0.753, p=0.0001$ )

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