Original Article

Is Red Blood Cell Distribution Width Predictive of Fatigue After Acute Myocardial Infarction to Improve Nursing Care?

Abstract

Background: Red blood cell Distribution Width (RDW) can help diagnose blood diseases and predict mortality in heart disease. Fatigue is one of the common symptoms of Acute Myocardial Infarction (AMI) and can affect the quality of life of patients. This study aimed to investigate the link between RDW at admission and fatigue severity 2 weeks after AMI. **Materials and Methods:** This cross-sectional study examined 250 consecutive patients with AMI during 2023–2024. The patients were assessed for RDW and other laboratory and demographic variables within 24 h of admission. The Fatigue Severity Scale (FSS), which is a 9-item and 7-point scale, was completed for patients. A score >36 was considered as Post-AMI Fatigue (PAF) and lower as non-PAF. Data analysis was performed by SPSS version 22 and R version 4.2.2 software. **Results:** Our findings indicated that 71.20% of patients experienced fatigue after AMI. There were no significant differences between age, gender, laboratory parameters, past medical history, underlying diseases, and blood pressure of patients with and without fatigue ($p > 0.05$). RDW distribution for non-PAF and PAF was 13.30% [12.50, 14.60%] and 13.30% [12.80, 14.00%], respectively, ($p = 0.726$). Multivariable regression results based on three models did not show any significant findings. **Conclusions:** The present study is the first study, designed to determine the predictive value of RDW on post-AMI fatigue, as far as we searched the recent literature. We did not find any significant relation between RDW and PAF. Therefore, it cannot be used to predict fatigue in patients with AMI until definitive results are found.

Keywords: *Biomarkers, fatigue, myocardial infarction, red cell distribution width*

Yasaman Borghei, Bahare Gholami Chaboki, Nasibe Goli, Aseme Pourrajabi, Samira Arami, Arsalan Salari

Department of Cardiology, Cardiovascular Diseases Research Center, Heshmat Hospital, School of Medicine, Guilan University of Medical Sciences, Rasht, Iran

Address for correspondence:
Prof. Arsalan Salari, Department of Cardiology, Cardiovascular Diseases Research Center, Heshmat Hospital, School of Medicine, Guilan University of Medical Sciences, 15 Khordad Street, District 2, Rasht, Guilan Province, Iran.
E-mail: gums.icrc@gmail.com

Introduction

Red blood cell Distribution Width (RDW) is a parameter that indicates the size variation of Red Blood Cells (RBCs)[1] and is usually reported as part of a standard blood cell count. It should be noted that RDW is used along with other complete blood cell count parameters to identify hematological diseases.[2] This parameter reflects the systemic inflammatory state and oxidative stress.[3] Recently, it has been shown that RDW can be used to predict mortality in coronary artery diseases, acute heart failure, and Acute Myocardial Infarction (AMI).[4] In Iran, the incidence and prevalence of Cardiovascular Diseases (CVDs) have increased in recent years and about 43% of all deaths are caused by CVDs.[5,6]

One of the important warning signs of experiencing AMI is fatigue and weakness,[7] which is associated with reduced social and professional participation and may hinder the progress of rehabilitation.[8] Fatigue is a common and debilitating symptom experienced by many patients following MI. Many factors are related to fatigue in the patients and it lasts for about 2 months to 1 year after treatment.[9,10] Tiredness, or fatigue, is a natural response to stressors aimed at adaptation. However, fatigue indicates reduced adaptability. The inability to cope with stressors can lead to exhaustion. Post-MI fatigue (PAF) is different from normal tiredness and is challenging.[11] One study found that a high level of RDW on admission and its changes during hospitalization were associated with a risk of 30-day mortality in acute respiratory failure.[12] Previously, only one study reported RDW as a new biomarker for predicting post-stroke fatigue in the acute phase.[13] Therefore, we decided to conduct a study to determine the relationship

How to cite this article: Borghei Y, Chaboki BG, Goli N, Pourrajabi A, Arami S, Salari A. Is red blood cell distribution width predictive of fatigue after acute myocardial infarction to improve nursing care? Iran J Nurs Midwifery Res 2025;30:270-3.

Submitted: 16-Jan-2024. **Revised:** 15-Jun-2024. **Accepted:** 14-Oct-2024. **Published:** 10-Mar-2025.

Access this article online

Website: https://journals.lww.com/jnmr

DOI: 10.4103/ijnmr.ijnmr_57_24

Quick Response Code:

between the RDW during admission and the severity of fatigue and weakness 2 weeks after AMI.

Materials and Methods

This cross-sectional study investigated 250 consecutive patients who visited Dr. Heshmat Hospital, "the only specialized heart center in Guilan province, Iran," between August 2023 and February 2024. According to Peng *et al.*[13] using the logistic regression method in the PASS software with a power of 0.8, a significance level of 0.05, and an odds ratio of 1.5, the sample size was calculated to be 227 patients, assuming a base probability of 0.3 for the dependent variable (fatigue). Considering a 10% attrition rate, the final sample size was adjusted to 250. Patients were selected from the emergency and post-angiography wards.

Inclusion criteria were, the diagnosis of AMI by a cardiologist, age above 18 years, adequate cognitive ability of patients to answer questions, absence of mental or physical problems, and absence of neurological and mental diseases (including depression). The existence of fatigue before the occurrence of AMI according to the patient's statements, failure to measure RDW within 24 h after admission, presence of blood diseases such as leukemia and myelodysplastic syndrome, death during hospitalization or within 1 day of discharge, were the exclusion criteria.

Demographic and clinical characteristics (including age, sex, systolic and diastolic blood pressure [BP], and history of diseases), were obtained from patients' medical records and by asking the patient himself. Laboratory parameters (including fasting blood sugar [FBS], total cholesterol, triglycerides, blood urea nitrogen [BUN], creatinine, and RDW [as our main variable]) were obtained from the laboratory test results of patients within 24 h after admission, which were available at the specialized laboratory of Dr. Heshmat Hospital. The Fatigue Severity Scale (FSS) was completed for patients if they reported no previous fatigue and weakness. In a previous study, which examined the validity and reliability of the Persian version of this questionnaire, the Cronbach alpha was 0.96, which was a sign of the high reliability of this tool. Moreover, its validity was 0.93.[14] This scale included nine items, each item was responsible for evaluating the severity of fatigue after AMI, and its scoring ranged from 1 to 7 points. Each item was scored on a Likert scale of seven points, one being "strongly disagree" and seven "strongly agree." The sum of all items could range from 9 to 63. The cut-off point was considered as 36.[13] A score, of more than 36 was considered as PAF, and less than it was considered as non-PAF. Patients were assessed for FSS 2 weeks after the onset of AMI.

Qualitative variables are reported with frequency and percentage. Kolmogorov–Smirnov test was used to check the normality of quantitative variables. If these variables were normal, they were reported with mean and standard deviation, and otherwise with median and interquartile range. Based on the results of the FSS, the data were divided into two groups with and without fatigue. The initial investigation of the research variables in two groups was conducted with the independent *t*, Mann–Whitney, Chi-square, and Fisher tests. Finally, to check the relationship between RDW and fatigue with adjustment of covariates variables, the logistic regression model was fitted to the data. Data analysis was performed by SPSS (version 22, IBM, Corporation, Armonk, NY, USA) and R version 4.2.2 software.

Ethical considerations

Participants were provided with an explanation of the study's objective, and oral informed consent were obtained from them prior to their participation. They were allowed to withdraw from the study at any time. Ethical approval was obtained from Guilan University of Medical Sciences with the code of IR.GUMS.REC.1402.237 (date: 7.12.2023).

Results

In this study, we evaluated 250 patients who had AMI diagnosis during their hospital admission. Then they were divided into PAF and non-PAF groups, based on the result of FSS. Interestingly, we found that 178 (71.20%) patients experienced fatigue following AMI, whereas only 28.8% reported no fatigue. Furthermore, we evaluated FSS during admission to assess the presence of fatigue before AMI. Only six (2.40%) patients had fatigue before hospitalization.

In Table 1, baseline data of patients (including age, gender, laboratory parameters, past medical history, underlying diseases, and BP), in these groups has been shown. Among these variables, only BUN was statistically significant different between PAF and non-PAF groups ($p = 0.017$). Figure 1 demonstrates RDW distribution for non-PAF and PAF by violin plot. The median in both two groups was the same. The third quartile in the non-PAF group was larger than that of the PAF group. The RDW in two groups had one mode. The violin plot detected outliers for the PAF and non-PAF groups (13.30% [12.50, 14.60%] and 13.30% [12.80, 14.00%], respectively, $p = 0.726$).

Table 2 provides multivariable regression results to show the relationship between RDW and PAF. In model 1 (unadjusted model) (odds ratio [OR], 0.96; 95% CI, 0.78–1.17; $p = 0.689$], model 2 (which adjusted for age and gender) [OR, 0.94; 95% CI, 0.77–1.15; $p = 0.580$] and model 3 (which adjusted for age, gender, and BUN) [OR, 0.92; 95% CI, 0.75–1.13; $p = 0.477$], no relation was found between RDW and PAF/non-PAF.

Discussion

As mentioned in the literature review, only one study revealed RDW as a new biomarker for the prediction of fatigue post-stroke; therefore, we conducted this study with the aim of discovering the relationship between RDW predictive values for PAF. Based on our findings, 71.2% of patients experienced PAF. Similarly, one study reported 76% post-MI fatigue in the

Table 1: Baseline information of patients in two non-PAF* and PAF groups

Variables	Categories	Non-PAF	PAF	*p*
Gender *n* (%)	Female	18 (25)	50 (28.10)	0.619
	Male	54 (75)	128 (71.90)	
Age mean (SD**)		59.50 (9.80)	62 (11.80)	0.171
	FBS***	141.40 (64.80)	137.09 (62.80)	0.254
	Cholesterol	151.09 (55.70)	155.30 (45.30)	0.297
Laboratory parameters	Triglyceride	194 (120.10)	196.90 (158.40)	0.380
Mean (SD)	Bun****	20.40 (7.20)	18.50 (6.02)	0.017
	Creatinine	1.10 (0.31)	2.03 (9.09)	0.054
	RDW*****	13.60 (1.40)	13.50 (1.30)	0.726
Hypertension *n* (%)	Yes	37 (51.40)	106 (59.60)	0.238
	No	35 (48.60)	72 (40.40)	
Hyperlipidemia *n* (%)	Yes	32 (44.40)	78 (43.80)	0.928
	No	40 (55.60)	100 (56.20)	
Diabetes *n* (%)	Yes	30 (41.70)	58 (32.60)	0.173
	No	42 (58.30)	120 (67.40)	
Arthritis *n* (%)	Yes	0 (0)	4 (2.20)	0.581
	No	72 (100)	174 (97.80)	
Previous AMI[$] *n* (%)	Yes	0 (0)	6 (3.40)	0.186
	No	72 (100)	172 (96.60)	0.763
Previous CVDs[$$] *n* (%)	Yes	3 (4.20)	11 (6.20)	
	No	69 (95.80)	167 (93.80)	
Diastolic BP[$$$] mean (SD)		79.30 (15.70)	79.80 (14.08)	0.551
Systolic BP mean (SD)		137.10 (24.60)	134.80 (22.60)	0.519

* Post-myocardial infarction fatigue. **Standard deviation. *** Fasting blood sugar. **** Blood urea nitrogen. ***** Red blood cell distribution width. [$]Acute myocardial infarction. [$$$]Cardiovascular disease. [$$$]Blood pressure

Table 2: Logistic regression analysis of relation between PAF*/non-PAF and RDW**

Model	SE	Wald	OR (95%CI)	*p*
Model 1	0.10	0.16	0.96 (0.78-1.17)	0.689
Model 2	0.10	0.30	0.94 (0.77-1.15)	0.580
Model 3	0.10	0.50	0.92 (0.75-1.13)	0.477

Model 1 unadjusted model. Model 2 was adjusted for age and gender. Model 3 was adjusted for age, gender and Bun. *Post-myocardial infarction fatigue. **Red blood cell distribution width

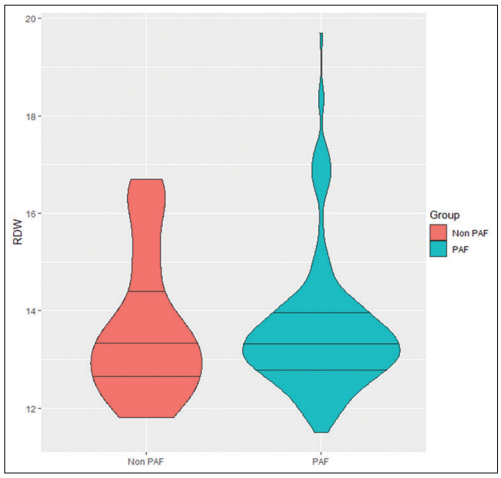

Figure 1: Violin plot for PAF* and non-PAF distribution. *Post-myocardial infarction fatigue

older population during 6 months after MI.[15] Moreover, our finding was in line with Horne *et al.'s*[16] findings, whereas in the other study, only 33.2% of their participants had fatigue.[17] It should be noted that the assessment tool for fatigue was different in the mentioned studies with our study.

The multiple regression model analysis did not find any relation between fatigue 2 weeks after AMI and RDW value. Peng *et al.*,[13] who evaluated the relation between RDW and post-stroke fatigue, reported the predictive value of this parameter for fatigue after ischemic stroke. In a study involving patients with systemic lupus erythematosus, researchers found a statistically significant link between RDW and fatigue levels. This suggests a potential novel biological explanation for fatigue in cases where other causes were not apparent.[18] Another study found that individuals with chronic fatigue syndrome had significantly higher rates of abnormal RDW, mean cell volume (MCV), and lymphocyte concentrations. These irregularities may be linked to iron deficiency and immune cell dysfunction.[19] One possible explanation for this correlation is that elevated RDW often serves as an early marker of iron deficiency, a well-known cause of fatigue.[20] Wang *et al.*[21] revealed that serum RDW may be significantly correlated with fatigue in patients with Parkinson's.

To the best of our knowledge, there has been no study aimed at evaluating the correlation between fatigue after

AMI and RDW, until now. Some limitations should be noted in this study. For instance, as our study was the first work in this field, so we were not able to compare our results with others. Moreover, our small sample size may have affected the results and generalizability. It should be noted that we calculated our sample size by referring to the only study in this field which evaluated post stroke fatigue and RDW.[13] The other limitation was follow-up length. We assessed patients 2 weeks after AMI, and maybe spending a longer time post-AMI shows different results. Furthermore, we analyzed our findings based on baseline RDW. Because the RDW may have fluctuations during hospitalization, assessment of RDW at different time intervals can be important. Therefore, we suggest for future studies to evaluate the relationship between RDW and fatigue at a longer time after AMI.

Conclusion

The present study was the first study, which was designed to determine the predictive value of RDW on post-AMI fatigue, as far as we know. We did not find any significant relation between RDW and PAF. Therefore, until definite results are found, the RDW marker cannot be used for the prediction of fatigue in AMI patients. Maybe, spending a longer time post-AMI shows different results. It seems that conducting more studies in this field can confirm or deny these results, which can be beneficial for cardiologists and nurses to perform appropriate measures on these patients.

Acknowledgments

We thank all the participants who were investigated in the study and the Manager of Dr. Heshmat hospital.

Financial support and sponsorship

Nil.

Conflicts of interest

Nothing to declare.

References

1. Yu X-S, Chen Z-Q, Hu Y-F, Chen J-C, Xu W-W, Shu J, *et al.* Red blood cell distribution width is associated with mortality risk in patients with acute respiratory distress syndrome based on the Berlin definition: A propensity score matched cohort study. Heart Lung 2020;49:641-5.
2. Chen M, Liao L, Yan J, Lin F-Q. Predictive value of red blood cell distribution width for 1-year all-cause mortality in critically ill patients with acute myocardial infarction. Int J Gen Med 2022;15:465-71.
3. Valenti AC, Vitolo M, Imberti JF, Malavasi VL, Boriani G. Red cell distribution width: A routinely available biomarker with important clinical implications in patients with atrial fibrillation. Curr Pharm Des 2021;27:3901-12.
4. Ye W-Y, Li J, Li X, Yang X-Z, Weng Y-Y, Xiang W-W, *et al.* Predicting the one-year prognosis and mortality of patients with acute ischemic stroke using red blood cell distribution width before intravenous thrombolysis. Clin Interv Aging 2020;15:255-63.
5. Borghei Y, Moghadamnia MT, Sigaroudi AE, Ghanbari A. Association between climate variables (cold and hot weathers, humidity, atmospheric pressures) with out-of-hospital cardiac arrests in Rasht, Iran. J Therm Biol 2020;93:102702.
6. Moghadamnia MT, Borghei Y, Amini S, Maroufizadeh S. The cardiopulmonary resuscitation success rate and its related factors in patients referred to Dr. Heshmat Hospital in Rasht, Iran. J Guilan Univ Med Sci 2022;31:62-73.
7. Blakeman JR. An integrative review of the theory of unpleasant symptoms. J Adv Nurs 2019;75:946-61.
8. Lenaert B, van Kampen N, van Heugten C, Ponds R. Real-time measurement of post-stroke fatigue in daily life and its relationship with the retrospective Fatigue Severity Scale. Neuro Rehabil 2022;32:992-1006.
9. Saha AK, Schmidt BR, Wilhelmy J, Nguyen V, Abugherir A, Do JK, *et al.* Red blood cell deformability is diminished in patients with Chronic Fatigue Syndrome. Clin Hemorheol Microcirc 2019;71:113-6.
10. Karadas C, Oksul M, Ozer N, Ozdemir L. Effects of daily mindfulness practice on fatigue, kinesiophobia, and quality of life in patients with acute myocardial infarction: A randomized controlled trial. Eur Heart J Acute Cardiovasc Care 2021;10(Suppl 1):zuab020.138.
11. Bagherian-Sararoudi R, Maracy M, Sanei H, Shiri M. Factors in relation with fatigue and illness perception in patients with myocardial infarction and the changes in fatigue due to intervention on illness perception: Research design, methodology, and preliminary results. Arya Atheroscler 2019;15:74-81.
12. Shi Y, Shi L, Chen F, Jiang Z, Sheng K. Association of red cell distribution width and its changes with the 30-day mortality in patients with acute respiratory failure: An analysis of MIMIC-IV database. PLoS One 2023;18:e0293986.
13. Peng M, Chen Y, Chen Y, Feng K, Shen H, Huang H, *et al.* The relationship between red blood cell distribution width at admission and post-stroke fatigue in the acute phase of acute ischemic stroke. Front Neurol 2022;13:922823.
14. A'zimiyan M, Fallah-Pour M, Karimlou M. Fatigue Severity Scale (FSS): Evaluation of reliability of the Persian version among persons with multiple sclerosis. Arch Rehab2010;10:1.
15. Crane PB, Efird JT, Abel WM. Fatigue in older adults postmyocardial infarction. Front Public Health 2016;4:55.
16. Horne CE, Johnson S, Crane PB. Comparing comorbidity measures and fatigue post myocardial infarction. Appl Nurs Res 2019;45:1-5.
17. Jiao J, Song J, Cui Y, Wang Y, Li Y, Li J, *et al.* Correlation analysis of fatigue with sleep disturbance, depression and anxiety in elderly patients with myocardial infarction. Pak J Zool 2023;56.
18. Wincup C, Parnell C, Cleanthous S, Segura BT, Nguyen MH, Bryant K, *et al.* Red cell distribution width correlates with fatigue levels in a diverse group of patients with systemic lupus erythematosus irrespective of anaemia status. Clin Exp Rheumatol 2019;37:852-4.
19. Broadbent S, Coutts R. Irregularities in red cell distribution width and lymphocyte concentration in individuals with chronic fatigue syndrome. Int J Health Res 2015;3:71-8.
20. Badrick T, Richardson AM, Arnott A, Lidbury BA. The early detection of anaemia and aetiology prediction through the modelling of red cell distribution width (RDW) in cross-sectional community patient data. Diagnosis 2015;2:171-9.
21. Wang H, Liu Y, Zhao J, Guo X, Hu M, Chen Y. Possible inflammatory mechanisms and predictors of Parkinson's disease patients with fatigue (brief review). Clin Neurol Neurosurg 2021;208:106844.