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Impact of Chronic Alcohol Consumption on Some Blood Parameters; A Comparative Study between Healthy and Alcohol Consumers

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Abstract **Background:** Alcohol, a catalyst for oxidative stress, is considered one of the most significant health problems facing the world today. Chronic alcohol consumption is associated with a wide range of haematological abnormalities resulting from multiple biological mechanisms, including nutritional deficiencies and oxidative stress reported in previous studies. **Methods:** A cross-sectional study was conducted in 2024 in Diyala Province, Iraq. 150 subjects participated in our study, divided into two groups: 75 were daily consuming alcohol and the other 75 were healthy as the control group. The mean age of the participants was comparable between the two groups. Complete blood count (CBC) parameters were measured using an automated haematology analyser and statistical analyses were performed to compare haematological parameters between the groups **Results:** the study found that there was significant decrease in haematological indices (HB, RBC, HCT, MCV, MCH, MCHC, MPV, PCT and Platelets) for daily consuming alcohol subjects comparing with healthy subjects while RDW CV. and RDW SD. Show a significant increase in alcoholic participants compared to healthy p-0.05, with a significant positive correlations. Chronic alcohol consumers demonstrated significantly lower haemoglobin (Hb), red blood cell count (RBC), haematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean platelet volume (MPV), plateletcrit (PCT) and platelet count compared with healthy controls ($p<0.05$). In contrast, red cell distribution width indices (RDW-CV and RDW-SD) were significantly higher among chronic alcohol consumers, whereas platelet distribution width (PDW) showed no statistically significant difference. Correlation analysis demonstrated several significant positive and negative associations among haematological parameters within the alcohol-consuming group **Conclusion:** Chronic alcohol consumption was associated with significant alterations in several haematological parameters. Although oxidative stress has been proposed as a possible mechanism in previous studies, oxidative stress biomarkers were not measured in the present study; therefore, this explanation should be interpreted with caution. Future studies incorporating oxidative stress biomarkers, liver function tests and nutritional assessments are recommended to clarify the underlying biological mechanisms.

Key Words Chronic Alcohol Consumption, Blood Parameters, Red Blood Cells, Platelets, Red Cell Distribution Width

INTRODUCTION

Alcohol consumption is common worldwide and remains a major contributor to the global burden of disease [1]. Three million deaths annually are attributed to alcohol addiction [2].

Alcohol addiction is defined as Alcohol Use Disorder, which is recognized as a chronic health condition characterized by an inability to control alcohol consumption due to a strong desire to drink [3]. It is marked by a loss of control over limiting alcohol intake, tolerance resulting from the pressing need to consume increasing amounts of alcohol and psychological dependence, manifested by symptoms such as tremors, sweating and nausea when alcohol consumption is reduced [2,3]. This leads to significant physiological consequences, in addition to its social and behavioural impacts.

In Iraq, a societal increase in alcohol consumption has been observed in recent years [4]. For some individuals, this has progressed to addiction and daily alcohol consumption [5], which, in turn, leads to changes in certain blood parameters [6]. These changes result from bone marrow suppression, blood loss from the gastrointestinal tract, reduced progenitor cells in the bone marrow and structural abnormalities in blood cells [6]. Consequently,

this can lead to moderate or severe anaemia and abnormal enlargement of red blood cells.

The effects of alcohol on blood parameters are complex, primarily due to its role in increasing oxidative stress [7]. Recent evidence indicates that ethanol metabolism generates reactive oxygen species [ROS] and acetaldehyde, both of which contribute to oxidative damage affecting cellular proteins, lipids and nucleic acids thereby disrupting normal cellular function [8]. Other studies have indicated that alcohol addiction can cause issues with the absorption of essential nutrients such as folate and vitamin B12, which are crucial for blood cell production [9]. This can result in coagulation disorders, anaemia, reduced haemoglobin synthesis, shortened lifespan of blood cells and suppression of the immune system.

Despite the growing body of international evidence describing alcohol-related haematological abnormalities, limited data are available from Iraq, particularly from Diyala Province. Regional differences in nutritional status, socioeconomic conditions, healthcare accessibility and patterns of alcohol consumption may influence haematological responses to chronic alcohol exposure. Therefore, investigating these alterations in the local population is important for improving clinical understanding and providing evidence that may support early diagnosis and preventive healthcare strategies.

Accordingly, we hypothesized that chronic alcohol consumers would exhibit significant alterations in haematological parameters compared with healthy individuals, reflecting the potential impact of prolonged alcohol exposure on haematopoietic function.

METHODS

A cross-sectional case-control study was conducted in a private pathological analysis laboratory centre in Diyala Province, Iraq. Ethical approval was obtained from the ethical approval committee of the College of Medicine, University of Diyala. Samples were collected during the period from February to December 2024. 150 subjects participated in our study, divided into two groups: 75 were daily consuming alcohol and the other 75 were healthy as the control group. After discussing the study's goal and contents, all individuals in both groups provided written and informed permission. Participants were recruited consecutively from individuals attending a private pathological laboratory and internal medicine clinic during the study period. Eligibility was assessed according to predefined inclusion and exclusion criteria before enrolment.

The study focused exclusively on individuals who made daily alcohol consumption a ritual, indulging in varying quantities. Their habits included savouring 2-3 litres of beer and no less than 250 ml of whiskey, a routine they maintained religiously for no less than three years, as revealed through the survey.

Samples were collected from participants in the study during their visits to a specialized internal medicine clinic. These visits were prompted by gastrointestinal concerns unrelated to liver issues or for routine health check-ups.

Healthy controls were recruited from the same pathological laboratory during routine health examinations. Their health status was confirmed by complete blood count (CBC), C-reactive protein (CRP) testing and clinical examination performed by an internal medicine specialist before enrolment in the study.

Inclusion / Exclusion Criteria

The control group was composed of healthy individuals who neither drank alcohol nor smoking and were not suffering chronic disease. As for the alcohol-consuming group, only healthy individuals without any existing health issues were included. Those who consumed alcohol but suffered from chronic conditions such as diabetes, hypertension or heart diseases were excluded. Additionally, individuals with viral hepatitis or kidney function disorders were also ruled out, ensuring the study focused on a clear and unbiased comparison.

Alcohol consumption history was obtained through participant interviews; therefore, recall bias cannot be completely excluded

Blood Collection

Exactly 5 mL of venous blood was obtained from each participant, taking all aseptic precautions and put in EDTA tubes with a thorough mix for measuring CBC. CBC were tested using a fully automated blood cell counter XN-3000 (Sysmex Co., Kobe, Japan). All haematological analyses were performed according to the manufacturer's instructions. Internal quality control procedures were routinely conducted before sample analysis to ensure the accuracy and reliability of laboratory measurements.

Statistical Analysis

The current study's data were analysed using the Chi-square (X2) test to compare percentages. (Mean SD) was used to describe numerical data. The T test is used to compare two numerical variables, whereas the F test (ANOVA) is used to compare three or more numerical variables. The test was run with a significant level of =0.05. Programs for analysing current data (SPSS v.22 and Excel 2013).

RESULT

The average age of the participants in the healthy group was 40.43, while it was 41.09 in the alcoholic group. There was no age difference between the two groups, as shown in Figure 1A. Interestingly, the weights of the alcoholic participants showed a significant difference compared to the healthy participants, with a notable increase in the weights of the alcoholic group compared to the healthy group, as illustrated in Figure 1B.

Regarding blood parameters, our current study observed a significant decrease in haematological indices (HB, RBC, HCT, MCV, MCH, MCHC, MPV, PCT and Platelets) among the alcoholic participants compared to the healthy participants, with a significant difference at $p<0.05$. on the other hand, RDW CV. and RDW SD. Show a significant increase in alcoholic participants compared to healthy. PDW showed no significant difference (Table 1).

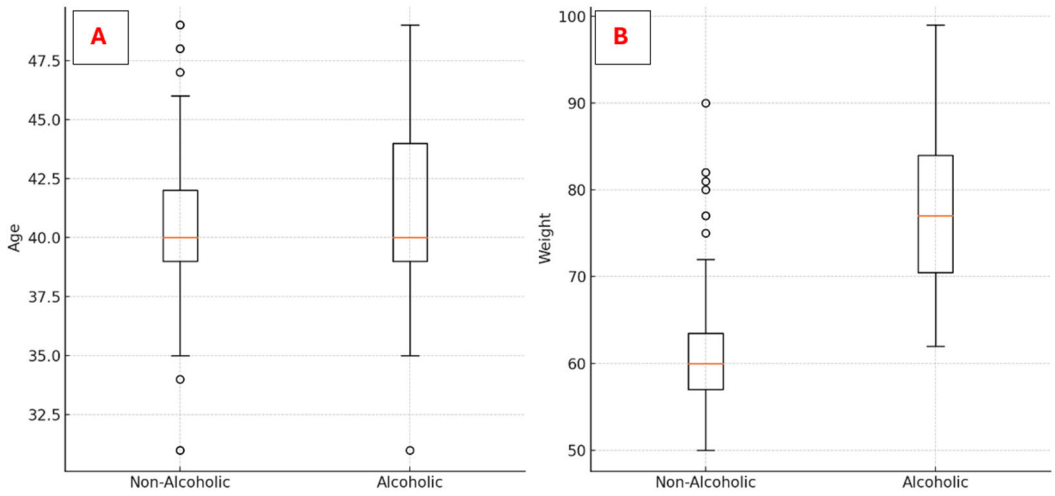

Figure 1 A&B: A) The age distribution for Alcoholic and Non-alcoholic participants, B) The weight distribution for Alcoholic and Non-alcoholic participants.

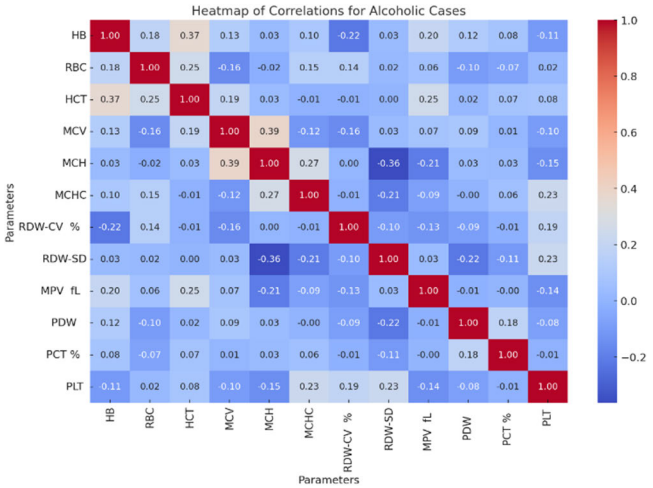

Figure 2: mean±SD of blood parameters distribution for alcoholic and non-alcoholic groups

There were varying correlations among the blood parameters of alcoholic individuals. Strong positive correlations were observed between HB and HCT, HCT and RBCs, HCT and MCH, MCV and MCH, HCT and MCV and MCH and MCHC, with correlation coefficients of 0.98, 0.79, 0.75, 0.72, 0.97 and 0.88, respectively. Moderate positive correlations were found between HB and RBCs, RDW-CV and MCV and MPV and PDW, with correlation coefficients of 0.68, 0.43 and 0.65, respectively.

In contrast, inverse correlations were noted between MPV and PLT and HCT and RDW-CV, with correlation coefficients of -0.47 and -0.41, respectively Figure 2.

DISCUSSION

The widespread consumption of chronic alcohol poses a major problem for the world. Because of its negative effects on consumer health, which result in physiological changes that are reflected in general health. Hence, the current study

Table 1: Statistical comparison between alcoholic and non-alcoholic groups

Parameter	Non-Alcoholic N=75	Alcoholic N=75	p-value
HB	14.07±2.5	13.04±2.11	0.007
RBCs	4.8±0.85	4.51±0.67	0.02
HCT	44.32±3.98	42.32±3.79	0.002
MCV	92.4±4.73	89.9±4.91	0.001
MCH	31.21±3.19	29.82±2.82	0.005
MCHC	34.08±2.31	32.91±2.89	0.006
RDW CV	13.52±0.93	14.58±0.7	0.001
RDW SD	45.78±5.51	48.28±5.09	0.004
MPV	9.89±2.39	9.16±1.92	0.04
PDW	15.16±0.43	15.2±0.57	0.6
PCT	0.248±0.11	0.21±0.13	0.05
PLT	259.29±31.79	238.6±46.78	0.001

aimed to evaluate some blood indicators compared to healthy individuals, given the importance of this topic to public health.

Initially, the ages of the participants in the current study were similar in both groups. Based on weight, the alcoholics in the study weighed significantly more than the control group. This finding may be explained by the high caloric content of alcoholic beverages and the metabolic alterations associated with chronic alcohol consumption, which can influence appetite regulation, energy balance and fat metabolism [8]. In addition, fat burning stops as a result of the liver prioritizing the breakdown and elimination of alcohols, which leads to the cessation of carbohydrate, fat and protein burning.

Interestingly, the percentage of red blood cells and their effective indicators, including (MCV, MCH, MCHC), in addition to haemoglobin, haematocrit, mean platelet volume, platelets and PCT, were significantly reduced in daily alcoholics compared to healthy participants.

Recent clinical investigations have demonstrated that chronic alcohol consumption is associated with significant alterations in haematological and inflammatory biomarkers, reflecting systemic biological effects of prolonged alcohol exposure [10]. Furthermore, some studies have shown that

alcoholics suffer from nutritional deficiencies due to alcohol's negative role in inhibiting the absorption of essential vitamins such as B12, reducing folate absorption and accelerating red blood cell destruction [11]. Therefore, the reduced red blood cell count observed in the present study may reflect anaemia; however, iron status, folate and vitamin B12 levels were not measured and this interpretation should therefore be made with caution.

Recent evidence indicates that chronic alcohol consumption may alter red blood cell morphology, although the direction and magnitude of these changes vary according to nutritional status, duration of alcohol exposure and population characteristics [6], resulting from an increase in MCV, contrary to what our current study found, where the blood biomarkers and red blood cell content MCV, MCH, MCHC in the alcoholics participating in the study were lower than in the control group, which could be due to microcytic anaemia or iron deficiency resulting from alcohol-related malnutrition or malabsorption.

Regarding platelet count, size and plateletcrit, the present study demonstrated significant reductions among chronic alcohol consumers compared with healthy controls. These findings are consistent with recent evidence indicating that chronic alcohol consumption may impair platelet production and function through bone marrow suppression and altered platelet turnover, thereby increasing the risk of haematological abnormalities and bleeding complications. Similar observations have been reported in recent studies evaluating haematological changes associated with chronic alcohol consumption [12]. The variation in red blood cell size, represented by RDW-CV and RDW-SD, which have become important indicators in determining or diagnosing the expected pathological picture of diseases in general [13], was significantly elevated in daily alcoholics. RDW-CV and RDW-SD are considered sensitive indicators that provide clear evidence of important early changes in the process of red blood cell formation.

Elevated RDW-CV and RDW-SD values in daily alcoholics can be linked to erythropoiesis, a disorder of red blood cell formation resulting from bone marrow suppression caused by high alcohol concentrations in the body. This suppression leads to the production of abnormally sized cells due to iron deficiency, resulting in microcytosis or due to vitamin B12 deficiency, which leads to macrocytosis due to excessive alcohol consumption, resulting in a mixture of red blood cells of different sizes.

As mentioned above, some studies have linked alcohol consumption with an increase in Macrocytosis MCV [6], while the results of the current study showed a significant increase in RDW, which coincided with a decrease in MCV, which in turn can indicate a severe deficiency in food absorption, especially iron and reflects a different pattern of anaemia rather than a single effect.

The observed correlations among haematological biomarkers suggest statistically significant associations between these variables in chronic alcohol consumers. However, correlation analysis does not establish causal relationships and these findings should therefore be interpreted with caution. Further studies using multivariable analytical approaches are recommended to confirm these associations

A significant positive correlation was observed between Hb, HCT, RBCs and between mcv, MCH, HCT and between MCH, MCHC and MCV, reflecting a complete functional correlation of haematopoietic cell formation in alcoholics.

Previous studies have suggested that chronic alcohol consumption may contribute to oxidative stress and impaired haematopoiesis. However, oxidative stress biomarkers were not measured in the present study; therefore, the proposed mechanisms should be interpreted as potential explanations rather than confirmed pathways

These correlations, along with the elevated RDW response, indicate coordinated shifts in haematological biomarkers due to alcohol. The systematic nature of these correlations reveals cellular heterogeneity, suggesting a dynamically unstable state.

Previous studies have suggested that oxidative stress may contribute to impaired red blood cell formation and haematopoietic function [14]. However, because oxidative stress biomarkers were not measured in the present study, this mechanism should be considered a possible explanation rather than a confirmed cause. The generation of ROS resulting from ethanol metabolism via alcohol dehydrogenase and CYP2E1 has been reported to affect membrane lipids, proteins and DNA within the bone marrow [14,15]. Recent studies suggest that oxidative stress may impair erythroid cell differentiation and haematopoietic function, although the precise biological mechanisms require further investigation [16]. These mechanisms may partly explain the reductions in Hb, RBC and HCT observed in the present study; however, further biochemical investigations are required to confirm these mechanisms. Similarly, the observed reductions in platelet parameters may be related to mechanisms previously reported in the literature, including oxidative stress and bone marrow suppression; however, these mechanisms were not directly investigated in the present study [14,16].

Although the current study found significant findings, it is necessary to support the study by evaluating and measuring indicators of oxidative stress such as TAC, MDA and iron and folate stores to support the interpretations of the current study.

From a clinical perspective, routine haematological assessment may facilitate the early detection of alcohol-related haematological abnormalities and support timely medical intervention before severe complications develop.

CONCLUSIONS

Chronic alcohol consumption was associated with significant alterations in several haematological parameters, including red blood cell indices, haemoglobin concentration, haematocrit, platelet count and red cell distribution width. These findings suggest that prolonged alcohol consumption may adversely affect haematopoiesis and overall

haematological health. Although oxidative stress has been proposed as a possible mechanism in previous studies, no oxidative stress biomarkers were measured in the present study; therefore, this explanation should be interpreted with caution. Further studies incorporating oxidative stress biomarkers, liver function tests and nutritional assessments are recommended to clarify the underlying mechanisms.

Limitations

The present study has several limitations. First, the cross-sectional design does not allow causal relationships to be established. Second, alcohol consumption history was self-reported and may therefore be subject to recall bias. Third, participants were recruited from a single pathological laboratory centre, which may limit the generalizability of the findings. Fourth, oxidative stress biomarkers, liver function tests, iron profile, folate and vitamin B12 levels were not measured. Finally, nutritional status and smoking intensity were not objectively assessed and may have influenced the observed haematological parameters.

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