Original Article

An epidemiologic blood group-1

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ABSTRACT

Aim

Polycythemia, also known as erythrocytosis, is an abnormal accumulation of red blood cells, packed cell volume, and hemoglobin that can lead to debilitating symptoms and significant mortality. Polycythemia is estimated to affect 22 people per 100,000. The epidemiology of polycythemia in Iraq is limited. This study aimed to investigate the prevalence and incidence of polycythemia in Babylon City, Iraq, from 2018 to 2022 and to identify populations at high risk.

Materials and Methods

Due to the relative scarcity of epidemiological studies on polycythemia in Iraq, this study was conducted to identify some epidemiological features of polycythemia patients in Babylon province. A study conducted at the Babylon Central Blood Bank included 220 polycythemia patients. This data was obtained by reviewing all patient documents and the registration book from 2018 to 2022. Participants completed a questionnaire with information about their Sex, age, place of residence, smoking habits, and blood group. Statistics were analyzed using SPSS version 23.0 and Prism software. Results were presented in numbers and percentages and analyzed using the Chi-square test.

Results

Results indicated that polycythemia increased between 2018 and 2020, with the highest numbers in 2018 and decreasing in 2022. There was a higher frequency in the age group of (41-50) years, and it was more common in males with polycythemia (92.72%) who were smokers (79.09%). Most polycythemia patients had the B blood group (38.2%), while the AB blood group had the lowest percentage (5.5%), and most cases were Rh-positive (91.8%).

Conclusion

this study provided an overview of the epidemiology of polycythemia in Babylon, Iraq. The findings indicate that polycythemia was more prevalent in men of middle age and with blood group B+. Therefore, further research is needed to examine the relevance of the ABO blood group to polycythemia severity and susceptibility.

Keywords

ABO blood group; age; blood disorder; Rh; smoking

INTRODUCTION

Erythrocytosis, also known as polycythemia, is characterized by an excess of red blood cells (RBCs) in the body due to unchecked erythroid lineage development. Increased hemoglobin levels, or hematocrit, exceeding normal levels for the specific age and gender, indicate this[1]. Overproduction of red blood cells and even more severe disorders like type 2 diabetes (T2DM) may have a hereditary basis for a population. Hereditary abnormalities and secondary diseases, such as tobacco smoking, may also play a role in these processes [2,3]. Primary and secondary forms of polycythemia

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can be distinguished based on their clinical importance. People with polycythemia vera (PV) are most frequently affected by primary erythrocytosis, defined by the independent generation of excess erythrocytes[3]. PV was identified by the World Health Organization (WHO) as a chronic myeloproliferative neoplasm (MPN) due to its aberrant myeloid lineage hematopoiesis and elevated levels of pro-inflammatory cytokines produced. It is also linked to changes in the bone marrow brought on by somatic mutations in JAK2 [1, 3]. PV is typically discovered by chance when a blood count reveals high hematocrit (Hct) or hemoglobin (Hb) [4]. There are three primary criteria and one minor criterion for PV diagnosis based on the latest WHO recommendations. The main requirements are Hb >16.5g/dl/Hct >49% for men and Hb > 16g/dl/Hct > 48 for women. Second, the bone marrow is experiencing pleomorphic mature megakaryocyte growth. The third criterion involves the V617F mutation in JAK2, while a minor criterion is a decrease in serum erythropoietin. PV diagnosis requires three primary criteria, or the significant criteria 1 and 2 combined with the minor criteria must be present for PV to be diagnosed [5]. Fox et al. [6] noted that PV can also be caused by other myeloproliferative neoplasms, secondary erythrocytosis, and, rarely, erythropoietin-producing tumors. Secondary polycythemia, on the other hand, is characterized by increased red blood cell counts caused by hypoxia, insufficient erythropoietin (EPO) secretion, or other effects.

Epidemiological factors like gender, race, and geography have been shown to influence hematological malignancies. Blood types are linked to various cancers, although their exact relationship is unclear [7]. Because blood group antigens of the ABO and RhD systems help to ensure safe blood transfusions, they are important in transfusion medicine. Additionally, these cell surface antigens seem to correlate directly with disease vulnerability [8,9]. The ABO blood group antigens are determined by red blood cell antigens, which are generally thought of as carbohydrate molecules. These antigens are encoded by two codominant functional alleles (A and B) and are expressed indirectly by a single locus on chromosome 9 (9q34.1-q34.2). Recessive O alleles produce inactive proteins devoid of the functions of either transferase [10]. Accordingly, four primary ABO phenotypes can be distinguished: A, B, AB, and O. ABO blood groups have also been reported to be genetic risk factors for various diseases (viruses, bacterial infections, fungi, parasites, and malignancies) [11]. In this regard, the literature confirms that certain diseases affect ABO blood types. Yadav et al. [7], Abegaz [12], and Su et al. [13] have shown a link between the ABO blood group and susceptibility to various diseases, including cancer, cardiovascular disease, infection, and hematologic disorders. The epidemiology of polycythemia in Iraq is scarce. Therefore, this study aimed to evaluate polycythemia prevalence and incidence in Babylon/ Iraq and then use it as an epidemiological marker to identify high-risk populations between 2018 and 2022.

MATERIALS AND METHODS

Study population and ethical approval

The study was performed following the Helsinki Declaration and after ethics approval from the University of Al-Qasim Green (Approval No. 015, 7, 21) and the informed consent form signed by all participants before the study. A study was conducted between July 2021 and April 2022 at the Babylon Central Blood Bank in Babylon province, Iraq. A trend of polycythemia patients in the previous five years was estimated based on data from registration books, which included the number of new patients each year and the overall number of polycythemia patients. The study included 220 participants between the ages of 30-70. According to WHO guidelines, patients were selected based on three primary and one minor criteria for diagnosing polycythemia Vera. Testing for hemoglobin and hematocrit was the primary criteria. A second finding was the abundance of mature megakaryocytes in the bone marrow. Lastly, a mutation in JAK2 V617F was required, while a decrease in serum erythropoietin was a minor requirement. Secondary polycythemia was excluded based on history, clinical findings, and relevant investigations due to hypoxia, sleep apnea, excessive smoking, drinking, high altitude, renal disease, and androgen use. Each subject completed a questionnaire that included information about a person's gender, age, place of residence, smoking habit, and blood group.

Statistical analysis

The SPSS v23.0 (IBM, NY, USA) and Prism were used for statistical data analysis. The normalized data were tested with the Kolmogorov-Smirnov test. There were two categorical variables for patients--relative and absolute frequency. A P-value of 0.05 was adopted to determine significance when comparing variables against the studied parameters using Pearson's chi-square test.

RESULTS

Babylon Central Blood Bank had 59384 polycythemia patients from 2018-2020. A prevalence of 0.03 percent was found in Babylon City's general population, whereas 0.26 percent was recorded among total patients of PV. In the same period, PV incidence was highest in 2018, declined in subsequent years, and appeared to be decreasing in 2022 (Figure 1).

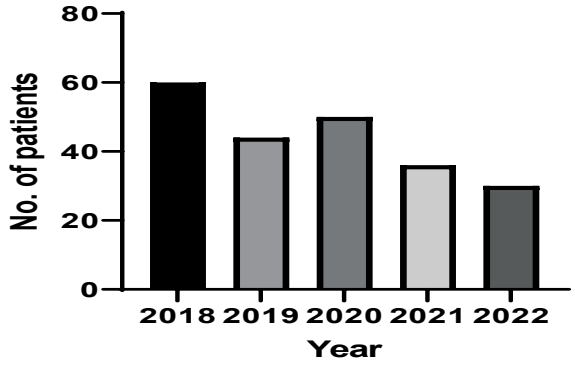

Figure 1. Distribution of polycythemia from 2018 to 2022.

Four age groups were identified in this study among patients with polycythemia vera. There are significant differences (P≤0.05) in the age group (41-50) years recorded 92 (41.8%), followed by 82 (37.3%) in the (30-40) years group. Age groups (51-60) and (61-70) present with the lowest rates, 30 (13.6%) and 16 (7.3%), as this group rarely presented without chronic diseases. Each of the 220 patients was grouped according to their geographical location. Notably, the statistical analysis by the Chi-square test shows significant differences between the urban and rural areas at the P≤0.05 level. There was a higher percentage of polycythemia in urban areas, 196 (89.09%), compared with 24 (10.91%) in rural areas. This might be related to the size of the population and, therefore, to the incidence rates (Figure 2).

Notably, the statistical analysis by the Chi-square test shows there are significant differences according to gender and tobacco smoking at the P≤0.05 level. The results of Figure 3 indicated that PV was more common among males 204 (92.72%) than females 16 (7.28%) and that most patients with essential polycythemia smoked 174 (79.09%).

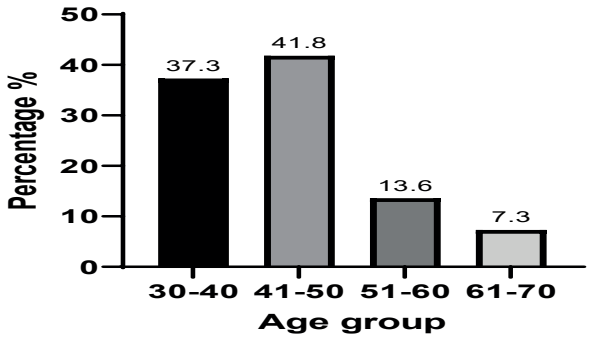

Figure 2. Distribution of polycythemia according to age group.

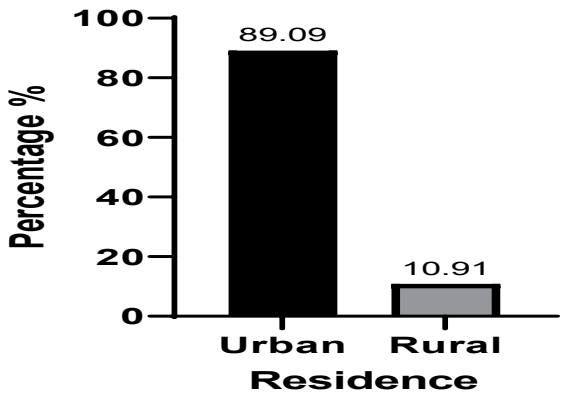

Figure 3. Distribution of polycythemia according to residence

According to Figure 4, the statistical analysis shows there are significant differences according to ABO blood group and Rh at the P≤0.05 level. Most PV patients had a B blood group of 84 (38.18%), whereas the AB blood group recorded the lowest percentage of 12 (5.45%). Most patients were Rh-positive 202 (91.81%), while 18 (8.18%) were Rh-negative.

DISCUSSION

According to this study, polycythemia rose between 2018 and 2020, peaked in 2018, and decreased in 2022. In Baghdad, Iraq, the prevalence of polycythemia is roughly 22 instances per 100,000 people. According to the same study, 36% of patients smoke, compared to 11% who do not [14]. Polycythemia vera prevalence in the US ranges from 44 to 57 per 100,000 (0.044 to 0.057%), but the prevalence of erythrocytosis is 3.4% by broad criteria (new, 2016) and 0.3% by rigorous

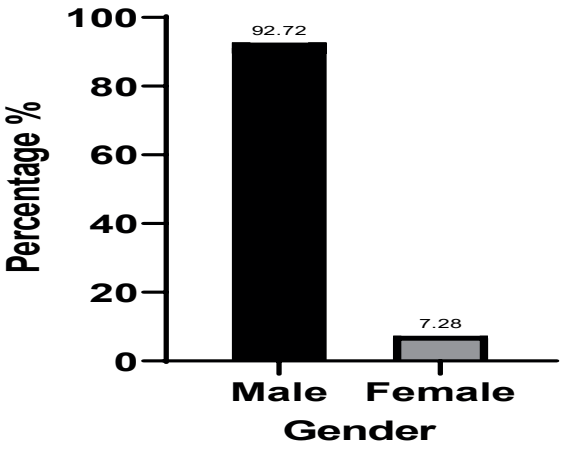

Figure 4. Distribution of polycythemia according to gender.

criteria (old, 2008) [15]. In instances formerly classified as myeloproliferative neoplasms (MPN), which are unclassifiable due to the lack of diagnostic criteria, more cases of polycythemia are diagnosed based on the revised WHO diagnostic criteria for 2016 [16]. The rise is mainly caused by the occurrence of polycythemia and is most likely the outcome of improved diagnostic techniques that include molecular testing for JAK2 mutations [17]. The detrimental health effects of polycythemia can also be eliminated by making a lifestyle change, such as giving up smoking. When smoking cessation occurs before the age of forty, the increased risk of death is lowered by ninety percent [2]. Research has demonstrated that quitting smoking corrects aberrant hematological markers. Hemoglobin, hematocrit, red blood cell, and white blood cell counts dramatically decrease as soon as smoking cessation is accomplished [2, 18].

Based on age group and place of residence, the age group of 41–50 years old had a higher prevalence of polycythemia, with a higher percentage in urban regions. Men are more likely than women to have polycythemia (1.3 vs. 0.8) per 100,000 people, and the incidence rose with age (0.1 in those 34 to 35, 0.7 in those 35 to 49, and 2.4 in those over 50) [19]. People between the ages of 50 and 70 are the primary demographic that polycythemia vera affects, according to Almohmmadi et al. [20]. Patients with polycythemia typically have a lower life expectancy than the average population, particularly when they are 50 years old. Venous and arterial thrombosis are the cause of this age's higher death rate. In addition to the standard risk factors, polycythemia raises the risk of thrombosis because of leukocytosis, thrombocytosis, and erythrocytosis [21, 41]. The urban-rural disparity in residence place is another crucial risk factor. Sedentary urban lives, low levels of physical exercise, and increased consumption of fat and energy have all been linked to an increased risk in urban settings [22]. Living in an urban area has been linked to several diseases, such as hematological cancer in Egypt [23], hypertension in Mysore [24, 40], and diabetes and hypertension in Tibetan communities [25].

Males (92.72%) and smokers (79.09%) had higher rates of polycythemia in terms of gender and smoking (Figure 5). There have been variations in the prognosis, response to treatment, and occurrence of several hematological illnesses based on gender. Differentially activated genes and molecular pathways, the functioning of the immune system, and the expression of sex hormones are some of the variables that may contribute to gender differences [26, 39]. Due to erythropoietin-producing kidneys in men, estrogen-inhibiting bone marrow in women, androgen-stimulating bone marrow in males, men and women have distinct mean venous hemoglobin and red cell mass [27, 28, 38]. Moreover, compared to nonsmokers, smokers have larger packed cell volumes. A significant effect of smoking is the reduction of arterial oxygen levels by increasing the carbon monoxide levels of the blood from less than 2.5% in nonsmokers to 10% or even higher, depending on the situation [4]. Smoking is also associated with high hemoglobin levels, which may be explained by hypoxia due to inhalation of carbon monoxide, which could result in the negative feedback of a decrease in erythropoietin serum levels [29].

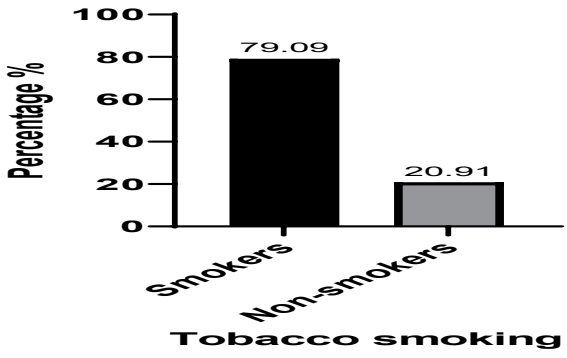

Figure 5. Distribution of polycythemia according to tobacco smoking.

Patients with polycythemia were primarily B blood type (38.2%), followed by blood group O (31.8%), and Rh-positive (91.8%), according to the ABO and RhD systems. There is a connection between health and illness and the ABO blood types. Only blood groups A, B, and AB have the ABO antigen, suggesting that genetic variations may play a role in the variance of these disorders among different blood groups [13,37,38]. Blood type-related illnesses and disorders are caused by the antigens in some blood types, which change the structure and functionality of blood membranes [12]. Males with Rh factor positivity and blood group B are more susceptible to myeloproliferative diseases, according to Yadav et al. [7]. Of the total patients, blood group B accounts for 35.34%, followed by blood group O 278.11%, blood group A 26.69%, and blood group AB 10.16%. Comparatively, to individuals with blood group O, individuals with blood group A develop hyperlipidemia, atherosclerosis, and heart failure; however, those with blood group B suffer from myocardial infarction [30] (Figure 6,7). In addition, Kumar et al. [31] found that leukemia is more likely to occur among B+ blood groups. A similar association of blood groups A, B, and Rh+ is found to be more susceptible to COVID-19 infection, whereas blood groups O, AB, and Rh− are at a lower risk of COVID-19 infection [31]. However, blood septicemia may be accrued and not easy to diagnose [32,33,36]. In light of these findings, different approaches are needed for maintaining health and preventing and treating a wide range of diseases based on blood group.

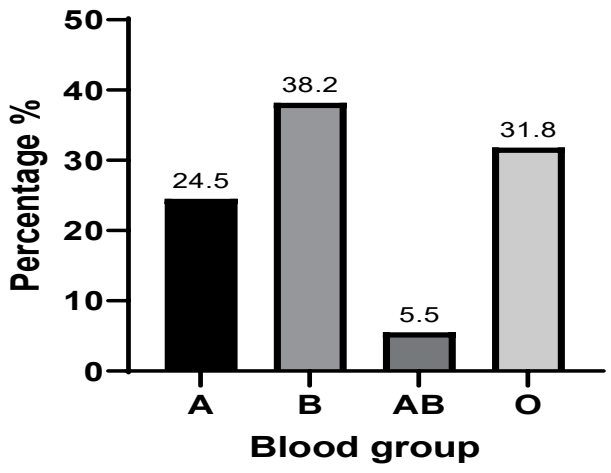

Figure 6. Distribution of polycythemia according to ABO blood group.

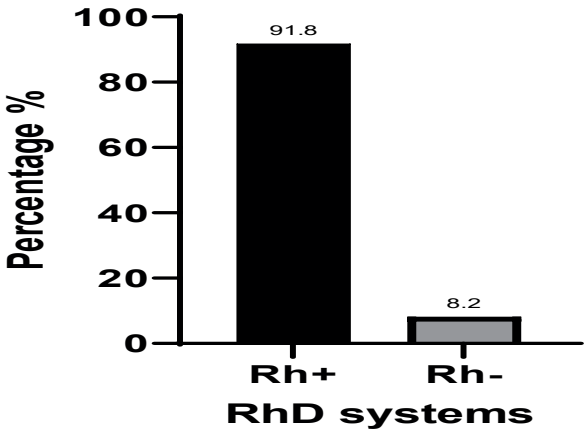

Figure 7. Distribution of polycythemia according to Rh.

CONCLUSION

Polycythemia was more prevalent at the median age and male gender, and those with group B+ have a higher risk of polycythemia. These findings suggest that blood groups could be an epidemiological marker for identifying populations at higher risk of diseases. Therefore, further research is required to discover the exact mechanisms behind the link between blood types and various disease conditions.

FUTURE DIRECTIONS IN RESEARCH:

Supplementary Materials: The datasets used during the current study are available from Google Scholar, Scopus, and PubMed databases.

Author Contributions: Conceptualization (Amera, Karar); Writing original draft preparation (Karar, Tahreer); Writing review and editing (Omar, Tengku). All authors revised the manuscript and approved the final version to be submitted.

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Ethical approval: The study followed the Helsinki Declaration and after ethics approval from the University of Al-Qasim Green (Approval No. 015, 7, 21).

Conflicts of Interest: The authors declare that they have no competing interests.

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