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Original Research Article

Investigating the Correlation between Blood Types and Blood Haemoglobin Levels in the Rural Population of the Bihar Area

Renu Kumari[1], Rajiv Ranjan Singh[2], Sheela Kumari[3], Ajit Kumar Chaudhary[4]

[1]Tutor, Department of Physiology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India

[2]Tutor, Department of Pathology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India

[3]Professor and HOD, Department of Physiology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India

[4]Professor and HOD, Department of Pathology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India

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Corresponding Author: Dr. Rajiv Ranjan Singh
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Abstract

Aim: Investigating the correlation between blood types and blood haemoglobin levels in the rural population of the Bihar area.

Material and Methods: The present retrospective study was conducted in the Department of Physiology and Pathology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India from December 2017 se November 2018. 100 adults (males and females) who arein the age group of 18-30 years were included in this study. Blood sample is taken using finger prick, under aseptic conditions and blood groupis determined using glass slide method using antisera A,B and D. Haemoglobin concentration is estimated using Sahli's method.

Results: Among participants with A positive blood type, 5 out of 25 (20%) were anaemic, while 20 (80%) were non-anaemic. In the A negative group, none of the 2 individuals were anaemic. For those with AB positive blood type, 1 out of 4 (25%) were anaemic, and 3 (75%) were non-anaemic. The single participant with AB negative blood type was anaemic. Among participants with B negative blood type, none were anaemic, while 1 was non-anaemic. In the B positive group, 14 out of 34 (41.18%) were anaemic, and 20 (58.82%) were non-anaemic. Lastly, among participants with O positive blood type, 9 out of 33 (27.27%) were anaemic, while 24 (72.73%) were non-anaemic.

Conclusion: We conclude that individuals with blood group B are more prone to anaemia followed by blood group O, AB and least is with blood group A. Based on their bloodgroups, we can advice regular intake of diet rich in iron and vitamins or also their supplements to the individualwho are more susceptible to anaemia.

Keywords: Blood group, haemoglobin, rural population

Introduction

The association between blood groups and haemoglobin (Hb) levels has garnered significant attention in recent years, reflecting ongoing advancements in genetic and clinical research. Haemoglobin, a pivotal protein in red blood cells responsible for oxygen transport, varies across different blood groups due to genetic influences. Understanding this relationship offers insights into haematological disorders and informs personalized healthcare strategies tailored to genetic predispositions. Blood groups are determined by the presence or absence of specific antigens on the surface of red blood cells, primarily categorized into the ABO and Rh systems. The ABO system classifies blood into types A, B, AB, and O based on the presence of A and B antigens, while the Rh system adds positive or negative designation based on the RhD antigen. [1] These blood group antigens are genetically inherited and play roles beyond immunological responses, influencing erythrocyte membrane stability and interactions with other cells. [2]

Haemoglobin levels serve as crucial indicators of blood health, with normal ranges varying by age, sex, and health conditions. Deviations from these norms can signify anaemia, where low haemoglobin levels impair oxygen delivery, or polycythaemia, an excess of red blood cells potentially indicating underlying health issues. [3] The clinical implications of haemoglobin levels extend to disease management and prognosis, highlighting the importance of understanding factors influencing these levels, including genetic predispositions linked to blood groups. Research has elucidated genetic links between blood groups and haemoglobin variation. For example, studies have shown that individuals with blood group O often exhibit lower average haemoglobin levels compared to other blood groups, potentially due to genetic factors affecting red blood cell production or turnover. [4] Conversely, individuals with blood group B may show higher haemoglobin levels, suggesting genetic mechanisms influencing erythropoiesis and red blood cell dynamics. [5-9] Recent studies continue to explore and validate the associations between blood groups and haemoglobin levels. Research by Stowell et al. (2017) [6] demonstrated significant variations in haemoglobin levels among different ABO blood groups, with individuals of blood group O consistently showing lower levels. Wang et al. (2019) [7] identified specific genetic variants associated with both blood group phenotypes and haemoglobin concentration, underscoring the intricate genetic underpinnings of these associations. Such findings contribute to the growing body of evidence supporting the genetic basis of blood group-related haemoglobin variation.

Material and Methods

The present retrospective study was conducted in the Department of Physiology and Pathology, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga ,Bihar, India from December 2017 se November 2018. 100 adults (males and females) who arein the age group of 18-30 years were included in this study. Blood sample is taken using finger prick, under aseptic conditions and blood group is determined using glass slide method using antisera A, B and D. Hemoglobin concentration is estimated using Sahli’s method. The brief of the study and procedure is given to the subjects and informed consent taken.

Results

Table No. 1: Distribution of Anaemic and Non-Anaemic Adults

Hb	Frequency	Percentage
<10	30	30
>=10	70	70
Total	**100**	**100**

The first table categorizes the study participants based on their haemoglobin (Hb) levels. Out of the 100 participants, 30 individuals had Hb levels below 10 g/dL, representing 30% of the total population and thus were classified as anaemic. The remaining 70 participants, accounting for 70%, had Hb levels of 10 g/dL or higher and were classified as non-anaemic. This distribution highlights that a significant portion of the population, 30%, suffers from anaemia.

Table No. 2: Anaemic Status in Males and Females

Sex	Hb		Total
	<10	**>=10**	
Female	20	21	41
Male	10	49	59
Total	**30**	**70**	**100**

The second table provides a detailed breakdown of anaemia status by gender. Among the 41 female participants, 20 (approximately 48.78%) had Hb levels below 10 g/dL, indicating a higher prevalence of anaemia in females. Conversely, 21 females (approximately 51.22%) had Hb levels of 10 g/dL or higher. In the male group, out of 59 participants, only 10 (approximately 16.95%) were anaemic, while a majority of 49 males (approximately 83.05%) had non-anaemic Hb levels. This data suggests that anaemia is significantly more prevalent among females compared to males in this study population.

Table No. 3: Different Blood Group Status in Anaemic and Non-Anaemic Adults

Blood group	Hb		Total
	<10	**>=10**	
A +ve	5	20	25
A–ve	0	2	2
AB+ve	1	3	4

AB-ve	1	0	1
B–ve	0	1	1
B+ve	14	20	34
O +ve	9	24	33
Total	**30**	**70**	**100**

The third table examines the distribution of anaemia across different blood groups. Among participants with A positive blood type, 5 out of 25 (20%) were anaemic, while 20 (80%) were non-anaemic. In the A negative group, none of the 2 individuals were anaemic. For those with AB positive blood type, 1 out of 4 (25%) were anaemic, and 3 (75%) were non-anaemic. The single participant with AB negative blood type was anaemic. Among participants with B negative blood type, none were anaemic, while 1 was non-anaemic. In the B positive group, 14 out of 34 (41.18%) were anaemic, and 20 (58.82%) were non-anaemic. Lastly, among participants with O positive blood type, 9 out of 33 (27.27%) were anaemic, while 24 (72.73%) were non-anaemic.

Discussion

The first table reveals that 30% of the study population is anaemic, a significant finding that underscores the need for public health interventions targeting anaemia. This prevalence aligns with global estimates suggesting that anaemia affects about one-third of the world's population, particularly in low- and middle-income countries (WHO, 2020). [10] The prevalence of anaemia can be attributed to various factors, including nutritional deficiencies, chronic diseases, and genetic conditions (Kassebaum, 2016). [11] Given that a considerable proportion of the population in this study is affected, further investigation into the underlying causes and contributing factors in this specific demographic is warranted.

The gender disparity in anaemia prevalence, with nearly half of the female participants being anaemic compared to only 16.95% of males, is a notable finding. This discrepancy is consistent with other studies that have documented higher anemia rates in women, often linked to menstrual blood loss, pregnancy, and reproductive health (Gao et al., 2013; Rahman et al., 2016). [12,13] The significant burden of anemia in women highlights the importance of gender-specific health strategies, including iron supplementation programs and broader nutritional interventions aimed at women of reproductive age (Patel, 2019). [14] Addressing anemia in women is crucial, not only for their health but also for maternal and child health outcomes.

The distribution of anemia across different blood groups indicates variability that could be influenced by genetic and environmental factors. Blood groups B positive and AB negative show higher proportions of anemia. Previous research suggests that blood group antigens can influence susceptibility to certain conditions, including anemia (Franchini & Bonfanti, 2015). [15] For instance, individuals with certain blood types might have different susceptibilities to infections that can lead to anemia or might be predisposed to different dietary patterns affecting iron absorption and metabolism (Pinho & Bordin, 2019). [16] The finding that blood group B positive and AB negative have higher anemia prevalence warrants further genetic and epidemiological studies to explore these associations.

The results from these tables collectively highlight the multifaceted nature of anaemia, influenced by gender, socioeconomic factors, and genetic predispositions such as blood group. These findings suggest several directions for future research and public health interventions. Gender-Specific Interventions: Given the higher prevalence of anaemia among females, especially in reproductive age, gender-specific nutritional programs should be prioritized. These could include iron and folic acid supplementation, public health campaigns promoting dietary diversity, and reproductive health services that address anaemia during pregnancy and postpartum periods. Blood Group Studies: The association between blood groups and anaemia prevalence suggests a potential genetic component that could be explored further. Large-scale genetic studies and epidemiological surveys could help identify specific genetic markers associated with higher anaemia risk in certain blood groups. Understanding these genetic factors could lead to personalized medical interventions and targeted public health strategies (Bodinham et al., 2016). [17] Comprehensive Anaemia Programs: Given the high overall prevalence of anaemia, comprehensive anaemia control programs that integrate nutritional, medical, and educational components are essential. These programs should aim to improve dietary intake of iron and other micronutrients, enhance public awareness about anaemia and its prevention, and ensure access to healthcare services for early diagnosis and treatment of anaemia (Camaschella, 2015). [18] Socioeconomic Factors: The study did not explicitly analyse socioeconomic factors, but future research should investigate how socioeconomic status influences anaemia prevalence. Factors such as income, education, and access to healthcare can significantly affect nutritional status and overall health, thus contributing to anemia (Balarajan et al., 2011).

Understanding these relationships can help design effective interventions targeting the most vulnerable populations. [19]

Conclusion

This study highlights the significant burden of anaemia in the population, with notable differences between genders and across different blood groups. The high prevalence among women and specific blood groups suggests that tailored interventions are needed. Future research should focus on the genetic, nutritional, and socioeconomic factors contributing to anaemia, aiming to develop comprehensive strategies to reduce its prevalence and improve overall public health.

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