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PREVALENCE OF HEPATITIS B AND C AMONG THALASSEMIC PATIENTS UNDER 12 YEARS CHILDRENS IN DISTRICT SWAT

Original Article

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ABSTRACT

Background: Thalassemia is a group of inherited hemoglobinopathies characterized by defective synthesis of alpha or beta globin chains, leading to microcytic hypochromic anemia. Patients with beta thalassemia major require lifelong blood transfusions to maintain adequate hemoglobin levels, increasing their risk of transfusion-transmitted infections (TTIs) such as hepatitis B virus (HBV) and hepatitis C virus (HCV). In regions with limited blood screening infrastructure, such as parts of Pakistan, this risk becomes a critical public health concern.

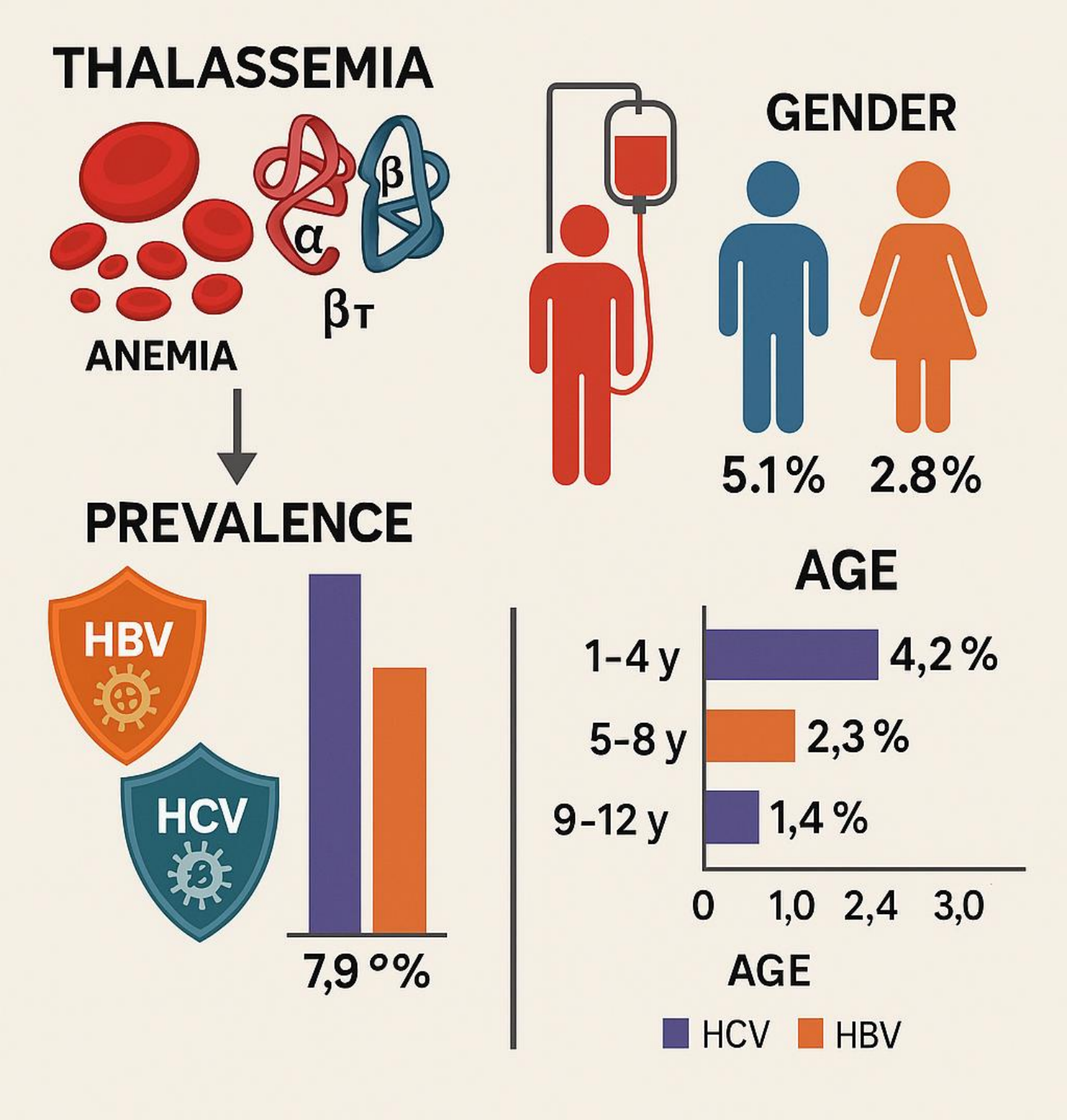
Objective: To determine the prevalence of HBV and HCV among transfusion-dependent thalassemic patients under 12 years of age in District Swat, Pakistan.

Methods: A descriptive cross-sectional study was conducted at the Pathology Department of Saidu Teaching Hospital, Swat, from August 2023 to March 2024. A total of 214 blood samples were collected from pediatric thalassemia patients (<12 years) using standardized phlebotomy procedures. Samples were centrifuged and screened for HBV (HBsAg) and HCV (anti-HCV antibodies) using Immunochromatographic Test (ICT) kits manufactured by Healgen Biotechnologies. Data were recorded using a pre-designed proforma and analyzed with SPSS v17.0.

Results: Out of 214 patients, 11 (5.1%) tested positive for HBV and 17 (7.9%) for HCV. Gender-wise, among 118 males, 11 (5.1%) were HCV positive and 6 (2.8%) HBV positive. Among 96 females, 5 (2.3%) were HCV positive and 6 (2.8%) HBV positive. Age-wise, in the 1–4 years group (n=89), 9 (4.2%) were HCV positive and 7 (3.3%) HBV positive; in 5–8 years (n=67), 5 (2.3%) HCV and 3 (1.4%) HBV; and in 9–12 years (n=58), 3 (1.4%) HCV and 1 (0.5%) HBV.

Conclusion: The study revealed a higher prevalence of HCV compared to HBV among transfusion-dependent thalassemia patients, particularly among males and younger age groups. These findings highlight the need for enhanced screening, immunization, and infection control strategies in pediatric thalassemia care.

Keywords: Child, Hepatitis B, Hepatitis C, Pakistan, Prevalence, Thalassemia, Transfusion-transmitted infections.



INTRODUCTION

Thalassemia is one of the most common hereditary blood disorders worldwide, affecting nearly 3% of the global population, which translates to approximately 1.5 million individuals (1). This group of inherited anemias arises due to abnormalities in hemoglobin synthesis, the molecule essential for oxygen transport in red blood cells. Hemoglobin consists of two alpha and two beta protein chains, and any defect in the genes responsible for producing these chains leads to thalassemia. Depending on the affected globin chain, the disorder is classified as either alpha (α) or beta (β) thalassemia. Beta thalassemia results from mutations in the beta-globin gene and varies in severity depending on whether one or both alleles are affected. The milder form, beta thalassemia minor, typically involves a single mutated gene, whereas thalassemia major, also known as Cooley's anemia, results from mutations in both genes and is associated with more severe clinical consequences, including transfusion dependency and growth impairments (2–4). Thalassemia major, in particular, places a significant burden on healthcare systems due to the need for lifelong blood transfusions and monitoring of transfusion-related complications. Regular transfusions, while life-saving, carry the risk of introducing transfusion-transmitted infections (TTIs), especially in regions where blood screening is not uniformly reliable. Globally, more than 120 million units of blood are donated each year (5), but despite donor health being a criterion, the threat of TTIs—especially in low- and middle-income countries—remains substantial due to inadequate screening protocols and higher background prevalence of infectious agents in the donor population (6–8). These infections include hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), malaria, and syphilis-causing *Treponema pallidum*, with HBV and HCV posing the most persistent public health challenge. In response to this global concern, the World Health Organization launched the Global Health Sector Strategy on Viral Hepatitis in 2016, aiming for a 65% reduction in hepatitis-related mortality and a 90% reduction in new infections by 2030 (9).

In Pakistan, the burden of TTIs is particularly concerning. Each year, approximately 1.5 million units of blood are donated in the country, yet the demand continues to rise due to high prevalence of conditions requiring frequent transfusions, such as thalassemia and hemophilia, alongside surgical procedures, trauma cases, obstetric emergencies, and dialysis requirements (7,10). Notably, Pakistan, along with Egypt, accounts for 80% of all viral hepatitis cases in the Eastern Mediterranean region. It ranks second globally in terms of HCV prevalence, affecting about 8 million individuals or roughly 5% of the population (11), while HBV affects an estimated 2.5% (12). Among multi-transfused patients, particularly those with transfusion-dependent thalassemia, the risk of acquiring HCV is disproportionately high, as evidenced by data from Hyderabad, India, showing a 3.52% infection rate among blood donors (3,13). Alarmingly, Pakistan reports approximately 150,000 new HBV and 250,000 new HCV cases each year, with transfusion-related transmission playing a significant role in perpetuating these infections (14). Furthermore, HBV can also be transmitted vertically during pregnancy, adding to its public health significance (15). Given the vulnerability of thalassemic patients to TTIs due to repeated blood transfusions, the present study was undertaken to determine the prevalence of HBV and HCV among this high-risk group. Understanding the scale of these infections in thalassemia patients is crucial for shaping targeted prevention strategies, improving transfusion safety, and aligning with global efforts to reduce viral hepatitis transmission and its long-term consequences.

METHODS

This cross-sectional study was conducted from August 2023 to March 2024 at the Department of Pathology, Saidu Teaching Hospital, Swat, located in Khyber Pakhtunkhwa, Pakistan. The target population comprised transfusion-dependent thalassemic patients residing in District Swat. A total of 214 patients were included through non-probability convenience sampling. Ethical approval for the study was obtained from the ethical review board of the hospital, and informed consent was secured using a pre-designed proforma at the time of blood sample collection. This proforma was also used to gather essential clinical and demographic information concurrently. Blood samples were collected from each participant by trained phlebotomists using sterile syringes under aseptic conditions and transferred to gel tubes for further processing. The inclusion criteria involved all diagnosed cases of thalassemia major receiving regular blood transfusions, while individuals unwilling to participate or with incomplete clinical data were excluded from the final analysis. To determine the appropriate sample size, the World Health Organization (WHO) sample size formula for an infinite population was employed: $\mathbf{S = Z^2 \times P \times (1-P) / M^2}$, where S is the sample size, Z is the Z-score (typically 1.96 for 95% confidence), P is the assumed population proportion (0.5), and M is the margin of error. The calculation was referenced against previous literature on the prevalence of HBV and HCV in thalassemic patients (14). Upon collection, all blood samples were centrifuged at 4000 rpm for five minutes to separate the serum from whole blood. Screening for hepatitis B virus (HBV) and hepatitis C virus (HCV) was performed using Immunochromatographic Test (ICT) kits, manufactured by Healgen Biotechnologies, which are recognized for their high specificity and

sensitivity. The test for HBV detected the presence of Hepatitis B surface antigen (HBsAg), while HCV testing was based on the detection of anti-HCV antibodies. Results were interpreted qualitatively as either "positive" or "negative" (16). For statistical analysis, Microsoft Excel and SPSS version 17.0 were employed. The prevalence and frequency of HBV and HCV infections among the study population were calculated and tabulated accordingly. Descriptive statistics were primarily used to represent the findings due to the categorical nature of the data.

RESULTS

The study analyzed a total of 214 thalassemic patients for the presence of hepatitis B virus (HBV) and hepatitis C virus (HCV). The overall prevalence showed that 11 patients (5.1%) tested positive for HBV, while 17 patients (7.9%) were found to be positive for HCV. When stratified by gender, blood samples were obtained from 118 male patients (55%) and 96 female patients (45%). Among the male cohort, 11 individuals (5.1%) were positive for HCV, and 6 (2.8%) tested positive for HBV. In the female group, 5 patients (2.3%) were positive for HCV, and 6 (2.8%) were positive for HBV. Regarding age distribution, 89 participants (42%) were within the 1–4 years age group, 67 patients (31%) were aged between 5–8 years, and 58 individuals (27%) belonged to the 9–12 years age category. In the 1–4 years group, 9 patients (4.2%) were HCV positive, and 7 (3.3%) were HBV positive. Among those aged 5–8 years, 5 cases (2.3%) were positive for HCV, and 3 (1.4%) tested positive for HBV. In the oldest age group of 9–12 years, 3 individuals (1.4%) were found positive for HCV, while 1 patient (0.5%) tested positive for HBV. To evaluate whether the observed differences in HBV and HCV prevalence across gender and age groups were statistically significant, Chi-square tests of independence were conducted. The analysis revealed no statistically significant association between gender and HBV prevalence ($p = 0.944$), as well as between gender and HCV prevalence ($p = 0.381$). Similarly, no statistically significant difference was found in HBV prevalence across age groups ($p = 0.246$) or in HCV prevalence by age ($p = 0.548$). These findings suggest that the variations in infection rates observed across different demographic categories in this study were not statistically meaningful, indicating that gender and age may not independently influence the risk of acquiring HBV or HCV among transfusion-dependent thalassemic patients in this sample.

Table 1: Gender wise distribution of HBV and HCV in Thalassemic patients

Distribution	Gender	Samples (%)	Infection	Prevalence
Gender Wise	Male	118 (55 %)	HCV	11 (5.1 %)
			HBV	06 (2.8 %)
	Female	96 (45 %)	HCV	06 (2.8 %)
			HCV	05 2.3 %)

Table 2: Gender wise distribution of HBV and HCV in Thalassemic patients

Distribution	Age	Samples (%)	Infection	Prevalence (%)
Age Wise	1-4 Years	89 (42 %)	HCV	09 (4.2 %)
			HBV	07 (3.3 %)
	5-8 Years	67 (31 %)	HCV	05 (2.3 %)
			HBV	03 (1.4 %)
	9-12 Years	58 (27 %)	HCV	03 (1.4 %)
			HBV	01 (0.5 %)

Table 3: Statistical Comparison of HBV and HCV Prevalence by Gender and Age

Comparison	Chi-square Statistic	p-value
HBV by Gender	0.005	0.944
HCV by Gender	0.767	0.381
HBV by Age Group	2.794	0.246
HCV by Age Group	1.206	0.548

Interpretation: None of the p-values are below the commonly accepted significance threshold of 0.05, indicating no statistically significant differences in the prevalence of HBV or HCV by gender or age group in this study population.

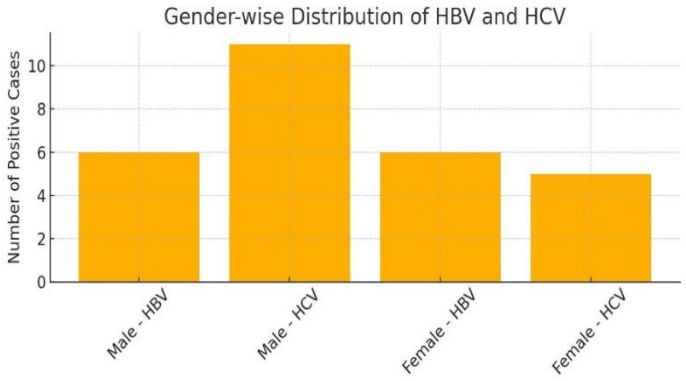


Figure 1 Gender-wise Distribution of HBV and HCV

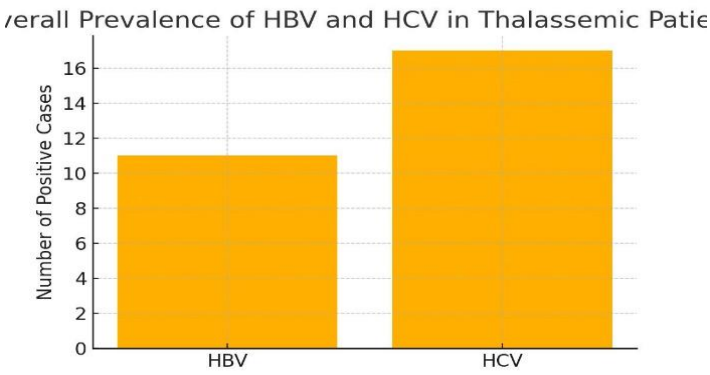


Figure 2 Overall Prevalence of HBV and HCV in Thalassemic Patients

DISCUSSION

Patients with thalassemia major are especially vulnerable to transfusion-transmitted infections such as hepatitis B virus (HBV) and hepatitis C virus (HCV), primarily due to their lifelong dependence on frequent blood transfusions to maintain adequate hemoglobin levels. The current study identified a prevalence of 5.1% for HBV and 7.9% for HCV among 214 transfusion-dependent thalassemic individuals, with a relatively higher burden observed in males and in the youngest age group (1–4 years). These findings align partially with existing literature. One study documented that approximately 5% of thalassemia patients were infected with HBV and a considerably higher proportion—61.2%—were HCV positive, suggesting regional variations in infection control practices and blood screening effectiveness (17,18). Another report highlighted a higher HCV prevalence among males and in early childhood, especially among children aged 3 to 5 years, mirroring the trend observed in the present study (19). The increased prevalence of HCV among patients with a longer transfusion history noted in this study is consistent with previously reported evidence that implicates repeated transfusions as the primary risk factor for acquiring HCV in thalassemia patients (20). Additional contributing factors cited in other investigations include surgical procedures, dialysis, parenteral drug use, and familial history of infection (21). A noteworthy finding from earlier studies is the role of HBV vaccination in prevention; in one study, none of the HBV-infected patients had received the vaccine, underscoring the protective value of immunization (22). This supports the emphasis on structured vaccination programs for vulnerable populations such as thalassemic.

Although the overall prevalence rates reported in the present study are lower than those documented in certain international studies, they remain clinically significant and reflect the ongoing threat of TTIs in resource-limited healthcare settings. The relatively lower HBV prevalence may be attributed to wider HBV vaccine coverage, whereas the persistently higher HCV rates point toward gaps in blood safety, particularly in terms of inadequate screening or reliance on less sensitive diagnostic modalities in some centers (20,22). One of the strengths of this study lies in its real-world representation of transfusion-dependent patients from a high-risk region, using standardized screening methods to detect infection status. Moreover, the stratified analysis by age and gender adds depth to the epidemiological understanding of HBV and HCV risks in this cohort. However, several limitations must be acknowledged. The use of only ICT-based screening methods, without confirmatory tests such as ELISA or PCR, limits diagnostic accuracy, particularly for early or low-viremia cases. Additionally, the absence of data regarding HBV vaccination status, transfusion frequency, and source of blood units restricts the ability to fully characterize risk exposure. The lack of follow-up data also prevents assessment of treatment status or clinical outcomes among infected individuals.

To improve future research, studies should include confirmatory diagnostic methods, comprehensive clinical histories including immunization and transfusion records, and larger sample sizes to enhance generalizability. Longitudinal designs may also help in monitoring disease progression and evaluating the effectiveness of infection control interventions. Furthermore, the potential of genetic-level therapies such as CRISPR/Cas9 in correcting β-thalassemia mutations warrants deeper investigation, as it may eventually reduce dependence on transfusions and consequently the risk of transfusion-transmitted infections. Overall, the study highlights the critical need for strengthened infection prevention protocols, regular monitoring, and tailored public health strategies to manage and mitigate

the burden of HBV and HCV in thalassemia patients. Integration of vaccination, rigorous blood screening, and access to antiviral therapies can significantly enhance long-term outcomes for this vulnerable population.

CONCLUSION

This study concluded that hepatitis C virus emerged as the most prevalent transfusion-transmitted infection among thalassemia patients, with a comparatively higher occurrence observed in male patients and those in the youngest age group. The findings underscore the ongoing vulnerability of transfusion-dependent individuals to blood-borne infections, emphasizing the urgent need for robust infection control measures, routine screening, and vaccination programs. These results contribute valuable insight into the demographic patterns of HBV and HCV prevalence, reinforcing the importance of strengthening preventive strategies and healthcare policies aimed at improving the safety and quality of life for thalassemia patients.

AUTHOR CONTRIBUTION

Author	**Contribution**
Hamad Ali*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Arif Ali	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Usama	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hammad Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Abdullah Jan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Qaisar Ali	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Atif Jamal	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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