Prognostic Value of Red Cell Distribution Width in Outcome of Acute Ischemic Stroke

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KEYWORDS
Modified Rankin scale, NIHSS SCORE, Red Cell Distribution Width, Stroke.

ABSTRACT
Background: Red cell distribution width (RDW) is a haematological parameter that indicates the range of sizes of red blood cells. It is now widely acknowledged as a prognostic indicator for ischaemic stroke. Aim and Objective: To Study theprognostic value of red cell distribution width (RDW) in outcome of acute ischemic stroke. Materials and Method: The cross-sectional study was undertaken at Aarupadi Veedu Medical College in Puducherry. It included 61 patients, aged 18-80 years, who were diagnosed with acute ischemic stroke within 48 hours. Clinical assessment of patient by NIHSS Score and measuring the outcome by modified Rankin scale. The study took place in both the Outpatient and Inpatient in Department of General Medicine. Results: The study indicates a notable proportion of male more than female ,older participants (64.0% aged 56 years and above), There is a significant occurrence of hypertension (62.3%) and diabetes mellitus (63.9%) a substantial frequency of individuals who do not smoke (63.9%), and a majority of participants who do not use alcohol (77.0%). Levels of RDW exhibited significant positive relationships with stroke severity. Conclusion: The study highlights the potential of Red Cell Distribution Width (RDW) as a helpful predictive indicator in outcome of ischemic stroke. Increased RDW levels were observed to have a substantial correlate with more severe stroke and disability, as indicated by strong associations with NIHSS and mRS scores. The study emphasizes the usefulness of RDW in assessing the severity of ischaemic stroke and emphasizes the need for additional research to improve its clinical use.

1. Introduction and Background

Red cell distribution width (RDW) is a hematological metric that indicates the degree of variation in the size of red blood cells (RBCs). In recent years, it has gained interest for its possible use as a prognostic marker in many medical situations, such as ischemic stroke. Higher levels of RDW have been linked to greater rates of death and illness in individuals with cardiovascular illnesses and stroke[i]. It suggests that RDW could be a useful tool in clinical settings for evaluating the severity and outcomes of strokes. Multiple studies have confirmed a strong association between RDW (Red Cell Distribution Width) and the severity of strokes. Ani and Ovbiagele (2009) discovered that increased RDW levels can be used to predict death in stroke patients, suggesting that it has the potential to serve as a prognostic indicator in this particular group[ii]. Wang and Liu (2022) showed that elevated RDW levels were linked to unfavorable functional outcomes in patients receiving endovascular therapy for acute ischemic stroke[iii]. In addition, a meta-analysis conducted by Feng et al. (2017) emphasized that there is a strong correlation between RDW and the severity of ischemic stroke[iv]. Although, RDW can be used to predict unfavourable outcomes, which further supports its clinical importance.

2. Review of Literature

Some of the studies has been conducted on different times, and highlighted their different findings in their studies. A study conducted by Ani C and Ovbiagele B (2009) found that an increased red cell distribution width (RDW) is a predictor of mortality in individuals with a diagnosed stroke. The article titled "J Neurol Sci." has been published in volume 277 and spans from page 103 to page 8[v]. The study examines the predictive significance of RDW in individuals with stroke.

Wang Z and Liu Y (2022) conducted a study on the use of RDW as a prognostic indicator for one-year outcomes and mortality in patients undergoing endovascular therapy for acute anterior circulation ischemic stroke. The article is titled "J Stroke Cerebrovasc Dis." and has the reference number 31:106243. The study highlights the correlation between Red Cell Distribution Width (RDW) and the functional results following stroke treatments[vi].

Soderholm M et al. (2015) conducted a population-based cohort study to investigate the association between RDW (red cell distribution width) and the occurrence of stroke and carotid atherosclerosis. The article is titled "PLoS One" and has the identification number "10:e0124957." The study establishes a connection between RDW and the likelihood of experiencing a stroke, indicating that RDW has the potential to serve as a biomarker for ischemic events[vii].

Pinho J et al. (2018) conducted a study to determine if the red cell distribution width (RDW) may be used as a reliable indicator to predict the one-year survival rate in ischemic stroke patients who had intravenous thrombolysis treatment. The research is titled "Thrombosis Research" and is published in volume 164, pages 4-8. The study emphasizes the significance of Red Cell Distribution Width (RDW) in predicting the results of thrombolytic therapy[viii].

However, there is still a lack of knowledge on the specific processes via which RDW affects the severity and outcomes of strokes. Although RDW is acknowledged as a possible biomarker, additional investigation is required to clarify its function in the pathophysiology of ischemic stroke and to establish universally accepted thresholds for therapeutic application. Ultimately, the measurement of RDW has great potential in evaluating the seriousness of ischemic stroke. However, further research is necessary to completely comprehend its consequences and improve its use in medical environments.

3. Research Methodology

Material and methods: The study was designed as an observational cross-sectional study, conducted from June 2022 to June 2024. The study was carried out in the Outpatient Department (OPD) and Inpatient Department (IPD) of the Department of General Medicine at Aarupadi Veedu Medical College. Participants include the patients aged 18-80 years diagnosed with acute ischemic stroke within 48 hours of presentation Patients were excluded if they had any of the condition like Hemorrhagic stroke, Iron deficiency anemia, Sepsis, Cancer. Consecutive Sampling technique was employed to include all eligible patients until the sample size was reached. The sample size was determined to be 61 patients. This calculation was based on the statistical formula for estimating a single mean, with the expected mean in RDW (Red Cell Distribution Width) being 13.1 and a standard deviation of 4. The level of significance was set at 5%, using a study by Chizobam Ani et al. as a reference.

4. Results

Table: 1. Age distribution

Age distribution	F	Percentage
≤25 yrs	1	1.6%
26 – 35 yrs	2	3.3%
36 – 45 yrs	10	16.4%
46 – 55 yrs	9	14.8%
56 – 65 yrs	14	23.0%
>65 yrs	25	41.0%
Total	61	100%

Table 1 depicts the concentration of older individuals, with 64.0% being over 56 years old, and the largest age group being those over 65 years (41.0%). This indicates that the study population is predominantly older adults.

Table: 2. Respondents based on Variables Responses

S.No	Variables	Options	Frequency	Percentage
1	Smoking	Yes	22	36.1%
		No	39	63.9%
		Total	61	100%
2	Alcohol	Yes	14	23.0%
		No	47	77.0%
		Total	61	100%
3	HTN	Yes	38	62.3%
		No	23	37.7%
		Total	61	100%
4	DM	Yes	39	63.9%
		No	22	36.1%
		Total	61	100%

Table 2 depicts the health conditions among the respondents reveal a high prevalence of hypertension (62.3%) and diabetes mellitus (63.9%), suggesting a significant burden of Non communicable diseases in the population.

Table: 3. mRS distribution

mRS

Value	Frequency	Percent	Valid Percent	Cumulative Percent
1.00	13	21.3	21.3	21.3
2.00	15	24.6	24.6	45.9
3.00	6	9.8	9.8	55.7
4.00	8	13.1	13.1	68.9
5.00	19	31.1	31.1	100.0
Total	61	100.0	100.0	

Table 3 depicts frequency distribution of population with different mRS Values which further signifies the out outcome of the patient.

Table: 4 RDW with Age Comparison

			RDW	Age
Spearman's rho	RDW	Correlation Coefficient	1.000	.024
		Sig. (2-tailed)	.	.856
		N	61	61
	Age	Correlation Coefficient	.024	1.000
		Sig. (2-tailed)	.856	.
		N	61	61

Table 4 depicts the correlation between RDW and Age among the study population. There is no statistically significant correlation found between RDW and Age

Table: 5 RDW with Hb Comparison:

			RDW	HB
Spearman's rho	RDW	Correlation Coefficient	1.000	.012
		Sig. (2-tailed)	.	.929
		N	61	61
	HB	Correlation Coefficient	.012	1.000
		Sig. (2-tailed)	.929	.
		N	61	61

Table 5 depicts the comparison between RDW and Age among the study population. There is no statistically significant correlation found between RDW and haemoglobin

Table: 6 RDW with NIHSS Comparison:

			RDW	NIHSS
Spearman's rho	RDW	Correlation Coefficient	1.000	.708**
		Sig. (2-tailed)	.	.000
		N	61	61
	NIHSS	Correlation Coefficient	.708**	1.000
		Sig. (2-tailed)	.000	.
		N	61	61

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6 depicts the comparison between RDW and NIHSS among the study population. There is statistically significant correlation found between RDW and NIHSS

Table: 7. RDW with mRS Comparison:

Correlations

			RDW	mRS
Spearman's rho	RDW	Correlation Coefficient	1.000	.688**
		Sig. (2-tailed)	.	.000
		N	61	61
	mRS	Correlation Coefficient	.688**	1.000
		Sig. (2-tailed)	.000	.
		N	61	61

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 depicts the comparison between RDW and mRS among the study population. There is statistically significant correlation found between RDW and NIHSS

Table: 8. Comparison of RDW levels with HTN

Variable	HTN	N	Mean ± SD	Min	Max	Mann-Whitney U test	P value
RBW	Yes	38	44.55 ± 8.39	13.40	57.30	-0.208	0.835
	No	23	45.36 ± 6.99	35.20	57.60		
	Total	61	44.86 ± 7.84	13.40	57.60		

Table 8 depicts the comparison between RDW and Hypertension among the study population. There is no statistically significant correlation found between RDW and hypertension.

Table: 9. Comparison of RDW levels with DM

Variable	DM	N	Mean ± SD	Min	Max	Mann-Whitney U test	P value
RDW	Yes	38	43.92 ± 8.18	13.40	57.30	-1.029	0.303
	No	23	46.51 ± 7.09	35.20	57.60		
	Total	61	44.86 ± 7.84	13.40	57.60		

Table 9 depicts the comparison between RDW and DM among the study population. There is no statistically significant correlation found between RDW and DM

Table: 10. Comparison of RDW levels with Smokers

Variable	Smokers	N	Mean ± SD	Min	Max	Mann-Whitney U test	P value
RBW	Smoker	22	42.87 ± 6.06	35.20	57.30	-1.863	0.062
	Non-Smoker	39	45.98 ± 8.56	13.40	57.60		
	Total	61	44.86 ± 7.84	13.40	57.60		

Table 10 depicts the comparison between RDW and Smokers among the study population. There is no statistically significant correlation found between RDW and smokers This data suggests that while lifestyle factors do not significantly impact RDW levels, they may still play a role in overall health and warrant further investigation.

Table: 11. Comparison of RDW levels with Alcoholic

Variable	Alcoholic	N	Mean ± SD	Min	Max	Mann-Whitney U test	P value
RBW	Alcoholic	14	42.10 ± 4.88	35.70	51.20	-1.733	0.083
	Non-Alcoholic	47	45.68 ± 8.40	13.40	57.60		
	Total	61	44.86 ± 7.84	13.40	57.60		

Table 11 depicts the comparison between RDW and Alcoholics among the study population. There is no statistically significant correlation found between RDW and alcoholics.

INTERPRETATION OF THE TABLES

The age distribution of the respondents shows a significant concentration of older individuals, with 64.0% being over 56 years old, and the largest age group being those over 65 years (41.0%). This indicates that the study population is predominantly older adults.

Regarding lifestyle habits, the majority of respondents do not smoke (63.9%) and do not consume alcohol (77.0%). However, there is a noteworthy percentage of smokers (36.1%) and alcohol consumers (23.0%), indicating a potential area for public health interventions.

Health conditions among the respondents reveal a high prevalence of hypertension (62.3%) and diabetes mellitus (63.9%), suggesting a significant burden of chronic diseases in the population. These conditions are prevalent among a majority of the respondents, highlighting the need for targeted health services and preventive measures.

The Modified Rankin Scale (mRS) distribution shows that a large portion of the respondents (31.1%) are at the highest level of disability (mRS 5.00), with varying degrees of disability across the population. The correlation analysis further reveals significant positive correlations between RDW and both NIHSS ($r = 0.708$, $p < 0.01$) and mRS ($r = 0.688$, $p < 0.01$), indicating that higher RDW levels are associated with higher disability and stroke severity scores. However, RDW does not show significant correlations with age or hemoglobin levels.

Comparisons of RDW levels with various conditions such as hypertension, diabetes, smoking, and alcohol consumption reveal no significant differences, although smokers and alcoholics tend to have lower RDW levels compared to their non-smoking and non-drinking counterparts. This data suggests that while lifestyle factors do not significantly impact Rdw levels, they may still play a role in overall health and warrant further investigation.

5. Discussion

The major findings of the study are as:

A significant proportion of the participants are elderly, with 64.0% being above the age of 56, and 41.0% being above the age of 65, suggesting a largely older adult demographic. The respondents exhibit a significant burden of hypertension, with a prevalence rate of 62.3%. Similarly, diabetes mellitus has a high prevalence rate of 63.9% in the population, highlighting the importance of implementing focused health services and preventive measures. The majority of participants (63.9%) reported not smoking, but, a substantial proportion (36.1%) identified as smokers, indicating a necessity for public health measures. Approximately 77.0% of the respondents abstain from alcohol consumption, whereas 23.0% engage in it, indicating a noteworthy aspect that warrants attention from the public health sector. The 31.1% of the respondents had the greatest level of disability (mRS 5.00), whereas the rest of the population has different degrees of disability. Elevated RDW levels have a strong positive association with increased disability (mRS, $r = 0.688$, $p < 0.01$) and stroke severity (NIHSS, $r = 0.708$, $p < 0.01$), whereas no significant correlation is observed with age or haemoglobin levels. There are no notable variations in RDW levels associated with hypertension, diabetes, smoking, or alcohol intake. However, those who smoke or consume alcohol often exhibit lower RDW levels compared to those who do not smoke or drink.

6. Conclusion

The study highlights the potential of Red Cell Distribution Width (RDW) as a helpful predictive indicator in outcome of ischemic stroke. Increased RDW levels were observed to have a substantial correlate with more severe stroke and disability, as indicated by strong associations with NIHSS and mRS scores. The data also suggest that lifestyle factors such as smoking and alcohol intake do not have a substantial effect on RDW levels. However, these factors are still important for overall health and should be addressed through further public health measures. However, further investigation is required to completely understand the ways in which RDW affects stroke outcomes and to develop universally accepted benchmarks for its therapeutic use. RDW measurement has potential for improving the assessment and treatment of ischemic stroke severity, but further research is necessary to optimize its application in medical practice.

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