livers

Article

Prevalence and Trends in Hepatitis B & C Virus among Blood Donors in Pakistan: A Regional Transfusion Center Study

Tehreem Zorob [1,2,†], Muhammad Awais Farooqi [1,3,†], Ali Ahsan [4], Abdullah Zaki [5], Muhammad Ali Rathore [1,*] and Hafiz Muhammad Umer Farooqi [6,*]

1 Department of Virology, Armed Forces Institute of Transfusion, National University of Medical Sciences, Rawalpindi 46000, Pakistan
2 Department of Life Sciences, Abasyn University Islamabad Campus, Islamabad 44000, Pakistan
3 Department of Mechatronics Engineering, Jeju National University, Jeju-si 63243, Republic of Korea
4 Graduate School of Science, Osaka Metropolitan University, Osaka 558-0022, Japan
5 Department of Neurology, Shifa International Hospital, Sector H-8, Islamabad 44000, Pakistan
6 Board of Governors Regenerative Medicine Institute, Cedars-Sinai Medical Center, Los Angeles, CA 90048, USA
* Correspondence: robert50pk@yahoo.com (M.A.R.); umer.farooqi@cshs.org (H.M.U.F.)
† These authors contributed equally to this work.

Abstract: Around 118.5 million blood donations are collected annually to save precious lives. The donated blood may also be associated with blood-borne infections. With around 247 million population, Pakistan is an endemic country for viral hepatitis, and there is a high risk of having asymptomatic blood donors among healthy donors. Viral hepatitis is 2.5% prevalent in the general population, and blood donation and its screening have become grave health concerns for Pakistani health authorities. Asymptomatic viral hepatitis needs screening to rule out subliminally diseased individuals, as recommended by the World Health Organization. Knowing the prevalence of the transfusion transmissible infectious (TTIs) agents in healthy blood donors helps assess the disease burden in any population, boosts treatment rates, and precludes dreaded complications in the affected people. The objective of the current study was to determine the prevalence and trends of significant TTIs among blood donors visiting the Armed Forces Institute of Transfusion (AFIT), Rawalpindi, Pakistan. A total of 15,405 blood donors were screened for HBV, HCV, HIV, malaria, and syphilis during this cross-sectional descriptive study. Most donors had an O-positive blood group; AB-negative donors were only 0.7%. Out of the study population, we reported 1.06% HBV, 0.54% HCV, 0.19% HIV, and 0.31% syphilis-positive asymptomatic blood donors. However, no blood donor was found positive for malaria. The Punjab province was reported as the most burdened for TTIs, and youngsters aged 18–27 years were mainly positive, indicating the need to conduct national-level awareness campaigns about TTIs. The stakeholders need to strengthen the blood collection guidelines, and effective performance should be strictly monitored through internal and external audits considering the aim of reaching non-infectious blood products.

Keywords: transfusion transmissible infections; HBV; HCV; blood donation in Pakistan

check for updates

Citation: Zorob, T.; Farooqi, M.A.; Ahsan, A.; Zaki, A.; Rathore, M.A.; Farooqi, H.M.U. Prevalence and Trends in Hepatitis B & C Virus among Blood Donors in Pakistan: A Regional Transfusion Center Study. *Livers* **2023**, *3*, 271–281. https://doi.org/10.3390/livers3020018

Academic Editor: Leonardo Baiocchi

Received: 20 February 2023
Revised: 26 April 2023
Accepted: 11 May 2023
Published: 17 May 2023

Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Blood transfusion plays a pivotal role in the healthcare system by improving the patient's life, is considered a lifesaving intervention, and supports countless patients globally. According to World Health Organization (WHO), 118.5 million blood donations are collected worldwide annually, and around two-fifth of these are made in high-income countries [1]. Pakistan, a developing nation, faces healthcare system challenges due to a lack of resources, including being the globally second highest prevalence of Hepatitis B Virus (HBV) infection in the general population, succeeded by Egypt, and being the 5th most burdened country with Tuberculosis. Out of the world's 8 billion population, around

296 million people are infected with HBV, followed by 0.82 million deaths yearly [2]. A recent study reported that 9 million people out of the 232 million population of Pakistan harbor the HBV infection [3]. Blood donation saves lives and, at the same time, is a risk factor associated with Transfusion transmissible infections (TTIs). The major pathogens involved in TTIs are HBV, Hepatitis C virus (HCV), Human Immunodeficiency Virus (HIV), syphilis-associated *Treponema pallidum*, and *Plasmodium* species-associated malaria. The transfusion of infected blood or blood components increases the probability of patients' mortality and morbidity; thus, measuring the risk of TTIs linked with the blood transfusion is prudent.

Viral hepatitis is a global public health concern and is endemic in developing countries and a significant cause of morbidity and mortality in Pakistan [4]. It is caused by hepatitis virus subfamilies, including Hepatitis A, B, C, D, E, and G. The HBV and HCV belong to the genus of Orthohepadnavirus and Hepacvirus, respectively, and are involved in severe liver pathologies leading to cirrhosis and hepatocellular carcinoma. HBV is a silent killer that persists in the body as a carrier. Blood-transfusion-related HBV infection remains a critical concern in transfusion medicine. HBV, HCV, and HIV spread when blood, semen, or other body fluids from an infected person enter the body of someone who is not infected. The etiologies also include using unautoclaved instruments during surgical procedures, drug abuse, unprotected sex, unregulated piercing and tattooing with non-sterile instruments, and, sometimes, the vertical transmission of infections from the mother to the newborn [5]. In developing countries, unsafe blood products are still a significant problem due to the transmission of the pathogenic virus, posing enormous public health concerns [6,7]. According to the U.S. Centers for Disease Control and Prevention, approximately 3000 people in the U.S. and more than 600,000 people worldwide die from HBV-related liver disease yearly. The statistics by WHO reported at the end of 2021 that approximately 38.4 million of the world's population were infected with HIV [8], 2–3% of the global population harbor HCV [9], around 3.2% people were reported syphilis positive in 2019 [10], and 247 million malaria cases were reported across the globe [11].

The clinical picture of blood-borne infections is highly variable. The infected individuals can be asymptomatic or present with typical signs of disease, including jaundice, dark urine, hepatomegaly, anorexia, malaise, fever, nausea, abdominal pain, and vomiting [12–14]. Pakistan is an endemic country for TTIs; thus, there is a high risk of having asymptomatic donors among healthy individuals. These TTIs need strict screening and compliance with safe blood transfusion practices to rule out subliminally diseased individuals. The Ministry of National Health Services, Regulations and Coordination (MoNHSR&C), Government of Pakistan has issued Safe Blood Transfusion Guidelines (SBTG) for screening five cardinal TTIs-associated pathogens before proceeding with the blood transfusion [15]. Knowing the prevalence proportion of the viral markers associated with blood donation can help to assess the disease burden in any population. Preventive measures can be taken, and policymakers and stakeholders will help allocate the public-health-related budget in the endemic areas accordingly. Awareness seminars and volunteer camps can be accordingly planned to prevent and limit blood-transfusion-related infections spread in society. This study aimed to identify the incidence rate of TTIs-associated pathogens in healthy donors visiting the Armed Forces Institute of Transfusion (AFIT), Rawalpindi, Pakistan. Concerning the objective, the study was conducted to determine the prevalence of viral markers in healthy blood donors.

2. Materials and Methods

2.1. Study Design

The descriptive cross-sectional, single-centered study was conducted from 1 July 2019 to 31 December 2019. A total of 15,405 samples of blood donors were screened during the study period using a convenient sampling technique.

2.2. Settings and Population

The study was conducted at the AFIT, a facility attached to Pakistan's primer reference laboratory, Armed Forces Institute of Pathology (AFIP), Rawalpindi, Pakistan [16]. Rawalpindi is a metropolitan city of the province of Punjab; it is the fourth largest city in Pakistan, with an area of 479 km^2 and a population of nearly 21 million people. Rawalpindi city is situated just adjacent to Islamabad's capital territory, and both cities are called twin cities. The study population belonged to all the provinces of Pakistan residing in Rawalpindi, Pakistan.

2.3. Sample Collection and Processing

The donor's blood was drawn in two blood collection vacutainers. The ethylenediamine tetra-acetic acid (EDTA) anticoagulant containing vacutainer was used to analyze the donors' hemoglobin, hematocrit, platelet levels, and blood groups. The other vacutainer containing no anticoagulant was used to obtain serum to screen HBV, HCV, HIV, *T. pallidum*, and *Plasmodium* spp. The selection criteria included only healthy blood donors who visited the health center and fulfilled the donor selection criteria according to the WHO and SBTG guidelines [17].

2.4. Screening of Samples

The donor's serum was quantified through chemiluminescence microplate immunoassay (CMIA) using the ABBOTT ARCHITECT i2000SR system (Sligo, Ireland). The concentrations of the analytes were determined using the ARCHITECT calibration curve. The sample was considered reactive if the sample's concentration was >0.05 IU/mL. The software protocols for ARCHITECT HbsAg, HCV, HIV, malaria, and syphilis files were installed in the computer to run the instrument; frozen samples were thoroughly mixed after thawing. The reagent kit for the test assay was mixed around 30 times to resuspend microparticles. The discard cap and bag septum were removed and snapped onto the top of the bottle. The volume of reagent required for one test was around 150 µL and 25 µL of the sample. The recipients' platelet levels, hemoglobin concentration, and hematocrit were measured using a Mindray BC-6200 (Nanshan, Shenzhen 518057, China) 5 parts differential hematology analyzer. The device could process 110 samples in 60 min. Hematocrit was the percentage by volume of red cells in the blood.

2.5. Ethical Approval

The Institutional review board's (IRB) ethical approval (approval number AFIT-ERC-19-047) was taken before the sampling process. It was made sure that the participants' information remained confidential and inaccessible to outsiders except for the research team. The data were analyzed and aligned using the software Statistical Package for Social Sciences (SPSS) v. 23.0, tables were drawn using Microsoft Excel 2019, and graphs were prepared using GraphPad Prism v.9.

2.6. Inclusion Criteria

The study included all recipients aged over 19 and under 60, with good physical health conditions and hemoglobin (Hb) levels no less than 12.5 g/dL. Vital signs of donors were noted, confirming the donors were healthy with systolic pressure between the range of 65–90 mmHg and systolic pressure between 100–120 mmHg, with few outliers depending upon the recipient's clinical condition.

2.7. Exclusion Criteria

Persons having a donation gap of <3 months, drug abusers, men younger than 18, and sex workers were excluded from the study.

3. Results

3.1. Demographics of the Study Population

In total, 15,405 blood donors were screened for HBV, HCV, HIV, syphilis, and malaria during the study period. All the donors recorded during the current study were male, and no female donor was reported during the study period. The demographic distribution of the donors showed that the maximum number of donors (44%) belonged to the age group 18 to 27 (n = 6704). The frequency and percentage for the age group 28–37 was 36% (n = 5482), 38 to 47 was 14% (n = 2209), 48–57 was 5% (n = 724), and the least number of donors were reported between the age group 58 to 67 was 2% n = 286). The province-wide distribution of donors showed that the maximum number of donors belonged to Punjab 97.7% (n = 14,879), followed by Khyber Pakhtunkhwa (KPK) 3% (n = 495), and less than 1% from Azad Jammu Kashmir (AJK), Balochistan, and Gilgit Baltistan (GB); however, no patient was registered from Sindh. The hematological parameters of the donors showed that all the donors fell in the healthy donors' category, indicating a healthy local population. The maximum number of donors had a hemoglobin value of 15 g/dL (n = 6732, 44%), followed by 16/dL 29% (n = 4419), 14 g/dL 23% (n = 3613), and the minimum reported value was 13 g/dL 4% (n = 641). The percentage of red cells by volume in the donors indicated that the maximum number of patients fell in the 45% hematocrit range (42%, n = 6437). The frequency of hematocrit values for the rest of the donors was 41% to 49%. The platelet count assessment showed that all the study participants had a standard range of platelet levels, with a maximum of participants 86% (n = 13,238) having 251–350 $\times$ 10^9 platelets per L. According to the province-wide distribution, the patients of Punjab province contributed the maximum to the study; 97% (n = 14,879) of the donors belonged to Punjab, followed by KPK 3% (n = 495), Balochistan was 0.10% (15), and 0.1% (n = 16) both for GB and AJK. However, no donor was registered from the Sindh province of Pakistan. The donors' frequencies and demographics are summarized in Table 1.

3.2. Blood Group Statistics

The forward blood group profiling using the tile method showed that 91.57% (14,107) of donors belonged to the Rhesus factor D (RhD) positive blood group, and 8.43% (1298) were the RhD, negative blood group. In the case of RhD-positive blood group donors, a major proportion was the O-positive blood group, 32.96% (n = 5077); followed by the B-positive blood group, 34.72% (n = 5349); and A-positive blood group, 16.46% (n = 2535). A minor percentage was witnessed in the case of AB-positive blood group donors, 7.44% (n = 1146). In the case of RhD-negative donors, the frequency and percentage of the donors for B-negative, O-negative, A-negative, and AB-negative donors was 3.25% (500), 2.99% (n = 461), 1.49% (n = 229), and 0.70% (n = 108), respectively (Table 2).

3.3. Disease Burden

The prevalence of the Hepatitis B surface-antigen-test-positive patients during the study period was 1.06% (n = 164). The age-wise distribution of the HBV-positive patients showed that half the blood donors were 18–27 years old. The HCV-positive patients contributed 0.54% (n = 83) burden of the study, and a varying range of patients was reported for 18–27 years (n = 37), 28–37 years (n = 28), and the rest of the patients belonged to age groups >37. The trend for HIV screening was 0.19% (n = 30), where, surprisingly, young adults aged 18–27 years showed a 3/4th burden of total HIV positivity. The syphilis screening test showed that 0.31% (n = 48) were positive for the *Treponema pallidum* test, and around half the burden of patients belonged to middle-aged young people, i.e., 28–37 years. The data for screening results and their association with age groups is shown in Figure 1.

Table 1. Demographics of the study population.

	Frequency (*n*)	Percentage (%)
Age Groups (Years)		
18–27	6704	44
28–37	5482	36
38–47	2209	14
48–57	724	5
58–67	286	2
Gender		
Male	15,405	100
Female	0	0
Ethnicity		
Punjab	14,879	97
KPK	495	3
Balochistan	15	0.10
Gilgit Baltistan	8	0.05
Azad Jammu Kashmir	8	0.05
Hemoglobin Levels (g/dL)		
12.5 to 13.99	641	4
14 to 14.99	3613	23
15 to 15.99	6732	44
16 to 16.99	4419	29
Hematocrit (%)		
41 to 41.99	183	1
42 to 42.99	1156	8
43 to 43.99	775	5
44 to 44.99	1221	8
45 to 45.99	6437	42
48 to 48.99	475	3
49 to 49.99	192	1
Platelets (10^9 platelets per L)		
149–250	2140	14
251–350	13,238	86
351–450	27	0.1
HBsAg		
Reactive	164	1
Non-Reactive	15,241	99
HCV		
Reactive	83	1
Non-Reactive	15,322	99
HIV		
Reactive	30	0
Non-Reactive	15,375	100
Malaria		
Non-Reactive	15,405	100
Syphilis		
Reactive	48	0
Non-Reactive	15,357	100

Table 2. Distribution of ABO and RhD blood grouping.

		Rhesus Factor-D (RhD)					
	Blood Group	**Positive (*n*)**	**Percentage (%)**	**Negative (*n*)**	**Percentage (%)**	**Total (*n*)**	**Percentage (%)**
ABO	A	2535	16.46	229	1.49	2764	17.94
	B	5349	34.72	500	3.25	5849	37.97
	AB	1146	7.44	108	0.70	1254	8.14
	O	5077	32.96	461	2.99	5538	35.95
	Total	14,107	91.57	1298	8.43	15,405	100.00

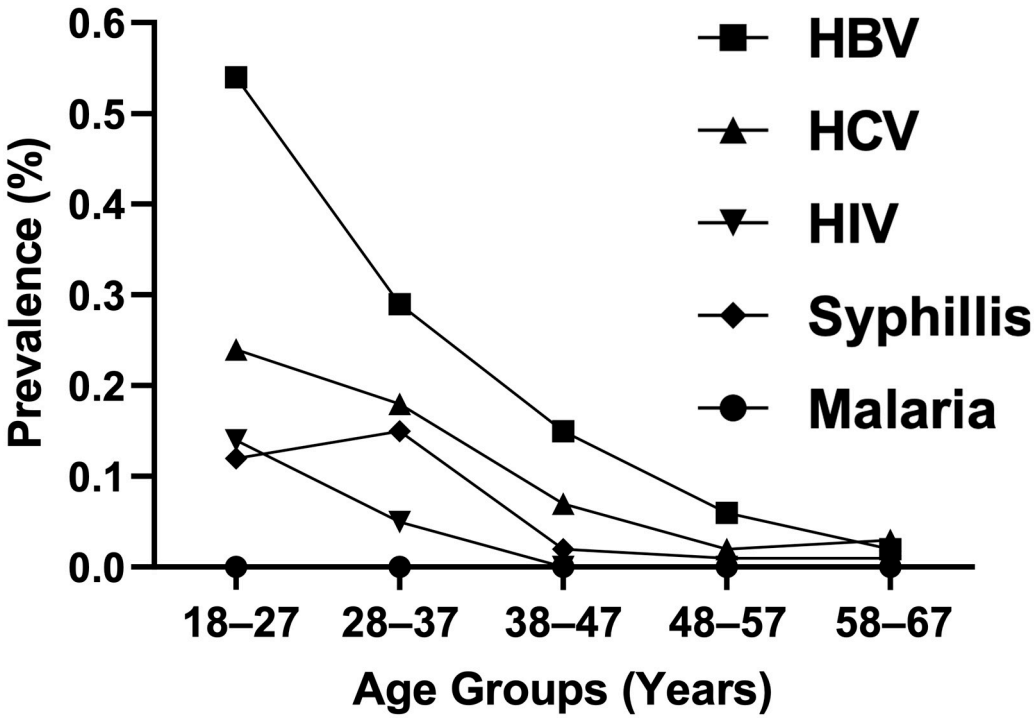


Figure 1. Age versus pathogen analysis.

Concerning the positivity related to provincial categorization, the maximum positive cases for HBsAg were reported from Punjab at 1.02% (n = 157), 0.5% (n = 81) for HCV, 0.17% (n = 26) for HIV, and 0.29% (n = 46) for syphilis. Succeeded by Punjab, KPK remained 2nd in trend, and HBsAg positive was 0.05% (n = 7), HCV positive was 0.01% (n = 3), HIV positive was 0.02 (n = 2), and syphilis positive was 0.01% (n = 2). The trend for the province-wide distribution of patients with age and screening tests is given in Figure 2.

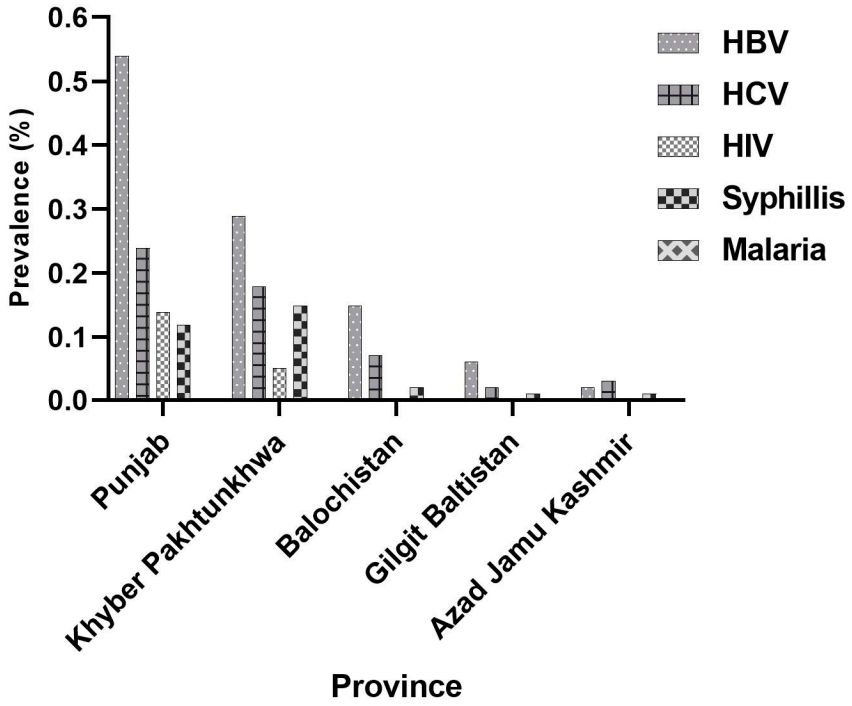


Figure 2. The burden of TTI diseases.

The chemiluminescence microplate immunoassay for the patients showed that the population had a high burden of Hepatitis B surface antigen in their blood in around one-fifth of the study. The antigen quantification showed that the antigen burden in 29.3% of patients ranged between a quarter proportion (24.4%) of patients that went between 3001 and 4500, 21.3% fell within the 1501–3000 range, around two fifths of the proportion (20.7%) were between 4501 and 6000, and the low sensitive zone, i.e., grey-zone-ranged patients, were only 4.3%, with the sample to the cutoff ratio between 0.8 and 1. The grey zone of the quantitative test was an area of values where the discriminatory performance was 'insufficient', The value in the grey zone did not allow the target disease to be scored as either present or absent. Grey zone values for the HBsAg were generally considered indeterminate, as they did not necessarily indicate a positive or negative result for HBV infection. Our study defined the grey zone as HBsAg values between 0.05 IU/mL and 0.49 IU/mL. We performed repeat testing of the same sample using a similar assay to determine the accuracy of the initial test results in the grey zone. We also tested a second sample collected from the same participant at a later point to confirm the initial results. If the results of both tests were positive or negative, we classified the participant accordingly [18] (Table 3).

Table 3. Serum to cut off value for HBV.

Parameter	Frequency	Percentage (%)
Grey Zone 0.8–1	7	4.30
>1–1500	48	29.30
1501–3000	35	21.30
3001–4500	40	24.40
4501–6000	34	20.70%

4. Discussion

Around 118.5 million people donate blood annually for charity, emergencies, operations, and maternity cases. Blood donation is a noble cause of saving one's life. For instance, in the case of roadside accidents with massive bleeding, screening individuals with TTIs gives an insight into the burden and magnitude of certain diseases in the country [19]. Hepatitis B and Hepatitis C infections are characterized by short-term infection within the first six months after someone is infected with these pathogens. The severity can range from mild illness with few or no symptoms to a severe condition requiring immediate hospitalization and intensive care [20,21]. Some adults can get rid of the virus without treatment, and those that can clear the virus become immune and do not develop clinical symptoms and infection with subsequent exposure. The medications for HBV and HCV are routinely available in Pakistan's public and private sectors. The government of Pakistan provides free-of-cost antiviral medications for HBV and HCV in public sector hospitals and clinics. These medications are included in the essential medicines list and are distributed through the National Program for Hepatitis Control and Prevention (NPHCP). The NPHCP aims to provide prevention, diagnosis, and treatment services for HBV and HCV at the national level and has set up dedicated treatment centers nationwide to facilitate patient access to care. In addition, private healthcare facilities in Pakistan also offer medications for HBV and HCV. However, the cost of these medications may vary depending on the brand and the facility's location. It is worth noting that access to treatment for HBV and HCV remains a challenge in Pakistan despite the availability of medicines. Factors such as limited healthcare infrastructure, low awareness about disease screening and their treatment, and stigma associated with these infections contribute to inadequate treatment uptake [22]. In addition to this, there could be several reasons for the higher prevalence of these infections in the younger population. One possible explanation is that young individuals may engage in more high-risk behaviors, such as unprotected sex or injection-based narcotics or drug abuse, which increase their risk of acquiring such infections. Additionally, younger indi-

viduals may be less likely to have been vaccinated against HBV or previously exposed to the virus, which could also contribute to the higher prevalence observed in this age group.

In the current study, the overall seroprevalence of HBV in the subjects was 1.06%. While a previous study by Niazi et al., 2016 [23] at the same institution reported a 1.48% prevalence of HBV in blood donors. Similarly, another study by Butt et al., 2017 [24] reported a 1.57% burden proportion of HBV in Rawalpindi, and the report of Abdullah et al., 2019 [25] suggested a 1.5% HBV burden in Lahore city of Punjab. In the southern part of Punjab, a study by Akhter et al., 2018 and Billah et al., 2018 reported 1.5% and 1% HBV burdens in blood donors visiting health facilities, respectively [26,27]. These results were consistent with the current research that the overall burden was less than two percent in major cities in Pakistan. Concerning the country-wise burden of HBV, Sajjadi et al., 2018 reported 0.13% in Iran [28], Hussein et al., 2017 reported 0.78% in Iraq [29], Alzahrani et al., 2019 reported 3.24% in Eastern Saudi Arabia [30], Ezeonu et al., 2019 [31] and Shah et al., 2018 reported 0.7% in Nepal [32], Bartonjo reported 6.8% in Kenya, Bartonjo et al., 2019 reported 6.8% in Kenya [33], Islam et al., 2016 reported 5.4% in Afghanistan [34], Baptiste et al., 2018 reported 3.80% in Haiti [35], and Wang et al., 2019 reported 6.89% HBV-positive patients in China [36].

The current study reported that most HBV-infected patients, 70% (n = 115), belonged to younger age groups, i.e., 18 to 30 years of age, which showed the state that authorities need to be more vigilant about to work against the spread of the Hepatitis infection. Another study [23] reported a higher prevalence of HBV infection in age groups of 31 to 45 years of age in Rawalpindi than in the current study. Another survey by Billah et al., 2018 in Multan reported a prevalence of HBV-infected donors aged 18–30 [27]. The report by Naveed et al., 2016 in Multan City also reported the detection of HBV infection in the age groups 31–45 years [37]. The current study's findings were also consistent with the results cited previously in the literature from Nigeria [31]. The stakeholders and policymakers should seriously take up measures to combat against spread of all blood-borne pathogens to create a healthy society [38]. Additionally, if the prevalence of such cases increases, the community would be short of blood donors in medical emergencies such as natural disasters, terrorism-related events, roadside accidents, or maternity case emergencies.

The results depicted in our study are an appreciating outcome of the current implementing policies by the regional Punjab Blood Transfusion Authority (PBTA). Still, it is also evident that the progress toward achieving specific results is slow or sluggish. Another reason for the reduction in HBV, HCV, and HIV proportion that might be associated with the Extended Program on Immunization (EPI) by MoNHSR&C and the utilization of retroviral therapies [39]. An enormous load of the patient population and disease-free state policies are a severe challenge to healthcare departments. The upsurge in disease burden is an intense concern for the patients, physicians, policymakers, and society who wish to see a safe blood supply.

The global proportion of HIV is increasing enormously; the recent study by Marfani et al., 2022 reported that the National Aids Control Program has 24,331 registered cases of HIV-positive patients, and they estimated the number of infected persons is around 165,000 in total [40]. The current study reported 30 HIV-positive patients belonging to very young age groups, indicating that the preventive measures taken by the state still need to be improved. With the increase in drug addiction among youngsters, the non-utilization of precautions before intercourse with sex workers and the use of contaminated and reused surgical instruments might be a leading cause of this grave concern. The situation with the case of syphilis is almost similar to other TTIs; however, the number is still low compared to the TTIs mentioned above.

Immunocompetent adults recover from HBV after 4–8 months; however, for the rest of the population, the need of the hour is to ensure low-cost treatment and follow-up check-ups with the addition of volunteer camps, government, and adoption. They are considering the regional differences in disease prevalence to support the periodic update of the majority in the country. One of the critical limitations of this study is the single-

gender participation because the highly predominant male population might cause biases compared to the contrasting gender, i.e., females [41,42]. The lack of female donors in the study population may limit our findings' generalizability to Pakistan. However, the current study aimed to assess the prevalence of TTIs among healthy donors in the study area and not to evaluate gender-specific donation rates in Pakistan. Moreover, the study is based on single regional center data, and the results cannot broadly represent the general population of Pakistan. At the same time, the females should also be encouraged to donate blood, which would not only meet the growing demand of short blood supply in healthcare departments but also the screening of those females for TTIs would give an insight into the burden of blood-borne diseases in women as well. Using a single-centered institution, we conducted the study to assess the nationwide TTIs' burden. More studies should be conducted in the general population and areas where the disease is endemic, and treatment facilities and guidelines should be given accordingly.

5. Conclusions

A high percentage of healthy donors affected with HBV, HCV, and HIV were witnessed in the tertiary care healthcare center, with the prevalence of people from the youngest age groups. The study showed a decline in the HBV burden compared to the previous studies, indicating a better but slow implementation of the health policies. The stakeholders need to strengthen the guidelines, and effective performance should be strictly monitored through internal and external audits, considering the aim of reaching a disease-free society. The disease burden was found more in the Punjab province in the young age group, indicating the need to conduct awareness seminars and volunteer camps for youngsters. Effective screening should be made mandatory, thus achieving zero transmission risk.

Author Contributions: Conceptualization, H.M.U.F. and M.A.R.; methodology, T.Z. and M.A.F.; software, A.A.; validation, M.A.F. and A.Z.; formal analysis, T.Z.; investigation, M.A.F.; resources, M.A.R.; data curation, M.A.F.; writing—original draft preparation, T.Z. and M.A.F.; writing—review and editing, A.Z.; visualization, A.A.; supervision, H.M.U.F. and M.A.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted following the Armed Forces Institute of Transfusion Medicine's declaration and approved by the Institutional Review Board letter AFIT-ERC-19-047.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All the supporting data concerning the study are available and can be obtained from the corresponding authors upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. World Health Organization. *Global Status Report on Blood Safety and Availability 2021*; World Health Organization: Geneva, Switzerland, 2022.
2. Conners, E.E.; Panagiotakopoulos, L.; Hofmeister, M.G.; Spradling, P.R.; Hagan, L.M.; Harris, A.M.; Rogers-Brown, J.S.; Wester, C.; Nelson, N.P.; Rapposelli, K. Screening and testing for hepatitis B virus infection: CDC recommendations—United States, 2023. *MMWR Recomm. Rep.* **2023**, *72*, 1–25. [CrossRef]
3. Kubo, A.; Shlager, L.; Marks, A.R.; Lakritz, D.; Beaumont, C.; Gabellini, K.; Corley, D.A. Prevention of vertical transmission of hepatitis B: An observational study. *Ann. Intern. Med.* **2014**, *160*, 828–835. [CrossRef] [PubMed]
4. Osei, E.; Lokpo, S.Y.; Agboli, E. Sero-prevalence of hepatitis B infection among blood donors in a secondary care hospital, Ghana (2014): A retrospective analysis. *BMC Res. Notes* **2017**, *10*, 391. [CrossRef] [PubMed]
5. Farooqi, H.M.U.; Kim, K.-H.; Kausar, F.; Muhammad, J.; Bukhari, H.; Choi, K.-H. Frequency and molecular characterization of *Staphylococcus aureus* from placenta of mothers with term and preterm deliveries. *Life* **2022**, *12*, 257. [CrossRef] [PubMed]
6. Ejaz, H.; Imran, M.; Zafar, A.; Javed, H.; Al Farraj, D.A.; Younas, S.; Ahsan, A.; Sharif, M.A.; Riaz, M. Phenotypic Characterisation of Carbapenemase-Producing *Escherichia coli* Isolated from a Tertiary Care Paediatric Hospital. *Int. Med. J.* **2020**, *27*, 155–158.

7. Farooqi, H.M.U. Liver-on-Chip Development for Pathophysiological Emulation and Drug Toxicity Testing. Ph.D. Thesis, Jeju National University Graduate School, Jeju-si, Republic of Korea, 2022.
8. World Health Organization. *Consolidated Guidelines on HIV Testing Services, 2019: Web Annex H. Considerations for Monitoring HIV Testing Services Programmes*; World Health Organization: Geneva, Switzerland, 2020.
9. World Health Organization. *Recommendations and Guidance on Hepatitis C Virus Self-Testing*; World Health Organization: Geneva, Switzerland, 2021.
10. Heath, K.; Alonso, M.; Aguilar, G.; Samudio, T.; Korenromp, E.; Rowley, J.; Suleiman, A.; Shwe, Y.Y.; Htin, K.C.W.; Ishikawa, N. WHO method for estimating congenital syphilis to inform surveillance and service provision, Paraguay. *Bull. World Health Organ.* **2022**, *100*, 231. [CrossRef]
11. Sherrard-Smith, E.; Winskill, P.; Hamlet, A.; Ngufor, C.; N'Guessan, R.; Guelbeogo, M.W.; Sanou, A.; Nash, R.K.; Hill, A.; Russell, E.L. Optimising the deployment of vector control tools against malaria: A data-informed modelling study. *Lancet Planet. Health* **2022**, *6*, e100–e109. [CrossRef]
12. Farooqi, H.M.U.; Kang, B.; Khalid, M.A.U.; Salih, A.R.C.; Hyun, K.; Park, S.H.; Huh, D.; Choi, K.H. Real-time monitoring of liver fibrosis through embedded sensors in a microphysiological system. *Nano Converg.* **2021**, *8*, 3. [CrossRef] [PubMed]
13. Yasin, S.; Bhatti, T.; Farooqi, M.U.; Mateen, F. Immunologic aspect in diagnosis and treatment of SARS-CoV-2 patients. *J. Shifa Tameer-E-Millat Univ.* **2020**, *3*, 113–121. [CrossRef]
14. Farooqi, M.A.; Ahsan, A.; Yousuf, S.; Shakoor, N.; Farooqi, H.M.U. Seroprevalence of Hepatitis E Virus Antibodies (IgG) in the Community of Rawalpindi. *Livers* **2022**, *2*, 108–115. [CrossRef]
15. Zaheer, H.; Ahmed, S.; Waheed, U.; Wazeer, A. *National Guidelines for Quality Control in Transfusion Medicine*; Safe Blood Transfusion Programme, Ministry of National Health Services, Regulations & Coordination, Government of Pakistan: Islamabad, Pakistan, 2020.
16. Ahmad, S.A.; Aamir, M.; Ahmad, M.; Javed, M.; Memon, A. Standardisation of pathology laboratories in Pakistan: Where we stand today. *Clin. Biochem.* **2018**, *53*, 38–42. [CrossRef] [PubMed]
17. WHO. *Blood Donor Selection: Guidelines on Assessing Donor Suitability for Blood Donation*; World Health Organization: Geneva, Switzerland, 2012.
18. Wang, J.; Yan, X.; Zhu, L.; Liu, J.; Qiu, Y.; Li, Y.; Liu, Y.; Xue, R.; Zhan, J.; Jiang, S. Significant histological disease of patients with chronic hepatitis B virus infection in the grey zone. *Aliment. Pharmacol. Ther.* **2023**, *57*, 464–474. [CrossRef]
19. Miah, M. Study of blood donation campaign communication methods and attributes of donors: A data analytics approach. *Int. J. Healthc. Manag.* **2022**, *15*, 17–27. [CrossRef]
20. Zahid, A.S.; Farooqi, H.M.U.; Ahsan, A.; Farooqi, M.A.; Kausar, F.; Muhammad, J.; Ahmad, A. Comparative analysis of antigenic strength and in vivo serum antibodies concentration of tetanus toxoid vaccine adsorbed in Pakistan. *Saudi J. Biol. Sci.* **2022**, *29*, 103337. [CrossRef] [PubMed]
21. Farooqi, H.M.U.; Khalid, M.A.U.; Kim, K.H.; Lee, S.R.; Choi, K.H. Real-time physiological sensor-based liver-on-chip device for monitoring drug toxicity. *J. Micromech. Microeng.* **2020**, *30*, 115013. [CrossRef]
22. Weng, M.K.; Doshani, M.; Khan, M.A.; Frey, S.; Ault, K.; Moore, K.L.; Hall, E.W.; Morgan, R.L.; Campos-Outcalt, D.; Wester, C. Universal hepatitis B vaccination in adults aged 19–59 years: Updated recommendations of the Advisory Committee on Immunization Practices—United States, 2022. *Am. J. Transplant.* **2022**, *22*, 1714–1720. [CrossRef]
23. Niazi, S.K.; Mahmood, A.; Alam, M.; Ghani, E. Seroprevalence of transfusion transmissible infections in blood donors: A three year experience. *Pak. Armed Forces Med. J.* **2016**, *66*, 190–193.
24. Butt, T.; But, B. Is Seroprevalence of Hepatitis B And C Among Blood Donors Changing In Northern Pakistan. *Pak. Armed Forces Med. J.* **2017**, *67*, 627–629.
25. Abdullah, S.; Zahoor, S.; Rao, M.A.; Abdullah, S.M.; Asif, S.; Wajid, A.; Zaidi, A.R.Z. Seroprevalence of hepatitis B virus in blood donors at a large teaching hospital of Pakistan: A potential health policy concern. *J. Appl. Hematol.* **2019**, *10*, 29. [CrossRef]
26. Akhter, N.; Fatima, S.; Batool, Y.; Samad, A.; Fayyaz, N.; Khan, M. Seroprevalence Of Transfusion Transmitted Infections among Healthy Donors in a Tertiary Care Hospital in Southern Punjab, Pakistan. *Biomedica* **2018**, *34*, 169.
27. Billah, M.; Shah, S.M.R.; Hashir, M.M. Frequency of Hepatitis B And C Among Blood Donors Reporting at Blood Bank of Ibne-Siena Hospital Multan, Pakistan. *Prof. Med. J.* **2018**, *25*, 1245–1251.
28. Sajjadi, S.M.; Pourfathollah, A.A.; Mohammadi, S.; Nouri, B.; Hassanzadeh, R.; Fariba, R. The prevalence and trends of hepatitis B, hepatitis C, and HIV among voluntary blood donors in kohgiluyeh and boyer-ahmad transfusion center, Southwestern Iran. *Iran. J. Public Health* **2018**, *47*, 944. [PubMed]
29. Hussein, N.R.; Haj, S.M.; Almizori, L.A.; Taha, A.A. The prevalence of hepatitis B and C viruses among blood donors attending blood bank in Duhok, Kurdistan region, Iraq. *Int. J. Infect.* **2017**, *4*, e39008.
30. Alzahrani, F.M.; Shaikh, S.S.; Alomar, A.I.; Acharya, S.; Elhadi, N. Prevalence of Hepatitis B Virus (HBV) among blood donors in Eastern Saudi Arabia: Results from a five-year retrospective study of HBV seromarkers. *Ann. Lab. Med.* **2019**, *39*, 81. [CrossRef] [PubMed]
31. Ezeonu, C.M.; Garba, S.A.; Adabara, N.U.; Kuta, F.A. Prevalence of hepatitis B virus infections among blood donors in Federal Capital Territory, Abuja, Nigeria. *Afr. J. Clin. Exp. Microbiol.* **2019**, *20*, 182–194. [CrossRef]
32. Shah, G.B.; Gurung, K.; Baral, B.P.; Gurung, R.R.; Bhattachan, B. Hepatitis B and C Virus Infections among Blood Donors in Blood Transfusion Center, Pokhara, Nepal: Seroprevalence and its Associated Risk Factors. *Nepal J. Biotechnol.* **2018**, *6*, 33–38. [CrossRef]

33. Bartonjo, G.; Oundo, J. Prevalence and associated risk factors of transfusion transmissible infections among blood donors at Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital, Kenya. *Pan Afr. Med. J.* **2019**, *34*. [CrossRef] [PubMed]
34. Islam Saeed, K. Prevalence and associated factors of hepatitis B, hepatitis C and HIV infection in Jalalabad city, Afghanistan. *GMJ* **2016**, *1*, 62–74.
35. Jean Baptiste, A.; Chevalier, M.; Polo, E.; Noel, E.; Hulland, E.; Archer, W. Trends in hepatitis B and hepatitis C seroprevalence among blood donors–Haiti, 2005–2014. *ISBT Sci. Ser.* **2018**, *13*, 150–157. [CrossRef] [PubMed]
36. Wang, H.; Men, P.; Xiao, Y.; Gao, P.; Lv, M.; Yuan, Q.; Chen, W.; Bai, S.; Wu, J. Hepatitis B infection in the general population of China: A systematic review and meta-analysis. *BMC Infect. Dis.* **2019**, *19*, 811. [CrossRef]
37. Muhammad Naveed, A.; Muhammad, N.; Umar Farooq, Q. Hepatitis B and C; prevalence in south Punjab population. *Prof. Med. J.* **2016**, *23*, 25–28.
38. Shoaib, N.; Noureen, N.; Faisal, A.; Zaheer, M.; Imran, M.; Ahsan, A.; Munir, R.; Zaidi, N. Factors associated with cycle threshold values (Ct-values) of SARS-CoV2-rRT-PCR. *Mol. Biol. Rep.* **2022**, *49*, 4101–4106. [CrossRef] [PubMed]
39. Mooneyhan, E.; Qureshi, H.; Mahmood, H.; Tariq, M.; Maqbool, N.A.; Anwar, M.; Aslam, M.; Azam, F.; Blach, S.; Khan, A.G. Hepatitis C prevalence and elimination planning in Pakistan, a bottom-up approach accounting for provincial variation. *J. Viral Hepat.* **2023**, *30*, 345–354. [CrossRef] [PubMed]
40. Marfani, W.B.; Khan, H.A.; Sadiq, M.; Outani, O. The rise in HIV cases in Pakistan: Prospective implications and approaches. *Ann. Med. Surg. (2012)* **2022**, *81*, 104492. [CrossRef]
41. Ahmed, M.; Saeed, M.; Waheed, U.; Mujtaba, A.; Hanif, A.; Khalid, A.; Rasheed, F. Perception of Blood Donation among Pakistani Youth. *Pak. Armed Forces Med. J.* **2020**, *70*, 1360–1365.
42. Faqah, A.; Moiz, B.; Shahid, F.; Ibrahim, M.; Raheem, A. Assessment of blood donation intention among medical students in Pakistan–An application of theory of planned behavior. *Transfus. Apher. Sci.* **2015**, *53*, 353–359. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.