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Original Research Article

Epidemiological Assessment of Hepatitis C Virus Infection among Patients from Swat and Neighboring Districts

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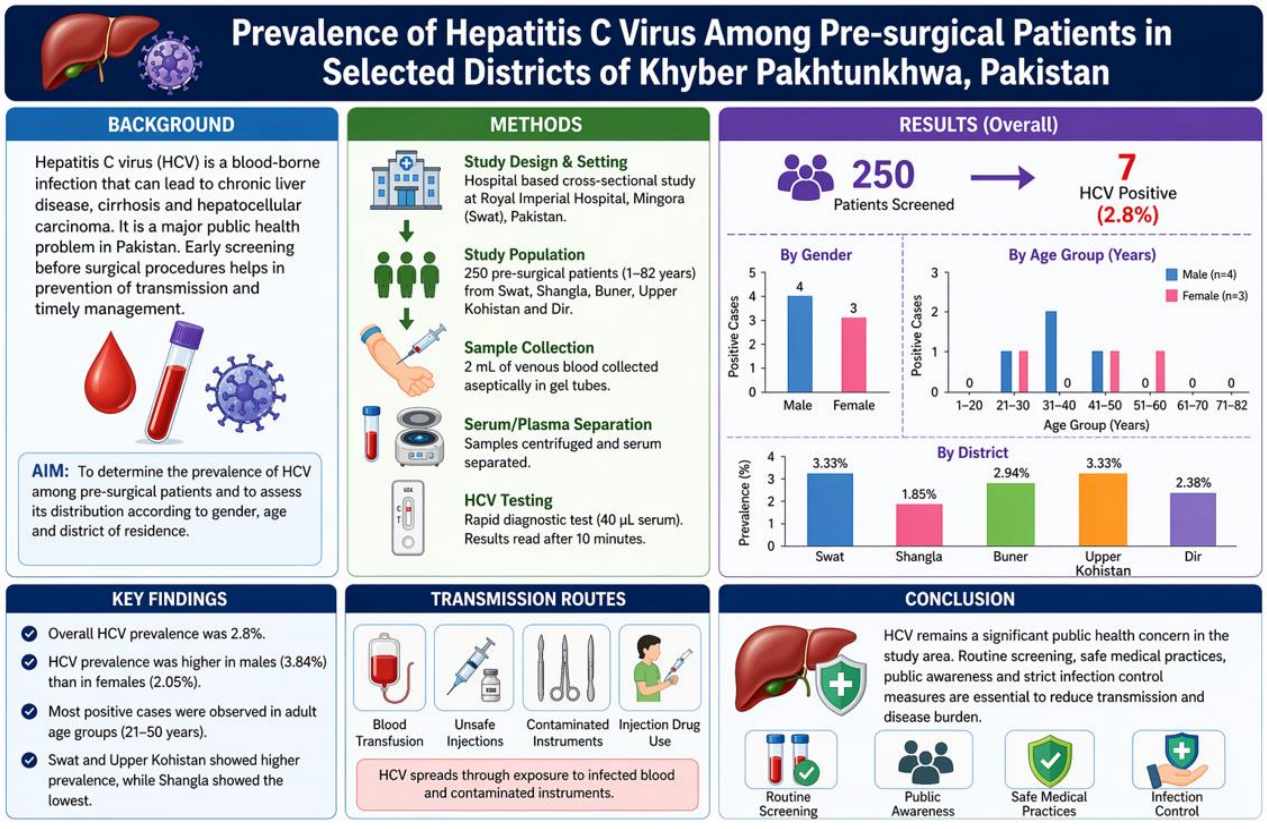
Abstract



Hepatitis C virus (HCV) is a single-stranded, blood-borne, RNA virus, which infects hepatocytes and can cause chronic hepatitis, liver cirrhosis and hepatocellular carcinoma. The task of this hospital-based study was to identify the level of HCV infection in patients in some of the districts of Khyber Pakhtunkhwa, Pakistan. There were 250 patients attending

Royal Imperial Hospital, Mingora, to have pre-surgery assessment. Data analyses were performed based on gender, age group and district of residence. Blood samples were taken, serum/plasma was separated and HCV screening was done by the use of rapid diagnostic device. Among 250 patients, 7 were positive of HCV which constitutes a total of 2.8 prevalence. The positive rate of males was 4 out of 104 with a prevalence of 3.84, and the positive rate of females was 3 out of 146 with a prevalence of 2.05. Analysis by district indicated that most positive cases were in Swat with Shangla having the least prevalence. The distribution in terms of age showed that HCV positivity was more common among the adult age groups than among the young people. The results indicate that HCV is a health issue to the community of the study area especially adults and males. To decrease transmission, better screening, awareness, safe blood transfusion practices, sterilization of surgical and dental instruments, and avoidance of sharing needles are advised.

Keywords: Hepatitis C virus; HCV prevalence; pre-surgical screening; Khyber Pakhtunkhwa; Swat; rapid diagnostic test; gender-wise prevalence.

1. INTRODUCTION

Hepatitis C virus (HCV) is a significant worldwide public health issue and a primary cause of chronic liver disease worldwide (Alberts *et al.,* 2022). It is a positive-sense, enveloped and single stranded non-enveloped RNA virus that falls within the family of Flaviviridae. Hepatocytes of the liver are the main targets of the virus as it replicates there and may cause progressive liver damage (Singh & Kumar, 2025). HCV has chronic infection that results in severe complications, such as liver cirrhosis, hepatocellular carcinoma (HCC), and liver failure, all of which are major contributors to morbidity and mortality worldwide (Dash *et al.,* 2020).

The most common mode of HCV transmission is through exposure to infected blood. The most common modes of transmission include improper sterilization of surgical and dental equipment, unsafe blood transfusion, reuse of contaminated needles and syringes, intravenous drug use and improper sterilization of surgical and dental equipment (Rani, 2016). Sexual transmission can also take place, but is less common than blood-borne methods. The risk of transmission is further enhanced in developing countries such as Pakistan where there is lack of proper screening of blood products and good infection control practices (Shiferaw *et al.,* 2024). Millions of people around the world are infected with HCV and its burden is ever-growing, especially in low- and middle-income nations. Unsafe medical practices, lack of awareness, and inadequate access to healthcare facilities have contributed to high prevalence rates of HCV in Pakistan, which is one of the most prevalent in the world. The spread of HCV also depends largely on injection drug use where a significant proportion of the infections have been reported among intravenous drug users (Javed *et al.,* 2022). HCV infection has a diverse clinical manifestation. HCV is a so-called silent infection because many people with this infection remain without symptoms. In the event that the symptoms occur, they are likely to be fatigue, nausea, abdominal pain, jaundice, and appetite loss (Trickey *et al.,* 2019). With an asymptomatic early infection, most cases are not diagnosed until late liver damage has been reached.

Early and correct diagnosis of HCV is the key to successful management and prevention of the disease (Yang, 2023). There are a number of diagnostic techniques, such as rapid diagnostic tests, enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR). ELISA is usually employed in screening the first time to identify the anti-HCV antibodies and PCR is employed to ascertain active infection and viral load (Yang, 2023).

Whereas the treatment of HCV has been greatly improved due to the invention of direct-acting antiviral (DAA) drugs, there is no viable vaccine that can prevent the infection (Maness *et al.,* 2021). Prevention strategies are therefore important and involve safe blood transfusion, adequate sterilization of medical equipment, needle sharing, and awareness creation among the people. The epidemiological research is necessary to comprehend the distribution and determinants of HCV infection among various groups of people. In Pakistan, the problem of underreporting and remote regions especially Swat and the adjacent districts are limited, with respect to region specific data. Screening data at the hospital can give important information on the prevalence of HCV and aid in identifying high-risk populations (Ahmed *et al.,* 2018).

National or provincial prevalence estimates may conceal substantial geographic variation because access to healthcare, population mobility, socioeconomic conditions, blood-screening coverage, and infection-control practices differ between districts. Evidence from relatively underserved and mountainous districts of Khyber Pakhtunkhwa remains limited, particularly among patients undergoing routine preoperative screening. Hospital screening records cannot provide population-level prevalence, but they can offer useful sentinel information regarding anti-HCV seropositivity among individuals accessing surgical services and may help identify groups requiring confirmatory testing and linkage to care.

Therefore, this study aimed to estimate the seroprevalence of anti-HCV antibodies among patients undergoing pre-surgical screening at Royal Imperial Hospital, Mingora, Swat. It also described the distribution of reactive screening results according to sex, age group, and district of residence. The findings are intended to provide preliminary hospital-based evidence that may support improved screening, confirmatory testing, patient referral, and infection-prevention planning in the study area.

2. MATERIALS AND METHODS

2.1. Study Design

A hospital-based cross-sectional study was conducted at Royal Imperial Hospital, Mingora, District Swat, Khyber Pakhtunkhwa, Pakistan. The hospital receives patients from Swat and surrounding districts, including Shangla, Buner, Upper Kohistan, and Dir. Patients undergoing routine preoperative laboratory assessment during the study period constituted the source population (Baumert *et al.,* 2019).

2.2. Study Area

The study included male and female patients aged 1–82 years who attended the hospital for surgical procedures and underwent routine preoperative anti-HCV screening. Participants were selected using sampling. Patients with incomplete demographic records, invalid test results, or refusal to participate were excluded. A total of 250 eligible patients were included in the final analysis (Alshehri *et al.,* 2024).

2.3. Study Population

The study population consisted of patients of both genders, aged 1 to 82 years, who visited the hospital for surgical procedures and were routinely screened for viral infections prior to surgery.

2.4. Sample Size

A total of 250 patients were included in the study using available hospital records and samples collected during the study period.

2.5. Inclusion Criteria

- Patients undergoing pre-surgical screening
- Individuals from selected districts (Swat, Shangla, Buner, Upper Kohistan, Dir)
- Both male and female patients

2.6. Exclusion Criteria

- Patients with incomplete data records
- Patients who refused testing or whose samples were invalid

2.7. Sample Collection

Sterile disposable syringes were used to aseptically collect about 2 mL of the venous blood of each patient. Alcohol swabs were used to disinfect the collection room before sampling to prevent contamination.

2.8. Serum/Plasma Separation

The blood samples collected were centrifuged to isolate serum/plasma and whole blood. The serum was separated and transferred to the labelled sterile tubes where it was stored until testing.

2.9. HCV Detection Method

HCV screening was performed using a rapid diagnostic test (strip/device method) (Young *et al.,* 2019). Approximately 40 µL of serum was added to the test device, and results were observed after 10 minutes according to the manufacturer's instructions.

2.10. Interpretation of Results

- **Positive Result:** Appearance of two lines (Control line "C" and Test line "T")
- **Negative Result:** Appearance of only one control line (C)
- **Invalid Result:** Absence of control line or unclear result

2.11. Data Collection

Patient data, including age, gender, and district of residence, were recorded from hospital records and laboratory reports.

2.12. Data Analysis

The collected data were analyzed using descriptive statistics. Frequencies and percentages were calculated to determine:

- Overall prevalence of HCV
- Gender-wise prevalence
- Age-wise distribution
- District-wise prevalence

3. RESULTS AND DISCUSSION

Results

A total of 250 pre-surgical patients were included, comprising 104 males (41.6%) and 146 females (58.4%). Seven participants had reactive anti-HCV antibody screening results, corresponding to an overall seroprevalence of 2.8%. Participant characteristics and subgroup-specific findings are summarized in Table 1.

Table 1: Demographic characteristics and anti-HCV seroreactivity among pre-surgical patients

Characteristic	Screened	n Reactive	n Seroprevalence%	95% CI
Overall	250	7	2.80	To calculate
Male	104	4	3.85	To calculate
Female	146	3	2.05	To calculate
Swat	Insert	3	3.33	To calculate
Shangla	Insert	1	1.85	To calculate
Buner	Insert	1	2.94	To calculate
Upper Kohistan	Insert	1	3.33	To calculate
Dir	Insert	1	2.38	To calculate

3.1. Gender-wise prevalence

Among 104 male participants, four had reactive screening results, yielding a seroprevalence of 3.85%. Among 146 female participants, three were reactive, corresponding to a seroprevalence of 2.05%. Although the point estimate was higher among males, the small number of reactive cases limits the precision of this comparison. Therefore, the observed difference should be interpreted cautiously shown in Figure 1.

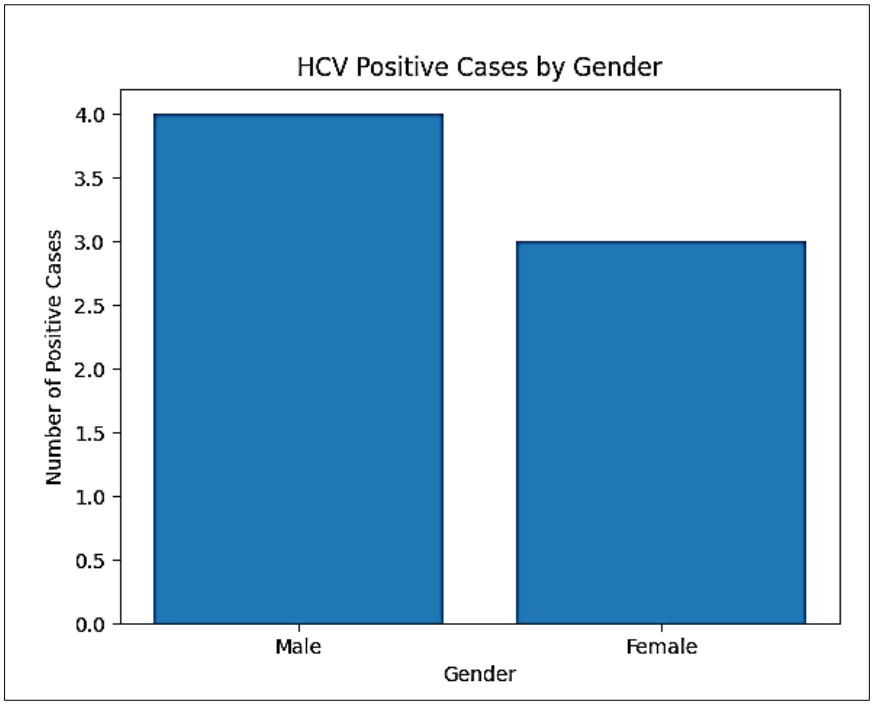


Figure 1: Distribution of HCV positive cases among male and female patients

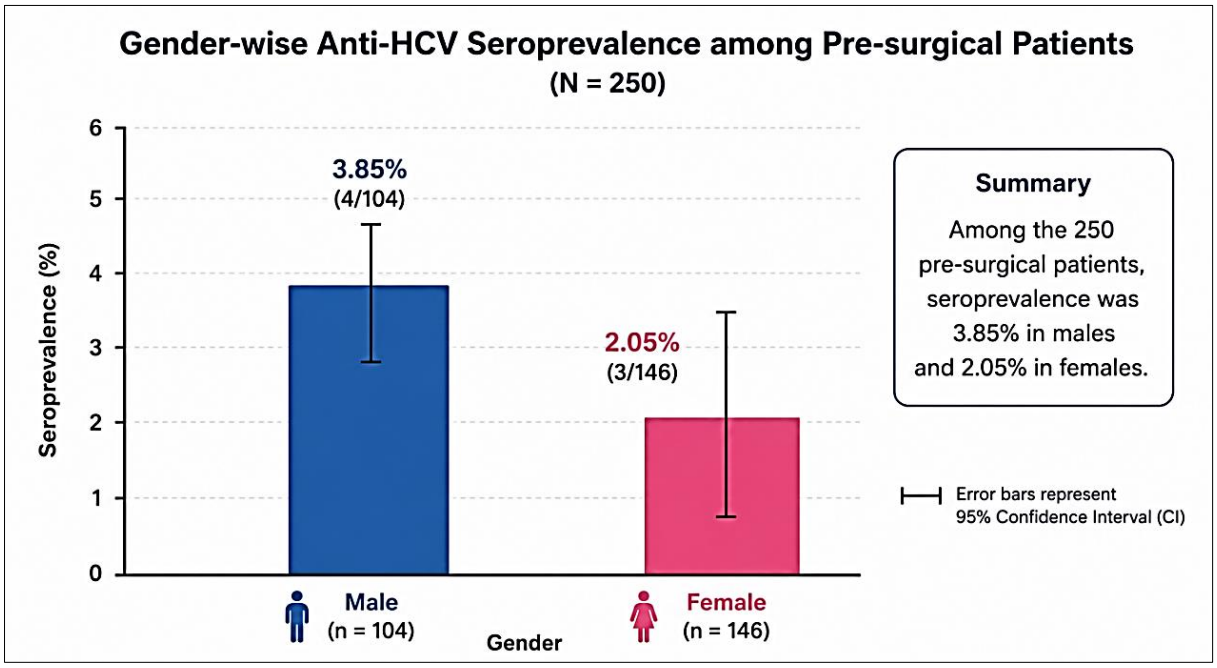


Figure 2: Gender-wise distribution of anti-HCV seroprevalence among pre-surgical patients

3.2. Age-wise prevalence

Analysis based on age showed that there were no HCV-positive cases in younger ages (1-20 years) in both males and females (Thrift *et al.,* 2017). Reactive anti-HCV results were observed only among participants aged 21–60 years. Among males, one reactive result occurred in the 21–30-year group, two in the 31–40-year group, and one in the 41–50-year group. Among females, one reactive result was recorded in each of the 21–30, 41–50, and 51–60-year groups. No reactive results were

detected among participants aged 1–20 or over 60 years. These data describe the distribution of the seven reactive cases; they do not establish that any age group had a higher prevalence unless the total number screened within each age group is considered (Figure 3 and 4).

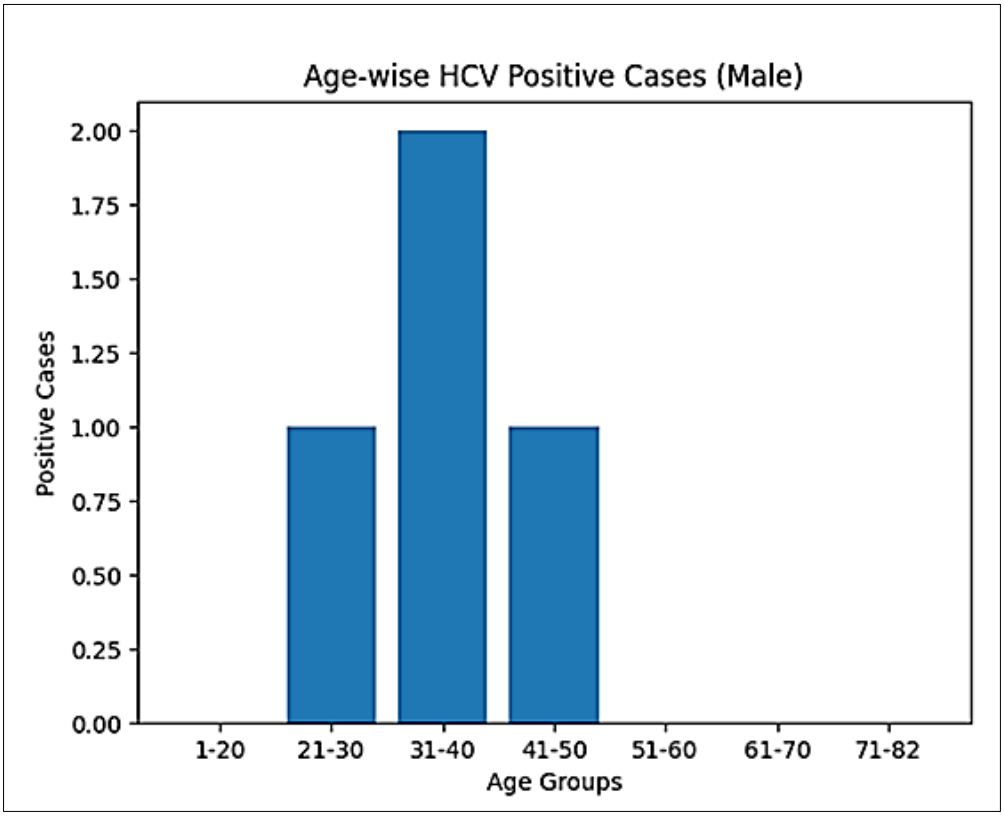
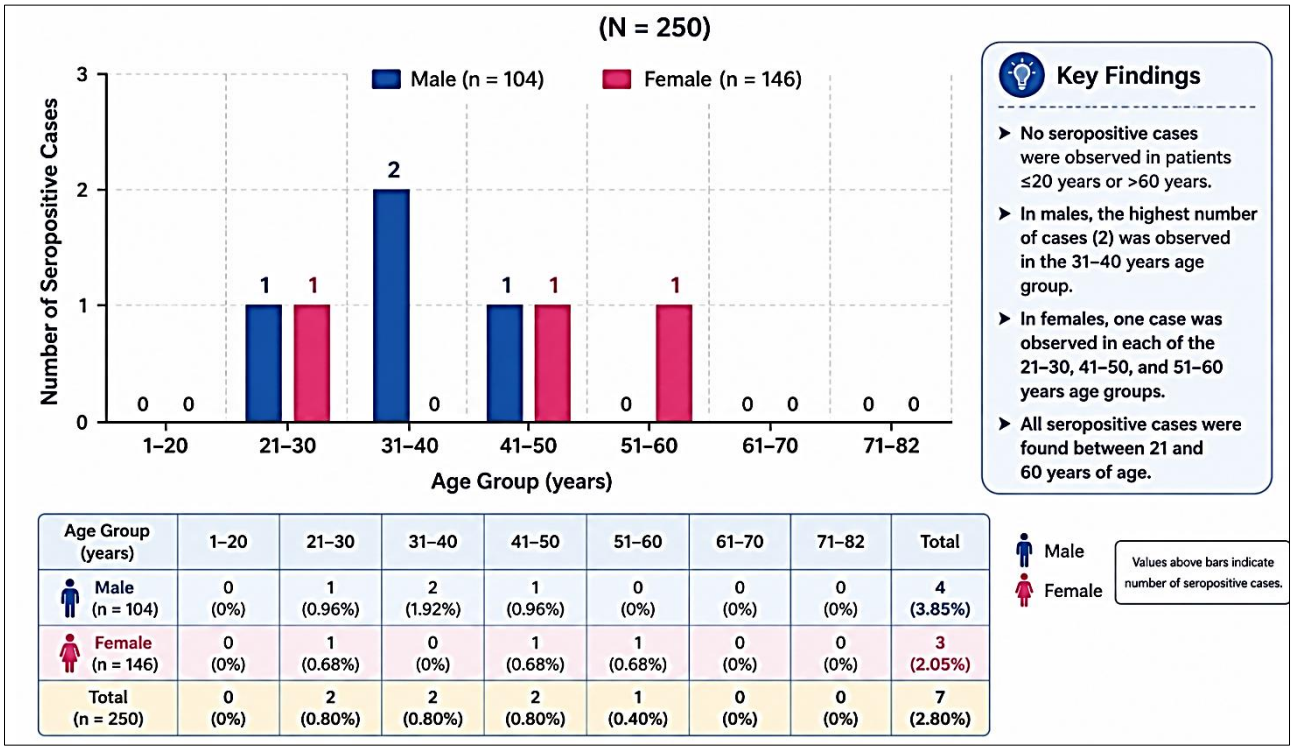


Figure 3: Age-wise distribution of HCV positive cases in male patients



Age Group (years)	1–20	21–30	31–40	41–50	51–60	61–70	71–82	Total
Male (n = 104)	0 (0%)	1 (0.96%)	2 (1.92%)	1 (0.96%)	0 (0%)	0 (0%)	0 (0%)	4 (3.85%)
Female (n = 146)	0 (0%)	1 (0.68%)	0 (0%)	1 (0.68%)	1 (0.68%)	0 (0%)	0 (0%)	3 (2.05%)
Total (n = 250)	0 (0%)	2 (0.80%)	2 (0.80%)	2 (0.80%)	1 (0.40%)	0 (0%)	0 (0%)	7 (2.80%)

Figure 4: Age- wise Distribution of Anti-HCV Seropositive Cases by Gender

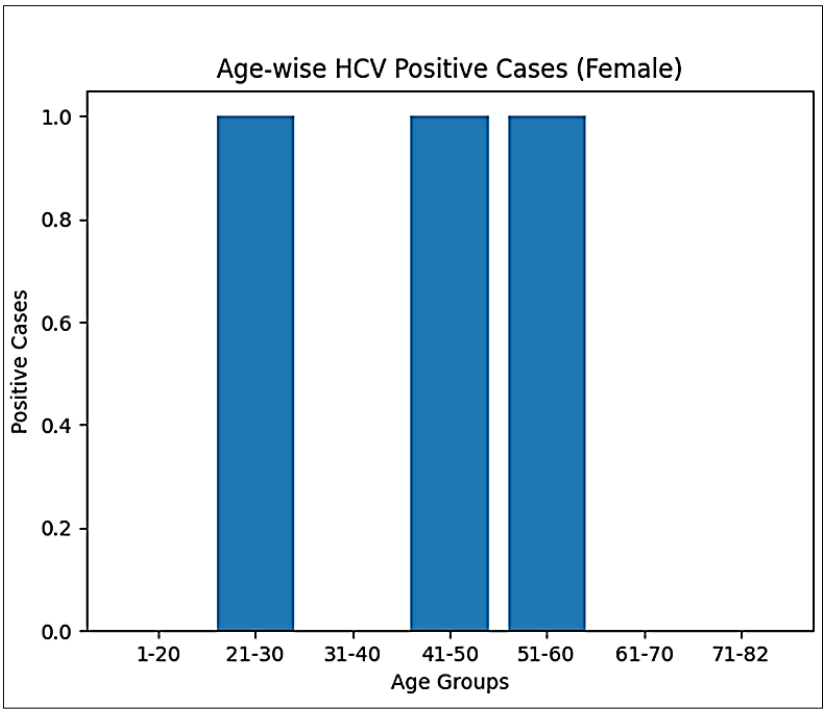


Figure 5: Age-wise distribution of HCV positive cases in female patients

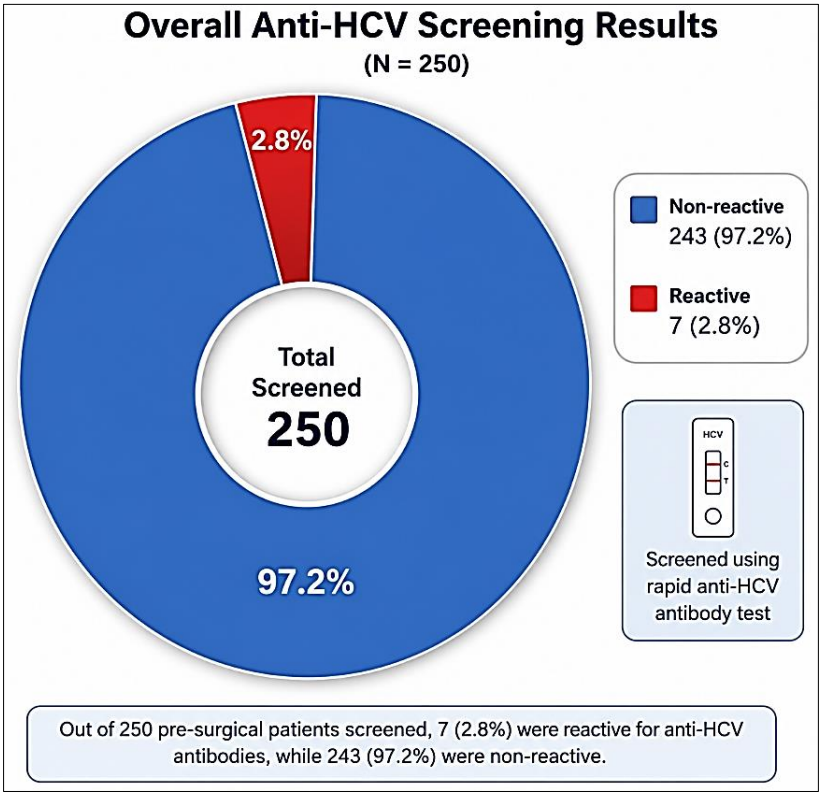


Figure 6: Overall anti-HCV antibody screening results among pre-surgical patients

3.3. District-wise prevalence

Distribution by district revealed discrepancy in HCV prevalence in various regions (Grover *et al.,* 2024). District-specific seroprevalence ranged from 1.85% in Shangla to 3.33% in Swat and Upper Kohistan. Buner and Dir showed seroprevalence estimates of 2.94% and 2.38%, respectively. Each district estimate was based on only one to three reactive participants; consequently, these apparent geographic differences are imprecise and should not be interpreted as evidence of genuine variation without larger, population-based studies.

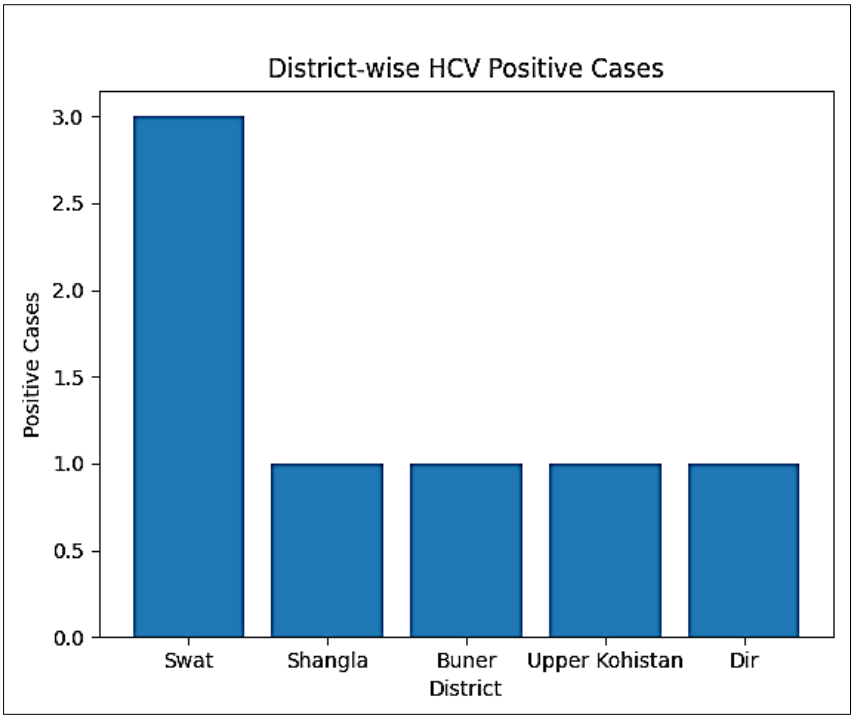


Figure 7: District-wise distribution of HCV positive cases

4. DISCUSSION

his hospital-based study identified reactive anti-HCV antibody results in 7 of 250 pre-surgical patients, corresponding to an overall seroprevalence of 2.8%. The finding demonstrates that previously unrecognized anti-HCV seroreactivity was present among patients undergoing routine surgical assessment in the study setting. However, the estimate should be interpreted as hospital-based seroprevalence rather than prevalence in the general population because the participants were selected from a single hospital and were not recruited through population-based sampling (Abrahim *et al.,* 2025).

An important consideration is that the rapid test used in this study detected antibodies against HCV rather than viral RNA (Feld, 2024). A reactive antibody result indicates previous exposure to HCV but does not, by itself, establish current viremia (Feld, 2024). Some antibody-reactive individuals may have spontaneously cleared the virus or achieved viral clearance following treatment, whereas false-reactive results may also occur. Consequently, all reactive screening results should ideally be followed by confirmatory HCV RNA testing to determine active infection and guide clinical management (George *et al.,* 2025).

The seroprevalence point estimate was higher among males than females; however, only four reactive males and three reactive females were identified (Rosenberg *et al.,* 2020). Such small event counts produce considerable statistical uncertainty and do not support a firm conclusion that male sex was independently associated with anti-HCV seroreactivity (Langer & Lemoine, 2020). Potential differences in healthcare exposure, occupational activities, injection practices, shaving practices, or other blood-related exposures could be investigated in a larger analytical study using a structured risk-factor questionnaire(George *et al.,* 2025).

All reactive participants were between 21 and 60 years of age (Schweizer *et al.,* 2019). This pattern may reflect cumulative exposure to healthcare-related or community transmission risks during adulthood, but the present data cannot establish that interpretation (Ito *et al.,* 2026). In addition, the absence of reactive cases in younger and older groups should not be treated as evidence that these populations were free from risk, particularly because the number screened within each age category and the limited total number of reactive cases affect the stability of the estimates (Mane *et al.,* 2019).

District-level estimates varied numerically, but each estimate was based on only one to three reactive participants (Mwape *et al.,* 2025). The apparent differences could therefore have arisen from random variation, differences in the number of patients referred for surgery, or the characteristics of individuals accessing the hospital. Because the study was not designed as a district-representative survey, comparisons between districts should be regarded as exploratory (Brown *et al.,* 2024). Larger multicenter studies using probability-based or clearly defined consecutive sampling would be needed to determine whether meaningful geographic variation exists (Kumar & Jain, 2025).

Routine preoperative screening may provide an opportunity to identify individuals with previously unrecognized HCV exposure and refer them for confirmatory testing (Cartwright & Patel, 2024). Nevertheless, screening should be connected to an appropriate care pathway that includes counselling, HCV RNA confirmation, assessment for treatment eligibility, and infection-prevention advice. Screening alone has limited public-health value when reactive individuals are not linked to confirmatory diagnosis and treatment (Lim *et al.,* 2018).

This study provides preliminary data from a relatively understudied hospital population serving Swat and neighboring districts and describes anti-HCV seroreactivity according to basic demographic characteristics. Several limitations must be acknowledged. The study was conducted at a single hospital, used a modest sample size, and identified only seven reactive participants. The sampling strategy may have introduced selection bias, and pre-surgical patients may not represent the general community. Risk-factor information was not collected, preventing assessment of potential transmission routes. The rapid antibody test did not distinguish active from resolved infection, and confirmatory HCV RNA results were unavailable. In addition, the precision of subgroup estimates was limited, particularly for age and district comparisons. These limitations should be considered when interpreting and generalizing the findings.

5. CONCLUSION

Anti-HCV antibody seroreactivity was detected in 2.8% of the 250 pre-surgical patients screened at a hospital in Mingora, Swat. Reactive results were observed in both sexes and were confined to participants aged 21–60 years, while district-specific estimates showed modest numerical variation. Because the study was hospital based, involved only seven reactive participants, and relied on an antibody rapid diagnostic test without RNA confirmation, the findings should not be interpreted as population-level prevalence or confirmed active HCV infection. Routine screening should be accompanied by confirmatory HCV RNA testing, counselling, referral for antiviral treatment when indicated, and strengthened infection-prevention practices. Larger multicenter studies incorporating representative sampling and detailed exposure histories are required to characterize the regional epidemiology of HCV more accurately.

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