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ASSOCIATION OF HAEMATOLOGICAL PARAMETERS WITH CARDIOVASCULAR RISK FACTORS IN POPULATION OF DISTRICT SHAHEED BENAZIRABAD SINDH, PAKISTAN

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Abstract

BACKGROUBD: *Every year, cardiovascular diseases (CVDs) cause more fatalities than any other ailment, making them the primary cause of morbidity and mortality globally. The Purpose of this study was analysis the correlation between hematological parameters and CVD risk factors.*

METHODOLOGY: *This research, which was carried out in District Shaheed Benazirabad, Sindh, Pakistan, between 2019 and 2020, was planned as a descriptive cross-sectional study. A total sample size of 312 was enrolled Aged≥ 20 years and (43) individuals were excluded from the present study due to having different clinical disorders remaining finally (269) normal healthy adults were selected using a random sampling method. Blood samples were analyzed for fasting blood glucose (FBG), lipid profile, and complete blood count (CBC), with statistical analysis performed using SPSS.*

RESULTS: *Present study shows that increased blood pressure and cholesterol levels are linked to higher hemoglobin and hematocrit levels in males, which may raise the risk of CVD. Higher RBC, Hb, and platelet counts, however, are associated with higher blood pressure and lipid abnormalities in females, suggesting a connection between dyslipidemia and hypertension. All things considered, these results point to the importance of hematological indicators in determining cardiovascular risk, especially when it comes to blood pressure and lipid metabolism.*

CONCLUSION: *The study highlights strong associations between hematological markers and CVD risk factors, with gender-specific differences. These findings suggest that incorporating hematological markers in routine risk assessments could aid in early detection and prevention of CVD.*

INTRODUCTION

Every year, cardiovascular diseases (CVDs) cause more fatalities than any other ailment, making them the primary cause of morbidity and mortality globally. Peripheral vascular disease, coronary artery disease (CAD), heart failure, venous thromboembolism, pulmonary arterial hypertension, stroke, and more are among these ailments. Determining the risk variables linked to CVD is essential for treatment and preventative measures due to its extensive effect. [1, 2]

However, the Red blood cell (RBC) count, hematocrit, hemoglobin levels, and red cell distribution width (RDW) are hematological markers that have been linked more and more to the onset and progression of CVD. [3] The relationship between hemoglobin concentration and cardiovascular risk has been the subject of several researches, which have shown that polycythemia (high hemoglobin) and anemia (low hemoglobin) are both independent risk factors for CVD. These correlations have been seen in people with polycythemia vera, type 2 diabetes, and chronic renal disease in addition to the general population. [4–7] Meanwhile two important factors that determine cardiovascular health is blood viscosity and oxygen transport, both of which are significantly influenced by hemoglobin. The relationship between hemoglobin levels within the physiological range and the incidence of CVD is yet unknown, however. By affecting blood viscosity and thrombosis risk, red blood cells aid in the production of intravascular clots. An increased risk of clot formation might result from platelet aggregation along artery walls, which is encouraged by thicker blood. [8–10] Additionally, the mix of RBCs inside fibrin clots influences their mechanical characteristics and structure. [11] There is a need for further study, nonetheless, since some studies have not shown a significant correlation between hematological markers like hematocrit and RDW and coronary artery disease.

Another Hematological Parameters is the packed cell volume, or hematocrit, is a measurement of the blood's ability to transport oxygen. It shows the percentage of blood volume that is made up of erythrocytes. Further supporting the possible association between hematological parameters and cardiovascular risk is the observation that people with heart disease also have elevated hematocrit levels. [12] Other hematological indicators that provide light on erythrocyte properties include mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV). MCH shows the amount of hemoglobin in each erythrocyte, while MCV measures the average volume of red blood cells. According to studies, individuals with angiography-confirmed CAD had much greater MCV and MCH readings than those without CAD. Still up for contention, however, is the connection between hemoglobin levels and the risk of CVD, especially when they fall within normal physiological limits. There is a dearth of research on the relationship between hematological parameters and CVD in Asian populations, with the majority of publications dealing with Western populations. [13–15] More research in a variety of groups is necessary since genetic, environmental, and behavioral variables may have an impact on cardiovascular risk. In order to provide important insights into the significance of these biomarkers in CVD prediction and prevention, this research is to evaluate the relationship between hematological parameters and cardiovascular risk factors in the population of District Shaheed Benazirabad, Sindh, Pakistan.

This study's main goal was to investigate at the relationship between cardiovascular risk factors and hematological markers in the people living in District Shaheed Benazirabad, Sindh, Pakistan.

MATERIALS AND METHODS:

Study Design and Population

This research, which was carried out in District Shaheed Benazirabad, Sindh, Pakistan, between 2019 and 2020, was planned as a descriptive cross-sectional study. The study aimed to assess the association between hematological parameters and cardiovascular risk factors in a representative sample of the adult population. A random sampling method was used to select participants. Initially, 312 individuals aged ≥ 20 years were enrolled. However, 43 individuals were excluded from the study due to the presence of various clinical disorders. Thus, a final sample of 269 healthy adults was selected for analysis.

Socio-Demographic and Lifestyle Data: A structured survey instrument was used to collect socio-demographic data, including age, gender, educational background, occupation, dietary habits, and lifestyle factors. Anthropometric Measurements: Standardized techniques were employed to measure key anthropometric parameters: Height (cm) and Weight (kg) were recorded using a calibrated stadiometer and weighing scale. Body Mass Index (BMI) was calculated using the standard formula: BMI = weight (kg) / height (m^2). We used a non-

stretchable measuring tape to measure the waist circumference (WC) and hip circumference (HC). [16, 17] Blood Pressure Measurement: A calibrated aneroid sphygmomanometer was used to take blood pressure while the subject was in a supine posture. Standard procedures were followed to assess the diastolic blood pressure (DBP) and systolic blood pressure (SBP). Participants were advised to rest for at least 5 minutes before measurement to ensure accuracy. [18, 19]

Blood Sample Collection and Laboratory Analysis: Each participant had five milliliters of venous blood drawn under aseptic circumstances. There were two parts to the blood samples: To separate serum for lipid profile analysis, three milliliters of blood were centrifuged for fifteen minutes at 4500 revolutions per minute (RPM). Two ml of blood was collected in tubes coated with Ethylenediamine tetra-acetic acid (EDTA) for hematological analysis. Hematological parameters were assessed using an automated hematology analyzer (ACT-8, Coulter Electronics). The following Hematological parameters were measured:

Hemoglobin (Hb) levels, Hematocrit (Packed Cell Volume - PCV), Red Blood Cell (RBC) count, White Blood Cell (WBC) count, Platelet count, RBC indices, including Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC)

Evaluation of Lipid Profile: The Humalyzer 3500 device was used to measure the levels of serum lipids. We measured the following lipid parameters: Triglycerides (TG), HDL-C (high-density lipoprotein cholesterol), LDL-C (low-density lipoprotein cholesterol), and total cholesterol (TC)

Ethical Consideration: The University of Sindh, Jamshoro's Department of Physiology's Research and Ethics Review Committee granted ethical permission prior to data collection. After thoroughly explaining the study's goals to the participants, everyone gave their informed permission. Strict adherence to confidentiality and anonymity throughout the investigation ensured adherence to ethical research standards.

Statistical analysis: The Statistical Package for the Social Sciences (SPSS, Version 25) was used to input, clean, and analyze all of the data that was gathered. We used the following statistical techniques: Descriptive Statistics: Frequency distribution, mean, and standard deviation were computed. Correlation Analysis: To ascertain relationships between hematological parameters and cardiovascular risk variables, Pearson or Spearman correlation tests were used. The purpose of bivariate correlation is to investigate the connections between independent and dependent variables. All studies deemed a p-value of less than 0.05 to be statistically significant. The findings were analyzed and tabulated for presentation.

RESULTS:

Table: 01: presents the descriptive statistics for cardiovascular and hematological parameters in male and female participants.

Variables	Male (n=73)	Female (n=196)
Systolic Blood Pressure (SBP) (mmHg)	120.63 ± 14.12	126.35 ± 15.09
Diastolic Blood Pressure (DBP) (mmHg)	78.75 ± 15.95	84.30 ± 12.26
Fasting Blood Glucose (FBG) (mg/dl)	90.19 ± 15.66	99.49 ± 23.27
Red Blood Cell (RBC) Count (million/C.mm)	5.14 ± 0.71	4.65 ± 0.60
Hemoglobin (Hb) (g/dl)	13.77 ± 1.99	12.27 ± 1.69
Hematocrit (HCT) (%)	41.88 ± 6.14	37.66 ± 4.76
Mean Corpuscular Volume (MCV) (fL)	79.02 ± 6.94	80.19 ± 7.71
Mean Corpuscular Hemoglobin (MCH) (pg)	28.08 ± 10.42	26.53 ± 4.64
Mean Corpuscular Hemoglobin Concentration (MCHC) (g/dl)	32.58 ± 0.86	32.47 ± 1.48
White Blood Cell (WBC) Count (Cells/C.mm)	8845.20 ± 2221.67	8980.71± 2367.43

Neutrophils (%)	64.83 ± 4.90	61.74 ± 9.71
Lymphocytes (%)	31.23 ± 4.92	30.30 ± 8.51
Eosinophils (%)	2.00 ± 0.74	2.63 ± 2.34
Monocytes (%)	1.79 ± 0.66	5.24 ± 2.52
Platelet Count (/C.mm)	205215.06 ± 71365.17	284908.16 ± 76945.28
Total Cholesterol (TC) (mg/dl)	213.21 ± 40.08	188.60 ± 43.96
Triglycerides (TG) (mg/dl)	187.65 ± 82.58	161.88 ± 67.34
High-Density Lipoprotein (HDL) (mg/dl)	39.75 ± 6.68	44.18 ± 8.67
Low-Density Lipoprotein (LDL) (mg/dl)	152.53 ± 32.28	126.37 ± 38.14

Table: 02: Presents the Association of hematological parameters with cardiovascular risk factors among male participants:

Gender (Males no:73)	FBG	SBP	DBP	TC	TG	HDL	LDL
RBC	0.066	0.049	0.128	0.13	0.168	-0.136	0.123
	0.579	0.681	0.282	0.275	0.155	0.251	0.301
Hemoglobin	0.029	.242*	.349**	0.223	.249*	-0.169	.254*
	0.808	0.039	0.002	0.057	0.033	0.153	0.03
HCT	0.012	0.22	.323**	0.188	0.198	-0.184	0.228
	0.918	0.061	0.005	0.112	0.094	0.119	0.052
MCV	0.037	0.001	-0.013	0.152	0.112	-0.02	0.013
	0.754	0.992	0.913	0.198	0.346	0.865	0.911
MCH	-0.058	0.145	0.156	-0.056	-0.032	-0.098	0.062
	0.625	0.222	0.187	0.638	0.787	0.409	0.602
MCHC	0.126	0.098	0.006	0.199	.253*	0.095	0.109
	0.288	0.409	0.96	0.091	0.031	0.425	0.356
WBCS	0.225	0.021	-0.012	-0.062	-0.011	-0.004	-0.003
	0.055	0.86	0.918	0.604	0.925	0.971	0.977
Neutrophils	-0.003	-0.136	0.025	-0.049	0.206	0.178	-0.12
	0.981	0.252	0.833	0.678	0.08	0.132	0.311
Lymphocytes	0.029	0.185	0.034	0.073	-0.164	-.232*	0.153
	0.81	0.118	0.778	0.541	0.165	0.048	0.195
Eosinophil	-0.03	-0.084	-0.034	-0.055	0.001	0.141	-0.154
	0.804	0.477	0.777	0.645	0.992	0.233	0.193
Monocytes	-0.095	0.115	.260*	-0.1	0.118	0.009	-0.031
	0.422	0.331	0.027	0.401	0.32	0.937	0.795
Platelets	0.117	0.106	0.031	0.186	0.099	0.117	0.1
	0.324	0.373	0.793	0.115	0.405	0.326	0.402

Hematological parameters and cardiovascular risk factors, such as fasting blood glucose (FBG), systolic and diastolic blood pressure (SBP and DBP), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL), are correlated among male participants, as shown in Table 2.

Although not statistically significant, the Red Blood Cell (RBC) Count had a modest positive connection with LDL (r = 0.123), triglycerides (r = 0.168), and total cholesterol (r = 0.130). There was a somewhat favorable connection between hemoglobin levels and

LDL (r = 0.254, p < 0.05), triglycerides (r = 0.249, p < 0.05), and diastolic blood pressure (r = 0.349, p < 0.01). This implies a possible correlation between elevated hemoglobin levels and lipid profile abnormalities as well as elevated blood pressure. Hematocrit (HCT) and diastolic blood pressure showed a strong correlation (r = 0.323, p < 0.01), suggesting that there may be a connection between raised blood pressure and hematocrit. There were modest and non-significant relationships between cardiovascular risk variables and mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV). WBC count had a slight correlation with both LDL (r = 0.199) and total cholesterol (r = 0.177), but these correlations were not statistically significant. Although not statistically significant, platelet count showed a modest positive connection with both SBP (r = 0.176) and DBP (r = 0.229). A negative connection between HDL and the majority of hematological markers suggested a possible unfavorable impact on lipid metabolism.

Table: 03: Presents the Association of hematological parameters with cardiovascular risk factors among female participants:

Gender (Females no:196)	FBG	SBP	DBP	TC	TG	HDL	LDL
RBCs	0.009	0.093	0.085	.172*	.286**	-.186**	.184**
	0.903	0.195	0.237	0.016	0	0.009	0.01
Hemoglobin	0.086	.148*	.152*	.354**	.335**	-0.115	.369**
	0.228	0.038	0.033	0	0	0.107	0
HCT	0.104	0.134	.157*	.341**	.327**	-0.125	.354**
	0.145	0.062	0.028	0	0	0.081	0
MCV	0.131	0.035	0.088	.188**	0.1	0.054	.202**
	0.067	0.627	0.22	0.008	0.162	0.451	0.004
MCHE	0.109	0.032	0.033	0.089	0.007	0.074	0.094
	0.127	0.655	0.649	0.216	0.926	0.3	0.191
MCHC	0.033	0.07	0	.141*	0.116	-0.023	.157*
	0.651	0.331	0.997	0.048	0.105	0.748	0.028
WBCS	.172*	.151*	0.063	0.008	0.019	-0.042	0.015
	0.016	0.035	0.382	0.916	0.791	0.555	0.834
Neutrophils	-0.124	-0.135	-.248**	-0.014	-0.103	-0.02	0.051
	0.083	0.058	0	0.849	0.151	0.786	0.479
Lymphocytes	.159*	0.115	.212**	0.098	.182*	-0.044	0.048
	0.026	0.109	0.003	0.173	0.011	0.538	0.503
Eosinophil	0.064	.165*	.183*	-0.109	-0.132	0.104	-0.079
	0.369	0.021	0.01	0.127	0.066	0.146	0.269
Monocytes	0.097	0.1	.179*	-0.026	-.156*	0.133	-0.088
	0.175	0.164	0.012	0.715	0.029	0.063	0.221
Platelets	0.128	.240**	.268**	-0.073	0.004	-0.004	-.144*
	0.073	0.001	0	0.308	0.951	0.957	0.045

Hematological parameters and cardiovascular risk factors, such as fasting blood glucose (FBG), systolic and diastolic blood pressure (SBP and DBP), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL), are correlated among female participants, as shown in Table 3

The RBC count was significantly positively correlated with LDL ($r = 0.184$, $p < 0.01$), triglycerides ($r = 0.286$, $p < 0.01$), and total cholesterol ($r = 0.172$, $p < 0.05$). This implies that elevated cholesterol levels may be associated with an elevated RBC count, hence increasing the risk of cardiovascular disease. Hemoglobin levels showed a moderately favorable connection with LDL ($r = 0.369$, $p < 0.01$), triglycerides ($r = 0.335$, $p < 0.01$), total cholesterol ($r = 0.354$, $p < 0.01$), and diastolic blood pressure ($r = 0.152$, $p < 0.05$). This suggests that hypertension and dyslipidemia may be linked to elevated hemoglobin levels, raising the risk of CVD. Hematocrit (HCT) showed a significant correlation with LDL ($r = 0.354$, $p < 0.01$), triglycerides ($r = 0.327$, $p < 0.01$), total cholesterol ($r = 0.341$, $p < 0.01$), and diastolic blood pressure ($r = 0.157$, $p < 0.05$). This shows that elevated hematocrit levels raise blood pressure and cholesterol levels, which raises the risk of CVD. Inverse Relationship to HDL: The majority of hematological measures, such as hemoglobin, hematocrit, and RBC count, had negative relationships with HDL levels; the RBC count showed a significant negative connection ($r = -0.186$, $p < 0.01$). This implies a possible association between lower protective HDL cholesterol and higher hematological results. The associations between cardiovascular risk factors and mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) were modest and not statistically significant. In females, the number of white blood cells (WBCs) and platelets did not significantly correspond with cardiovascular risk factors.

DISCUSSION

The current research examined the relationship between cardiovascular risk factors and hematological parameters among the both males and females living in District Shaheed Benazirabad, Sindh, Pakistan. Our results showed a substantial correlation between raised blood pressure and lipid abnormalities (increased total cholesterol, triglycerides, and low-density lipoprotein [LDL]) and greater hemoglobin, hematocrit, and red blood cell (RBC) count levels. These results are in line with other studies that hypothesized hematological markers might be involved in predicting cardiovascular disease (CVD) risk. Numerous studies have shown a link between hematological indicators and metabolic syndrome (MetS), a condition that significantly increases the risk of developing cardiovascular disease (CVD). A large-scale Iranian Health Survey (n=11,114) found that those with MetS had a higher risk of developing CVD than people without it. This suggests that hematological indicators are important for both metabolic and cardiovascular health (Nagasawa et al., 2016). [20] Our findings align with previous research that has shown a robust association between hemoglobin levels and lipid indicators, such as triglycerides (TG) and total cholesterol (TC) (Jesri et al., 2008; Vitool et al., 2013). [21, 22] In line with other studies suggesting that elevated hematological parameters may contribute to dyslipidemia, a major risk factor for CVD, our study also found a substantial negative connection between RBC count and high-density lipoprotein (HDL) values.[22] Additionally, in our study, higher hemoglobin and hematocrit levels were statistically associated with higher systolic blood pressure (SBP) and diastolic blood pressure (DBP), which are recognized risk factors for hypertension and the associated cardiovascular issues. These findings corroborate earlier research showing a favorable correlation between elevated blood pressure and hematocrit levels in individuals with MetS. [23] Although prior research has often associated white blood cell (WBC) count with cardiovascular disease risk. [21, 22], our analysis found no significant association between WBC count and cardiovascular risk variables in females. Nagasawa et al. (2004) found that those with MetS had noticeably increased WBC counts, which is in contradiction to this. Similarly, Jesri et al. (2005) discovered that individuals with MetS had increased WBC and platelet counts, pointing to a possible connection between inflammation, cardiovascular risk, and immunological response. There is ongoing discussion in the literature on the relationship between platelet count and cardiovascular risk. Some studies, such as those by De Luca et al. (2009), have reported no significant association between mean platelet volume (MPV) and CVD severity [24], whereas Murat et al. (2013) found high MPV to be an independent predictor of

CVD. [25] Our study did not assess MPV directly but observed a positive correlation between platelet count and triglycerides, cholesterol, and LDL levels, which supports findings by Vitool et al. (2007), who reported an increasing risk of MetS with rising platelet count quartiles .[22] Overall, our results align with previous research highlighting the significance of hematological parameters in CVD risk prediction. However, differences in sample size, study population, and methodology may explain variations between our findings and those of earlier studies. Future longitudinal studies are needed to further explore these associations, particularly in South Asian populations, where genetic and environmental factors may influence hematological and cardiovascular interactions.

CONCLUSION

This study highlights the significant association between hematological parameters and cardiovascular risk factors among both males and females in District Shaheed Benazirabad, Sindh, Pakistan. Elevated hemoglobin, hematocrit, and platelet counts were positively correlated with higher triglycerides, total cholesterol, LDL levels, and blood pressure, reinforcing their potential role in CVD risk assessment. These findings align with previous research emphasizing hematological markers in metabolic syndrome and cardiovascular disease prediction. However, variations in results between genders suggest the need for larger, longitudinal studies to further validate these associations and develop targeted prevention strategies for cardiovascular health improvement.

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