

Prevalence and Association of Transfusion-Transmitted Infections with ABO and Rh Blood Groups among Blood Donors

Fatima Mohammed Aaltawee¹, Hesah Sarrai Altuwalah¹, Abdulrhman Abdu Arishi¹, Abdulrahman Mohammed Zaila¹, Reem Abdulaziz Aldosary¹, Abdulaziz Ibrahim Aldowish¹

¹Medical Laboratory Specialist, Prince Sultan Military Medical City, Riyadh, Saudi Arabia

ABSTRACT

Introduction: Blood transfusion is a vital medical intervention. However, this intervention is associated with several problems, including transfusion-transmitted infections (TTIs). The ABO blood group, which is inherited, plays an important role in susceptibility to TTIs. Previous studies have shown that some blood groups are receptors for pathogens, indicating a possible association between blood group antigens and the risk of infection. However, the findings regarding the association between ABO and Rh blood groups and TTIs are inconsistent. Understanding these relationships is crucial to improving blood transfusion safety and developing targeted blood screening and donor selection strategies.

Aim: This study aimed to investigate the prevalence of TTIs among blood donors and explore any potential associations between these infections and ABO and Rh blood groups using data from the Regional Blood Bank in Riyadh, Saudi Arabia.

Methodology: This was a retrospective study analyzing the pre-existing data of 300 donors who visited the Regional Blood Bank in Riyadh, Saudi Arabia, between January 1, 2022, and December 31, 2023. Data were collected through a retrospective analysis of existing medical records at the bank. Potential associations between blood group types and TTI prevalence were explored using the chi-square test.

Results: A significant association was observed between the Rh blood group and TTI prevalence, indicating that the Rh factor influences susceptibility to TTIs. However, no significant association was observed between the ABO blood group and TTI prevalence, indicating the **complexity of** factors contributing to TTI transmission.

Conclusions: The results provided a comprehensive overview of TTI prevalence among blood donors with different blood groups and insights into how these relationships might affect transfusion safety and donor screening protocols.

Keywords: Transfusion-transmitted infections, Transfusion-transmitted infection prevalence, blood type, ABO blood group, Rh blood group.

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INTRODUCTION

Blood transfusion is a critical medical procedure that saves countless lives annually. However, it is associated with the risk of transfusion-transmitted infections (TTIs), which remain a significant concern for healthcare systems worldwide. Therefore, this study aimed to explore the prevalence of TTIs among blood donors and investigate potential associations between TTIs and ABO and Rh blood groups.

First, this study highlighted the importance of understanding TTIs, including hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), human T-lymphotropic virus (HTLV), and syphilis. Transmission of these infections through blood transfusion can lead to serious health complications in recipients. Therefore, screening blood donors for TTIs is a crucial step to ensure the safety of blood transfusion practices.

Next, this study delved into the ABO and Rh blood group systems, which are the most significant blood group systems in transfusion medicine. These blood groups are known for their role in determining blood type compatibility between donors and recipients. However, emerging research has shown that the ABO and Rh blood groups may be associated with susceptibility to certain infections. Thus, this study examined the correlation between blood groups and the prevalence of TTIs among donors.

The methodology section describes the data collection and analysis processes used to identify the prevalence of TTIs and their correlation with different blood group types, as well as the blood screening tests and statistical methods used to assess any significant associations.

Finally, the significance of this study lies in its potential to enhance blood transfusion safety. Understanding the relationship between blood groups and TTI prevalence can help healthcare providers develop more targeted strategies

*Author for Correspondence: dalkhathaimy@gmail.com

for blood screening and donor selection, thereby reducing the risk of TTIs and improving patient outcomes.

In conclusion, this study seeks to contribute to the existing body of knowledge on blood transfusion safety by exploring the potential association between ABO and Rh blood groups and the prevalence of TTIs among blood donors, which is an under-researched aspect.^{q0}

Blood transfusion, a life-saving medical intervention, is associated with several risks, especially TTIs. These infections, including HIV, HBV, HCV, HTLV, and syphilis, pose significant health threats with varying prevalence globally (Hroob, et al., 2020; Bharadva, et al., 2016). The World Health Organization (WHO) emphasizes the importance of rigorous screening of blood and its products for these pathogens as a crucial step toward safe transfusion practices (Legese, et al., 2022).

The ABO blood group system, which is the most important blood group system in transfusion medicine, is inherited and determines individual blood types. Research has indicated that these blood groups play an important role in susceptibility to various infections, including TTIs (Altayar, et al., 2022). Al-Hroob et al. (2020) discussed how certain blood groups might act as receptors or ligands for TTIs, suggesting a potential association between blood group antigens and the risk of infection.

Furthermore, Altayar et al. (2022) clarified the genetic and biochemical basis of the ABO blood group system and how variations in antigen expression could influence the host's susceptibility to infections. Understanding this is crucial in assessing the risk of TTIs in blood transfusion. Additionally, previous studies have shown that the distribution of these blood groups varies across different populations, which may have implications for transfusion safety and disease susceptibility.

Despite the recognized importance of blood group systems in transfusion medicine, findings related to the association between ABO and Rh blood groups and TTIs are inconsistent. Some studies have reported associations with specific blood groups, whereas others have reported no significant association, indicating a complex and potentially context-dependent relationship (Legese, et al., 2022).

This study sets the stage for a more detailed exploration of the prevalence rates of TTIs in different regions and their potential association with ABO and Rh blood groups. Understanding these relationships is crucial in improving blood transfusion safety and developing targeted strategies for blood screening and donor selection.

This study aimed to make significant contributions to transfusion medicine and public health. The primary objective of this study was to determine the current prevalence rates of critical TTIs, including HIV, HBV, HCV, HTLV, and syphilis, among blood donors. An accurate assessment of these rates is necessary for evaluating the safety of current blood transfusion practices and pinpointing potential improvements. The findings of this study are vital for healthcare providers and blood banks to ensure the safety and reliability of blood supply.

Furthermore, this study aimed to explore the potential association between TTIs and blood groups, with a focus on

the ABO and Rh blood groups using data from the Regional Blood Bank in Riyadh, Saudi Arabia. Previous research has shown an association between blood groups and susceptibility to TTIs. However, the findings are inconsistent. Therefore, this study investigates whether certain blood groups are more prone to TTIs, which could significantly impact blood donor screening and selection strategies.

Another crucial objective of this study was to provide a better understanding of the relationship between blood groups and TTIs to enhance the overall safety of blood transfusions. This can help healthcare professionals develop more targeted and effective screening strategies, thereby improving donor selection protocols and reducing the risk of infection transmission through blood transfusions. The study findings are expected to inform healthcare policies and practices and provide updated and reliable data on the risk of TTIs associated with different blood groups. Furthermore, these findings can help healthcare providers make informed decisions about blood donation and transfusion procedures. Finally, this study aimed to fill the existing knowledge gaps in transfusion medicine and contribute new information to this field.

Aim and Objectives

The primary aim of this study was to investigate TTI prevalence among blood donors and explore potential associations between these infections and ABO and Rh blood groups using data from the Regional Blood Bank in Riyadh, Saudi Arabia. To achieve this aim, the following objectives were implemented:

- 1 Determine the prevalence of TTIs among blood donors. This involved quantifying the incidence rates of key TTIs, such as HIV, HBV, HCV, HTLV, and syphilis, in the blood donor population. These data are necessary for understanding the current landscape of blood safety and identifying potential risk factors.
- 2 Analyze the distribution of ABO and Rh blood groups among blood donors. This involved assessing the proportion of different ABO and Rh blood groups in the donor population. These data are essential for the subsequent analysis of any correlations between blood groups and TTIs.
- 3 Explore the association between TTIs and blood group types. The objective was to investigate whether a statistically significant relationship exists between specific blood groups (ABO and Rh blood groups) and the prevalence of TTIs. This involved analyzing whether certain blood groups were more susceptible to specific infections.
- 4 Assess the impact of blood group types on blood transfusion safety. This study aimed to clarify how the relationship between blood groups and TTIs might affect the safety of blood transfusions. This involved considering how blood group typing can be integrated into donor screening protocols to enhance safety.
- 5 Contribute to the development of enhanced blood screening strategies. Based on the findings, this study aimed to provide recommendations for improving

blood donor screening processes. This involved suggesting targeted screening for donors with certain blood groups that are more prone to TTIs.

- 6 Inform policy and guidelines in transfusion medicine. This study aimed to provide data on donor selection and blood product allocation that can be used to inform policymaking and guidelines in transfusion medicine.
- 7 Provide a basis for further research. Finally, this study aimed to identify areas where further research is needed, thus contributing to the broader body of knowledge in transfusion medicine and infectious disease control.

This study has significant implications for enhancing blood transfusion safety, informing public health policies, filling critical knowledge gaps, and contributing to the broader goals of global health and infectious disease control. The potential impact of this study extends beyond transfusion medicine, as it provides valuable insights for healthcare providers, policymakers, and researchers. The following are the most prominent of these implications:

- 1 Enhancing blood transfusion safety. This study is significant as it directly contributes to enhancing the safety of blood transfusions. With the global dependency on blood transfusions for various medical procedures (Al-Hroob et al., 2020), understanding the relationship between TTIs and blood groups is necessary. This can lead to improved screening and selection protocols, thereby reducing the risk of infection transmission.
- 2 Informing blood donor screening policies. By elucidating the prevalence of TTIs and their association with the ABO and Rh blood groups, this study can inform blood donor screening policies. The WHO emphasizes the importance of rigorous blood screening for transfusion safety (Legese et al., 2022). The findings of this study can refine these screening processes, making them more targeted and effective.
- 3 Addressing public health concerns. This study addresses significant public health concerns by providing data on the prevalence of common TTIs, such as HIV, HBV, HCV, and syphilis (Bharadva et al., 2016). These data are essential for public health authorities to develop strategies to control the spread of these infections.
- 4 Filling knowledge gaps in transfusion medicine. Findings regarding the association between blood group types and susceptibility to TTIs in the literature are inconsistent (Arif et al., 2021; Bharadva et al., 2016). Therefore, this study aimed to fill these gaps and provide a more comprehensive understanding of transfusion medicine and infectious disease dynamics.
- 5 Guiding future research and development. The findings of this study can guide future research in transfusion medicine and infectious disease control. It can provide a basis for further studies exploring the complex interactions between genetic factors, such as blood groups, and infectious diseases, paving the way for

innovative approaches in medical research and practice.

The prevalence of TTIs and their association with blood groups have attracted significant attention from researchers. Al-Hroob et al. (2020) emphasized the global scale of blood donations and the corresponding risk of TTIs, particularly when blood is insufficiently screened. They reported the role of ABO blood group antigens in potentially influencing susceptibility to TTIs and showed that certain blood groups serve as receptors for TTI agents (Hroob, et al., 2020).

Furthermore, Altayar et al. (2022) investigated the polymorphic nature of blood group antigens and their role in infection susceptibility and immune response. They investigated the genetic basis of the ABO blood group system and how blood group antigens act as receptors for bacteria, viruses, and parasites, potentially increasing the risk of TTIs (Altayar, et al., 2022).

Legese et al. (2022) focused on the prevalence of TTIs, particularly in developing countries, and the importance of WHO recommendations for blood screening. They also showed that ABO and Rh blood group antigens are not only significant for transfusion compatibility but also potentially associated with various diseases, including TTIs. Their study highlighted the varying prevalence rates of TTIs in different countries and the need for stringent blood donor screening processes (Legese, et al., 2022).

Arif et al. (2021) and Bharadva et al. (2016) emphasized the importance of understanding ABO and Rh blood group distributions in different populations in providing effective transfusion services. They clarified the broad range of diseases associated with blood groups, including infectious diseases that are of concern due to their potential transmission through blood transfusion (Arif, et al., 2021; Bharadva, et al., 2016).

The literature indicates a complex relationship between blood groups and susceptibility to or protection against TTIs. Although some studies have shown an association between certain blood groups and TTIs, others have reported no significant relationships. Thus, further research is required in this area. These inconsistent findings across various geographical and demographic contexts underscore the importance of context-specific studies and the potential for blood group typing to enhance blood transfusion safety.

Methodology

This chapter outlines the methodology employed to investigate the prevalence of TTIs and the association between TTIs and ABO and Rh blood groups among blood donors using data from the Regional Blood Bank in Riyadh, one of the most prominent blood banks in Saudi Arabia.

Research Design

This was a retrospective study investigating the prevalence of TTIs among blood donors and their potential associations with ABO and Rh blood groups. This design was chosen due to its efficiency in analyzing pre-existing data within a defined period, allowing for the examination of historical patterns and correlations without the need for real-time data collection.

Research Approach

A quantitative research approach was used, focusing on numerical data to identify patterns. Additionally, this approach was used to measure prevalence and examine the relationship between blood group types and TTIs. This approach facilitated the objective assessment of data through statistical analysis, thereby providing quantitative insights into the study's focal points.

Research Settings

This study was conducted at the Regional Blood Bank in Riyadh, one of the most prominent blood banks in Saudi Arabia. Data were collected at a specific time in recent times. This setting was strategically chosen due to its extensive database of blood donors, providing a rich data source for the study.

Data Sample

A total of 300 blood donors who donated blood at the Regional Blood Bank from January 1, 2022, to December 31, 2023, were included in this study. These donors were selected to represent a broad cross-section of the population, encompassing various age groups and both genders within the eligible age range of 18–65 years.

The inclusion criteria were blood donors aged between 18 and 65 years, those who donated blood at the Regional Blood Bank in Riyadh between January 1, 2022, and December 31, 2023, those weighing more than 50 kg, and those with a comprehensive record of the results of blood tests for HIV, HBV, HCV, HTLV, and syphilis, in addition to their ABO and Rh blood groups. The exclusion criteria were donors with incomplete data records, those outside the specified age range, those weighing less than 50 kg, and those with a known medical history that could affect the study results, such as known pre-existing conditions affecting the immune response or blood characteristics. The application of these inclusion and exclusion criteria enhances the validity and reliability of the study results by ensuring that the sample accurately reflects the target population while minimizing potential confounding variables.

Sampling Method

A random sampling method was used to select participants for this study. This method was chosen to mitigate the risk of selection bias, which is a critical factor in ensuring the validity and reliability of the study findings. Random sampling was adopted to obtain a sample accurately representing the broader population of blood donors in the Riyadh region. This approach enhances the generalizability of the study findings, allowing the results to be applied to a wider population beyond the initial study population. This method ensures that the study conclusions are based on a fair and unbiased representation of the donor community, thus providing valuable insights into the prevalence of TTIs and their association with different blood groups in this region.

Data Collection

Data were collected from existing medical records at the Regional Blood Bank. The Regional Blood Bank serves a broad geographical area and acts as a central hub for blood collection, processing, and distribution. This ensures the availability of blood products to hospitals and medical facilities throughout the Riyadh region. It plays a critical role in healthcare and emergency services. Its operations encompass a wide demographic, collecting data from a diverse donor base with various ages, ethnicities, and backgrounds. This diversity provides a comprehensive overview of the regional donor pool, making it an invaluable resource for this study.

The Regional Blood Bank maintains a detailed and extensive database of donor records, including information on donor demographics, blood types, medical histories, and donation frequencies. These extensive data, spanning several years, offer a rich historical perspective crucial to understanding shifts in blood donation patterns and identifying areas for improvement.

An official request was submitted to access the required data, which included ABO and Rh blood groups and blood test results for HIV, HBV, HCV, HTLV, and syphilis. The donors included in this study met the eligibility criteria of the national blood bank, ensuring a consistent and relevant dataset for analysis.

Data Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). Following the preliminary analysis, the prevalence rates of TTIs, including HIV, HBV, HCV, HTLV, and syphilis, were calculated among the study population. This involved the quantification of infection rates to establish a baseline understanding of TTIs within the donor pool. The prevalence rates were expressed as percentages, offering a direct measure of the burden of these infections among the sampled population.

The potential associations between blood group types (ABO and Rh) and the prevalence of TTIs were investigated using the chi-square test. The chi-square test was used due to its suitability for analyzing categorical data and testing the independence between blood group types and TTI prevalence, its effectiveness with large sample sizes, and its ability to guide further research by identifying significant associations crucial for improving transfusion medicine practices.

A significance level of $p < 0.05$ was used for all inferential statistics to indicate statistical significance. This threshold was chosen to minimize the likelihood of type I errors, ensuring that any observed association between blood group types and TTIs was not due to random chance. Statistical significance indicated a reliable association between variables, which warrants further investigation or consideration in blood donor screening and selection processes.

The descriptive and inferential analysis results were interpreted in the context of the study objectives. Significant associations between blood groups and TTIs were discussed in light of existing literature and theories regarding the potential roles of blood group antigens in

infection susceptibility. The analysis provided a comprehensive overview of TTI prevalence among different blood group types and valuable insights into how these relationships might affect transfusion safety and donor screening protocols.

Ethical considerations

This study was approved by the Ethics Committee of the Regional Blood Bank of the Riyadh Region and the Institutional Review Board of Kind Saud Medical City and was conducted in strict accordance with the ethical guidelines for research involving human subjects. All data were anonymized to protect donor privacy. Furthermore, confidentiality was ensured, the necessary permissions to access data were obtained, and the study adhered to the principles of respect, benevolence, and justice.

Results And Discussion

In this chapter, the main findings and implications of the study are delved into to examine the prevalence of TTIs among blood donors and explore potential associations between TTIs and the ABO and Rh blood groups. This chapter is organized so that the results and analyses derived from a close examination of data collected from the Regional Blood Bank are first presented. Then, a comprehensive discussion is provided, placing the findings in the context of the broader landscape of transfusion

medicine and public health. The Discussion section also synthesizes these findings with existing literature, identifying convergences and differences and suggesting areas for future research.

4.1 Results and Analysis

This section presents the prevalence rates of TTIs among blood donors facilitated using tables and charts. The calculated prevalence rates of HIV, HBV, HCV, HTLV, and syphilis within the donor population are also presented, focusing on the distribution across different blood group types.

Furthermore, this section presents an analysis of the associations between blood groups and TTIs by comparing blood groups using the chi-square test. This analysis examined the relationship between blood group types and the prevalence of TTIs. Additionally, this section discusses the direction and strength of associations, indicating the susceptibilities of certain blood groups to specific TTIs, using regression coefficients, *R*-squared values, and *p*-values to support the analysis.

Table 1 shows the data of the 300 donors collected from the Regional Blood Bank in Riyadh and the distribution of HBV, HCV, HIV, HTLV, and syphilis infections among donors according to blood group type. These data represent the prevalence of TTIs across different ABO and Rh blood groups.

Table 1: Prevalence of TTI across different blood groups

Blood groups		TTI					Total
RH	ABO	HBV	HCV	HIV	HTLV	Syphilis	
Positive	O+	27	28	7	5	61	128
	A+	20	14	5	2	34	75
	B+	10	13	2	1	30	56
	AB+	6	2	1	1	4	14
Negative	O-	3	4	0	2	2	11
	A-	0	0	0	2	3	5
	B-	0	1	0	0	7	8
	AB-	0	0	0	0	0	0
Total	Total	66	62	15	13	141	292

4.1.1 Blood Group Distribution among Blood Donors

The distribution of ABO and Rh blood groups in the study sample (Table 1) was summarized in a structured chart to

visually present the information. Figure 1 shows the distribution of each blood type in the study sample.

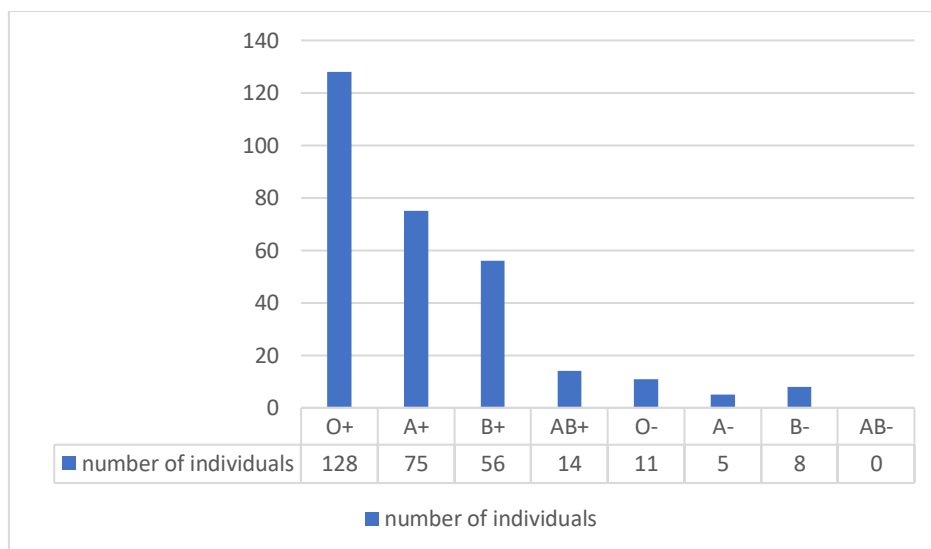


Figure 1: Blood type distribution among blood donors.

The distribution highlighted the diversity in blood types among the study population, with a clear predominance of Rh-positive donors over Rh-negative donors (Figure 1). O+ was the most common blood type ($n = 128$). This finding is consistent with global trends, where O+ is typically the most prevalent blood type. A+ is the second most represented blood type ($n = 75$). This indicates the significant presence of the A antigen in the study population. The number of donors with B+ blood type was 56, indicating a moderate representation of the B antigen in the study population. AB+ blood type was the least common ($n = 14$), which is consistent with the general expectation of AB rarity.

4.1.2 Prevalence Rates of TTIs according to Blood Group

Based on the data presented in Table 1, TTIs according to Rh factor and ABO blood type showed distinct patterns in the prevalence of these infections among blood donors. Regarding the Rh factor, Rh-positive donors showed a significantly higher prevalence of all TTIs, including HBV (63 cases), HCV (57 cases), HIV (15 cases), HTLV (9 cases), and syphilis (129 cases). Figure 2 shows the distribution of TTI according to the Rh group.

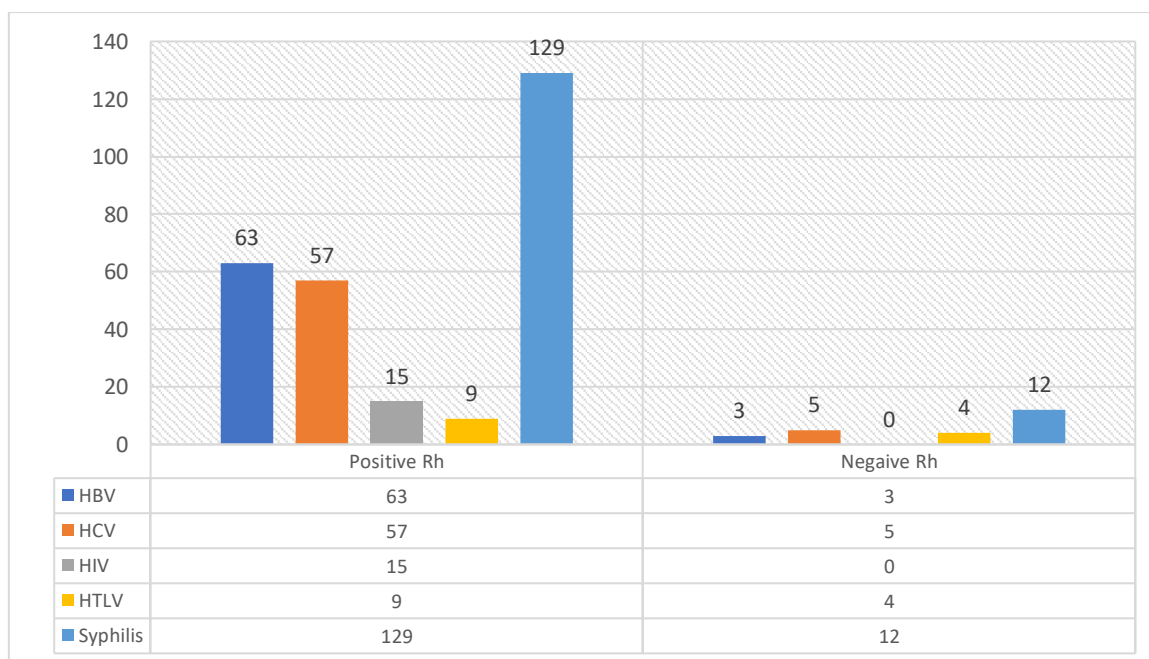


Figure 2: TTI distribution according to the Rh group.

Conversely, Rh-negative donors showed a significantly lower prevalence of TTIs, with 3 HBV cases, 5 HCV cases,

no HIV cases, 4 HTLV cases, and 12 syphilis cases. These findings indicate the potential influence of the Rh factor on the prevalence of TTIs among donors.

Regarding the ABO blood types, donors with O blood type exhibited the highest prevalence of TTIs, with 30 HBV

cases, 32 HCV cases, 7 HIV cases, 7 HTLV cases, and 63 syphilis cases, indicating a particular vulnerability or a higher likelihood of exposure among individuals with this blood type. Figure 3 shows the distribution of TTI according to the ABO group.

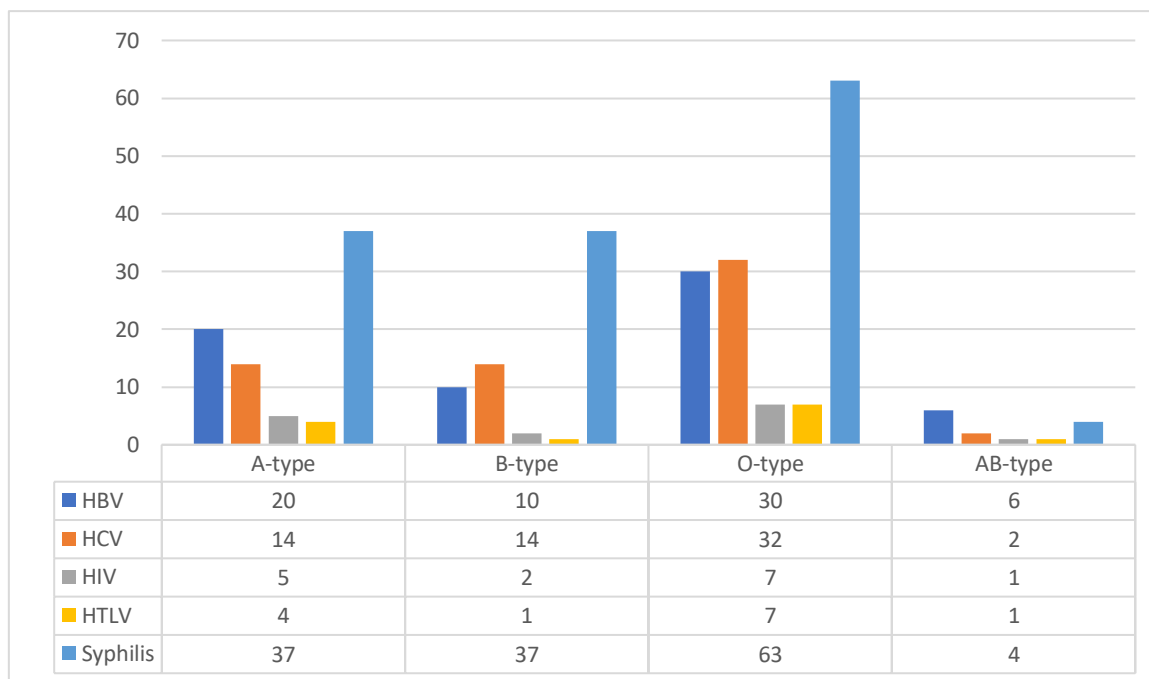


Figure 3: TTI distribution according to the ABO group.

Donors with A and B blood types showed a moderate prevalence of TTIs, with 37 syphilis cases each. This finding aligns with the observed trend for this infection. Specifically, donors with A blood type exhibited 20 HBV cases and 14 HCV cases, whereas donors with B blood type exhibited 10 HBV cases and 14 HCV cases, similar to the pattern for HCV in donors with A blood type. Donors with

AB blood type, which is the least common among the population, exhibited the lowest number of TTI cases, with 6 HBV cases, 2 HCV cases, 1 HIV case, 1 HTLV case, and 4 syphilis cases (Figure 3).

Table 2 shows the new rearrangement for data distribution according to Rh and ABO blood group classification.

Table 2: TTI distribution according to the Rh and ABO groups

TTI		HBV	HCV	HIV	HTLV	Syphilis
Rh factor	Positive Rh	63	57	15	9	129
	Negative Rh	3	5	0	4	12
ABO group	A-type	20	14	5	4	37
	B-type	10	14	2	1	37
	O-type	30	32	7	7	63
	AB-type	6	2	1	1	4
Total		66	62	15	13	141

Syphilis was the most prevalent infection among the donors, with 141 cases (Table 2). This high prevalence was particularly pronounced in the O+ and A+ blood groups, indicating that more attention should be paid to syphilis screening within these groups. This indicates that these blood groups (A+ and O+) may be more commonly represented within the donor population or may have factors that increase their exposure or susceptibility to syphilis, keeping in mind that syphilis shows a high biological false result in screening tests.

Furthermore, more attention should be paid to the distribution of HBV (66 cases) and HCV (62 cases) across blood groups. Both infections were more prevalent in the O+ blood group, with 27 HBV cases and 28 HCV cases, followed by the A+ and B+ blood groups. This pattern may indicate a higher risk or higher prevalence rates of these infections in these specific blood groups. In contrast, HIV and HTLV showed a relatively lower prevalence, with 15 and 13 cases, respectively. This lower prevalence rate across all blood groups could indicate effective screening

practices for these specific TTIs or a lower transmission rate among the study population.

The absence of any TTIs in the AB⁻ blood group may be attributed to its rarity and possibly fewer donations from this group. This underscores the need for a diverse donor pool to mitigate the risk of shortages in rare blood types. Furthermore, this result could be due to the smaller sample size rather than the lower risk of TTIs.

4.1.3 Association between ABO and Rh Blood Groups and TTI Markers

The associations between blood groups and the prevalence of TTIs were examined using advanced statistical methods. This analysis aimed to uncover significant patterns and associations that can inform targeted screening strategies and enhance the safety of blood transfusions. The association between TTI prevalence and blood groups (ABO and Rh) was tested using chi-square analysis. The chi-square test analysis results are shown in Table 3, providing insights into the association between blood groups (Rh factor and ABO group) and the prevalence of TTIs.

Table 3: Chi-square test analysis results

Analysis	Chi-square statistic	p-value
Rh factor	11.474	0.022
ABO group	10.391	0.582

Analysis of the Rh factor using the chi-square statistical method revealed a chi-square statistic of approximately 11.474 with a *p*-value of 0.022 ($p < 0.05$) (Table 3). This finding indicates a statistically significant association between the Rh factor and the prevalence of TTIs, indicating notable differences in the distribution of these infections between individuals with Rh-positive and Rh-negative blood groups. These findings indicate that the Rh factor plays a critical role in susceptibility or resistance to various TTIs. This merits further investigation and consideration in the development of targeted screening and prevention strategies.

Conversely, the analysis of the ABO blood group indicated a chi-square statistic of approximately 10.391 with a *p*-value of 0.582 ($p > 0.05$). This finding indicates the absence of a statistically significant association between the ABO blood group types and the prevalence of TTIs within the study population. This finding indicates that, unlike the Rh factor, the ABO blood group does not significantly influence the distribution of TTIs among individuals, reinforcing the complexity of factors that contribute to TTI transmission and highlighting the unique role of the Rh factor in such dynamics.

These findings indicate a significant relationship between the Rh factor and TTI prevalence and a lack of association between TTI prevalence and ABO blood types. This differentiation emphasizes the importance of considering the Rh factor in the context of blood transfusion safety and donor selection processes, potentially guiding more nuanced approaches to managing and mitigating the risk of TTIs in blood donation and transfusion practices.

Discussion

The prevalence rates of various TTIs, including HIV, HBV, HCV, HTLV, and syphilis, were calculated across the donor population, with a focus on the distribution among different blood groups. This reveals the prevalence of TTIs across varying ABO and Rh blood groups, providing a critical approach to assessing the potential association between TTIs and blood groups.

In this study, the data of 300 donors were collected from the Regional Blood Bank in Riyadh and analyzed. The analysis results showed the distribution of infections (HBV, HCV, HIV, HTLV, and syphilis) among donors, segmented by blood type. The results showed that O⁺ blood type was the most common blood group among the study population, which is consistent with global trends.

A distinct pattern in TTI prevalence was observed, with a significantly higher prevalence of all TTIs observed among Rh-positive donors. Furthermore, the notable contrast between Rh-positive and Rh-negative groups emphasizes the potential influence of the Rh factor on susceptibility to TTIs.

Analysis of ABO blood types revealed that donors with O blood type showed the highest prevalence of HBV, HCV, and syphilis, indicating a potential vulnerability among individuals with this blood type. Meanwhile, donors with AB blood type, the least common among the general population, exhibited the lowest prevalence of all TTIs.

The chi-square test analysis results are intriguing, particularly regarding the Rh factor. A statistically significant association was observed between the Rh factor and the prevalence of TTIs (chi-square statistic of approximately 11.474 and a *p*-value of 0.022). This significant relationship indicates that the Rh factor may play a pivotal role in susceptibility or resistance to various TTIs, which requires further investigation and consideration for targeted screening and prevention strategies. Conversely, the analysis of the ABO blood group revealed no statistically significant association between ABO blood group types and TTI prevalence (chi-square statistic of approximately 10.391 with a *p*-value of 0.582). This finding indicates that the ABO blood group does not significantly impact the distribution of TTIs among individuals, highlighting the **complexity of** factors contributing to TTI transmission and the unique role of the Rh factor in such dynamics.

The results of this study confirmed the significant relationship between the Rh factor and TTI prevalence and the lack of association with ABO blood group types. This distinction underscores the importance of considering the Rh factor in blood transfusion safety and donor selection processes, guiding nuanced approaches to managing and mitigating the risk of TTIs in blood donation and transfusion practices. These results are consistent with those of a previous study, which confirmed the potential role of ABO blood group antigens in influencing susceptibility to TTIs, suggesting that certain blood groups might act as receptors for TTI agents, a perspective that finds partial support in our results, particularly concerning the Rh factor (Al-Hroob et al., 2020).

In their study, Legese et al. (2022) emphasized the need for stringent blood donor screening processes, considering varying TTI prevalence rates. Similarly, this study, which also highlighted the predominance of certain TTIs in specific blood groups, underscored the critical importance of adapting blood screening strategies in line with WHO recommendations to mitigate the risk of TTI transmission through blood transfusion.

Arif et al. (2021) and Bharadva et al. (2016) investigated the distribution of ABO and Rh blood groups and their association with a wide range of diseases, including TTIs, which serves as the foundation for our study. They showed the potential of blood group typing to enhance transfusion safety. These findings are consistent with those of our study, which similarly calls for a nuanced understanding of blood group distributions to optimize donor selection and screening processes.

Conclusions

This study aimed to investigate the prevalence of TTIs among blood donors and explore any potential associations between these infections and ABO and Rh blood groups using data from the Regional Blood Bank in Riyadh, Saudi Arabia. The results showed intricate dynamics between TTIs and blood groups, specifically ABO and Rh blood groups, which were thoroughly explored. A significant emphasis was placed on the prevalence of TTIs among blood donors and the potential associations between these infections and blood group classifications. A notably higher prevalence of TTIs was observed among Rh-positive donors, indicating a potential susceptibility associated with this blood group. Conversely, no significant association was observed between TTIs and ABO blood groups, indicating that factors beyond blood group classification may influence the risk and transmission of these infections.

The findings of this study necessitate further research to clarify the complex interplay between genetic markers, such as blood group types, and susceptibility to or protection against TTIs. Furthermore, exploring additional variables and their impact on the transmission of blood-borne infections is recommended, potentially broadening the scope to include genetic predispositions, environmental factors, and the efficacy of current screening methodologies. Developing targeted screening and prevention strategies informed by a nuanced understanding of blood group-related susceptibility to TTIs is also

advocated. This future research could significantly contribute to enhancing blood transfusion safety, ensuring that blood donation remains a safe process for both donors and recipients.

Additionally, adopting more advanced statistical methods and incorporating larger and more diverse datasets could provide a more robust analysis of the associations between blood groups and TTIs. Further studies investigating the mechanisms underlying the observed associations through interdisciplinary approaches combining genetics, epidemiology, and immunology are needed. Such studies could offer invaluable insights into the development of novel therapeutic interventions and preventive measures against TTIs

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