The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 12, 2025

EPIDEMIOLOGICAL ASSESSMENT OF HEPATITIS-B IN BAJAUR: A REMOTE TRIBAL DISTRICT OF EX-FATA, KHYBER PAKHTUNKHEWA, PAKISTAN

Ikramud Din[1], Ashfaq Ahmad[2], Farman Ullah[3], Sabeeh Ullah[4], Ilyas Ahmad[5], Ishaq Ahmad[6], Nazima[7], Azhar Ullah[8], Muhammad Mustafa[9], Kalsoom[10], Farman Ullah[*11]

[1,2]*Department of Zoology, Government Post Graduate College Khar, Bajaur KP Pakistan*
[3]*Department of Biochemistry, Quaid-i-Azam University, Islamabad Pakistan*
[4]*Deparment of Zoology, Government Post Graduate College Charsadda, KP Pakistan*
[5]*Department of Zoology, Government Degree College Lalqilla, Dir Lower, KP Pakistan*
[6,7,8, 9]*Department of Zoology, Islamia College Peshawar, KP Pakistan*
[10]*Department of Zoology, University of Bunir, KP Pakistan*
[*11]*Department of Biology, Government Degree College Barang, Bajaur KP Pakistan*

[1]ikramsahilhjk@gmail.com, [2]ashfaqaqjan149@gmail.com, [3]farman.ullah@bs.qau.edu.pk, [4]sabeehsabeeh1996@gmail.com, [5]ilyasahmadpst@gmail.com, [6]ishaqahmad3098@gmail.com, [7]nazmarahman443@gmail.com, [8]azharullah278@gmail.com, [9]mustafaicp2024@gmail.com, [10]kalsoom.tazeem@gmail.com, [*11]farman@bs.qau.edu.pk

DOI: https://doi.org/10.5281/zenodo.18465957

Keywords
Hepatitis-B, Prevalence Study, Epidemiological Survey, Rural Health, District Bajaur.

Article History
Received: 29 October 2025
Accepted: 17 December 2025
Published: 30 December 2025

Corresponding Author: *
Farman Ullah

Abstract

Viral hepatitis, particularly hepatitis-B and C, represents a major global public health concern. Pakistan bears one of the highest burdens worldwide, with significant morbidity and mortality resulting from chronic infections, liver failure, and hepatocellular carcinoma. However, reliable national level estimates of prevalence and associated risk factors remain limited. This study aimed to determine the prevalence of hepatitis-B in the general population of District Bajaur, Khyber Pakhtunkhwa, Pakistan, and to assess its distribution across tehsils and genders. The research data were collected from the District Hospitals of Bajaur between March and June, 2022. A total of 260 individuals were surveyed using structured questionnaires based on patient age, gender, family history, and the blood samples were analyzed for hepatitis-B infection. Among participants, 190 (73.07%) were male and 70 (26.92%) were female. The prevalence of hepatitis-B was 6.92% in males and 0.38% in females. Hepatitis-C prevalence was 4.23% in males and 3.07% in females, while hepatitis-E was detected in 0.38% of both sexes such as male and female. Tehsil-wise active cases were distributed such as Tehsil Mamund is high active cases (4.5%), followed by Nawagai (1.2%), Barang (1.15%), Khar (1.15%), Salarzai (0.3%), Utman Khel (0.76%), and Chamarkand (0.76%). The findings indicate that hepatitis-C is more prevalent than hepatitis-B in District Bajaur. These results highlight the need for strengthened surveillance, awareness campaigns, and preventive strategies to control the growing burden of viral hepatitis in the region. We recommend that public health campaigns are needed to raise awareness about safe medical practices, vaccination, and preventive measures, especially in rural, and

underserved areas.

1. Introduction

Hepatitis is a general term referring to inflammation of the liver, most commonly caused by infection with one of five viruses such as hepatitis A, B, C, D, and E. Among these, hepatitis-B virus (HBV) is the most widespread, and serious cause of liver infection across the world. The HBV is a DNA virus measuring 42-47nm in diameter, which enters the liver via the bloodstream (Liang, 2009). The transmission of virus occurs through contact with infected blood, semen, vaginal secretions, and other body fluids. The most common routes include unprotected sexual contact, contaminated blood transfusions, unsafe use of needles, and mother-to-child transmission during childbirth, and horizontal transmission among children in early childhood (WHO, 2012). Approximately, 90% of HBV cases occur in developing countries, with nearly 50 million infections reported only in Africa. Globally, HBV ranks as the tenth leading cause of death, responsible for an estimated one million deaths annually. It is implicated in up to 80% of hepatocellular carcinoma (HCC) cases worldwide, making it second only to tobacco among known human carcinogens. Currently, an estimated 400 million individuals are chronic carriers of the hepatitis-B surface antigen (HBsAg), with nearly one million HBV-related deaths are reported each year (Lavanchy et al., 2004).

However, HBV is a DNA virus first identified in the 1960s. According to the International Committee on Taxonomy of Viruses (ICTV), it belongs to the genus *Orthohepadnavirus* within the family *Hepadnaviridae*. It is one of the few DNA viruses that replicate via reverse transcription of a viral RNA intermediate (Seeger et al., 2007). More broadly, hepatitis refers to inflammation of the liver, which can result from viral infections, bacterial infections, toxic chemicals, aerosol sprays, or drugs. Inflammation is a localized immune response characterized by redness, pain, and swelling caused by injury or infection of tissues. Hepatitis may also arise from autoimmune disorders, where the immune system mistakenly targets healthy liver cells (Ganem et al., 2004; Ganem and Prince, 2004). The infection rate of hepatitis-B virus (HBV) has declined significantly in developed countries. For example, in the United States, the incidence of acute HBV infection decreased by approximately 78% between 1990, and 2005. In contrast, developing and underdeveloped countries, including Pakistan, have not experienced a comparable reduction. This persistent burden is largely attributed to the high cost of antiviral drugs, insufficient vaccination coverage, limited public awareness, and inadequate healthcare management strategies (Hanif et al., 2013).

Additionally, HBV can be detected in various body fluids, including blood, saliva, sweat, breast milk, tears, urine, vaginal secretions, semen, and menstrual blood. Due to its ability to remain stable outside the body, the virus is easily transmitted through vertical (mother-to-child), parenteral, and mucosal routes of exposure. The incubation period ranges from 45 to 160 days, with prenatal vertical transmission representing the most common mode worldwide (Wright, 2006). Additionally, the transmission routes of HBV are comparable to those of hepatitis-C virus (HCV). The major risk factors include transfusion of unscreened blood or blood products, use of unsterilized surgical or dental instruments, shaving with contaminated razors at local barbershops, ear, and nose piercing, tattooing with unsterilized needles, and sharing personal items such as toothbrushes with infected individuals. In addition, poor infection-control practices in healthcare facilities, particularly during surgery, and dialysis (Kumar et al., 2017).

Moreover, Hepatitis-B virus (HBV) is responsible for approximately 300 million cases of chronic liver disease worldwide. In India, the average prevalence of hepatitis-B surface antigen (HBsAg) among healthy blood donors is about 4.7%, representing an estimated 43 million chronic HBV carriers (Arora et al., 2005). The clinical outcome of HBV infection depends on the host

immune response, if the immune system successfully clears the virus, symptoms resolve within weeks to months, a condition referred to as acute hepatitis-B. However, in individuals unable to completely eliminate the virus, chronic hepatitis-B develops (Shepard et al., 2006). However, in Pakistan, a nationwide study conducted by the Pakistan Medical Research Council (PMRC) between July 2007, and May 2008 reported an overall HBV prevalence of 2.5% in the general population (Qureshi et al., 2010). Inter-provincial variation was observed, with the highest prevalence in Baluchistan (4.3%), followed by Sindh (2.5%), Punjab (2.4%), and Khyber Pakhtunkhwa (1.3%) (Chaudhary et al., 2005). Globally, the World Health Organization (WHO, 2002) estimated that approximately 350 million people live with chronic HBV infection, leading to about 563,000 deaths annually (Qureshi et al., 2010). Pakistan, administratively divided into four provinces Punjab, Sindh, Khyber Pakhtunkhwa, and Balochistan, the Federally Administered Tribal Areas (FATA), and parts of Jammu and Kashmir, represents one of the regions most affected by HBV in South Asia. Moreover, although developing regions such as Africa, Asia, and the Pacific Islands exhibit a high prevalence of hepatitis-B virus (HBV), prevalence rates are comparatively low in developed regions such as Europe, North America, and Australia (Schweitzer et al., 2015). In many developed countries, including Western Europe, and North America, the primary routes of HBV transmission are sexual activity, unsafe needle use, injection drug use, and exposure to contaminated instruments, particularly during young adulthood (Piot et al., 1990).

Further, the high prevalence of hepatitis-B virus (HBV) in Pakistan imposes a substantial burden on patients, and their families, particularly those with low socioeconomic status. This is especially concerning given that approximately 67.5% of Pakistan population resides in rural areas with limited economic resources (Khan et al., 2011). The report shows that HBV prevalence rates in Pakistan vary considerably across different population groups such as 2-10% among healthy blood donors, 5-95% among healthcare personnel, 3.6-18.66% in the general population, and 3-16% among pregnant women (Khan et al., 2010). Regionally, the prevalence rates have been reported as 2.4% nationwide, 2.5% in Sindh, 2.4% in Punjab, 1.3% in Khyber Pakhtunkhwa, and 4.3% in Baluchistan (Ali et al., 2011). According to Pakistan Institute of Medical Sciences (PIMS) in Islamabad, HBV prevalence among hospital patients was reported as 2.8% (Basit et al., 2014). Among Afghan refugees, a high prevalence of hepatitis-B surface antigen (HBsAg) (8.3%) has been reported, primarily linked to unsafe injection practices. This creates a persistent, and often unrecognized chain of HBV transmission in displaced populations, posing a significant public health challenge even when preventive measures are implemented (Quddus et al., 2006). This study was conducted across all seven tehsils of District Bajaur to assess the prevalence and distribution of hepatitis-B. The primary objectives were to determine the overall prevalence of hepatitis-B, and its distribution by tehsil, age, and gender. In addition, the study aimed to evaluate the occurrence of different types of hepatitis within the district. These findings are intended to provide baseline data for future planning, prevention, and control strategies against hepatitis in the region.

2. Methodology

2.1 Study Area

Bajaur is a tribal district of Khyber Pakhtunkhwa (KP), located at latitude 71°25′27.77″E and longitude 71°25′47.77″N, with an elevation of 1,195.72 m above sea level. The district covers an area of approximately 1,290 km², and has a population of 1,093,684, according to the 2017 national census. Administratively, it comprises seven tehsils, 120 village councils, and seven neighborhood councils. Formerly part of the Ex-Federally Administered Tribal Areas (Ex-FATA), Bajaur was recently merged into Khyber Pakhtunkhwa Province. Geographically, Bajaur shares its western boundary with Afghanistan Kunar Valley, separated by rugged extensions of the Hindu Kush Mountains, with notable passes including Nawa Pass, Ghakhi Pass, and Letai Sar. To the south, it borders the Mohmand tribal

district, while to the east, across the Panjkora River, lie the Malakand hills overlooking Batkhela, and Dargai. The northern boundary is marked by a watershed separating Bajaur from the small tehsil of Dir. The district experiences an extreme climate. The winter session begin in November, and extend until the end of March, characterized by severe cold (**Figure.1**; Ali et al., 2017).

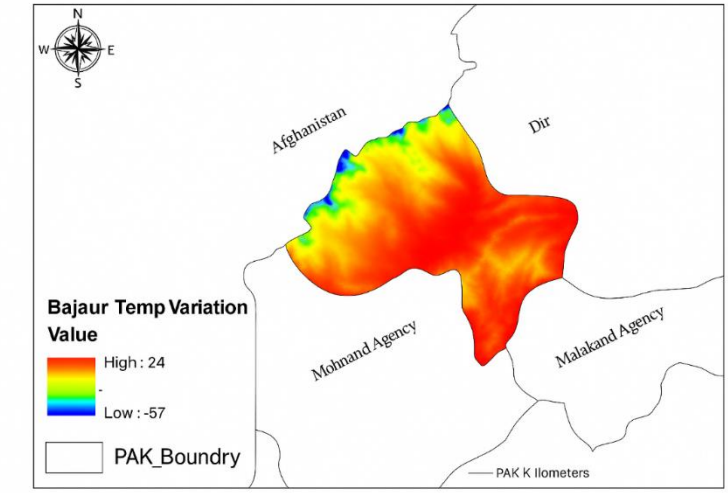

Figure .1 Map showing the location of district Bajaur.

2.2 Study design and population

The patients diagnosed with Hepatitis-B were randomly selected from all seven tehsils of District Bajaur. The study was conducted over a three month period, from 15 March 2022 to 20 June 2022. A random sampling strategy was employed to ensure representative participation from each tehsil. Only confirmed cases were included to maintain accuracy of data. This approach allowed for a comprehensive assessment of Hepatitis-B distribution across the district.

2.3 Research population

The target population for this study consisted of 260 individuals. These participants were selected to represent the general population of District Bajaur. Inclusion criteria were applied to ensure that only relevant, and confirmed cases were considered. The sample size was considered sufficient to provide reliable findings for the study objectives.

2.4 Sampling procedure

In this study, patients diagnosed with Hepatitis-B were randomly selected from different areas across District Bajaur. A structured questionnaire was administered to collect relevant information from each participant. Patients were asked to provide their names, family history, and daily activities. In addition, demographic details such as area of residence, age, and gender were carefully recorded. This approach ensured the collection of both clinical, and socio-demographic data for a comprehensive analysis.

2.5 Laboratory technique

The blood samples were collected from the study population, and analyzed in the virology laboratory of DHQ Hospital Bajaur for the detection of hepatitis-B surface antigen (HBsAg) using the immune chromatographic test (ICT). Approximately, 1mL of venous blood was drawn from each patient into a sterile test tube. The samples were centrifuged at 3000 rpm for 3 minutes to separate plasma. Subsequently, 1-2 drops of plasma were placed into the sample well using a sterile dropper, and results were read after 15-20 minutes. Laboratory diagnosis focused on detecting HBsAg, where a positive test indicated

an active hepatitis-B infection (Okonko et al., 2012).

2.6 Statistical Analysis

In this study all the statistical analyses were carried out by using Microsoft Office Excel, 2010. The prevalence rate of hepatitis-B was calculated using the standard epidemiological formula adopted from Ali et al., (2011). This formula allowed for the determination of the proportion of positive cases within the total population examined. The collected data were organized, and tabulated to ensure clarity, and accuracy in reporting. The use of this approach provided a reliable estimate of the prevalence of hepatitis-B in the study area.

2.7 Ethical issue

Permission to conduct this study was obtained from the virology laboratory of DHQ Hospital Bajaur. The formal approval ensured that the research complied with institutional guidelines, and ethical standards. The laboratory provided access to the necessary diagnostic facilities for testing hepatitis-B surface antigen (HBsAg). This collaboration enabled accurate screening of participants from District Bajaur. The ethical considerations were strictly observed to maintain the rights, and confidentiality of all individuals involved in the study.

3. Results

The present study was carried out to investigate the prevalence of Hepatitis-B, and Hepatitis-C in District Bajaur, Khyber Pakhtunkhwa, Pakistan. The data were obtained from laboratory records spanning a six-month period, and were collected from government hospitals located in Khar, Mamund, Nawagai, and Salarzai regions. These data represented patients from all seven tehsils of the district. A total of 252 laboratory reports were reviewed, including both positive, and negative cases. Out of these, 18 cases (6.9%) were tested positive, while 240 cases (93.1%) were tested negative (**Table. 1**). The positive cases were further classified according to age, gender, and tehsil to identify potential patterns of distribution. However, a tehsil-wise comparison of the results has been summarized in the subsequent tables. This approach provides a clearer understanding of how Hepatitis-B, and Hepatitis-C are distributed across different demographic and geographic groups within the district. The findings are important for guiding public health strategies aimed at controlling viral hepatitis in Bajaur.

3.1 Assessing the distribution of Hepatitis-B based on Gender and Age

In the present study, a total of 260 hepatitis patients were randomly selected. Among these, 190 were male, and 70 were female. In the male group, the highest prevalence of Hepatitis B was observed in the age group 30-40 years (44.73%), followed by 20-30 years (23.68%), 10-20 years (15.78%), 40-50 years (10.52%), and 50-60 years (5.26%). In contrast, among female patients, the highest infection rate was reported in the age group 10–20 years (64.28%), while the lowest prevalence was observed in the 30–40 years group. No cases of Hepatitis B were reported in female patients above 40 years of age (**Table. 1; Figure. 2**).

Table. 1 Shows the Age and Gender wise distribution of Hepatitis-B in the district.

Age	Male	Male%	Female	Female%
10-20	30	15.78	45	64.28
20-30	45	23.68	0	0
30-40	85	44.73	25	35.71
40-50	20	10.52	0	0
50-60	10	5.26	0	0
Total	**190**	**99.97**	**70**	99.99

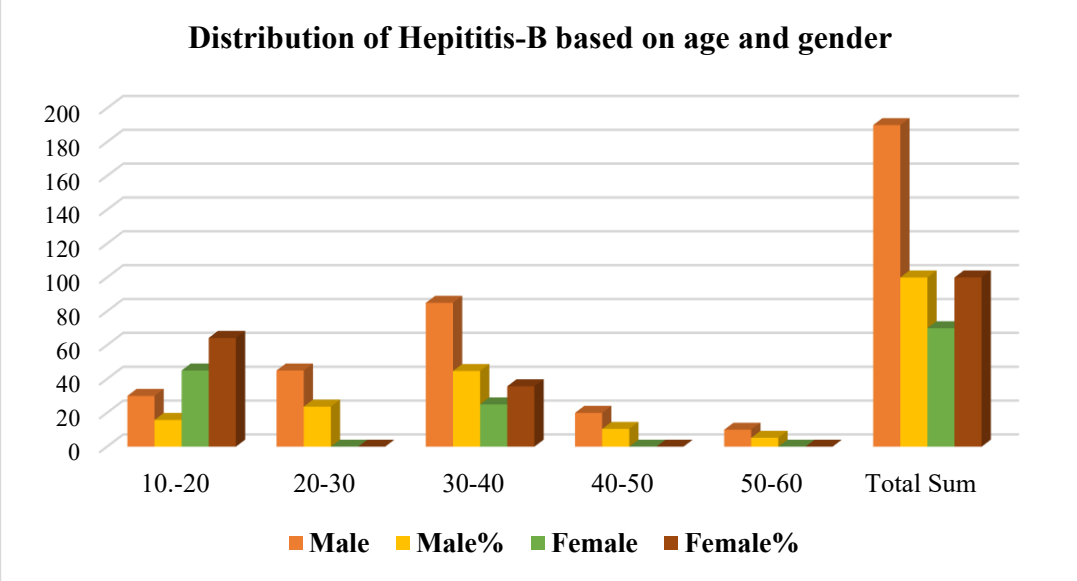

Figure. 2 The Age and Gender wise distribution of Hepatitis-B in the district.

3.2 Assessing the distribution of Hepatitis B based on Gender and Tehsil

A total of 225 male and 35 female patients of Hepatitis-B were randomly selected from the seven tehsils of Bajaur District, namely Mamund, Nawagai, Salarzai, Utmankhel, Khar, Chamarkand, and Barang. Statistical analysis revealed that among male patients, the highest prevalence was recorded in Tehsil Mamund (22.22%) and Nawagai (17.77%), followed by Salarzai, Utmankhel, and Khar (13.33% each). The lowest prevalence was reported in Tehsil Chamarkand (8.88%) and Barang (11.11%). In contrast, among the 35 female patients, the highest proportion of cases was observed in Tehsil Mamund (71.42%), followed by Khar (28.57%). There were no female patient were reported from the remaining tehsils (**Table. 2; Figure. 3**).

Table. 2 Shows Tehsil wise distribution of male and female patients.

Tehsil	Male	Male %	Female	Female %	Total Patients
Mamund	50	22.22	25	71.42	75
Nawagai	40	17.77	0	0	40
Salarzai	30	13.33	0	0	30
Utmankhel	30	13.33	0	0	30
Khar	30	13.33	10	28.57	40
Chamarkand	20	8.88	0	0	20
Barang	25	11.11	0	0	25
Total	**225**	**99.97**	**35**	**99.99**	**260**

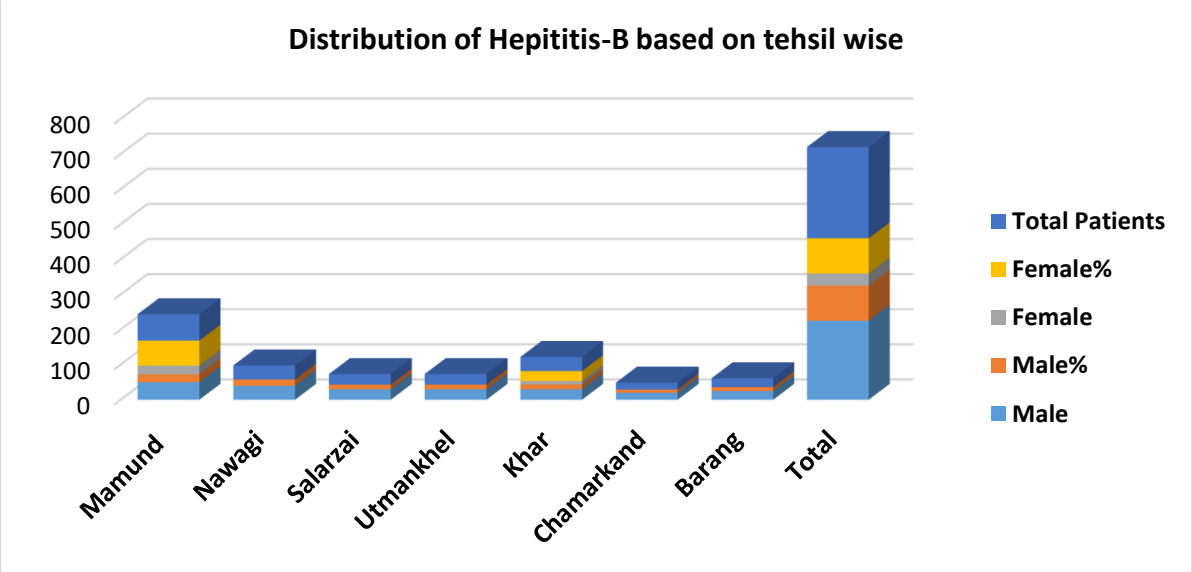

Figure. 3 Tehsil wise distribution of male and female patients.

3.3 Assessing the patients based on disease symptoms

The statistical analysis revealed that clinical symptoms varied among Hepatitis B patients in the study population. Fatigue and fever were the most commonly reported symptoms, affecting approximately 90 patients. Jaundice was observed in 60 patients, while 50 patients presented with dark-colored urine. In addition, 20 patients reported physical weakness as a primary symptom of infection. These findings indicate that fatigue, fever, and jaundice are the most prevalent clinical manifestations associated with Hepatitis B in the study area (**Table. 3; Figure. 4**).

Table. 3 Distribution of Patients on the bases of disease symptoms.

Symptoms	Number of patients	Percentage
Jaundice	60	23.07
Fatigue and fever	90	34.61
Dark urine	50	19.23
Weakness	20	7.69
Nausea and vomiting	40	15.38

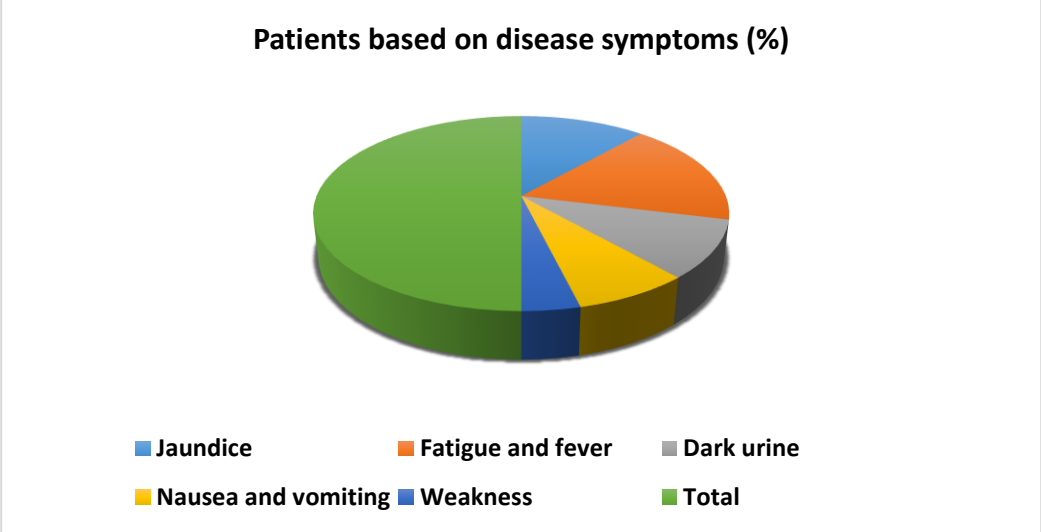

Figure. 4 Distribution of patients on the bases of disease symptoms.

4. Discussion

In this study, a total of 260 patients were examined, including 190 males (73.07%), and 70 females (26.92%). Among them, 18 cases (6.92%) of Hepatitis-B were reported in males, while 2 cases (0.76%) were reported in females. The highest prevalence of Hepatitis-B was observed among males aged 30-40 years. Similarly, Hepatitis-C infections were identified in both sexes, with 15 cases (5.7%) in males and 5 cases (1.9%) in females, predominantly within the 30-40 years age group. Hepatitis-E was also reported in both genders, with a prevalence of 0.38% in each. To the best of our knowledge, this is the first study investigating the prevalence of Hepatitis-B in District Bajaur. Globally, the burden of Hepatitis-B remains a major public health concern. The highest prevalence has been reported in the Western Pacific Region (6.2%) and the African Region (6.1%) (Hennessey et al., 2013; Schweitzer et al., 2015). The HBV infection is highly endemic in parts of Africa and Asia, where prevalence ranges from 5% to 20% (Shin et al., 2006). Worldwide, approximately 350 million individuals are living with chronic HBV infection (WHO, 2011). Hepatitis-B is estimated to cause about 563,000 deaths annually, primarily due to liver cirrhosis and hepatocellular carcinoma (WHO, 2006).

Among Afghan refugees, a high prevalence of HBsAg (8.3%) has been reported, largely attributed to unsafe injection practices. These practices contribute to a persistent and often unrecognized transmission chain of Hepatitis-B within displaced populations, representing a significant public health challenge even when preventive measures are implemented (Quddus et al., 2006). The burden of HBV infection can be reduced through regular health education programs that promote awareness, safe injection practices, and adherence to infection control protocols among healthcare providers serving refugee populations. Globally, approximately 90% of HBV cases occur in developing countries, with nearly 50 million cases reported from Africa. Hepatitis-B is the tenth leading cause of death worldwide, responsible for an estimated one million deaths annually (Lavanchy, 2004). Furthermore, HBV is implicated in up to 80% of hepatocellular carcinoma cases globally, making it the second most important human carcinogen after tobacco (Lavanchy, 2004).

The infection rate of HBV has decreased significantly in developed countries such as the United States, where acute HBV incidence declined by 78% between 1990 and 2005. In contrast, in many developing and underdeveloped countries, including Pakistan, the infection rate

has not declined to an appreciable level. This persistence has been attributed to the high cost of antiviral drugs, limited vaccination coverage, low public awareness, and inadequate management strategies to address the disease burden (Hanif et al., 2013). The transmission routes of Hepatitis-B virus are similar to those of HCV. Major risk factors include the use of unsterilized surgical or dental instruments, transfusion of unscreened blood or blood products, shaving with contaminated razors by local barbers, ear and nose piercing, tattooing with unsterilized needles, sharing toothbrushes with infected individuals, and dialysis or medical procedures conducted in poorly equipped healthcare settings (Kumar et al., 2017). According to the present study, the prevalence of Hepatitis B was higher in males (6.9%) compared to females (0.76%) in District Bajaur. This gender disparity may be linked to the higher mobility of males, who frequently travel to other cities and provinces in search of employment, thereby increasing their exposure to risk factors. Clinically, acute Hepatitis-B infection may present with liver inflammation, jaundice, and fever. Chronic infection, however, can progress to cirrhosis and hepatocellular carcinoma, conditions with limited therapeutic options and poor prognosis (Ali et al., 2009).

In our study, the most common clinical symptoms observed among Hepatitis-B patients were jaundice, fever, nausea, vomiting, and dark-colored urine. In Pakistan, the prevalence of HBV has been reported to range from 2-10% among healthy blood donors, 5-95% among healthcare personnel, 3.6-18.66% in the general population, and 3-16% among pregnant women (Khan et al., 2010; Khan et al., 2011). The regional reports indicate prevalence rates of 2.4% in Pakistan overall, 2.5% in Sindh, 2.4% in Punjab, 1.3% in Khyber Pakhtunkhwa, and 4.3% in Balochistan (Qureshi et al., 2010). Furthermore, a study conducted at the Pakistan Institute of Medical Sciences, Islamabad, reported a prevalence of 2.8% among hospital patients (Basit et al., 2014). Our findings are consistent with previous research, as the highest infection rates of Hepatitis-B and C in District Bajaur were observed among males in the 30-40 years age group.

5. Conclusion

This study was conducted to determine the prevalence of Hepatitis-B and C in District Bajaur. The findings revealed that the highest infection rate of Hepatitis-B (6.9%) and Hepatitis-C (6.1%) occurred among males in the 30-40 years age group. In contrast, the prevalence of both infections was very low among females, and no cases were reported in children (both males and females) below 10 years of age. The study also highlights that most affected individuals were non-educated, smokers, and frequently traveled to other cities and provinces in search of employment, which may increase their exposure to risk factors. These results emphasize the need for targeted awareness programs, improved screening, and preventive strategies to reduce the burden of Hepatitis-B and C in the region. The study recommended that the Ministry of Health should establish additional vaccination centers at the district level to enhance accessibility and coverage. Furthermore, both the government and non-governmental organizations (NGOs) need to expand the currently available prevention facilities and implement effective infection control and prevention strategies. Awareness campaigns should be organized in universities and colleges to educate students about the benefits and protective role of Hepatitis vaccination. In addition, stronger coordination between the Ministry of Health and the Ministry of Education is necessary to discuss the findings of this study and to integrate preventive measures into community health and educational programs.

Declaration

Acknowledgment: The author is grateful to the GPGC Khar Bajaur for providing support, and facilities in the preparation of manuscript.
Funding: This study received no external funding.
Conflict of interest: The author declares no conflict of interest.

Author's contribution:

Ikramud Din[1], Farman Ullah[*11] and Ashfaq Ahmad[2] conceived the main idea, Sabeeh Ullah[4], Ilyas Ahmad[5] and Azhar Ullah[8] designed the

methodology, Ikramud Din[1], Ishaq Ahmad[6], Nazima[7] and Kalsoom[10], helps in data collection, Sabeeh Ullah[4] and Muhammad Mustafa[9] design references, Ikramud Din[1], Farman Ullah[*11], Ashfaq Ahmad[2] and Farman Ullah[3] helps in scientific writing, critical review and final approval of the draft.

References

Ahmad, A., Khan, W., Das, S. N., Pahanwar, W. A., Khalid, S., Mehmood, S. A., & Maqbool, A. (2020). Assessment of ecto and endo parasites of Schizothorax plagiostomus inhabiting river Panjkora, Khyber Pakhtunkhwa, Pakistan. *Brazilian Journal of Biology*, *81*, 92-97.

Ali, S. A., Donahue, R. M., Qureshi, H., & Vermund, S. H. (2009). Hepatitis B and hepatitis C in Pakistan: prevalence and risk factors. *International journal of infectious diseases*, *13*(1), 9-19.

Ali, K., Ullah, F., Khan, N., Rahman, I. U., Ullah, S., Khan, W., & Nisar, M. (2017). Ethnobotanical and ecological study of Myrtus communis (L.) in Bajaur agency (FATA) Khyber-Pakhtunkhwa, Pakistan. *J of Biod and Envir Sci (JBES)*, *11*(1), 152-164.

Allenbach, Y., Chaara, W., Rosenzwajg, M., Six, A., Prevel, N., Mingozzi, F., & Benveniste, O. (2014). The response and systemic treg deficiency in inclusion body myositis. *PloS one*, *9*(3), e88788.

Arora, D. R., Sehgal, R., Gupta, N., Yadav, A., Mishra, N., & Siwach, S. B. (2005). Prevalence of parenterally transmitted hepatitis viruses in clinically diagnosed cases of hepatitis. *Indian journal of medical microbiology*, *23*(1), 44-47.

Ali, M., Idrees, M., Ali, L., Hussain, A., Ur Rehman, I., Saleem, S., & Butt, S. (2011). Hepatitis B virus in Pakistan: a systematic review of prevalence, risk factors, awareness status and genotypes. *Virology journal*, *8*(1), 102.

Bhatti, F. A. (1996). Epidemiology of hepatitis C virus in blood donors in Northern Pakistan. *PAFMJ-Pakistan Armed Forces Medical Journal*, *46*(2), 91-92.

Brewer, K. R., & Hanif, M. (2013). *Sampling with unequal probabilities* (Vol. 15). Springer Science & Business Media.

Basit, A., Rahim, K., Ahmad, I., Shafiq, M., Mushtaq, S., Shaheen, H., & Khan, I. (2014). Prevalence of hepatitis B and C infection in Pakistan. *J Inf Mol Biol*, *2*(3), 35-8.

Cao, J., & Ramsay, J. O. (2007). Parameter cascades and profiling in functional data analysis. *Computational Statistics*, *22*(3), 335-351.

Chao, J., Chang, E. T., & So, S. K. (2010). Hepatitis B and liver cancer knowledge and practices among healthcare and public health professionals in China: a cross-sectional study. *BMC Public Health*, *10*(1), 1-11.

Flisiak, R., Halota, W., Jaroszewicz, J., Juszczyk, J., Małkowski, P., Pawłowska, M., & Wawrzynowicz-Syczewska, M. (2017). Recommendations for the treatment of hepatitis B in 2017. *Clinical and experimental hepatology*, *3*(2), 35-46.

François, G., Dochez, C., Jeffrey Mphahlele, M., Burnett, R., Van Hal, G., & Meheus, A. (2008). Hepatitis B vaccination in Africa: mission accomplished? *Southern African Journal of Epidemiology and Infection*, 23(1), 24-28.

Ganem, D., & Prince, A. M. (2004). Hepatitis B virus infection natural history and clinical consequences. *New England Journal of Medicine*, *350*(11), 1118-1129.

Ganem, D., & Prince, A. M. (2004). Hepatitis B virus infection—natural history and clinical consequences. *New England journal of medicine*, *350*(11), 1118-1129.

Hanif, M., Zaidi, P., Habib, S., Ahmed, A., Raza, A., Ahmed, S., & Irfan, J. (2013). Study of genotypes and subgenotypes of Hepatitis B virus prevalent in big cities of Pakistan. *Afr J Microbiol Res*, *7*(3), 152-7.

Hytiroglou, P. (2004, January). Morphological changes of early human hepatocarcinogenesis. In *Seminars in liver disease* (Vol. 24, No. 01, pp. 65-75). Copyright© 2004 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, *New York*, NY 10001, USA.

Kumar, S., Soukup, M., & Elbaum, R. (2017). Silicification in grasses: variation between different cell types. *Frontiers in Plant Science*, *8*, 438.

Khan, F., Akbar, H., Idrees, M., Khan, H., Shahzad, K., & Kayani, M. A. (2011). The prevalence of HBV infection in the cohort of IDPs of war against terrorism in Malakand Division of Northern Pakistan. *BMC infectious diseases*, *11*(1), 176.

Khan, F., Shams, S., Qureshi, I. D., Israr, M., Khan, H., Sarwar, M. T., & Ilyas, M. (2011). Hepatitis B virus infection among different sex and age groups in Pakistani Punjab. *Virology journal*, *8*(1), 225.

Liang, T. J. (2009). Hepatitis B: the virus and disease. *Hepatology*, *49*(S5), S13-S21.

Lavanchy, D. (2004). Hepatitis B virus epidemiology, disease burden, treatment, and current and emerging prevention and control measures. *Journal of viral hepatitis*, *11*(2), 97-107.

Muhammad Ali, M. A., Muhammad Idrees, M. I., Liaqat Ali, L. A., Abrar Hussain, A. H., Irshad-ur-Rehman, I. U. R., Sana Saleem, S. S., & Sadia Butt, S. B. (2011). Hepatitis B virus in Pakistan: a systematic review of prevalence, risk factors, awareness status and genotypes.

Okonko, I. O., Okerentugba, P. O., Adeniji, F. O., & Anugweje, K. C. (2012). Detection of hepatitis B surface antigen (HBsAg) among intending apparently healthy blood donors. *Nat Sci*, *10*(4), 69-75.

Piot, P., Goilav, C., & Kegels, E. (1990). Hepatitis B: transmission by sexual contact and needle sharing. *Vaccine*, *8*, S37-S40.

Qureshi, H., Bile, K. M., Jooma, R., Alam, S. E., & Afrid, H. U. R. (2010). Prevalence of hepatitis B and C viral infections in Pakistan: findings of a national survey appealing for effective prevention and control measures. *EMHJ-Eastern Mediterranean Health Journal*, *16 (Supp.), 15-23, 2010*.

Quddus, A., Luby, S. P., Jamal, Z., & Jafar, T. (2006). Prevalence of hepatitis B among Afghan refugees living in Balochistan, Pakistan. *International Journal of Infectious Diseases*, *10*(3), 242-247.

Shepard, C. W., Simard, E. P., Finelli, L., Fiore, A. E., & Bell, B. P. (2006). Hepatitis B virus infection: epidemiology and vaccination. *Epidemiologic reviews*, *28*(1), 112-125.

Seeger, C., Zoulim, F., & Mason, W. S. (2007). Hepadnaviruses, p. 2977–3030In Knipe DM, Howley PM (ed.), *Fields virology*.

Schweitzer, A., Horn, J., Mikolajczyk, R. T., Krause, G., & Ott, J. J. (2015). Estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2013. *The Lancet*, *386*(10003), 1546-1555.

World Health Organization. (2012). Prevention and control of viral hepatitis infection: framework for global action (No. WHO/HSE/PED/HIP/GHP 2012.1). *World Health Organization*.

Wright, T. L. (2006). Introduction to chronic hepatitis B infection. *Official journal of the American College of Gastroenterology| ACG*, *101*, S1-S6.

World Health Organization. (2011). Progress towards meeting the 2012 hepatitis B control milestone: WHO Western Pacific Region, 2011= Progrès réalisés en vue de respecter l'échéance de 2012 concernant la lutte contre l'hépatite B: Région OMS du Pacifique occidental, 2011. *Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire*, *86*(19), 180-188.