Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.676
*Biol. Clin. Sci. Res. J., Volume, **2024**: 676*
Original Research Article

RED BLOOD CELL INDICES IN PATIENTS WITH CARDIOVASCULAR DISEASES AT A TERTIARY CARE HOSPITAL PESHAWAR

KHAN A[1], GOHAR F[2], AHMAD J[3], HUMAYUN L[4], KHAN A[1], REHMAN AK*[5]

[1]*Afridi Medical Complex and Teaching Hospital, Peshawar, Pakistan*
[2]*Department of Microbiology, Faculty of Life Sciences, University of Central Punjab, Lahore, Pakistan*
[3]*Faculty of Allied Health Science, University of Lahore, Pakistan*
[4]*Department of Pathology, University College of Medicine and Dentistry University of Lahore, Pakistan*
[5]*Department of Haematology, Kabir Medical College/MMC-General Hospital Peshawar, Pakistan*
**Corresponding author email address:* ansakrehman85@gmail.com

(Received, 20th October 2023, Revised 09th December 2023, Published 25th January 2024)

Abstract: *Cardiovascular diseases are a major cause of health loss worldwide, regardless of a country's income, social status, or demographics. Many studies have reported a link between haematological parameters and cardiovascular diseases in patients. This study aimed to determine the red blood cell indices in patients with cardiovascular diseases at a tertiary care hospital in Peshawar. The study was conducted for six months, from January 1, 2023, to June 30, 2023, at the Pathology Department of Afridi Medical Complex and Teaching Hospital. Blood samples were taken from patients in EDTA vacutainers, and their haematological parameters were determined in the laboratory. The patients' clinical examinations, history, name, gender, age, and previous laboratory investigations were recorded in a proforma designed for this research. The data were analyzed using IBM SPSS version 23. The study enrolled 80 patients with cardiovascular diseases, including 44 (55%) male and 36 (45%) female patients. The mean age of the study participants was 47 years, with a standard deviation of ±12.3. The mean (±SD) haemoglobin, red blood cell count, hematocrit, mean corpuscular haemoglobin, red cell distribution width-SD, and red cell distribution width-CV were 13.99 (±1.86) (g/dl), 4.49 (±0.55) (million/cm3), 40.72 (±5.81), 28.99 (±2.22), 62.06 (±6.99), and 16.87 (±3.39), respectively. The study concludes that red blood cell indices such as red cell distribution width, haemoglobin, and mean corpuscular volume play a significant role in the pathogenesis of cardiovascular diseases. Routine health examinations and proactive precautions may help lower cardiovascular disease incidence.*

Keywords: Red Blood Cell Indices; Cardiovascular Diseases; Hemoglobin, Red Cell Distribution

Introduction

Cardio-vascular diseases (CVD) are one of the leading causes of health loss around the globe, irrespective of a country's income, social status, or demographics (Thomas et al., 2018). The age of the population, dietary practices, genetic predisposition, sedentary lifestyles, stress, diabetes mellitus, dyslipidemia, systemic arterial hypertension, smoking and alcohol misuse all contribute to the development of these disorders (Li et al., 2016). Because systemic and hypoxemia inflammation is involved in the pathophysiological processes of CVD, and because the severity of the damage may lead to circulatory failure and organic dysfunction, research has demonstrated a significant association between haematological parameters and the likelihood of unfavorable consequences in patients with CVD (Fan et al., 2018; Monteiro Júnior et al., 2015; Verbrugge & Huisman, 2015). The study of these blood biomarkers, particularly in the prognostic assessment of cardiovascular disorders, has been greatly influenced by technological improvements over the last fifty years and the creation of contemporary automated equipment for examining blood cells.

Limited research is available in the literature on how RBCs play a part in the pathogenesis of cardiovascular diseases. Components of intravascular clots include red blood cells. By making the blood viscous and pushing platelets toward the artery wall, RBCs may have a prothrombotic effect on blood coagulation (Goldsmith et al., 1995; Schmid-Schonbein et al., 1969; Wohner, 2008). RBC incorporation alters the mechanical characteristics and structure of the fibrin clot (Gersh et al., 2009). Even minor structural variations may significantly impact the pathophysiology of RBCs. RBCs may play a role in thrombin production (Whelihan & Mann, 2013). Recent research has raised the possibility of a connection between cardiovascular diseases and haemoglobin levels (Steptoe et al., 2012). An association between haematocrit and cardiovascular risk has only been shown in a few research (Gotoh et al., 2015; Toss et al., 2013). Red cell Distribution Width (RDW) has been demonstrated in recent research to be linked with several cardiovascular illnesses (Montagnana et al., 2012) and to be an independent prognostic factor of cardiovascular events in individuals who have a history of myocardial infarction (Tonelli et al., 2008). On the other hand, research has shown that RDW, haematocrit, and cardiovascular diseases are not associated (Khode et al., 2014). No research has been conducted in our setting on the association between cardiovascular diseases and haematological parameters. Therefore, this research was conducted to find the association of Red blood cell indices in patients with cardiovascular diseases.

[Citation: Khan, A., Gohar, F., Ahmad, J., Humayun, L., Khan, A., Rehman, A.K. (2024). Red blood cell indices in patients with cardiovascular diseases at a tertiary care hospital Peshawar. *Biol. Clin. Sci. Res. J.,* **2024***: 676*. doi: https://doi.org/10.54112/bcsrj.v2024i1.676]

Methodology

The current descriptive study was conducted at the Pathology Department, Afridi Medical Complex and Teaching Hospital, for six months, from 1 January 2023 to 30 June 2023. The ethical approval of the study was obtained from the hospital's IRB. A total of 80 patients were enrolled in our study using WHO's sample size calculator. The criteria for inclusion in our study were all patients of both genders and the age range of 30-60 years with symptoms of hyper-triglyceridemia, hypertension, diabetes and hypercholesterolemia. While all the patients with known congenital cardiac diseases or valvular cardiac diseases, impaired kidney or liver function, patients with thyroid disorders and pregnant women were excluded. All the patients visiting the cardiology department for coronary angiography were included if they fulfilled the inclusion criteria. All the patients were examined clinically, and the data, including history, name, gender, age and previous laboratory investigations, were recorded in a proforma designed for this research. Informed consent was obtained from all the participants of the current research. Blood samples were taken from all the patients in EDTA vacutainers and sent to the laboratory of the hospital for determining the haematological parameters like Haemoglobin, RBC count, Red cell Distribution Width (RDW), Haematocrit, Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC). IBM SPSS version 23 was employed for the analysis of data. Age and laboratory parameters were documented as mean (± SD), while gender age distribution was documented as percentage and frequency.

Results

In the current study, 80 patients with cardiovascular diseases were enrolled. Our study had 44 (55%) male and 36 (45%) female patients. (Figure 1) The mean age of study participants was 47 years, with a standard deviation of ±12.3. Based on age distribution, 10 (12.5%) participants were 30-40 years old, 30 (37.5%) patients were 41-50 years old, and 40 (50%) patients were observed in the 51-60 years age group. (Figure 2) The mean (±SD) Hb was 13.99 (±1.86) (g/dl), RBC 4.49 (±0.55) (Million/Cm3), HCT 40.72 (±5.81), MCH 28.99 (±2.22), RDW-SD 62.06 (±6.99) and RDW-CV was 16.87 (±3.39). (Figure 3) The participant's distribution according to various haematological parameters is given in Table 1.

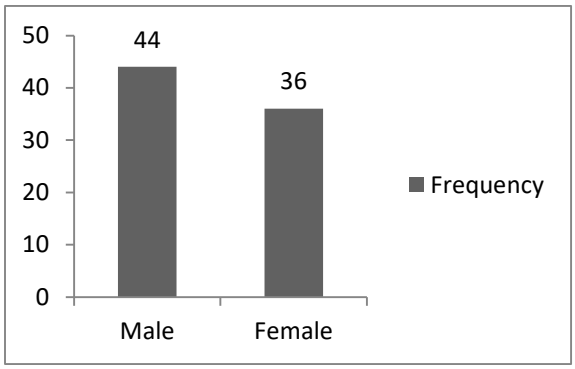

Figure 1: Distribution of patients based on gender.

Table 1: Participant's distribution according to various haematological parameters

Parameter	Subcategory	Frequency (%)
Hb (g/dl)	<12	14 (17.5%)
	12-15	40 (50%)
	>15	26 (32.5%)
RBC (million/cm^3)	<3.5	6 (7.5%)
	3.5-5.5	62 (77.5%)
	>5.5	12 (15%)
PCV	<36	12(15%)
	36-45	40(50%)
	>45	28(35%)
MCH	≤27.5	12(15%)
	27.6-32.2	52 (65%)
	>32.2	16 (20%)
RDW-SD	≤57.5	28 (35%)
	>57.5	52(65%)
RDW-CV	<14	00 (00%)
	14-16	40(50%)
	>16	40(50%)

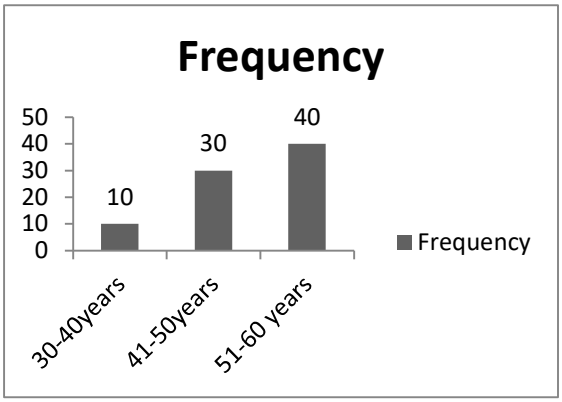

Figure 2: Distribution of patients based on age

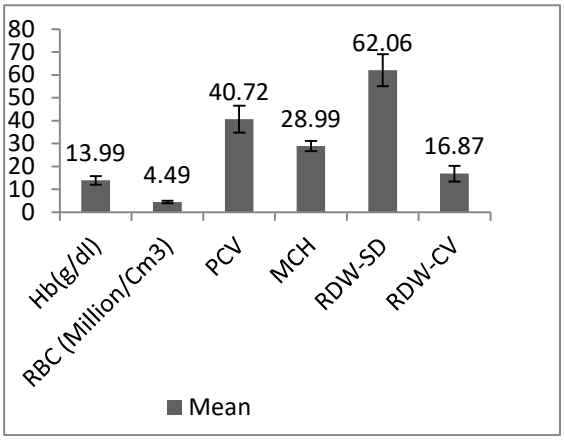

Figure 3: Mean value of different haematological parameters

Discussion

Cardiovascular disease is the term used to describe any condition that affects the heart and blood vessels. The frequency of these illnesses has a significant impact on the lives of millions of people worldwide. Cardiac disorders

[Citation: Khan, A., Gohar, F., Ahmad, J., Humayun, L., Khan, A., Rehman, A.K. (2024). Red blood cell indices in patients with cardiovascular diseases at a tertiary care hospital Peshawar. *Biol. Clin. Sci. Res. J.,* **2024***: 676*. doi: https://doi.org/10.54112/bcsrj.v2024i1.676]

include a variety of cardiovascular disorders. In our setting, no research has been carried out on the association between cardiovascular diseases and haematological parameters. Therefore, this research was conducted to find the association of haematological parameters with cardiovascular diseases.

In the current study, 80 patients with cardiovascular diseases were enrolled. There were 55% male and 45% female patients in our study. The mean age of study participants was 47 years, with a standard deviation of ±12.3. Based on age distribution, 12.5% of participants were 30-40 years old, 37.5% of patients were 41-50 years 50% of patients were observed in the 51-60 years age group. The mean (±SD) Hb, RBC, PCV, MCH, RDW-SD and RDW-CV were 13.99 (±1.86) (g/dl), 4.49 (±0.55) (Million/Cm3), 40.72 (±5.81), 28.99 (±2.22), 62.06 (±6.99) and 16.87 (±3.39) respectively.

In our study, the Hb (gm/dl) level was <12 in 17.5% of patients, 12-15 in 50% of patients, while in 32.5%, the level of haemoglobin was more than 15 gm%. Viscosity and oxygen delivery are the two ways that haemoglobin concentration may impact the cardiovascular system (Finch, 1972). Higher and lower haemoglobin levels are independently linked to a higher risk for cardiovascular diseases (Chonchol & Nielson, 2008). Lower haemoglobin levels were shown to be independently associated with the occurrence of cardiovascular diseases in a sample of individuals admitted for elective coronary angiography (Doganer et al., 2015).

In our study, the majority of patients (77.5%) have normal RBC count (million/cm^3), 7.5% of patients fall in the range of less than 3.5, while 15% of patients fall in the range of >5.5. RBCs are involved in the development of thrombus. Clinical evidence indicates that raising RBC numbers may treat several bleeding diseases, even while platelet levels decrease or remain stable (Wohner, 2008). Higher RBC counts make a person more susceptible to thrombosis by making the blood more viscous, which causes blockage. Research shows that red blood cells play a signalling function in haemostasis by releasing ATP and ADP in response to mechanical deformation, encouraging platelet aggregation and de-granulation at low PO_2 (partial pressure of oxygen) and low pH (Weiss et al., 1996). As a result of the loss of their phosphor-lipid asymmetry, which serves as a pro-coagulant surface, they are responsible for activating the coagulation cascade. This is particularly crucial for diabetes mellitus (Sprague et al., 1996).

In our study, the PCV was <36 in 15% of patients, 36-45 in 50%, and >45 in 35% of patients. The MCH was less than 27.5% in 15% of patients, 27.6-32.2 in 65% of patients and >32.2 in 20% of patients. The RDW-SD was ≤57.5% in 35% of patients and more than 57.5% in 65% of patients. The RDW-CV was less than 14 in none of our enrolled patients, 14-16 in 50% of patients, and more than 16 in 50% of patients.

High haematocrit encourages the transportation of platelets to the vessel wall, which enhances their encounters with the vasculature; it lengthens the time that circulating platelets and coagulation factors spend close to the activated endothelium (Wohner, 2008). Higher haematocrit levels were reported in research on people with coronary heart disease (Mayer, 1965). Compared to the angiography-negative cardiovascular disease group, MCV and MCH values were considerably greater in the angiography-positive cardiovascular disease group (Tülübaş et al., 2013). According to this, erythrocyte structure and haemoglobin concentration may have a substantial role in the development of cardiovascular diseases. In persons with a history of cardiovascular diseases, research has found a significant, independent relationship between RDW levels and risk of mortality and cardiovascular events (Felker et al., 2007). According to several researches, myocardial infarction patients' higher hospital mortality rates are likewise related to greater RDW levels (Sangoi et al., 2014). The small sample size and single-centre observations were the major limitations of our study. To better understand the association between haematological parameters and cardiac problems, a multicentre study with a large sample size should be done.

Conclusion

Our study concludes that Red blood cell indices such as Red cell Distribution Width, haemoglobin and Mean Corpuscular Volume play a significant role in the pathogenesis of cardiovascular diseases. One of the many causes of cardiovascular diseases may be long-term changes in several haematological parameters. Routine health examinations and proactive precautions may help lower cardiovascular disease incidence.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

Author Contribution

AJAB KHAN *(Assistant Professor*
Data acquisition, analysis.
Coordination of collaborative efforts.
FARYAL GOHAR
Data entry and Data analysis, drafting article
JAMIL AHMAD
Coordination of collaborative efforts.
Data acquisition, analysis.
LUBNA HUMAYUN
Manuscript revisions, critical input.
ASHRAF KHAN
Data acquisition, analysis.
ANSA KULSOOM REHMAN *(Assistant Professor)*
Coordination of collaborative efforts.
Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript

[Citation: Khan, A., Gohar, F., Ahmad, J., Humayun, L., Khan, A., Rehman, A.K. (2024). Red blood cell indices in patients with cardiovascular diseases at a tertiary care hospital Peshawar. *Biol. Clin. Sci. Res. J.,* **2024***: 676*. doi: https://doi.org/10.54112/bcsrj.v2024i1.676]

References

Chonchol, M., & Nielson, C. (2008). Hemoglobin levels and coronary artery disease. *American heart journal* **155**, 494-498.

Doganer, Y. C., Rohrer, J. E., Aydogan, U., Bernard, M. E., and Barcin, C. (2015). Haemoglobin levels correlates with the presence of coronary artery disease. *Journal of evaluation in clinical practice* **21**, 937-942.

Fan, L., Gui, L., Chai, E. Q., and Wei, C. J. (2018). Routine hematological parameters are associated with short-and long-term prognosis of patients with ischemic stroke. *Journal of clinical laboratory analysis* **32**, e22244.

Felker, G. M., Allen, L. A., Pocock, S. J., Shaw, L. K., McMurray, J. J., Pfeffer, M. A., Swedberg, K., Wang, D., Yusuf, S., and Michelson, E. L. (2007). Red cell distribution width as a novel prognostic marker in heart failure: data from the CHARM Program and the Duke Databank. *Journal of the American College of Cardiology* **50**, 40-47.

Finch, C. A. (1972). Oxygen transport in man. *Chest* **61**, 12S-13S.

Gersh, K. C., Nagaswami, C., and Weisel, J. W. (2009). Fibrin network structure and clot mechanical properties are altered by incorporation of erythrocytes. *Thrombosis and haemostasis* **102**, 1169-1175.

Goldsmith, H. L., Bell, D. N., Braovac, S., Steinberg, A., and McIntosh, F. (1995). Physical and chemical effects of red cells in the shear-induced aggregation of human platelets. *Biophysical journal* **69**, 1584-1595.

Gotoh, S., Hata, J., Ninomiya, T., Hirakawa, Y., Nagata, M., Mukai, N., Fukuhara, M., Ikeda, F., Ago, T., and Kitazono, T. (2015). Hematocrit and the risk of cardiovascular disease in a Japanese community: The Hisayama Study. *Atherosclerosis* **242**, 199-204.

Khode, V., Sindhur, J., Kanabur, D., Ruikar, K., and Nallulwar, S. (2014). Association of red cell distribution width, haematocrit and other RBC indices with coronay artery disease: A case control study. *Nigerian Journal of Cardiology* **11**, 88.

Li, L., Xie, W., Zheng, X.-L., Yin, W.-D., and Tang, C.-K. (2016). A novel peptide adropin in cardiovascular diseases. *Clinica chimica acta* **453**, 107-113.

Mayer, G. A. (1965). Hematocrit and coronary heart disease. *Canadian Medical Association Journal* **93**, 1151.

Montagnana, M., Cervellin, G., Meschi, T., and Lippi, G. (2012). The role of red blood cell distribution width in cardiovascular and thrombotic disorders. *Clinical chemistry and laboratory medicine* **50**, 635-641.

Monteiro Júnior, J. G. d. M., Torres, D. d. O. C., da Silva, M. C. F. C., Ramos, T. M. d. B., Alves, M. L., Filho, W. J. N., Damasceno, E. P., Brunet, A. F., Bittencourt, M. S., and Pedrosa, R. P. (2015). Nucleated red blood cells as predictors of all-cause mortality in cardiac intensive care unit patients: a prospective cohort study. *PLoS One* **10**, e0144259.

Sangoi, M. B., Rödel, A., Zorzo, P., Borges, P., Cargnin, L., De Carvalho, J., Premaor, M., and Moresco, R. (2014). Prognostic value of red blood cell distribution width in prediction of in-hospital mortality in patients with acute myocardial infarction. *Clinical laboratory* **60**, 1351-1356.

Schmid-Schonbein, H., Wells, R., and Goldstone, J. (1969). Influence of deformability of human red cells upon blood viscosity. *Circulation Research* **25**, 131-143.

Sprague, R. S., Ellsworth, M. L., Stephenson, A. H., and Lonigro, A. J. (1996). ATP: the red blood cell link to NO and local control of the pulmonary circulation. *American Journal of Physiology-Heart and Circulatory Physiology* **271**, H2717-H2722.

Steptoe, A., Wikman, A., Molloy, G. J., and Kaski, J.-C. (2012). Anaemia and the development of depressive symptoms following acute coronary syndrome: longitudinal clinical observational study. *BMJ open* **2**, e000551.

Thomas, H., Diamond, J., Vieco, A., Chaudhuri, S., Shinnar, E., Cromer, S., Perel, P., Mensah, G. A., Narula, J., and Johnson, C. O. (2018). Global atlas of cardiovascular disease. *Glob Heart* **13**, 143-163.

Tonelli, M., Sacks, F., Arnold, M., Moye, L., Davis, B., and Pfeffer, M. (2008). Relation between red blood cell distribution width and cardiovascular event rate in people with coronary disease. *Circulation* **117**, 163-168.

Toss, F., Nordström, A., and Nordström, P. (2013). Association between hematocrit in late adolescence and subsequent myocardial infarction in Swedish men. *International journal of cardiology* **168**, 3588-3593.

Tülübaş, F., Gürel, A., Akkoyun, D. C., Akyüz, A., Alpsoy, Ş., Erdoğan, H., and Yilmaz, A. (2013). MCV and MCH values in coronary artery patients with positive Gensini score. *European Journal of General Medicine* **10**, 131-135.

Verbrugge, S. E., and Huisman, A. (2015). Verification and standardization of blood cell counters for routine clinical laboratory tests. *Clinics in laboratory medicine* **35**, 183-196.

Weiss, H. J., Lages, B., Hoffmann, T., and Turitto, V. T. (1996). Correction of the platelet adhesion defect in delta-storage pool deficiency at elevated hematocrit--possible role of adenosine diphosphate.

Whelihan, M. F., and Mann, K. G. (2013). The role of the red cell membrane in thrombin generation. *Thrombosis research* **131**, 377-382.

Wohner, N. (2008). Role of cellular elements in thrombus formation and dissolution. *Cardiovascular & Hematological Agents in Medicinal Chemistry (Formerly Current Medicinal Chemistry-Cardiovascular & Hematological Agents)* **6**, 224-228.

[Citation: Khan, A., Gohar, F., Ahmad, J., Humayun, L., Khan, A., Rehman, A.K. (2024). Red blood cell indices in patients with cardiovascular diseases at a tertiary care hospital Peshawar. *Biol. Clin. Sci. Res. J.,* **2024***: 676*. doi: https://doi.org/10.54112/bcsrj.v2024i1.676]