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The Demographic Signature of Hepatitis C in Pakistan: Cross-Sectional Patterns Across Age and Sex

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Abstract

Hepatitis C Virus (HCV) remains a major cause of chronic liver disease, cirrhosis, and hepatocellular carcinoma, and Pakistan continues to experience one of the highest HCV burdens globally. This cross-sectional study estimated HCV prevalence in a sample population from Pakistan and explored variations across age and gender groups. Fifty-seven individuals who underwent HCV testing during routine clinical assessment were included. HCV status was determined using serological testing, and demographic variables were extracted from de-identified records. Overall and subgroup-specific prevalence estimates were calculated with 95% Confidence Intervals (CIs), using the Wilson score method to improve precision in small subgroups. Overall HCV prevalence was 15.79% (9/57; 95% CI: 8.56-27.18). The highest prevalence was observed among participants aged 21-40 years (37.5%; 95% CI: 14.78-69.95), followed by those aged 41-60 years (14.29%; 95% CI: 5.01-33.55) and 61-80 years (12.0%; 95% CI: 4.18-29.75). No positive cases were observed in the 0-20 years or 81+ years groups, although the very wide confidence intervals in these groups reflected limited sample size. Male participants had a slightly higher prevalence (17.14%; 95% CI: 8.13-32.57) than female participants (13.64%; 95% CI: 4.76-33.04), but overlapping confidence intervals suggested no clear gender-based difference. The findings indicate a substantial HCV signal in this sample and emphasize the need for targeted screening, risk-factor assessment, and linkage to curative direct-acting antiviral therapy, particularly among young and middle-aged adults.

Keywords: Hepatitis C Virus; Pakistan; Prevalence; Epidemiology; Age Distribution; Gender; Screening

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Introduction

Hepatitis C Virus (HCV) is a bloodborne pathogen that can cause acute infection, chronic hepatitis, cirrhosis, and hepatocellular carcinoma. The World Health Organization (WHO) estimates that tens of millions of people are living with chronic HCV infection globally, with substantial mortality attributable mainly to cirrhosis and liver cancer [1, 2]. Although Direct-Acting Antivirals (DAAs) can cure more than 95% of treated individuals, elimination remains difficult where diagnosis, infection prevention, and treatment access remain incomplete [1].

Pakistan has a persistently high HCV burden. Reviews and modelling studies describe a generalized and geographically widespread epidemic, with provincial differences but consistently high pooled estimates compared with many other countries [3, 4]. In addition, large population-based data from Punjab have suggested substantial HCV seroprevalence and marked variation by age, geography, and occupational or behavioral risk [5]. Unsafe medical injections, poor sterilization of equipment, unregulated dental or minor surgical procedures, unscreened blood products, and sharing of injection equipment remain important pathways for transmission [1, 3, 5].

Age- and gender-specific prevalence analyses can help identify subgroups that may benefit from prioritized screening and counselling. Younger adults may experience exposures related to occupational risk, injection practices, or high-risk behavior, whereas older adults may carry chronic infections acquired decades earlier. Gender differences can also reflect unequal exposure to healthcare, childbirth-related procedures, occupational risk, and healthcare-seeking behavior, although national data do not always show a consistent male or female predominance [6].

This study therefore aimed to estimate the prevalence of HCV in a Pakistani sample population

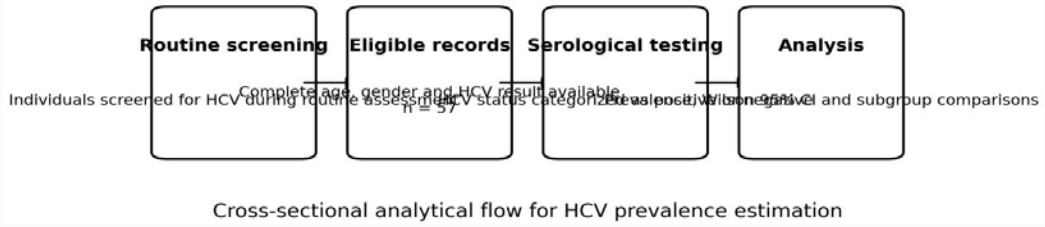

Figure 1: Analytical workflow for the HCV prevalence study.

and to describe differences across age and gender groups. The study was designed as a preliminary cross-sectional analysis to support targeted screening strategies and to generate hypotheses for larger surveillance studies.

Materials and Methods

Study design and setting

A cross-sectional analysis was performed using de-identified records of individuals tested for HCV during routine medical assessment in Pakistan. The study followed an observational design and included all available records with complete HCV status, age, and gender information. The clinical site, study period, and ethics approval number should be inserted by the authors before journal submission.

Participants

The final analytical sample included 57 individuals. Inclusion criteria were: (I) availability of an HCV screening result, (II) recorded age, and (III) recorded gender. Records were excluded if HCV status or essential demographic information was missing. Participants were categorized into five age groups: 0-20, 21-40, 41-60, 61-80, and 81+ years.

Laboratory testing

HCV status was determined by serological testing, reported as positive or negative. Where applicable, the exact assay platform, manufacturer, lot number, and cut-off values should be inserted in accordance with the journal template. If polymerase chain reaction confirmation was performed for HCV RNA, those details should be added in this section.

Statistical analysis

HCV prevalence was calculated as the number of HCV-positive participants divided by the total number tested. Prevalence estimates were expressed as percentages with 95% Confidence Intervals (CIs). Wilson score intervals were used because they provide more stable estimates for small samples and sparse subgroups. Age- and gender-specific prevalence estimates were calculated descriptively, and overlapping CIs were used to guide cautious interpretation of subgroup differences. Statistical analyses can be reproduced using SPSS, R, Python, or equivalent software; the exact package version should be inserted by the authors.

Results

Overall HCV prevalence

Among 57 individuals included in the analysis, nine tested positive for HCV, yielding an overall prevalence of 15.79% (95% CI: 8.56-27.18). The corresponding screening workflow is summarized in Figure 1, and subgroup findings are presented in Tables 1 and 2.

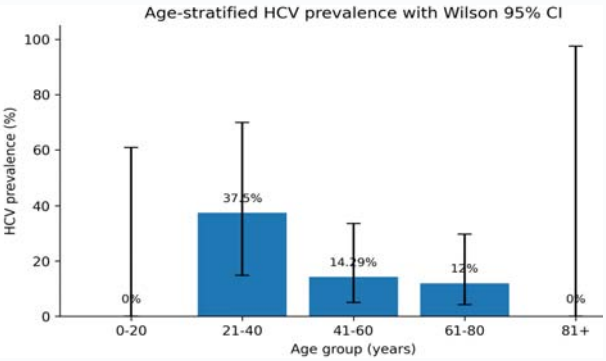

Figure 2: Age-stratified HCV prevalence with Wilson 95% confidence intervals.

Table 1: HCV prevalence and Wilson 95% confidence intervals by age group.

Age group (years)	Total patients	Positive cases	Prevalence (%)	95% CI
0-20	2	0	0	0.00-60.87
21-40	8	3	37.5	14.78-69.95
41-60	21	3	14.29	5.01-33.55
61-80	25	3	12.0	4.18-29.75
81+	1	0	0	0.00-97.50

CI: Confidence Interval; HCV: Hepatitis C Virus

Table 2: HCV prevalence and Wilson 95% confidence intervals by gender.

Gender	Total patients	Positive cases	Prevalence (%)	95% CI
Male	35	6	17.14	8.13-32.57
Female	22	3	13.64	4.76-33.04

CI: Confidence Interval; HCV: Hepatitis C Virus

Age-specific prevalence

HCV positivity varied by age group. The highest prevalence was detected in the 21-40 years age group, where three of eight participants were positive (37.5%; 95% CI: 14.78-69.95). The 41-60 years and 61-80 years groups had similar prevalence estimates of 14.29% and 12.0%, respectively. No HCV-positive cases were recorded in the 0-20 years or 81+ years groups; however, both groups had very small denominators and wide CIs, preventing firm conclusions about true absence of infection (Table 1; Figure 2).

Gender-specific prevalence

Six of 35 male participants and three of 22 female participants were HCV positive. Prevalence was therefore 17.14% among males and 13.64% among females. The overlapping confidence intervals suggest that the observed difference should not be interpreted as evidence of a statistically meaningful gender disparity in this sample (Table 2; Figure 3).

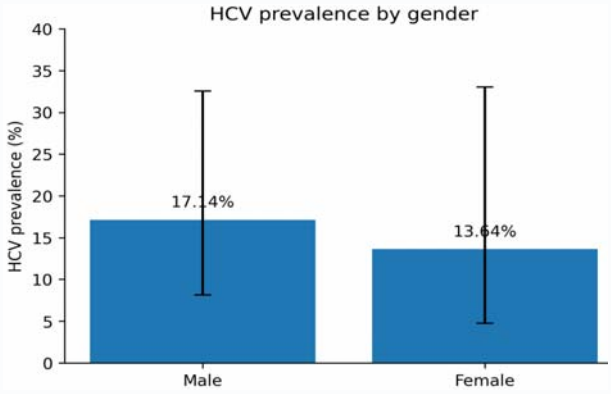

Figure 3: HCV prevalence by gender with Wilson 95% confidence intervals.

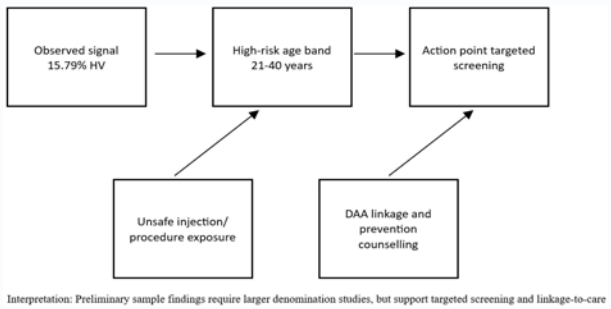

Figure 4: Public health interpretation model linking the observed prevalence signal to screening and linkage-to-care priorities.

Public health interpretation

The sample showed a high overall HCV positivity signal and a concentration of cases in the 21-40 years group. Although the small sample size limits generalizability, the pattern supports the need for risk-informed screening, infection-control reinforcement, and linkage to DAA-based treatment pathways (Figure 4).

Discussion

This cross-sectional analysis found an HCV prevalence of 15.79% in a sample of 57 individuals. This estimate is higher than many national and pooled general-population estimates for Pakistan but is plausible for a clinical or convenience sample in a high-burden setting. Pakistan's HCV epidemic has been described as persistent, geographically widespread, and strongly associated with population risk classification, with markedly higher prevalence in people who inject drugs and other high-risk clinical groups [3, 4].

The highest observed prevalence in the present sample occurred among individuals aged 21-40 years. This finding may reflect contemporary exposure through unsafe injections, informal healthcare practices, dental or minor surgical procedures, occupational exposure, or injection drug use. However, because the denominator in this age group was small, the estimate should be interpreted as a signal requiring confirmation rather than a definitive population prevalence. Larger studies should include risk-factor data, socioeconomic variables, injection history, prior surgery, transfusion history, dental care exposure, and confirmatory HCV RNA testing.

Gender-specific prevalence was slightly higher among males than females, but the confidence intervals overlapped. This is consistent with the mixed pattern reported in Pakistan, where some studies have observed higher male prevalence while others have reported similar or even higher estimates in women depending on geography, sampling frame, and healthcare exposure [5, 6]. The absence of a clear gender difference in this sample indicates that both men and women should remain included in screening and prevention programs.

The clinical and public health implications are important. HCV is now curable in most patients through DAA therapy, yet late diagnosis allows chronic infection to progress and maintains community transmission [1, 2]. A screening-positive result should therefore trigger confirmatory RNA testing, assessment of liver fibrosis, counselling on transmission prevention, evaluation of co-infections, and timely linkage to treatment. Prevention efforts should also address the reuse of syringes, unsafe injection practices, blood safety, infection prevention in dental and surgical settings, and public education [1, 5].

This study has limitations. The small sample size produced wide CIs, especially in the youngest and oldest age strata. The cross-sectional design cannot identify infection timing or causal risk factors. HCV serology alone cannot distinguish active infection from previously cleared or treated infection unless confirmatory RNA testing is performed. The findings should therefore be considered preliminary and hypothesis-generating.

Conclusion

This study demonstrates a substantial HCV positivity signal in a Pakistani sample population, with the highest prevalence observed among participants aged 21-40 years and no clear gender-based difference. The findings support targeted screening, confirmatory testing, infection-prevention measures, and linkage to curative antiviral treatment. Larger, risk-factor-enriched studies are needed to refine age- and gender-specific estimates and guide elimination-oriented strategies in Pakistan.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the relevant institutional review board/ethics committee before data analysis. Because this manuscript was prepared from de-identified routine clinical or programmatic data, the requirement for written informed consent should be confirmed and inserted according to the approving committee policy.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request and subject to institutional permission.

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Competing Interests

The authors declare no competing interests. Authors should update this statement if any competing interest applies.

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