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Association of Red Cell Distribution Width and Hba1c in Type-2 Diabetes Mellitus

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Abstract*: Background: Diabetes Mellitus is recognized as major cause of death and disability with public health burden worldwide. Prevalence of diabetes with impaired glucose regulation (IGT and/or IFG) is the highest in developing countries. Objective: To find out the association and contribution of Red Blood Distribution Width (RDW), CRP and Glycated Haemoglobin (HbA1C) with type-2 diabetes mellitus. Methods: It was laboratory based cross sectional study and conducted 80 subjects in the Department of Laboratory Medicine and Endocrinology, Bangobandhu Sheikh Mujib Medical University, Bangladesh. After the laboratory works, data were inputted and analyzed through SPSS 24 version. Results: The mean age of the respondents was 45.06±11.08 years. 35% patient belonged to age ≤40years and 11.3% was ≥60 years. Mean value of RBC (×10^{12}/L) was 4.73±0.57, RDW-CV (%) 14.55±1.11, HbA1c (%) 8.54±2.08 and CRP (mg/L) was 5.98±5.85. Correlation between HbA1c (%) and RDW was strongly related (P=0.001) and (r=0.457). CRP with RDW was p=0.001 and r=0.512. Conclusion: RDW and CRP were strongly correlated with HbA1c in type2 diabetes mellitus. Increased RDW likely reflects the presence of pro-inflammatory cytokines and oxidative stress. So, CBC, CRP and HbA1c test are very valuable and effective tool for monitoring DM and follow up.*

Key words: *Diabetes Mellitus (DM), Haemoglobin A1c (HbA1c), Complete blood count (CBC), Red blood Distribution width (RDW), C-reactive protein (CRP)*

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I. Introduction

Diabetes mellitus (DM) is a major global health problem. According to International Diabetes Federation, in 2015, 415 million people were suffering from diabetes worldwide. Prevalence of Diabetes is highest in developing nations, with major increases in South Asia, Middle-East, Sub-Saharan Africa and Latin America. Its global prevalence was about 8.8% in 2015 and is predicted to rise to 10.4% by 2040 (IDF, 2015). However, the prevalence of diabetes in Bangladesh is 8.4% and impaired glucose regulation (IGT or IFG) is 6.5% (IDF, 2016). It is estimated that more than 13.6 million people of Bangladesh will have diabetes by the year 2040 (IDF, 2016). Diabetes mellitus is the most important metabolic disease. It is recognized as one of the leading cause of death and disability worldwide (Zimmat et a1., 1999). According to American Diabetic Association (ADA) criteria, the diagnosis of diabetes is based on either of the followings - Fasting Plasma Glucose ≥ 126mg/dl (7.0 mmol/L) or 2-hours plasma glucose ≥200 mg/dl (11.1mmol/L) during an OGTT. The test should be performed as described by The WHO, using a glucose load containing the equivalent of 75g anhydrous glucose dissolved in water. Red cell distribution width (RDW) is a new routine parameter included in complete blood count (CBC). Higher RDW value indicate greater variation in red cell size which is related to impairment of erythropoiesis and degradation of erythrocytes, reflecting chronic inflammation and increased level of oxidative stress (Gerontol A Biol., 2010). RDW is recognized as global marker of chronic inflammation and oxidative stress (Lippi G et al., 2009). RDW has also been shown to independently predict overall and cardiovascular mortality in the general population and various high risk populations (Zalawadiya SK., 2011). It is also a strong predictor of mortality in many other conditions such as obesity, malignancies and chronic kidney

diseases (Patel KV., 2010). RDW has independent predictive value for various diseases. So, it is imperative to be studied in diabetes mellitus. Glycated haemoglobins are glucose-derived products of normal adult haemoglobin. HbA1c produced by the condensation of glucose with N-terminal valine of each β-chain of HbA (Satynarayana and Chakrapani, 2013). It is formed by a slow irreversible nonenzymatic reaction between haemoglobin and glucose. It represents the integrated values for glucose over the preceding 6-8weeks (Sacks DB., 2008). HbA1c is now regarded as a much more robust parameter than fasting plasma glucose for detecting and monitoring the impairment of glucose homeostasis in the general adult population (Lippi et al., 2010). RDW is positively associated with HbA1c and their relationship showing an increased in HbA1c of 0.10% per each standard deviation increase in RDW (Engstrom et al., 2014). The aim of this study was to show the association of RDW and HbA1c in type-2 diabetes mellitus. RDW is uprising as a new marker associated with health and diseases. RDW is a simple, less expensive and easily available parameter that is automatically generated by haematology autoanalyzer along with the CBC and claimed to have a role in the disease process and its complication. Routine RDW measurement might be regarded as a potential innovative biomarker for improving risk assessment of individuals with diabetes.

II. Materials and methods:

It was a laboratory based cross sectional study, conducted by 80 subjects agreed with inclusion criteria and face to face interviewed in the Department of Laboratory Medicine and Endocrinology of Bangobandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh in 2018. Data were analyzed using SPSS 24. After performing CBC, HbA1c, FBG and CRP in blood by Siemens Dimension RL Max.

III. Results:

Table I: Age distribution of the study patients (n=80).

Age (in years)	Number of patients	Percentage
≤40	28	35
41-59	43	53.7
≥60	9	11.3
Mean±SD	45.06±11.08	
Range (min-max)	23-70	

Among the participants majority of them (53.7%) belonged to age 41-59 years, and 11.3% was ≥60 years. Their mean age with standard deviation (SD) was 45.06±11.08 years.

Table II: Correlations between RDW with FBG, HbA1c and CRP (n=80).

	RDW (%)	
	r	p value
HBA_1c (%)	0.457	0.001
CRP (mg/L)	0.512	0.001

p value = Pearson R test

Table II shows HbA1c (%) and CRP (mg/L) were significantly correlated with RDW (P=0.001) in diabetic subjects.

Figure 1: Scatter diagram of HbA1c and RDW-CV (n=80).

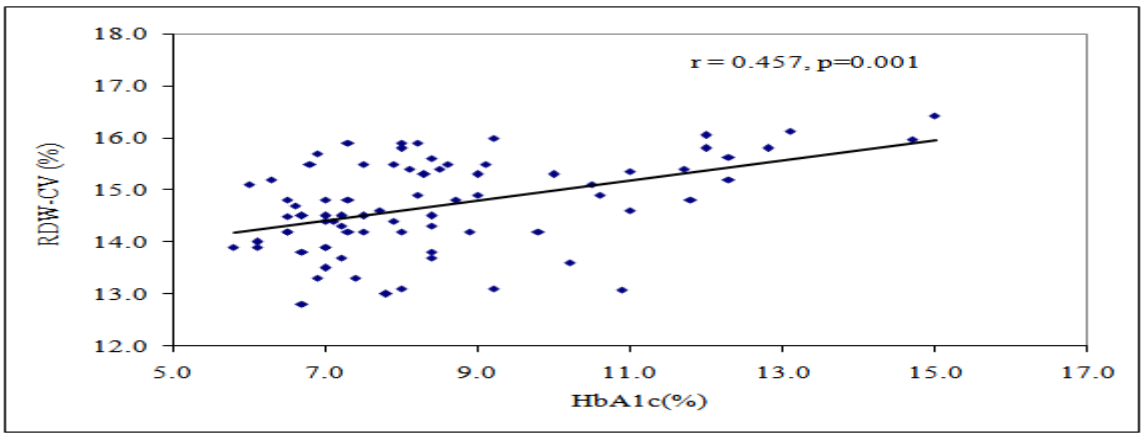
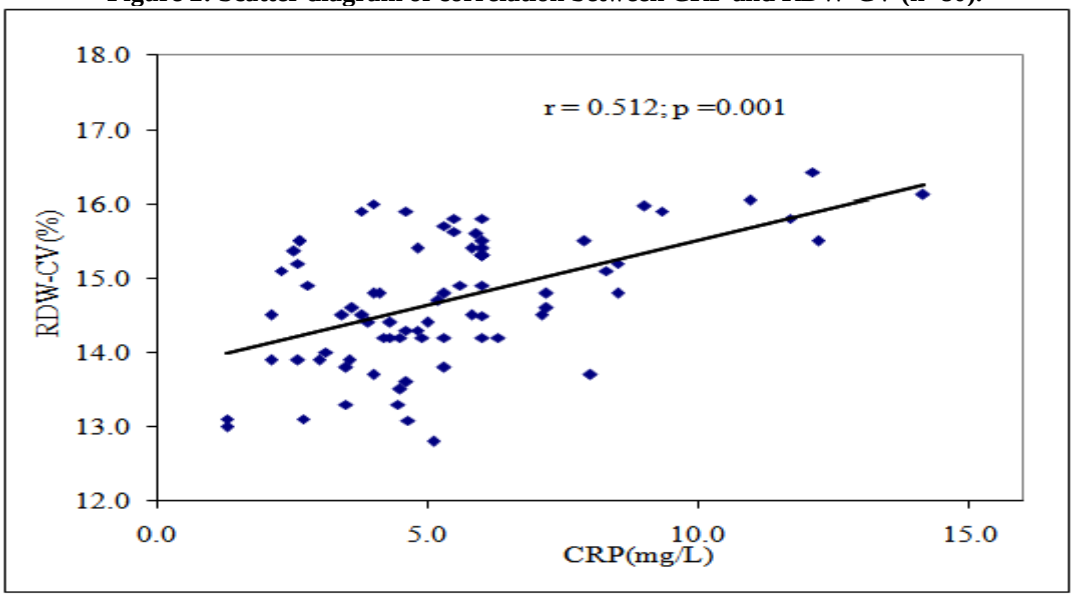


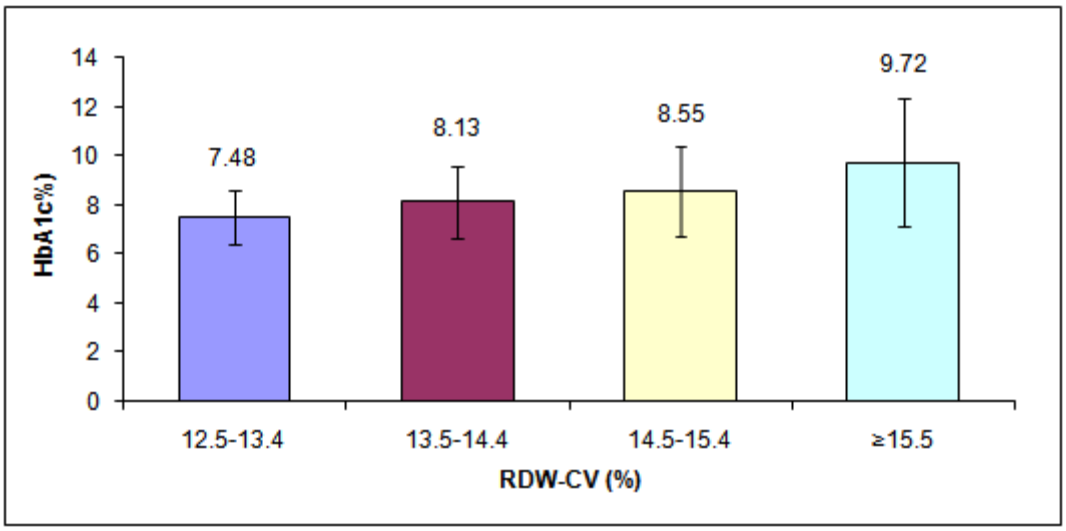
Figure 1: Scatter diagram showing positive correlation between HbAIc(%) and RDW-CV(%). The p-value is 0.001 and r-value is 0.457 which indicates statistically significant positive correlation.

Figure 2: Scatter diagram of correlation between CRP and RDW-CV (n=80).



The study found from this scatter diagram the p-value is 0.001 and r-value is o.512 which indicates statistically significant correlation. So, the study revealed the positive correlation between CRP and RDW-CV.

Figure 3: Bar diagram shows mean HbA1c in different RDW level (n=80).



Bar diagram (figure 3) shows the mean HbA1c's regarding different RDW levels. The mean HbA1c 7.48%, 8.13%, 8.55%, and 9.72% were found in RDW range from 12.5% to 13.4%, 13.5% to 14.4%, 14.5% to 15.4%, and ≥15.5% respectively.

IV. Discussion:

The mean age of the subjects of this study was 45.06±11.08 years. Our study found the mean RDW-CV (%) was 14.55±1.11% with ranged from 12.5 to 16.4. Normal range of RDW-CV% in healthy person is 11.5-14.5% (Al-Najjar et al., 2009). Nada AM., (2015), found mean RDW in their study was 14.29±1.36%. Another study Sherif et al., (2013), found mean RDW was 15.25±1.77%. It reveals that RDW increased in diabetes patients. So, the finding of our study was consistent with the others studies. In this study we found the mean with standard deviation (SD) HbA1c% was 8.54%±2.08%. The measurement of glycated haemoglobin (HbA1c) has now been established as an essential criterion for diagnosing diabetes in the general population (ADA. 1016). Demir et al., (2016), found mean HbA1c in diabetic patients were 7.7(6-14.9) %. Malandrino et al., (2011) found HbA1c was 7.0±1.9%. This result was near similar to the other studies. The association between RDW and HbA1c by pearson's correlation test has done. This study found strongly positive association between RDW and HbA1c. The r value was 0.457 and p-value was 0.001 that was statistically significant. Lippi et al.,

(2014), also found positive correlation between RDW and HbA1c, the p-value was 0.006. Another study by V. Veerenna et al., (2012), also found positive correlation between RDW and HbA1c, the p-value was 0.001. G. Engstrom et al., (2011), also found significant and positive relationship between RDW and HbA1c, the p-value was 0.001. This result of the study was consistent with published many studies. In our study, it was observed that there was positive correlation between CRP and RDW. The p-value was 0.001, which was significantly correlated. Lippi et al., (2014), found that graded and independent association existed between RDW and CRP. They were independently associated in Malandrino et al., (2011), the p-value was <0.001. Sherif et al., (2013), found higher CRP in diabetic patients and the p-value was 0.02. So, this finding of this study was consistent with other studies.

In the present study, it was observed that the patients those mean HbA1c was <7%, their mean±SD of RDW was 14.38±0.78% . Again, the patients those mean HbA1c was >7%, their mean ±SD of RDW was 14.30±0.88%. Increased RDW was higher in patients with HbA1c >7% indicating shorter lifespan with anisocytosis in diabetes mellitus. It was also found in the studies of Engstrom et al., (2011). Nada AM., (2015), here mean HbA1c was <7%, their mean ±SD of RDW was 13.94±1.29% and with HbA1c >7%, there mean ±SD of RDW was 14.29±1.36%. So, the present study was consistent with the previous studies. The mean CRP was 3.74 mg/L in RDW ≤14% and 5.81 mg/L in RDW >14%, their p-value was 0.001 which was significant. HbA_1c was 7.6 % with ranged from 5.8 to 10.9% in RDW ≤14% and 8.78 % with ranged from 6 to 15% in RDW >14%, their p-value was 0.006, which was significant. G Lippi et al., (2014), found HbA1c was 43 mmol/mol with RDW ≤ 14% and it was 45 mmol/mol with >14%. The result was similar to the other study.

V. Conclusion:

This study found RDW and HbA1c were increased in newly diabetic subjects. According to Pearson correlation, these variables were positively correlated. So, we can conclude that a type-2 diabetic patient can be screened by measuring RDW in CBC. High RDW gives a reflection of high HbA1c in type-2 DM. Therefore it may effective for monitoring of diabetes patients. Also improvement of patient's outcome can be expected. Therefore, these parameters can be used as a valuable and effective tool for monitoring of DM and follow up.

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