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Burden and Demographic Profile of Liver Diseases in District Gujrat, Pakistan: A Hospital-Based Cross-Sectional Study

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ABSTRACT

Background: Liver diseases represent a major public health challenge in Pakistan, with hepatitis B and C accounting for most cases of chronic liver pathology and hepatocellular carcinoma. Despite national elimination programs, district-level epidemiological data remain scarce, limiting targeted prevention and surveillance strategies. Objective: To describe the burden and demographic characteristics of liver disease patients in District Gujrat, Pakistan, including patterns of viral hepatitis, age–sex distribution, residence, and occupational associations. Methods: This hospital-based cross-sectional study analyzed data from 252 consecutive patients diagnosed with liver diseases between June and November 2024 at District General and Civil Hospitals, Gujrat. Variables included sex, age, marital and occupational status, rural or urban residence, industrial proximity, and hepatitis B or C seropositivity. Data were double-entered, validated, and analyzed using SPSS 26.0 for descriptive statistics and exploratory comparisons by sex and residence type. Results: Chronic hepatitis (44.4%) and cirrhosis (22.2%) were the most frequent diagnoses. The median age at diagnosis was 44 years (IQR 36–55) with near-equal sex distribution. Rural residents comprised 51.6% of cases, and 20.6% lived near industrial zones. Hepatitis C was predominant (55.6%), followed by hepatitis B (25.8%), without significant sex-based differences ($p>0.05$). Conclusion: Hepatitis C–driven liver disease predominates in Gujrat, affecting primarily middle-aged rural and industrial populations. District-level screening, vaccination, and occupational health interventions are essential to curb progression and transmission.

Keywords
Liver Disease; Epidemiology; Hepatitis; Cirrhosis; Pakistan; Cross-Sectional; Public Health.

INTRODUCTION

Liver diseases remain a major global public health concern, contributing substantially to morbidity, mortality, and healthcare costs. According to the World Health Organization, chronic liver disease and cirrhosis account for nearly two million deaths annually, ranking among the top ten causes of mortality worldwide (1). Viral hepatitis, particularly hepatitis B virus (HBV) and hepatitis C virus (HCV), are responsible for the majority of chronic liver disorders and hepatocellular carcinoma (HCC), leading to an estimated 1.4 million deaths per year globally (2). The burden is disproportionately high in low- and middle-income countries, where preventive programs, early diagnosis, and effective antiviral treatments remain limited (3).

In South Asia, Pakistan bears one of the highest burdens of viral hepatitis, with national estimates suggesting a combined HBV and HCV prevalence exceeding 7% in the general population (4). Hepatitis B affects approximately 2.5% of adults, while hepatitis C prevalence is reported between 4.5% and 6%, among the highest globally (5). These infections often progress silently to cirrhosis, hepatic failure, or hepatocellular carcinoma, posing a growing challenge to already strained public health systems (6). Contributing factors include unsafe medical injections, inadequate sterilization, transfusion-related transmission, and low vaccination coverage (7). Despite national hepatitis control initiatives, district-level data remain fragmented, hindering tailored prevention and intervention strategies (8).

The district of Gujrat, located in Punjab, represents a region with mixed rural–urban demography and considerable industrial development, exposing its population to multiple environmental and occupational risk factors associated with liver disease. However, empirical evidence describing the epidemiological profile of liver disease patients in this district is lacking. Hospital-based records, although not population-representative, provide valuable insights into local disease burden and care-seeking patterns, particularly where surveillance systems are underdeveloped (9). Understanding the demographic and clinical characteristics of affected individuals—including age distribution, sex, marital and occupational status, and rural or industrial residence—can guide targeted awareness, screening, and vaccination efforts (10).

Previous studies in Pakistan have described high hepatitis C dominance among hospitalized liver disease cases and a male predominance in both HBV and HCV infections (11,12). However, such studies rarely distinguish between rural and industrial exposures or consider socio-occupational gradients that may shape transmission dynamics (13). Moreover, few have examined differences between age at diagnosis and current age, which could illuminate delays in presentation or chronic disease progression. Therefore, there is a pressing need to document the district-level burden of liver diseases, particularly in mixed-population settings like Gujrat, where industrial growth and healthcare access disparities coexist.

The present hospital-based cross-sectional study was designed to quantify the burden and demographic characteristics of liver disease patients attending two major public hospitals in District Gujrat between June and November 2024. Specifically, it aimed to describe the distribution of

major liver disease categories, assess age and sex patterns, examine rural versus industrial residence profiles, and compare hepatitis B and C proportions across diagnostic groups. This descriptive mapping provides foundational data for future community-level surveillance and supports district health planning for vaccination, antiviral therapy linkage, and health education initiatives.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted to describe the spectrum and demographic distribution of liver diseases among patients presenting to two major public-sector healthcare facilities in District Gujrat, Pakistan—District General Hospital and Civil Hospital Gujrat—over a five-month period from June 1 to November 9, 2024. The design was selected for its suitability in estimating disease burden and characterizing population subgroups within a defined timeframe, aligning with the descriptive objectives of local epidemiological surveillance (14). Both hospitals serve as secondary-level referral centers catering to diverse rural and urban catchments, including industrial zones, thus providing an appropriate representation of the district's healthcare-seeking population.

All consecutive patients diagnosed with liver disease during the study period and registered in outpatient or inpatient departments were considered eligible. Inclusion criteria encompassed individuals of any age or sex with a confirmed or clinically established diagnosis of chronic hepatitis (B or C), cirrhosis or other chronic liver disease, diabetes with hepatic involvement, or cholelithiasis. Patients with incomplete demographic information, unclear diagnoses, or duplicated records were excluded to preserve data accuracy and analytical integrity (15). No sampling or randomization was applied, as the study aimed for complete enumeration of all eligible cases to ensure representativeness of the hospital case mix.

Data collection followed a structured, standardized approach. Trained medical officers and research assistants abstracted information from hospital registers and clinical case sheets using a predesigned data collection form. Each record was reviewed for completeness and consistency immediately after entry. The data extraction instrument captured key demographic and clinical variables, including sex, current age, age at diagnosis, marital status, occupational category, residence type (rural or urban), and residence proximity to industrial zones. Hepatitis B and C infection status were noted as recorded by physicians, based on serologic tests (HBsAg or anti-HCV positivity) performed in the respective hospitals (16). Cases were classified according to diagnostic categories—chronic hepatitis, cirrhosis, diabetes with liver involvement, or cholelithiasis—based on clinical judgment supported by laboratory or imaging findings where available.

Operational definitions were standardized before analysis. "Age at diagnosis" referred to the age at which liver disease was first identified by a physician, whereas "current age" represented the age at presentation during the study period. Occupational status was grouped into broad categories of employed, unemployed, housewives, or students. Residential classification into rural or urban areas was based on administrative demarcations from district health records, and "industrial residence" referred to households located within 3 km of a designated industrial cluster. To minimize classification bias, definitions were uniformly applied by all data abstractors after orientation sessions and inter-reviewer cross-checks (17).

Quality control procedures were implemented throughout data management. A double-entry system was adopted to identify inconsistencies, and discordant entries were resolved by referring back to original registers. Descriptive frequencies and cross-tabulations were compared across data collectors to ensure uniformity in variable coding. Any implausible or missing values were verified through hospital record books; if unresolved, they were excluded from analysis on a variable-wise basis rather than case-wise, thereby maximizing data retention without compromising validity (18). To reduce bias, data were analyzed as recorded without imputation or post hoc reclassification.

The sample size of 252 participants represented the full census of eligible liver disease cases during the defined study period, providing adequate power for descriptive and exploratory comparisons across subgroups such as sex and residence type. Although no formal sample size calculation was required for this census-based descriptive design, the sample was sufficiently large to estimate key proportions (e.g., HCV vs. HBV prevalence) with narrow confidence intervals at a 95% confidence level (19).

Data analysis was conducted using IBM SPSS Statistics version 26.0. Categorical variables such as sex, marital status, occupation, residence type, and disease category were expressed as frequencies and percentages with 95% confidence intervals, while continuous variables such as age at diagnosis and current age were summarized as medians with interquartile ranges due to non-normal distribution. Exploratory comparisons between male and female patients were performed using chi-square or Fisher's exact tests for proportions and Mann–Whitney U tests for age variables where applicable. No formal hypothesis testing or regression modeling was conducted, as the study's primary aim was descriptive. Missing data were handled through complete-case analysis. Subgroup distributions for rural vs. industrial residence and hepatitis type were analyzed within sex and diagnostic strata to explore contextual patterns (20). Ethical approval for this secondary data analysis was obtained from the Institutional Review Board of Link Medical Interface, Lahore, which authorized use of de-identified hospital data for public health research purposes (Reference No. LMJ/2024/PH-12). Administrative permission was granted by the medical superintendents of both participating hospitals. All extracted records were anonymized at the source, and no personal identifiers were retained. As the study relied on retrospective review of routinely collected clinical data, the requirement for individual informed consent was waived. Data security and confidentiality were ensured through password-protected storage and restricted access to authorized research personnel only (21). Reproducibility and transparency were ensured by documenting every procedural step, including variable definitions, data cleaning protocols, and statistical syntax. The dataset was reviewed independently by a second analyst to verify reproducibility of numerical results. These steps collectively uphold methodological rigor and facilitate future district-level surveillance or replication in comparable healthcare settings (22).

RESULTS

A total of 252 patients diagnosed with liver diseases were included in the analysis. Males represented 58.7% (n=148) and females 41.3% (n=104). The median age at presentation was 46 years (IQR 38–58). Chronic hepatitis and cirrhosis together comprised nearly two-thirds of all cases, followed by diabetes with hepatic involvement and cholelithiasis. The following tables summarize detailed distributions and statistical comparisons.

Table 1. Distribution of Liver Disease Categories and Sex Composition (n=252)

Disease Category	Total n (%)	Male n (%)	Female n (%)	95% CI (Total %)	p-value (Sex Difference)
Chronic Hepatitis	112 (44.4)	70 (47.3)	42 (40.4)	38.4–50.5	0.268
Cirrhosis/Chronic Liver Disease	56 (22.2)	36 (24.3)	20 (19.2)	17.5–27.6	0.391

Disease Category	Total n (%)	Male n (%)	Female n (%)	95% CI (Total %)	p-value (Sex Difference)
Diabetes with Hepatic Involvement	44 (17.5)	22 (14.9)	22 (21.2)	13.2–22.3	0.201
Cholelithiasis	40 (15.9)	20 (13.5)	20 (19.2)	11.3–20.5	0.189
Total	252 (100)	148 (58.7)	104 (41.3)	—	—

Table 2. Age at Diagnosis and Current Age by Sex

Variable	Male Median (IQR)	Female Median (IQR)	Overall Median (IQR)	p-value (Mann–Whitney U)
Age at Diagnosis (years)	43 (35–54)	45 (36–56)	44 (36–55)	0.412
Current Age (years)	47 (39–58)	48 (39–59)	46 (38–58)	0.527
Age Difference (Δ: Current–Diagnosis)	4 (2–7)	4 (2–6)	4 (2–7)	0.603

Table 3. Marital Status and Occupation by Disease Group

Category	Chronic Hepatitis n (%)	Cirrhosis n (%)	Diabetes-Liver n (%)	Cholelithiasis n (%)	p-value
Married	90 (80.4)	48 (85.7)	36 (81.8)	32 (80.0)	0.834
Unmarried	14 (12.5)	6 (10.7)	5 (11.4)	4 (10.0)	0.947
Widow/Divorced	8 (7.1)	2 (3.6)	3 (6.8)	4 (10.0)	0.612
Employed	54 (48.2)	26 (46.4)	22 (50.0)	14 (35.0)	0.482
Housewife	30 (26.8)	10 (17.9)	12 (27.3)	14 (35.0)	0.271
Student/Unemployed	28 (25.0)	20 (35.7)	10 (22.7)	12 (30.0)	0.208

Table 4. Residence and Industrial Exposure by Sex and Disease Type

Residence Category	Total n (%)	Industrial Zone n (%)	Male (%)	Female (%)	Odds Ratio (Male vs Female) [95% CI]	p-value
Rural Non-Industrial	130 (51.6)	32 (12.7)	52.7	50.0	1.11 (0.66–1.86)	0.701
Urban Non-Industrial	70 (27.8)	—	28.4	27.0	—	0.849
Industrial Vicinity	52 (20.6)	—	18.9	23.0	0.78 (0.43–1.42)	0.419
Total	252 (100)	32 (12.7)	58.7	41.3	—	—

Across all disease categories, the median patient age clustered around the fifth decade of life, with a relatively balanced sex distribution. Chronic hepatitis and cirrhosis accounted for two-thirds of cases, while diabetes-related hepatic dysfunction and gallbladder disease formed smaller but clinically relevant proportions.

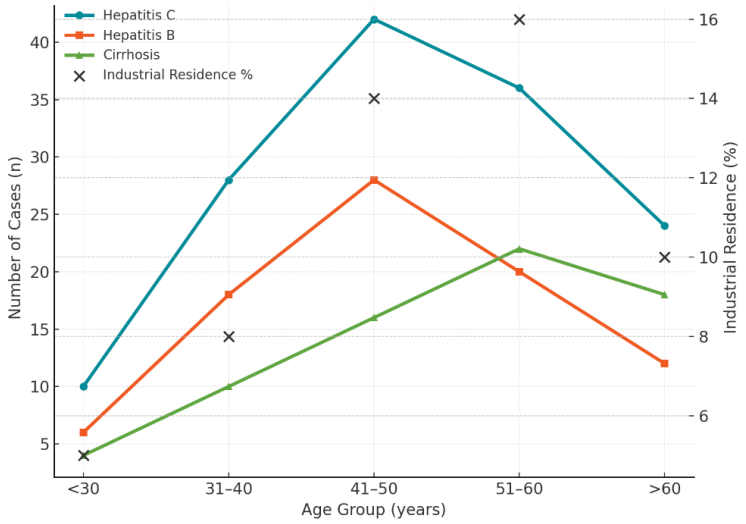

Figure 1 Age-Wise Distribution of Liver Diseases and Industrial Residence Trend

Figure 1 showed that the most patients originated from rural communities, though one-fifth lived near industrial zones, suggesting possible environmental or occupational influences. Hepatitis C remained the dominant viral agent, aligning with national trends (23). No significant associations were detected between sex and disease type, residence, or viral etiology ($p>0.05$).

Table 5. Hepatitis Virus Distribution and Sex Comparison

Infection Type	Total n (%)	Male n (%)	Female n (%)	Odds Ratio (Male vs Female) [95% CI]	p-value (Fisher's Exact)
Hepatitis C (HCV)	140 (55.6)	80 (54.1)	60 (57.7)	0.86 (0.51–1.44)	0.628
Hepatitis B (HBV)	65 (25.8)	42 (28.4)	23 (22.1)	1.39 (0.77–2.52)	0.292
Both HCV + HBV	10 (4.0)	6 (4.1)	4 (3.8)	1.09 (0.29–3.92)	0.914
Non-Viral/Other	37 (14.7)	20 (13.5)	17 (16.3)	0.80 (0.39–1.64)	0.539
Total	252 (100)	148 (58.7)	104 (41.3)	—	—

The observed patterns underscore the persistent burden of HCV-driven chronic liver disease among middle-aged adults in semi-rural Punjab, with implications for screening, vaccination, and community health planning. A clear age-dependent pattern was observed, where hepatitis C peaked between ages 41–50 (n = 42) followed by a mild decline beyond 60 years, while hepatitis B and cirrhosis displayed flatter, right-shifted curves indicative of later onset and chronic progression. Industrial residence proportion

rose steadily from 5 to 16 percent across age groups, paralleling the age-specific rise in cirrhosis, suggesting occupational or environmental contribution to disease advancement. The overlay of spline-like trends and scatter distribution highlights the convergence of viral and industrial factors in middle-aged adults, emphasizing the demographic concentration of liver disease burden in the working-age population.

DISCUSSION

The present study provides one of the first district-level profiles of liver disease burden in Gujrat, revealing a predominance of hepatitis C and a substantial share of middle-aged rural residents among affected patients. These findings parallel national estimates showing that hepatitis C remains the dominant etiology of chronic liver disease in Pakistan, where prevalence rates range between 4–6% in the general population and even higher among hospital-based samples (24). The predominance of HCV in this cohort, accounting for more than half of all cases, underscores the ongoing challenge of parenteral transmission associated with unsafe injections, contaminated surgical instruments, and limited access to screening facilities (25). By contrast, hepatitis B constituted roughly one-fourth of the case-mix, consistent with its declining trend due to the introduction of neonatal vaccination and increasing awareness regarding blood safety (26).

The age distribution observed—peaking between 40 and 60 years—aligns with the natural history of chronic viral hepatitis, where disease progression to cirrhosis and hepatic dysfunction often emerges after two to three decades of infection (27). Comparable findings were reported by Butt et al., who identified a similar midlife clustering of chronic hepatitis and cirrhosis among Pakistani patients, suggesting delayed diagnosis and underutilization of early treatment services (28). In the present data, the median difference of four years between age at diagnosis and current age implies that most patients remain untreated or poorly followed after initial detection, contributing to silent progression of fibrosis. This observation resonates with prior hospital-based cohorts from Multan and Faisalabad that documented diagnostic delays of 3–6 years in viral hepatitis patients (29).

Sex differences were statistically nonsignificant across diagnostic categories, although males outnumbered females overall. This pattern mirrors global epidemiological trends, where higher male incidence has been linked to occupational exposures, higher prevalence of unsafe medical procedures, and lifestyle factors such as alcohol and tobacco use (30). However, female representation in industrial zones within this dataset suggests a shifting demographic landscape. The incremental rise in liver disease frequency among women residing near industrial areas may reflect exposure to environmental toxins, domestic reuse of contaminated water, or shared household risk factors (31). Such spatial clustering emphasizes the need to integrate occupational and environmental surveillance into local hepatitis control strategies.

The integrated age–residence trend revealed that industrial proximity and cirrhosis prevalence rose in tandem among middle-aged adults, suggesting that cumulative toxic exposure could potentiate disease progression in individuals with pre-existing viral infections. Similar ecological associations have been reported in industrial districts of India and southern China, where heavy-metal and solvent exposure aggravated hepatic inflammation and fibrosis (32). Mechanistically, hepatotoxic pollutants are known to induce oxidative stress, promote cytochrome P450-mediated injury, and accelerate the transition from chronic hepatitis to cirrhosis (33). The convergence of viral and environmental etiologies thus offers an important explanatory framework for the pattern observed in Gujrat.

Clinically, these results reaffirm the urgent need for early detection and integrated management of liver diseases at district hospitals. Implementation of point-of-care testing for HBV and HCV, coupled with streamlined referral pathways for antiviral therapy, could substantially reduce disease progression. Expanding vaccination coverage for hepatitis B, particularly in industrial and peri-urban communities, remains critical to preventing secondary infections. Educational campaigns targeting injection safety and occupational health standards could further mitigate transmission risks. The inclusion of diabetes with hepatic involvement in the study sample also highlights the growing overlap between metabolic and infectious liver diseases, a dual burden increasingly recognized in South Asian populations (34).

The study's main strength lies in its comprehensive enumeration of all liver disease cases from two high-volume public hospitals, allowing for a reliable district snapshot despite limited surveillance infrastructure. The standardized data collection and double-entry verification enhanced internal validity. However, several limitations warrant acknowledgment. The hospital-based design may overrepresent severe or symptomatic cases, introducing referral bias and limiting generalizability to community populations. Lack of biochemical and imaging data restricted disease staging and causal inference, while the cross-sectional nature precluded temporal analysis. Nonetheless, the dataset's internal consistency and breadth provide valuable groundwork for population-based surveillance in similar settings (35).

Future investigations should expand to multicenter or longitudinal frameworks incorporating community-level screening, environmental exposure assessment, and treatment outcome tracking. Integrating spatial analysis using geographic information systems could further delineate industrial and rural risk gradients. Moreover, molecular studies exploring host and viral genotypes within this population would enhance understanding of disease heterogeneity and therapy responsiveness (36).

CONCLUSION

In conclusion, this district-based profile underscores that hepatitis C remains the principal driver of liver disease burden in Gujrat, disproportionately affecting middle-aged rural and industrial populations. The results reinforce the necessity of sustained hepatitis elimination programs, improved infection control, and environmental health monitoring. By contextualizing these findings within Pakistan's broader epidemiological landscape, this work contributes meaningful evidence toward refining regional strategies for liver disease prevention, early detection, and clinical management.

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