

# Red cell distribution width (RDW) in the diagnosis of iron deficiency anaemia in children between 6 months to 2 years

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## Abstract

**Objective:** To compare the usefulness of RDW in the diagnosis of iron deficiency anemia (IDA) with other blood indices and peripheral smear

**Methods:** Hundred children between the age group of 6 months to 2 years with hemoglobin less than 11 g/dl were included in the study. Complete Blood Counts and serum ferritin were performed in all children. Those with serum ferritin less than 12 ng/ml were taken as IDA group and those with more than 12ng/ml were taken as non IDA group. Sensitivity and specificity of RDW in detection of IDA was compared with other red cell indices and peripheral smear (PS).

**Results:** Out of hundred children studied, serum ferritin was less than 12ng/ml in 70 cases and remaining 30 cases had more than 12ng/ml. RDW had the highest sensitivity of 90 per cent followed by MCH (84.28%), PS (77.14%) MCV (72%) and MCHC (64.28%).

The specificity of RDW was highest (76.66%) followed by MCHC (53.3%), PS (50%), MCV (36.67%) and MCH (16.66%).

**Conclusion:** 1. RDW is more sensitive and specific parameter in the diagnosis of IDA compared to blood indices and peripheral smear examination

2. RDW can be used as an effective tool for the diagnosis of IDA where facilities for serum ferritin are not available.

**Key words:** Iron deficiency anemia, red cell distribution width (RDW), red cell indices.

## Introduction

The World Health Organisation (WHO) has estimated that globally 1.62 billion people are anemic with highest prevalence (47.4%) of anemia among preschool children [1]. Iron deficiency is the most important cause of anemia in India [2]. The diagnosis of anemia is important both in the management of individual patients and for the study of population with nutritional anemia. The present study was undertaken to test the utility of Red Cell Distribution Width (RDW) in diagnosis of iron deficiency anemia compared to peripheral smear and other red cell indices.

## Materials and methods

This was a cross sectional observational study carried

out at Karnataka Institute of Medical Sciences, Hubli, Karnataka, which is a tertiary care medical college hospital in North Karnataka. Hundred children in the age group of six months to two years attending pediatric OPD for minor illnesses with hemoglobin less than 11 g/dl were included in the study. Those children with hemolytic anemia, chronic diseases, on iron supplementation and who received blood transfusion in the past were excluded from the study. Red Cell Distribution Width (RDW) represents the coefficient of variation of red blood cell volume distribution and considered an index of heterogeneity, the equivalent of anisocytosis observed in peripheral smear examination [3].

All the cases were studied with detailed history and clinical examination. Blood samples obtained were

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put in EDTA tube for haematological studies and in plain tube for serum ferritin estimation. Haematological parameters were obtained by automated cell counter "SYSMAX K1000"(Transasia Ltd). The RBC indices comprised of Hemoglobin concentration, Hematocrit, MCV, MCH, MCHC and RBC count. For red cell morphology blood films were prepared and examined by a pathologist. Serum ferritin was determined by ELISA using human immunoassay kit (automated ELISA micro well, Monobind Inc, USA). Cases were divided into two groups based on following criteria

- a. Iron Deficiency anemia (IDA) if serum ferritin is less than 12ng/ml and
- b. Non iron deficiency anemia (non IDA) if serum ferritin was more than 12ng/ml based on the recommendations of WHO [2]. The red cell indices MCV (<75 fml) [4], MCH (<25pcgm) [4], MCHC (<30gm/dl) [5], RDW (>16%) [6] and peripheral smear (PS) morphology of microcytic hypochromic anemia were considered to be suggestive of iron deficiency anemia.

**Results**

Among the hundred children studied, 62 were males and 38 females. The mean age was 15.2 months, with 55 children between 6-12 months, 19 children between 13-18 months and 26 children between 19-24 months. Serum ferritin was done in all hundred cases. Out of 100 children, 70 children had serum ferritin levels less than 12ng/ml and remaining 30 children >12ng/ml. Distribution of various blood indices among IDA group and non IDA group is noted (Table 1) Sensitivity, specificity, positive predictive value and negative predictive value in detecting iron deficiency anemia was calculated (Table 2). Compared to other haematological indices RDW was raised in 90% of children with IDA. Increased RDW (>16%) had the highest sensitivity followed by MCH, PS, MCV and MCHC. Specificity of RDW was highest followed by MCHC, peripheral smear, MCV and MCH. Positive predictive value (PPV) of peripheral smear was highest followed by MCHC, RDW, MCV and MCH. Negative predictive value (NPV) of RDW was highest followed by PS, MCHC, MCV and MCH.

**Table 1. Distribution of various haematological parameters in the study population (N=100)**

Parameter	Frequency (%)	IDA group(N=70)	Non-IDA group(N=30)
Decreased MCV(<75fml)	70	51	19
Decreased MCH(25pgm)	84	59	25
Decreased MCHC (<30gm/dl)	59	45	14
PS of microcytic hypochromic picture	69	54	15
RDW (>16%)	86	63	23

**Table 2. Sensitivity, specificity, PPV and NPV of various haematological indices and peripheral smear in detecting IDA**

Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Decreased MCV(<75fml)	72	36.66	72	36.67
Decreased MCH(25pgm)	84.28	16.66	70.23	31.25
Decreased MCHC (<30gm/dl)	64.28	53.3	76.26	39.05
PS of microcytic hypochromic picture	77.14	50	77.14	48.38
RDW (>16%)	90	76.66	73.25	50

**Table 3. Sensitivity and Specificity of RDW in different studies in comparison with present study**

Studies	Gold standard used	Cut off value of RDW (%)	Sensitivity of RDW (%)	Specificity of RDW (%)
Aulakh et al <sup>[7]</sup> (2004-2005)	TIBC, serum ferritin	17.4	81	53
Zeben et al <sup>[8]</sup> (1990)	Bone marrow iron	14.5	94	59
Thompson et al <sup>[9]</sup> (1998)	BMI /serum ferritin	15	71	54
Flynn et al <sup>[10]</sup> (1998)	SI, TIBC, ferritin	13.4	94	51
Gupta et al <sup>[11]</sup> (1994)	SI, TIBC	17.1	61.3	92.5
Vishwanath et al <sup>[6]</sup> (2001)	Transferrin saturation	Children-14.5 Infants -16	92.1	90.9
Kim et al <sup>[12]</sup> (1996)	Serum ferritin transferrin	15	83.3	57.7
Present study (2008-2009)	Serum ferritin	16	90	76.66

## Discussion

We found that mean RDW in iron deficiency anemia group was higher (20.14+/-3.27) as compared to non iron deficiency anemia group (18.02+/-2.58). At cut off value of 16%, the sensitivity and specificity of RDW in diagnosing iron deficiency anemia was 90% and 76.6 % respectively. On comparison with previously published studies (Table 3), sensitivity of RDW in detecting iron deficiency anemia was comparable with Zeben et al study [8] (94%), Flynn et al [10] (94%) and Vishwanath et al [6]. study (92.1%) where as in Aulakh et al [7], Thompson et al [9], Gupta et al [11], Kim et al [12], S. Mc Clure et al [13] and Bessman et al [14] study it was 81%, 71%, 61.3 %, 83.3%, 100% and 96% respectively. Specificity of RDW in detecting IDA in the present study was 76.66% where as in Aulakh et al [8], Zeben et al [8], Thompson et al [9], Flynn et al [10] and Kim et al [12] study the specificity was comparatively low. But in Gupta et al [11] and Vishwanath et al [6] study specificity was higher than the present study. Compared to Vishwanath et al [6] study, PPV and NPV of RDW was lower in the present study.

## Conclusion

1. RDW is more sensitive and specific parameter in the diagnosis of IDA when compared to blood indices and peripheral smear.
2. RDW can be used as an effective tool for the diagnosis of IDA where facilities for serum ferritin are not available.

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