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RDW – A predictor of Diabetes Mellitus, a cross sectional study

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Introduction

Diabetes is a metabolic disorder that is being a global burden since many ages. It is a disease that has developed due to inadequate control of blood sugar levels. The incidence of diabetes globally. The incidence of diabetes at national level has risen from 7.1 in 2009 to 8.9 in 2019(1). The life long course disease leads to many micro and macro vascular complication. One which directly contribute on change on molecular structure of haemoglobin which is termed as HbA1c or Glycated Haemoglobin. Previously it was recognised as unusual haemoglobin in diabetic patients over 40 year but now it recognised important tool for diagnosis.

HbA1c is a direct measure of plasma glucose over a period of 8 to 12 week. It does not require patient's preparation and can be performed at any point of day. Other than glycosylation increased glucose level has effect had effect on mechanical properties of red cells including reduced deformability, increased adhesion and increased osmotic fragility leading to changes in structural and mechanical properties of RBC. These changes are reflected different parameter of red cells such Red cell distribution width.

RDW is measure variation in size of circulating red cells. In the previous year's blood glucose and OGTT were the main parameter for determining the blood glucose

Material and methods

This is cross sectional study conducted on patients which were diagnosed in Department of Pathology, Government Medical College, Kota from 1 January 2021 to 31 December 2021.All the patients were taken consent. Patients who were excluded from study were those having history hemo-globinopathies, anemia of any cause, chronic diseases like chronic liver disease, chronic renal failure, rheumatologic disorders, and acute or chronic infections like malaria, tuberculosis, or malignancy.

All the patients undergoing study underwent a detailed history, thorough physical examination, and routine relevant laboratory investigations for the implementation of inclusion and exclusion criteria.

Hplc machine used BIORAD D10.

Fasting blood glucose, random blood glucose, CBC, and HbA1c were studied on proforma.

Results

The study conducted on 961 patients who were found eligible. In present study 532 (55%) were male and 429 (45) were female. The mean age of distribution 49.9.with SD 15.23.

The mean for haemoglobin among these patients were 12.41 with SD 2.127. Mean RBC count among these patient 4.52. The mean MCH and MCV is 83.45fl and 27.86. The present study showed majority had poor diabetic control.

The data studied in present study showed there is significant correlation between HbA1c and RDW. The present study also shows significant correlation between HbA1c with other haematological parameter.

Statistics													
		Age	HB	RBC	MCV	MCH	RDW-CV	A1a	A1b	HbA1C	P3	A0	Total Area
N	Valid	961	961	961	961	961	961	961	961	961	961	961	961
Mean		49.909	12.411	4.517	83.449	27.866	14.975	0.870	1.322	7.651	6.231	83.489	1982799.683
Median		50	12.6	4.53	83.6	27.7	14.1	0.8	1.3	6.8	6.1	84.7	1803893
Std. Deviation		15.237	2.127	0.798	10.801	5.424	3.353	0.307	0.417	2.466	1.130	4.380	1434204.679
Range		85	14.8	6.3	115.6	98.4	33	2.9	3.3	16.4	23.2	41.4	23700041
Minimum		9	4.8	1	11.1	12.7	11.1	0.3	0.5	1.1	1.7	48.1	22250
Maximum		94	19.6	7.2	126.7	111.1	44.1	3.2	3.8	17.5	24.9	89.5	23722291
Percentiles	25	40	11.2	4.04	78.6	25.6	13.2	0.7	1	6	5.6	81.9	1487694.5
	50	50	12.6	4.53	83.6	27.7	14.1	0.8	1.3	6.8	6.1	84.7	1803893
	75	61	14	5.035	89.2	29.9	15.5	1	1.6	8.6	6.7	86.3	2203100

MCV=mean corpuscular volume, MCH=mean corpuscular haemoglobin, HB= haemoglobin, RBC= red blood cell counts, RDW CV= red cell distribution width

HbA1C * Conclusion			
	HbA1C		
Conclusion	Mean	N	Std. Deviation
Diabetes	6.664	107	0.1667
Good control	6.957	35	0.0948
Normal/Non Diabetic	5.171	136	0.4961
Poor control	10.690	293	2.1541
Pre Diabetic	6.122	267	0.7406
Unsatisfactory control	7.528	123	0.2904
Total	7.651	961	2.4661

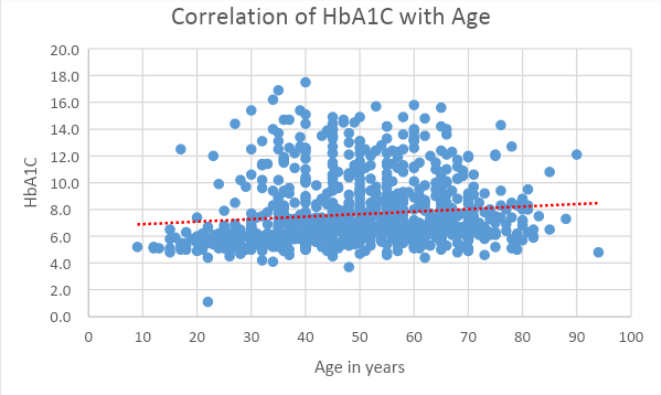
Sex		
	Sex	Frequency
	Male	532
	Female	429
	Total	961

HbA1C * Sex			
	HbA1C		
Sex	Mean	N	Std. Deviation
Male	7.644	532	2.4119
Female	7.660	429	2.5345
Total	7.651	961	2.4661

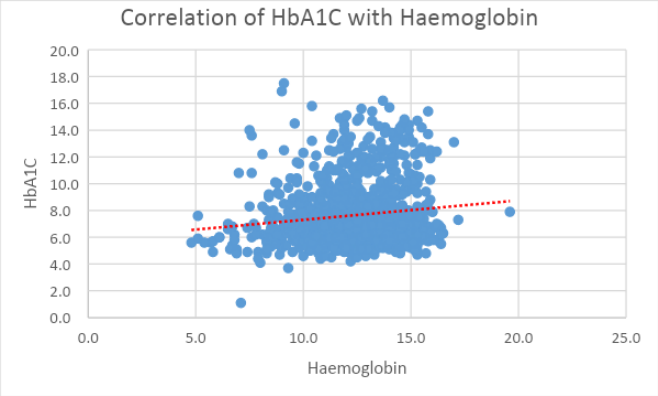
Independent Samples Test						
Independent Samples Test	Mean Difference	Std. Error Difference	test value	degree of freedom	p-value	Interpretation
Equal variances assumed	-0.016	0.160	-0.100	959.000	0.920	Not significant
Equal variances not assumed	-0.016	0.161	-0.099	896.149	0.921	Not significant

Correlations of HbA1c with different parameters (N = 961)				
Parameter	Correlation	p-value	95% CI	Interpretation
Age	0.116	3.25E-04	Significant	Weak correlation
Hb	0.125	9.90E-05	Significant	Weak correlation
RBC	0.192	1.86E-09	Significant	Weak correlation
MCV	-0.124	1.13E-04	Significant	Weak correlation
MCHC	-0.091	0.005	Significant	Weak correlation
RDW-CV	-0.089	0.006	Significant	Weak correlation
A1a	0.341	1.13E-27	Significant	Moderate correlation
A1b	0.171	8.99E-08	Significant	Weak correlation
P3	0.607	1.03E-97	Significant	Moderate correlation
A0	-0.782	2.24E-199	Significant	Strong correlation
Total Area	0.009	0.790	Not significant	No correlation

Graph 1:



Graph 2:



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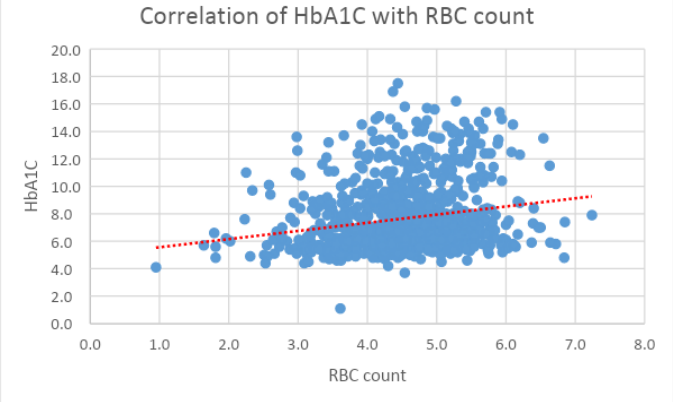

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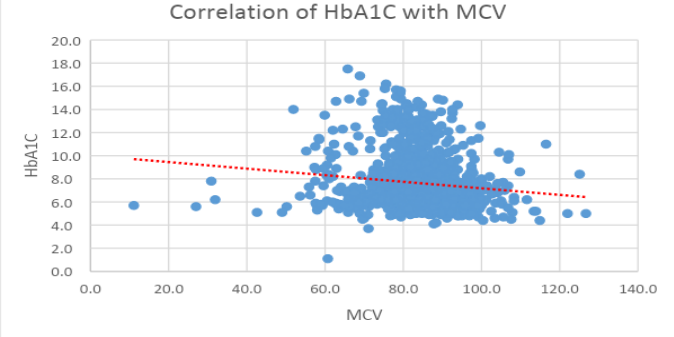

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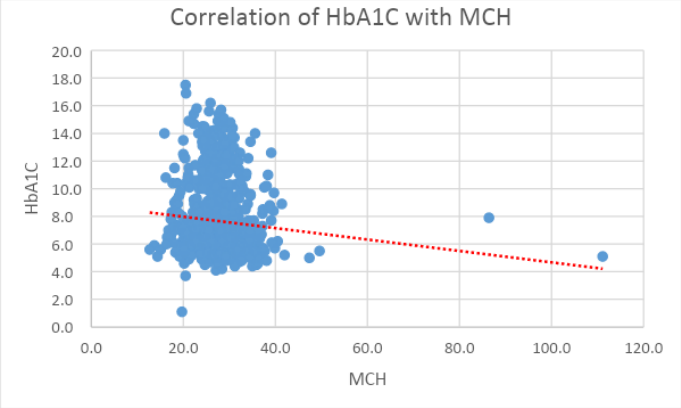
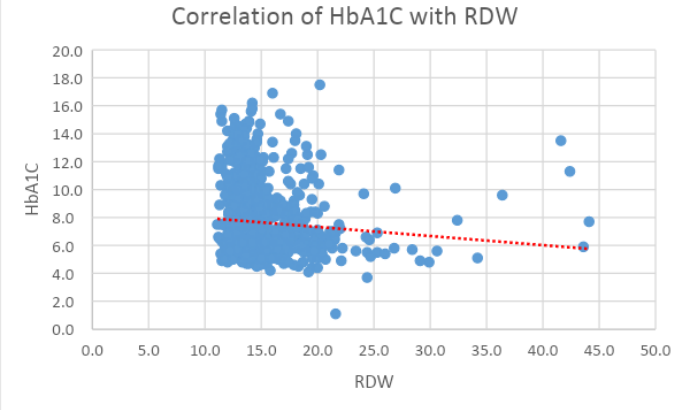


Graph 6:



Discussion

Diabetes mellitus is a group of metabolic disorder that shares a common phenotype of hyperglycaemia. Here insulin plays a very important role in regulation of metabolism od glucose. Main factors which are responsible for manifestation Diabetes mellitus is complex interaction between genetics, environmental factors and lifestyle. Poor control over disease lead to many severe complication. Major life threatening complication includes retinopathy, nephropathy and neuropathy. In order to avoid this life threatening complication frequent monitoring of blood glucose is essential. In routine practice fasting , post prandial and random blood glucose is used as parameter to diagnose Diabetes mellitus .Criteria defined by WHO for diabetes mellitus diagnosis include –fasting >126mg/dl , post

prandial >200mg/dl and random > 200mg/dl along with HbA1c >6.5%.

With the advancement in technology HbA1c is most popularly used tool for diagnosing and monitoring DM. It can also predict complication.

HbA1c initially defined as “unusual” haemoglobin in patients with diabetes over 40 years ago (1). HbA1c measure glucose over previous eight to 12 weeks (2). The test can be performed at any point of day without any special requirement.

Similar to increase in glycated haemoglobin, one of the parameter is also affected with increase in glucose – RDW. This parameter is routine investigation in complete blood count. It can also be an important marker, as with increase in glucose value there is also change in volume of RBC is observed. (3).

The role of RDW in various diseases as diagnostic and predictive is being discovered nowadays.

The mean age of diabetic patient in the study was 49 years, they had mean haemoglobin level of 12.41 gm. The mean MCV was 83.449 and MCH was 27.86, which were below normal value. So the patients suffering from diabetes mellitus are at verge of developing anaemia.

In present study most of the patient showed poor control over diabetes along with male predominance was also found.

In present study, we found a statistically significant correlation of RDW with HbA1c (r=0.193, p0.035), The same observations were evidenced by Suryavanshi et al. in their study (r=-0.235, p=0.001) [4] . Salimon et al. found in their studied that males have showed significant correlation more than females (r= 0.400 vs r= 0.04) [5].A study by Lippi et al demonstrated a significant correlation of HbA1c and RDW [6].While other parameters of RBCs like MCV and MCH have shown significant correlation with HbA1c.

A study consucted by Hardikar et al. on non-diabetic subjects observed an inverse correlation between HbA1c and MCV ($r = -0.22$, $p < 0.05$), MCH ($r = -0.30$, $p< 0.05$), and MCHC ($r = -0.32$, $p < 0.05$) [7] .

Another study which was performed by Koga et al. found HbA1c was inversely associated with MCV ($r = -0.368$, $p < 0.0001$) and MCH ($r = -0.320$, $p < 0.0001$) in premenopausal women but postmenopausal women have shown no such relation betweenHbA1c and MCV ($r = -0.019$, $p = 0.771$) and MCH ($r = -0.104$, $p = 0.107$) [8].

A study conducted by Abdul Rabb Bhutto , Amanullah Abbasi , Ali Hassan Abro – a correlation between HbA1c and RDW showed similar result. (9)

Conclusion

As India is a developing , majority of the population is poor. Although HbA1c is most commonly used diagnostic technique but cost effective is another criteria which should be consider according to the population. Complete blood count specific RDW a rountinely performed investigation which is inexpensive and freely available provide an alternate for HbA1c . RDW can be as a, marker of gylcemic index.

However study conducted in our college is small scale we need many other as well as much larger scale studies for establishing the role of RDW in Diabetes patient .

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