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Epidemiology of Hepatitis B and C Viruses in the General Population of Dera Ismail Khan District (D.I. Khan) Pakistan

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ABSTRACT

Objective: This study aimed to determine the prevalence and epidemiology of hepatitis B (HBV) and hepatitis C (HCV) in the general population of Dera Ismail Khan, Pakistan, and to identify demographic and biochemical associations. **Methods:** A cross-sectional study was conducted involving 1,244 individuals randomly selected across various age groups and genders. Blood samples were collected and analyzed using immunochromatographic testing (ICT) and enzyme-linked immunosorbent assay (ELISA) to detect HBV surface antigen (HBsAg) and HCV-specific antibodies. Biochemical analysis of alanine transaminase (ALT) was performed using Microlab 300 (Merck, USA). Statistical analysis was conducted using SPSS version 25 to evaluate associations between demographic variables and disease prevalence. **Results:** The overall prevalence of HBV and HCV was 25.72%. HBV was detected in 228 (29%) individuals, with a higher prevalence in males (34.31%) compared to females (19.20%) and the 16-30 years age group (43.17%). HCV was identified in 92 (20.08%) individuals, with males (22.05%) more affected than females (17.43%), and the 46-60 years age group showing the highest prevalence (27.82%). ALT levels were significantly elevated in infected individuals, with mean values of 111.63 ± 101.38 in males and 143.50 ± 52.50 in females. **Conclusion:** The study highlights the substantial burden of HBV and HCV, emphasizing the need for enhanced public health interventions, including vaccination, early screening, and community education, to mitigate the disease burden.

INTRODUCTION

Viral hepatitis is a significant public health challenge globally, characterized by inflammation of the liver and often leading to severe complications, including hepatocellular carcinoma and chronic liver disease. Among the various types of viral hepatitis, hepatitis B (HBV) and hepatitis C (HCV) remain the most pervasive and fatal, particularly in developing countries where healthcare resources are often limited. Hepatitis B virus is recognized as one of the most common infectious diseases worldwide, affecting over two billion people, with approximately 400 million living with chronic HBV infection (1, 2). Similarly, HCV has emerged as a global pandemic, with an estimated prevalence five times higher than that of human immunodeficiency virus type-1 (HIV-1) (3). These infections are predominantly transmitted through contact with infected blood and body fluids, posing substantial risks in medical settings, during unsafe blood transfusions, or through the

reuse of contaminated syringes and surgical instruments (4, 5).

In Pakistan, the burden of HBV and HCV infections is alarmingly high, with recent estimates suggesting that around nine million individuals are infected with HBV, and the prevalence continues to rise (6, 7). A similar trend is observed for HCV, with late-stage diagnoses often leading to poor prognoses due to cirrhosis or hepatocellular carcinoma, particularly among populations with limited access to screening and preventive measures (8, 9). The high endemicity of HBV and HCV in Pakistan can be attributed to multiple socio-economic and cultural factors, including inadequate blood screening practices, unsafe medical procedures, and lack of awareness about transmission risks. Moreover, the transmission of these viruses is exacerbated by factors such as barber-related shaving practices, unregulated blood donations, and intravenous drug use (10, 11).

The epidemiological trends of HBV and HCV also reflect distinct demographic and behavioral patterns. HBV is frequently diagnosed in younger populations, likely due to increased exposure to risk factors such as unsafe healthcare practices and higher social interaction, whereas HCV prevalence is often higher among older age groups, potentially due to cumulative risk exposure over time and weakened immunity (12, 13). Gender differences in prevalence have also been noted, with males exhibiting a higher infection rate than females, possibly due to occupational exposure and greater engagement in risk-prone activities (14). The progression of these infections to chronic stages often correlates with elevated levels of alanine transaminase (ALT), a biochemical marker indicative of liver damage (15).

The present study aims to investigate the epidemiological characteristics of HBV and HCV in the general population of Dera Ismail Khan District, Khyber Pakhtunkhwa, Pakistan. This region, representative of many rural and semi-urban settings in the country, faces significant challenges related to healthcare accessibility and disease awareness. By determining the prevalence of HBV and HCV across different age groups and genders, as well as examining associated biochemical markers such as ALT, this study seeks to provide critical insights into the burden of these infections. Such findings can inform targeted interventions to reduce the transmission and progression of these diseases, ultimately improving public health outcomes in the region. The results are further contextualized with comparisons to other national and international studies, highlighting both the unique and shared challenges faced by populations at risk (16, 17).

MATERIAL AND METHODS

The study was conducted in Dera Ismail Khan District, Khyber Pakhtunkhwa, Pakistan, to explore the epidemiology of HBV and HCV among the general population. The research followed the ethical principles outlined in the Declaration of Helsinki, ensuring that participants provided informed consent before enrollment. Ethical approval for the study was obtained from the institutional review board of the relevant medical authority. A cross-sectional design was employed, with individuals selected randomly to represent various age groups and both genders. Data collection took place over a six-month period, during which demographic and clinical information was recorded.

Blood samples were collected from participants using sterile, disposable syringes. Approximately 5 mL of blood was drawn from each individual and stored at –20°C until further processing. The samples were centrifuged at 1500 rpm for 20 minutes to separate serum, which was subsequently stored in polypropylene tubes. Serological testing for HBV and HCV was performed using immunochromatographic testing (ICT) and enzyme-linked immunosorbent assay (ELISA) methods. The detection of hepatitis B surface antigen (HBsAg) was conducted using the DS-EIA-HBsAg kit (DSI S.r.l., Italy), while the EIA-ANTI-HCV kit (DSI S.r.l., Italy) was utilized for identifying HCV-specific antibodies, following the manufacturer's protocols.

Biochemical analysis of alanine transaminase (ALT) levels was conducted for individuals testing positive for HBV or HCV. ALT was measured using the Microlab 300 analyzer (Merck, USA) and Diasys Diagnostic Systems ALT kits (Germany). Each sample was analyzed twice to ensure accuracy, and results were expressed as mean values with standard deviations.

Data analysis was performed using SPSS version 25. Descriptive statistics, including

frequencies and percentages, were calculated to summarize demographic and clinical characteristics. Chi-square tests were applied to examine associations between categorical variables, such as gender and age groups, with HBV and HCV prevalence. Continuous variables, including ALT levels, were analyzed using independent t-tests or one-way ANOVA as appropriate. A p-value of <0.05 was considered statistically significant.

The study's design ensured strict confidentiality of participants' data, with all identifying information anonymized during analysis. This comprehensive methodological approach allowed for robust examination of the epidemiological patterns of HBV and HCV in the region, providing valuable insights into disease prevalence and associated risk factors.

RESULTS

The study included a total of 1,244 individuals, of whom 458 were screened for HCV and 786 for HBV. The overall prevalence of HBV and HCV infections was 25.72%. Among the 458 individuals screened for HCV, 92 (20.08%) tested positive. Of these, 58 (22.05%) were males and 34 (17.43%) were females. Gender-wise prevalence data are presented in Table 1.

Table 1

Gender-wise Prevalence of HCV

Gender	Total Samples	Anti-HCV Positive (%)	Anti-HCV Negative (%)
Male	263	58 (22.05)	205 (77.95)
Female	195	34 (17.43)	161 (82.57)
Total	458	92 (20.08)	366 (79.92)

The prevalence of HCV was further analyzed across four age groups. The highest prevalence (27.82%) was observed in the 46-60 years age group, followed by 31-45 years (21.21%). The lowest prevalence (13.33%) was noted in the 1-15 years age group, as shown in Table 2.

Table 2

Age-wise Prevalence of HCV

Age Group (Years)	HCV Positive (%)	Total Samples
1-15	18 (13.33)	135
16-30	21 (19.26)	109
31-45	21 (21.21)	99
46-60	32 (27.82)	115
Total	**92 (20.08)**	**458**

Out of the 786 individuals screened for HBV, 228 (29%) were positive for HBsAg. Among males, 175 (34.31%) were positive, while 53 (19.20%) females tested positive. The results are summarized in Table 3.

Table 3

Gender-wise Prevalence of HBV

Gender	Total Samples	HBsAg Positive (%)	HBsAg Negative (%)
Male	510	175 (34.31)	335 (65.69)
Female	276	53 (19.20)	223 (80.80)
Total	786	228 (29)	558 (71)

Age-wise prevalence of HBV indicated the highest infection rate (43.17%) in the 16-30 years age group, followed by the 46-60 years group (31.15%). The lowest prevalence (11.20%) was found in the 1-15 years age group, as detailed in Table 4.

Table 4

Age-wise Prevalence of HBV

Age Group (Years)	HBsAg Positive (%)	Total Samples
1-15	13 (11.20)	116
16-30	98 (43.17)	227
31-45	36 (19.67)	183
46-60	81 (31.15)	260
Total	228 (29)	786

Biochemical analysis of ALT levels in HCV-positive individuals revealed elevated values. Among males, the mean ALT was 111.63 ± 101.38, while females had a mean ALT of 143.50 ± 52.50. These findings indicate significant liver function impairment in infected individuals.

The results underscore the substantial burden of HBV and HCV in Dera Ismail Khan, highlighting critical demographic patterns and associations with liver function abnormalities.

DISCUSSION

The findings of this study revealed a high prevalence of HBV and HCV in the general population of Dera Ismail Khan, with significant variations across gender and age groups. The overall prevalence of HBV and HCV infections, 25.72%, highlights the substantial burden these infections pose in the region. The prevalence of HBV at 29% and HCV at 20.08% underscores the urgent need for improved diagnostic and preventive measures, particularly in resource-limited settings. These findings align with previous studies conducted in Pakistan and other developing

countries, which have consistently reported higher prevalence rates compared to developed regions (6, 8). The higher rates in males compared to females, observed in both HBV and HCV cases, could be attributed to occupational exposures, higher rates of barber visits, and other social behaviors that increase contact with potential transmission sources (10, 11).

The age-wise analysis indicated that younger individuals (16-30 years) were most affected by HBV, while older individuals (46-60 years) had the highest prevalence of HCV. These age-specific trends may reflect differences in transmission dynamics. HBV is often associated with early life exposure, possibly through vertical transmission or unsafe medical practices, whereas HCV prevalence in older populations could be linked to cumulative exposure to risk factors such as unsafe injections or transfusions over time (14, 15). Similar patterns have been reported in other studies, emphasizing the role of age and exposure history in determining disease prevalence (13, 16).

The study's strength lies in its robust sampling strategy and the use of standardized diagnostic methods, including ELISA, to confirm HBV and HCV infections. Moreover, the inclusion of biochemical markers such as ALT provided a comprehensive assessment of liver function in infected individuals. However, certain limitations should be acknowledged. The cross-sectional design limits causal inferences regarding risk factors. Additionally, the study did not explore other potential risk factors, such as socioeconomic status or co-morbidities, which could influence infection rates. The reliance on self-reported data for certain variables may have introduced recall bias, and the exclusion of high-risk populations, such as intravenous drug users or prisoners, may have underestimated the true prevalence.

The elevated ALT levels observed among infected individuals indicate significant liver function impairment, particularly in HCV-positive females, who exhibited higher mean ALT values compared to males. These findings emphasize the need for early detection and management to prevent progression to chronic liver disease or hepatocellular carcinoma (15). Late-stage diagnoses remain a critical challenge in Pakistan, as many individuals only seek medical care when symptoms become severe, limiting the effectiveness of therapeutic interventions (9, 17).

To address the high burden of HBV and HCV in this region, several recommendations emerge from the study. Public health initiatives should prioritize community-based awareness campaigns focusing on transmission risks and prevention strategies, such as safe injection practices and regulated blood screening. Enhanced access to vaccination programs for HBV and the establishment of routine screening protocols for HCV could significantly reduce infection rates (18, 19). Targeted interventions addressing high-risk groups and incorporating comprehensive surveillance systems are also essential to monitor and control the spread of these infections. Further research should consider longitudinal designs to explore causative factors and the impact of interventions over time, as well as the role of genetic and environmental determinants in disease progression (20).

CONCLUSION

This study highlighted the significant burden of hepatitis B and C in the general population of Dera Ismail Khan, with a high prevalence particularly among males and specific age groups. The findings underscore the urgent need for improved public health interventions, including routine screenings, vaccination programs for HBV, and awareness campaigns to mitigate transmission risks. Elevated ALT levels in infected individuals emphasize the importance of early detection and management to prevent severe liver complications. These results provide critical insights for healthcare policymakers to implement targeted strategies, ensuring better prevention, early diagnosis, and treatment, ultimately improving human health outcomes in resource-limited settings.

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