

## Red Cell Distribution Width (RDW) and Hb% in the Detection of Iron Deficiency Anemia in Pregnant Women

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### ABSTRACT

**Background:** Detection of iron deficiency early during pregnancy is essential for correct management. Red cell distribution width (RDW) is a new routine parameter in fully automated hematology analyzer that can give the idea of early iron deficiency before Hb%. This study was aimed to see the role of red cell distribution width and Hb% in determining early iron deficiency in pregnant women.

**Methods:** In this study 190 pregnant women were included. CBC including Hb% and RDW and iron profile were done. RDW were compared with Hb% in various stages of iron deficiency.

**Results:** RDW was more significant than Hb level in latent iron deficiency when Hb level was normal ( $p < 0.05$ ). In mild and moderate iron deficiency anemia, RDW was increased progressively though Hb level was reduced. In this study RDW had sensitivity 82.3% and specificity 97.4%. Whereas Hb level had sensitivity 56.6% and specificity 90.9% for iron deficiency.

**Conclusion:** Latent iron deficiency without other complicating disease could be screened out early by increased RDW when Hb% was normal.

**Key Words:** Iron deficiency anemia, RDW, Hb%, pregnancy.

### Introduction

Anemia is the common nutritional problem in the world. The prevalence of anemia in pregnant women of Bangladesh was reported as 50% and 59% according to two different surveys on 1999 and 1998.<sup>1</sup> Jamil et al in 2004 found prevalence of anaemia in pregnant women of Bangladesh was 38.8%.<sup>2</sup> Among the various causes of anemia iron deficiency anemia (IDA) is the primary cause and one of the most important contributing factors to the global burden of the disease.<sup>3</sup> For detection of iron deficiency (ID) some biochemical tests like iron profile, zinc protoporphyrin, free erythrocyte protoporphyrins etc are used but those are costly. Red cell distribution

width (RDW) a new, routine parameter in fully automated hematology analyzer which is included in complete blood count (CBC) that can give the idea of early iron deficiency before other tests to become positive, as anisocytosis is the earliest morphologic changes in iron deficiency.<sup>4</sup> Anemia in pregnancy is usually not accompanied by obvious morphologic changes in RBC, so may lead to misinterpretation of microcytosis. RDW can express the variation of different population of cell and assess the percentage of cells falling above or below the given MCV threshold and flag the presence of an increased number of microcyte or macrocytes.<sup>5</sup> Early iron

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deficiencies only have high RDW because early iron deficiency is not associated with anemia.<sup>6</sup> In prelatent and latent iron deficiency Hb% are normal.<sup>8</sup> But in latent iron deficiency RDW would be expected to increase because a microcytic population of cells appears in the blood.<sup>6,7</sup> RDW also increases before hemoglobin concentration falls.<sup>8</sup> During normal pregnancy serum iron and percentage saturation falls and TIBC increases like iron deficiency.<sup>1,6,9</sup> As serum iron and percentage saturation progressively decrease in normal pregnancy but TIBC increases even in an iron replete women, the serum iron, percentage saturation and TIBC have less diagnostic value during pregnancy.<sup>10</sup> Serum ferritin also decreases progressively during normal pregnancy. Serum ferritin is gold standard for iron deficiency anemia but it is costly, may give misinterpretation due to physiological reduction and falsely elevated as an acute phase reactant.<sup>11</sup> For these RDW is a cheaper, simple parameter in CBC, which can give the idea of early iron deficiency before Hb%. The aim of this study is to see whether the RDW and Hb% can give idea about IDA in pregnancy.

## Methods

Study was conducted in the department of clinical pathology, Bangabandhu Sheikh Mujib Medical University, Dhaka from August 2008 to August 2009. About 6 ml blood was taken from all the pregnant women for antenatal checkup in Obstetrics outdoor, of which 2 ml in EDTA tube for complete blood count (CBC) including RDW and ESR and about 4 ml in a plain test tube for serum iron profile. CBC and Iron profile was done in all the cases and categorized as Group I/ iron deficient group (serum ferritin level <12 ng/ml) and Group II / non iron deficient group (serum ferritin 12 to 200 ng/ml).<sup>12</sup> Group II considered as control. Then all the pregnant women of group I were categorized as prelatent iron deficiency, latent iron deficiency, mild and moderate iron deficiency anemia.<sup>13</sup> Pregnant women with MCV >94 fl were excluded due to suspicion of macrocytosis. Women with serum ferritin normal or raised, serum iron low (<70 µg/dl), TIBC normal (250-435 µg/dl) or low and ESR >40 mm / hr suggestive of anemia of chronic disorder were excluded.<sup>14</sup> Hb level <11.0 g/dl were considered as

reduced and RDW-CV level >14.5% were considered as increased. Data were evaluated by standard statistical methods. Analysis was done by SPSS. Sensitivity, specificity, accuracy, positive predictive values (PPV) and negative predictive values (NPV) of RDW and Hb% were done. Unpaired t test, Chi square test and ANOVA test were calculated in diagnosing IDA.

## Result

The main objective of this cross sectional study was to see the role of RDW and Hb% in the detection of iron deficiency anaemia (IDA) in pregnancy. 190 pregnant women were enrolled in the study according to the case selection criteria out of 245 women. 113 pregnant women were identified as iron deficient (Group-I) and 77 women were identified as non iron deficient or control (Group-II). The distribution of group I are 8 (4%) women are in pre-late latent iron deficiency group, 41 (22%) in latent iron deficiency group, 38 (20%) in mild IDA group and 26 (14%) in moderate IDA group. (figure No- 1) {Pls .Insert Figure No-1 here}

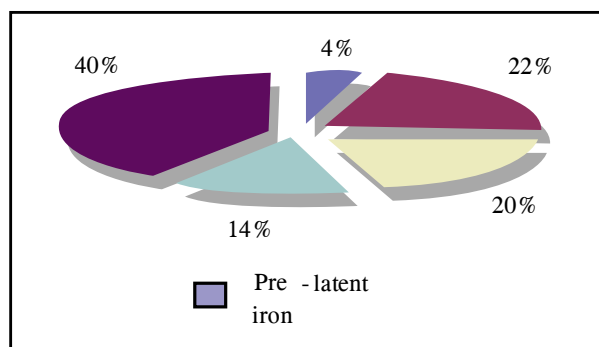


Figure 1: Pie diagram showing distribution of the study population in different categories (n=190)

The mean ( $\pm$ SD) Hb level was  $11.50 \pm 0.34$  gm/dl in pre-late latent iron deficiency,  $11.61 \pm 0.51$  gm/dl in latent iron deficiency,  $10.48 \pm 0.31$  gm/dl in mild IDA and  $8.94 \pm 0.83$  gm/dl in moderate IDA. In non iron deficient group the mean ( $\pm$ SD) Hb level was  $12.23 \pm 1.03$  gm/dl. The mean Hb difference was statistically significant in ANOVA test.

The mean ( $\pm$ SD) RDW-CV level was  $13.35 \pm 1.08$  % in pre-late latent iron deficiency,  $14.88 \pm 0.77$  % in latent iron deficiency,  $15.98 \pm 1.65$  % in mild IDA

and  $18.03 \pm 2.22\%$  in moderate IDA. In non iron deficient group the mean ( $\pm$ SD) RDW-CV level was  $13.21 \pm 0.70\%$ . The mean RDW-CV difference was statistically significant in ANOVA test.

In reduced Hb none were found in pre-latent iron deficiency and latent iron deficiency group, 38(100%) were in mild iron deficiency anaemia, 26(100%) in moderate iron deficiency anaemia and 7(9.1%) in non iron deficient group.

In increased RDW-CV 1(12.5%) were in pre-latent iron deficiency group, 34(82.9%) were in latent iron deficiency, 32(84.2%) were in mild iron deficiency anaemia, 26(100%) were in moderate iron deficiency anaemia and 2(2.6%) in non iron deficient group. The difference of Hb level and RDW was statistically significant ( $p < 0.05$ ) in latent iron deficiency and mild iron deficiency anaemia.  $p$  value of 0.001 in latent ID and 0.013 in mild IDA reached from chi square test. The results are shown in Table I.

**Table-I:** Difference of Hb and RDW-CV in the diagnosis of Iron deficiency of anaemia

Grade of iron deficiency Hb g/dl RDW-CV% Chi P value

Grade of iron deficiency	Hb g/dl		RDW-CV%		Chi value	P value
	Reduced		Increased			
	N	n %	n %			
Group I						
Pre - latent iron deficiency	8	0 0.0	1 12.5	1.07	0.500	<sup>ns</sup>
Latent iron deficiency	41	0 0.0	34 82.9	58.08	0.001	<sup>S</sup>
Mild iron deficiency Anaemia	38	38 100.0	32 84.2	6.51	0.013	<sup>S</sup>
Moderate iron deficiency Anaemia	26	26 100.0	26 100.0	-	-	
Group II						
Non Iron deficient	77	7 9.1	2 2.6	2.95	0.083	

Hb level: Normal:  $\geq 11$  g/dl, Reduced  $< 11$  g/dl

RDW-CV level: Increased:  $> 14.5\%$

Validity of RDW and Hb% were done by calculating sensitivity, specificity, PPV, NPV and accuracy. In this study RDW had sensitivity 82.3% and specificity 97.4% in the detection of iron deficiency (Table No-II). {Pls. Insert Table No-II here}.

**Table-II:** Sensitivity, specificity, accuracy, positive and negative predictive values of the Hb (gm/dl) and RDW (%) in diagnosis of IDA. (n=190).

Validity test	Hb(gm/dl)	RDW (%)
Sensitivity	56.6	82.3
Specificity	90.9	97.4
Accuracy	70.5	88.4
PPV	90.1	97.9
NPV	58.8	78.9

## Discussion

Women's were prone to develop iron deficiency especially when became pregnant.<sup>12</sup> Due to physiologic alteration of plasma volume and red cell mass in pregnancy, Hb level are unreliable.<sup>11</sup> Hb determination is neither sensitive nor specific as a screening test for iron deficiency.<sup>15</sup> Measurement of serum iron, TIBC and percentage saturation to detect iron deficiency during pregnancy has limited value.<sup>7,10</sup> S. ferritin considered as gold standard for IDA without other complicating disease though it is costly. Many studies were done by researchers for diagnosis of IDA by RDW. In this study RDW was compared to Hb% in various stages of iron deficiency (ID) and iron deficiency anemia (IDA) to see the role of RDW and Hb% in the early diagnosis of IDA in pregnancy.

In this study level of Hb were decreased progressively with the progression of iron deficiency while RDW was increased. In prelatent and latent iron deficiency Hb was not reduced but reduced in mild and moderate IDA. Hb level was reduced in non iron deficiency (NID). Difference was statistically significant between two groups that correspond to other study.<sup>16</sup> RDW was progressively increased in prelatent, latent, mild and moderate IDA. Difference found between group-I and group-II were statistically significant ( $p=0.001$ ). In prelatent and non iron deficiency, RDW was almost same and normal. Similar result was also observed by other studies<sup>13</sup>. RDW was increased in 26 women (100%) of moderate IDA, 32 women (84.2%) of mild IDA and 34 women (82.9%) of latent ID but RDW increases only in 1 women (2.5%) of prelatent and 2 women

(2.6%) of non iron deficiency. In prelatent and non iron deficiency group RDW may be increased due to co-existence of other nutritional deficiency like folate or vit B.<sup>12</sup> Mean RDW in both pre latent and non iron deficiency group were normal. The difference was statistically significant between two group ( $p=0.001$ ). Many researchers also found increased RDW in latent and iron deficiency anemia.<sup>13</sup>

Hb level was not reduced in prelatent, latent ID pregnant women while RDW was increased in 1 pregnant women (12.5%) and 34 womens (82.9%) of prelatent and latent ID. In mild and moderate IDA 38 women (100%) and 26 womens (100%) had reduced Hb level but RDW was increased in 32 women (84.2%) and 26 women (100%). Therefore RDW was more significant than Hb level in latent ID when Hb level was normal. In mild and moderate IDA, RDW was increased progressively though Hb level was also reduced. Uchida, 1989 also found normal Hb level with increased RDW in latent ID and reduced Hb level with incresed RDW in IDA.<sup>13</sup> In early iron deficiency without anemia and IDA was infrequently identified by increased level of RDW and found increased RDW in 4 out of 24 women of ID without anemia and 15 out of 49 women with anemia.<sup>17</sup>

Sensitivity, specificity, PPV and NPV were calculated for Hb level and RDW. In this study Hb level had sensitivity 56.6% and specificity 90.9% with accuracy 70.5%, PPV 90.1% and NPV 58.8% for iron deficiency. Casanova, Sammal and Macones (2004) also found low sensitivity (42.6%) and high specificity (86.2%) in IDA in pregnancy for Hb and classified 71.6% as iron deficient, but the sensitivity and specificity was less than RDW, which was almost consistent with the present study.<sup>16</sup>

In this study RDW has the highest sensitivity (82.3%) and specificity (97.4%). Accuracy, PPV and NPV was found 88.4%, 97.9% and 78.9% respectively. Aulakh et al, 2009 found almost same sensitivity 81.0% and NPV 72.4% but the specificity and PPV was low 53.4% and 63.0%<sup>18</sup>. Whereas vanZeben *et al.* in 1990 found sensitivity of RDW was 94% and specificity 59% and concluded that RDW was important than serum ferritin in infection, inflammation and tissue damage.<sup>20</sup> Viswanath *et al.*

2001 found high sensitivity of RDW 92.13% and specificity 90.9% with PPV 98.79% and NPV 58.8% which was also more or less similar with this study.<sup>21</sup>

**Limitation:** Due to lack of budget limited sample was taken and haemoglobin electrophoresis, serum vit B12 or folate study could not be done.

### Conclusion

RDW had found high sensitivity in this study. In latent iron deficiency RDW can give the idea of iron deficiency when Hb level is normal. Physician can get the idea of iron deficiency from RDW after doing CBC in pregnancy before doing confirmatory test.

**Conflict of interest:** Nothing to declare

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