OPEN ACCESS

Original Research Article

Assessment of the Relationship between Adverse Allergic Transfusion Reaction and Serum IgE Level

Dr. A. H. M. Saik Rahman[1*], Dr. Masrun Mostafa Chowdhury[2], Dr. Tania Mahabuba[3], Dr. Aklima Akther Urmi[4], Dr. Fatma Muzib[5], Dr. Urmi Rahman[6], Dr. Munasib Noor[7], Dr. Tanzila Tabib Chowdhury[8]

[1]Assistant Professor, Department of Transfusion Medicine, Ad-din Barrister Rafique-ul Huq Hospital, Dhaka, Bangladesh
[2]Consultant, Department of Dermatology and Venereology, Ad-din Barrister Rafique-ul Huq Hospital, Dhaka, Bangladesh
[3]Registrar, Department of Transfusion Medicine, Bashundhara Ad-din Medical College Hospital, Dhaka, Bangladesh
[4]Assistant Professor, Department of Transfusion Medicine, Dhaka Medical College Hospital, Dhaka, Bangladesh
[5]Assistant Professor, Department of Transfusion Medicine, Community Based Medical College, Bangladesh
[6]Medical Officer, Department of Transfusion Medicine, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh
[7]Medical Officer, Department of Transfusion Medicine, Chittagong Medical College Hospital, Chittagong, Bangladesh
[8]Assistant Professor, Department of Transfusion Medicine, Chittagong Medical College Hospital, Chittagong, Bangladesh

Abstract: ***Background:*** Allergic transfusion reactions (ATRs) are common adverse events during blood transfusions, ranging from mild urticaria to severe anaphylactic shock. Elevated serum immunoglobulin E (IgE) levels are known to mediate these reactions. This study aimed to assess the relationship between serum IgE levels and the Presence of ATRs in patients receiving fresh frozen plasma (FFP) transfusions. ***Methods:*** A cross-sectional observational study was conducted at the Department of Transfusion Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from March 2019 to August 2021. The study included 55 patients aged 5-60 years who received FFP transfusions. Demographic data, clinical symptoms, and IgE levels were recorded. Data were analyzed using SPSS version 26, with statistical significance set at p<0.05. ***Result:*** The majority of participants were males (94.55%) and aged 11-20 years (45.45%). Most patients (85.45%) received multiple units of FFP. Clinical symptoms included itching (56.36%), urticarial rash (29.09%), vomiting (7.27%), and hypotension (7.27%). Raised IgE levels were found in 52.73% of participants, and a significant association was observed between elevated IgE levels and the presence of allergic reactions (p<0.01). Patients with allergic reactions had significantly higher mean IgE levels (521.4±434.6 IU/mL) compared to those without allergic reactions (67.8±33.2 IU/mL). ***Conclusion:*** Elevated serum IgE levels are significantly associated with the Presence of ATRs in patients receiving FFP transfusions. Monitoring IgE levels can help predict and manage allergic reactions, thereby improving transfusion safety and patient outcomes.
Keywords: Allergic Reactions, Serum IgE, Plasma, Transfusion.

INTRODUCTION

Blood transfusions are a critical component of modern medical care, providing life-saving therapy for patients with severe anemia, trauma, surgical blood loss, and various hematological disorders. Despite their life-saving potential, transfusion practices are fraught with risks and challenges, particularly in developing countries like Bangladesh. Allergic transfusion reactions (ATRs) represent one of the most common adverse events associated with blood transfusions, occurring in approximately 1-4% of all transfusions. These reactions range from mild urticaria to severe anaphylactic shock,

with immunoglobulin E (IgE) playing a pivotal role in mediating these responses by binding to high-affinity receptors on mast cells and basophils, leading to the release of histamines and other inflammatory mediators [1,2]. In Bangladesh, blood transfusion services are integral to healthcare, especially in urban centers like Dhaka. However, ensuring the safety of blood transfusions remains a significant challenge due to various factors, including inadequate donor screening, lack of resources, and limited infrastructure. Studies conducted at Dhaka Medical College Hospital have identified critical barriers to safe blood transfusions, such as reliance on unregulated blood brokers and suboptimal

---

*Corresponding Author: Dr. A. H. M. Saik Rahman
Assistant Professor, Department of Transfusion Medicine, Ad-din Barrister Rafique-ul Huq Hospital, Dhaka, Bangladesh

testing and quality assurance practices [3,4]. Moreover, the use of blood components and the management of blood stocks are often inconsistent, leading to increased risks of transfusion-related complications [3]. The prevalence of allergic conditions in Bangladesh is notably high, with 20-25% of the population suffering from disorders such as asthma, allergic rhinitis, and atopic dermatitis. Urban areas like Dhaka report higher incidences of these conditions due to factors such as overpopulation, pollution, and poor living conditions [5]. A population-based survey in rural Bangladesh further highlighted the significant burden of atopic diseases, with high prevalence rates among children and adults [6]. Additionally, specific allergens have been identified as prevalent among asthmatic patients in Dhaka, further complicating the clinical management of these patients [7]. The role of IgE in allergic reactions is well-documented, with elevated serum IgE levels being associated with increased severity of various allergic conditions, including food allergies and asthma [8]. The binding of IgE to high-affinity receptors on mast cells and basophils triggers a cascade of immune responses, leading to the release of histamines and other mediators that cause the clinical symptoms of allergic reactions [9]. Studies have shown that individuals with higher serum IgE levels tend to experience more severe allergic reactions, underscoring the potential link between IgE levels and the severity of ATRs [10]. This is particularly relevant in the context of blood transfusions, where identifying patients with elevated IgE levels could help predict and mitigate the risk of severe allergic reactions [11]. Despite advances in blood transfusion safety, significant challenges remain. Errors in the transfusion process, including administrative mistakes and the risk of bacterial contamination in blood products, continue to pose serious risks to patients. In Bangladesh, these challenges are exacerbated by the limited availability of advanced diagnostic and screening technologies, as well as a lack of trained personnel [3]. Hemovigilance systems, which monitor and report adverse transfusion events, are crucial for improving transfusion safety but are often underdeveloped in resource-limited settings [12]. Additionally, the cost and logistical challenges associated with implementing pathogen reduction technologies and nucleic acid testing further hinder efforts to ensure the safety of the blood supply [13–15]. The need for comprehensive strategies to improve blood transfusion safety in Bangladesh is evident. These strategies should include enhancing donor recruitment and screening processes, improving blood testing and quality assurance protocols, and adopting new technologies to reduce the risk of transfusion-transmitted infections [14]. Moreover, educating healthcare providers and patients about the risks and limitations of blood transfusions, as well as promoting the use of alternatives such as autologous transfusions, are essential steps toward safer transfusion practices [15]. Given the high prevalence of allergic conditions and the associated risks of ATRs in Bangladesh, this study aims to assess the relationship between serum IgE levels and the severity of allergic transfusion reactions in patients receiving blood transfusions in Dhaka. By understanding this relationship, we can develop targeted strategies to predict and manage ATRs, ultimately improving patient safety and clinical outcomes in transfusion practices. This research will also contribute to the broader goal of enhancing transfusion safety in resource-limited settings, providing valuable insights for healthcare providers and policymakers alike.

METHODS

This study was designed as a cross-sectional observational study and was conducted in the Department of Transfusion Medicine at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. The study period spanned from March 2019 to August 2021. The study population comprised patients aged between 5 and 60 years who attended the Day Care Transfusion Unit of the Department of Transfusion Medicine at BSMMU for receiving fresh frozen plasma (FFP). Patients, or their legal guardians in the case of minors, who provided informed consent and met the eligibility criteria were included in the study. Convenient sampling was employed to select participants according to predefined inclusion and exclusion criteria. A total of 55 patients were enrolled in the study. The inclusion criteria for cases were: (i) patients aged between 5 and 60 years of both sexes, and (ii) patients who received FFP transfusion. The exclusion criteria were: (a) patients with a history of atopic conditions such as allergic rhinitis, asthma, and atopic dermatitis, (b) patients with a history of allergy to specific foods, drugs, or other substances, (c) patients currently taking anti-allergic medications, (d) patients who had received whole blood or blood products other than FFP, and (e) patients unwilling to provide informed consent to participate in the study. Data were collected and compiled on a master chart, followed by statistical analysis using the Statistical Package for Social Science (SPSS) software version 26. Qualitative data were expressed as numbers and corresponding percentages, while quantitative data were expressed as means and standard deviations. Categorical data were compared between groups using the Chi-square (χ^2) test. Correlation between quantitative variables was measured using Pearson's correlation coefficient (r). A significance level of 5% (0.05) was set, and a p-value of less than 0.05 was considered statistically significant. Participants and their guardians were thoroughly informed about the study, and written consent was obtained. The study did not involve any additional investigations that might cause financial burden to the patients, and participants had the freedom to withdraw from the study at any time. The study was approved by the Institutional Review Board (IRB) of BSMMU. All collected data, including laboratory test results, were kept confidential and were accessible only to the investigators, regulatory authorities, and the IRB. Patient identities were not disclosed during data analysis or in the publication of results.

RESULTS

Table 1: Distribution of baseline demographic characteristics of the participants (N=55)

Variables	Frequency	Percentage
Age		
<10	5	9.09%
11-20	25	45.45%
21-30	17	30.91%
31-40	7	12.73%
41-50	1	1.82%
Sex		
Male	52	94.55%
Female	3	5.45%
Residence		
Urban	44	80.00%
Rural	11	20.00%

The study included 55 participants aged between 5 and 60 years, with the majority falling within the age group of 11-20 years (45.45%). The demographic distribution showed a predominance of males (94.55%), with females comprising only 5.45% of the sample. Most participants were from urban areas (80%), while 20% resided in rural regions.

Table 2: Distribution of clinical symptoms among the participants (N=55)

Clinical Symptoms	Frequency	Percentage
Itching	31	56.36%
Urticarial rash	16	29.09%
Vomiting	4	7.27%
Hypotension	4	7.27%
Cough	3	5.45%
Tachycardia	2	3.64%
Respiratory distress	2	3.64%
Angioedema	1	1.82%

Clinical symptoms observed among the participants varied, with itching being the most common symptom, affecting 56.36% of the patients. Urticarial rash was reported in 29.09% of the cases, while vomiting and hypotension each occurred in 7.27% of the participants. Less common symptoms included cough (5.45%), tachycardia (3.64%), respiratory distress (3.64%), and angioedema (1.82%).
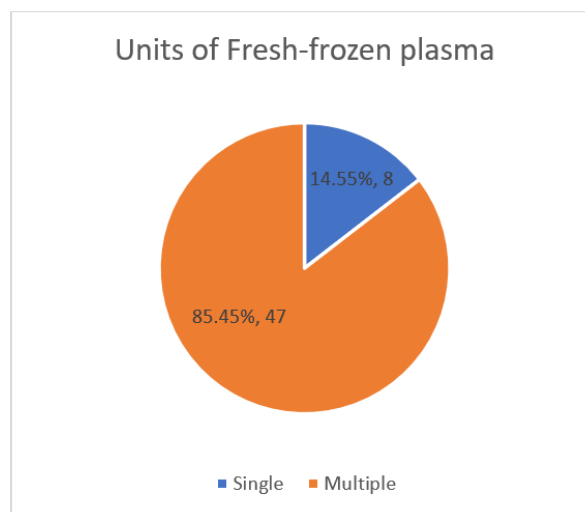

Figure 1: Distribution of the study patients by unit of fresh frozen plasma transfusion (N=55)

Regarding the units of fresh frozen plasma transfused, the majority of patients (85.45%) received multiple units, while only 14.55% received a single unit.

This distribution highlights the frequent need for multiple transfusions among the study population.

Table 3: Distribution of the study patients by allergic reaction type (N=55)

Type of reaction	Frequency	Percentage
Mild	31	56.36%
Severe	1	1.82%
Asymptomatic	23	41.82%

The types of allergic reactions observed varied significantly. Mild allergic reactions were the most prevalent, occurring in 56.36% of the patients. Severe reactions were rare, with only one case (1.82%) recorded. A substantial portion of the participants (41.82%) remained asymptomatic following the transfusion.
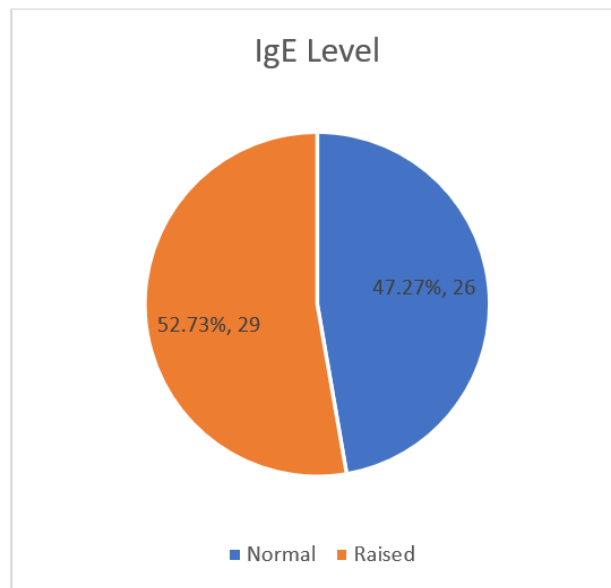

Figure 2: Distribution of the study patients by IgE level (N=55)

IgE levels were measured to assess their association with allergic reactions. The results indicated that 52.73% of the participants had raised IgE levels, while 47.27% had normal levels.

Table 4: Association of allergic reaction with IgE level (n=55)

IgE level	Allergic Reaction Present (n=32) n (%)	Allergic Reaction Absent (n=23) n (%)	p-value
Normal	3 (9.4%)	23 (100.0%)	
Raised	29 (90.6%)	0 (0.0%)	**<0.01**
Mean ±SD	521.4±434.6	67.8±33.2	

The analysis revealed a significant association between raised IgE levels and the presence of allergic reactions. Among those with allergic reactions, 90.6% had elevated IgE levels compared to none in the group without allergic reactions ($p<0.01$). The mean IgE level was significantly higher in the allergic reaction group (521.4±434.6 IU/mL) compared to the non-allergic group (67.8±33.2 IU/mL).

DISCUSSION

This study aimed to assess the relationship between serum IgE levels and the severity of allergic transfusion reactions in patients receiving fresh frozen plasma (FFP) transfusions at Bangabandhu Sheikh Mujib Medical University in Dhaka, Bangladesh. The findings indicate a significant association between elevated serum IgE levels and the occurrence of allergic transfusion reactions, with higher IgE levels correlating with more severe reactions. The demographic distribution of the study participants revealed a

predominance of males (94.55%) and a majority age group of 11-20 years (45.45%). This aligns with previous studies that have shown gender and age-related variations in transfusion practices and outcomes. For instance, Selik *et al.,* (1994) reported demographic differences in transfusion-related risks, highlighting the need to consider these factors in clinical practice [16]. Similarly, O'Shaughnessy *et al.,* (2021) found that non-White race/ethnicity and female sex were associated with increased transfusion rates among cardiac surgery patients, suggesting that demographic characteristics significantly influence transfusion practices and outcomes [17]. Clinical symptoms observed among the participants varied, with itching being the most common symptom, affecting 56.36% of the patients, followed by urticarial rash in 29.09%. These findings are consistent with those reported by Mercadante *et al.,* (2009), who observed similar clinical symptoms in cancer patients receiving red blood cell transfusions [18]. The high prevalence of multiple unit transfusions (85.45%) among our study participants underscores the frequent need for repeated transfusions, which has been documented in other studies as well. For example, Smith *et al.,* (2020) reported that higher plasma transfusion volumes during cardiac surgery were associated with worse clinical outcomes, emphasizing the complexity of managing transfusion needs [19]. The types of allergic reactions observed in our study varied significantly, with mild reactions being the most prevalent (56.36%), severe reactions being rare (1.82%), and a substantial portion of participants (41.82%) remaining asymptomatic. This distribution is similar to findings from other studies, such as Benhamou *et al.,* (2008), who found that specific IgE levels were significantly different between patients with mild, moderate, and severe allergic reactions to egg, supporting the use of IgE titres in predicting the severity of allergic responses [20]. Our study found that 52.73% of the participants had raised IgE levels, and there was a significant association between elevated IgE levels and the presence of allergic reactions. Among those with allergic reactions, 90.6% had elevated IgE levels compared to none in the group without allergic reactions. This significant correlation is corroborated by several studies. For instance, Laske *et al.,* (2003) reported that children with very high serum IgE levels were at a higher risk for severe allergic conditions such as atopic dermatitis and anaphylaxis [21]. Similarly, Burrows *et al.,* (1989) found a strong association between serum IgE levels and asthma prevalence, indicating that higher IgE levels are a significant predictor of allergic diseases [22]. The mean IgE level in our study was significantly higher in the allergic reaction group (521.4±434.6 IU/mL) compared to the non-allergic group (67.8±33.2 IU/mL). This difference underscores the role of IgE as a critical factor in allergic reactions. Guo *et al.,* (2016) also found that higher serum IgE levels were associated with increased severity of coronary artery disease, suggesting that IgE-mediated mechanisms could contribute to the pathogenesis of both allergic and cardiovascular conditions [23]. In conclusion, our findings highlight the significant association between elevated serum IgE levels and the severity of allergic transfusion reactions in patients receiving FFP transfusions. These results are consistent with existing literature on the role of IgE in allergic diseases and underscore the importance of monitoring IgE levels in patients at risk of allergic reactions. Future studies should explore the mechanisms underlying IgE-mediated allergic reactions in transfusion settings and develop strategies to mitigate these risks.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study demonstrates a significant association between elevated serum IgE levels and the Presence of allergic transfusion reactions in patients receiving fresh frozen plasma transfusions at Bangabandhu Sheikh Mujib Medical University in Dhaka, Bangladesh. The findings underscore the importance of monitoring IgE levels to predict and manage allergic reactions effectively. By identifying patients at higher risk for adverse reactions, healthcare providers can improve transfusion safety and patient outcomes. Further research is needed to explore the underlying mechanisms and develop targeted interventions for preventing allergic transfusion reactions in clinical practice.

REFERENCES

- KNOWLES, S. (2007). Blood transfusion: challenges and limitations. *Transfusion Alternatives in Transfusion Medicine*, *9*, 2-9.
- Bharucha, Z. S. (2001). Safe blood transfusion practices. *The Indian Journal of Pediatrics*, *68*, 127-131.
- Akhter, S., Anwar, I., Akter, R., Kumkum, F. A., Nisha, M. K., Ashraf, F., ... & Rahman, A. (2016). Barriers to timely and safe blood transfusion for PPH patients: evidence from a qualitative study in Dhaka, Bangladesh. *PLoS One*, *11*(12), e0167399.
- Chowdhury, F. S., Siddiqui, M. A. E., Islam, K., Nasreen, Z., Begum, H. A., & Begum, H. A. (2015). Use of blood and blood components in Dhaka medical college hospital. *Bangladesh Journal of Medicine*, *26*(1), 18-24.
- Khalequzzaman, M., Chiang, C., Hoque, B. A., Choudhury, S. R., Nizam, S., Yatsuya, H., ... & Aoyama, A. (2017). Population profile and residential environment of an urban poor

community in Dhaka, Bangladesh. *Environmental health and preventive medicine*, 22, 1-8.

- Pedersen, C. J., Uddin, M. J., Saha, S. K., & Darmstadt, G. L. (2020). Prevalence of atopic dermatitis, asthma and rhinitis from infancy through adulthood in rural Bangladesh: a population-based, cross-sectional survey. *BMJ open*, *10*(11), e042380.
- Chowdhury, M. A., Kabir, A. R. M., & Alam, M. M. (2008). Allergic rhinitis, asthma and atopic diseases: Bangladesh perspective. *Bangladesh Journal of Otorhinolaryngology*, *14*(2), 66-70.
- Shamji, M. H., Valenta, R., Jardetzky, T., Verhasselt, V., Durham, S. R., Würtzen, P. A., & van Neerven, R. J. (2021). The role of allergen-specific IgE, IgG and IgA in allergic disease. *Allergy*, *76*(12), 3627-3641.
- Yanagisawa, R., Ishimine, N., Komori, K., Kurata, T., Saito, S., Tanaka, M., ... & Nakazawa, Y. (2022). Relationship between allergic transfusion reactions and allergic predisposition among pediatric patients with hematological/oncological disease. *Transfusion*, *62*(5), 1035-1044.
- Goodnough, L. T. (2003). Risks of blood transfusion. *Critical care medicine*, *31*(12), S678-S686.
- Matsuyama, N., Yasui, K., Amakishi, E., Hayashi, T., Kuroishi, A., Ishii, H., ... & Hirayama, F. (2015). The IgE-dependent pathway in allergic transfusion reactions: involvement of donor blood allergens other than plasma proteins. *International journal of hematology*, *102*(1), 93-100.
- Dodd, R., Roth, W. K., Ashford, P., Dax, E. M., & Vyas, G. (2009). Transfusion medicine and safety. *Biologicals*, *37*(2), 62-70.
- Franklin, I. M. (2012). Blood transfusion safety: a new philosophy. *Transfusion Medicine*, *22*(6), 377-382.
- Strong, D. M., & Katz, L. (2002). Blood-bank testing for infectious diseases: how safe is blood transfusion?. *Trends in molecular medicine*, *8*(7), 355-358.
- Dzik, W. H., Corwin, H., Goodnough, L. T., Higgins, M., Kaplan, H., Murphy, M., ... & Yomtovian, R. (2003). Patient safety and blood transfusion: new solutions. *Transfusion medicine reviews*, *17*(3), 169-180.
- Selik, R. M., Ward, J. W., & Buehler, J. W. (1994). Demographic differences in cumulative incidence rates of transfusion-associated acquired immunodeficiency syndrome. *American journal of epidemiology*, *140*(2), 105-112.
- O'Shaughnessy, S., Tangel, V., Dzotsi, S., Jiang, S., White, R., & Hoyler, M. (2022). Non-white race/ethnicity and female sex are associated with increased allogeneic red blood cell transfusion in cardiac surgery patients: 2007-2018. *Journal of Cardiothoracic and Vascular Anesthesia*, *36*(7), 1908-1918.
- Mercadante, S., Ferrera, P., Villari, P., David, F., Giarratano, A., & Riina, S. (2009). Effects of red blood cell transfusion on anemia-related symptoms in patients with cancer. *Journal of palliative medicine*, *12*(1), 60-63.
- Smith, M. M., Kor, D. J., Frank, R. D., Weister, T. J., Dearani, J. A., & Warner, M. A. (2020). Intraoperative plasma transfusion volumes and outcomes in cardiac surgery. *Journal of cardiothoracic and vascular anesthesia*, *34*(6), 1446-1456.
- Benhamou, A. H., Zamora, S. A., & Eigenmann, P. A. (2008). Correlation between specific immunoglobulin E levels and the severity of reactions in egg allergic patients. *Pediatric allergy and immunology*, *19*(2), 173-179.
- Laske, N., Bunikowski, R., & Niggemann, B. (2003). Extraordinarily high serum IgE levels and consequences for atopic phenotypes. *Annals of Allergy, Asthma & Immunology*, *91*(2), 202-204.
- Burrows, B., Martinez, F. D., Halonen, M., Barbee, R. A., & Cline, M. G. (1989). Association of asthma with serum IgE levels and skin-test reactivity to allergens. *New England Journal of Medicine*, *320*(5), 271-277.
- Guo, X., Yuan, S., Liu, Y., Zeng, Y., Xie, H., Liu, Z., ... & Shen, Z. (2016). Serum IgE levels are associated with coronary artery disease severity. *Atherosclerosis*, *251*, 355-360.