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Comparative Clinical, Demographic, and Cardiometabolic Profile of Hepatitis B and Hepatitis C Patients in Khyber Pakhtunkhwa: A Cross-Sectional Study

Muhammad Tariq Shah
Lanzhou university
Tahir Ullah
Saidu Medical College
Hamza Nasir
Saidu Medical College
Abdul Qayum Khan
Saidu Medical College
Maxwell Afram
mafram001@st.ug.edu.gh

University of Ghana

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Abstract

Background and Objectives

Pakistan is disproportionately affected by HBV and HCV, which continue to be important causes of chronic liver disease. Although there is little evidence in Khyber Pakhtunkhwa, worldwide data indicates that infected individuals have different cardiometabolic and demographic characteristics. This study identified independent predictors of hepatitis type by comparing the demographic, cardiometabolic, and clinical characteristics of individuals with HBV and HCV.

Methodology

This comparative cross-sectional study included 549 laboratory-confirmed patients (249 HBV-positive, 300 HCV-positive) recruited from Khyber Pakhtunkhwa, Pakistan. Demographic, anthropometric, cardiometabolic, vaccination, and symptom data were extracted from clinical records; hypertension was defined using the 2017 ACC/AHA threshold, and presenting symptoms were grouped into seven clinical domains. Normality was assessed using the Shapiro-Wilk test; as continuous variables were non-normally distributed, between-group comparisons used the Mann-Whitney U test, while categorical variables were compared using the Pearson Chi-square test with Cramér's V as effect size. Multivariable binary logistic regression was performed to identify factors independently associated with hepatitis type, with model fit assessed via the Hosmer-Lemeshow goodness-of-fit test and Nagelkerke R^2.

Results

HBV patients were significantly older than HCV patients (41.03±10.61 vs. 36.64±10.35 years, $p<0.001$) with higher systolic blood pressure ($p<0.001$). Hypertension was more prevalent in HCV patients (96.7% vs. 86.7%, $p<0.001$), while diabetes was more prevalent in HBV patients (51.4% vs. 36.3%, $p<0.001$) on bivariate analysis. Sex, BMI, vaccination history, and symptom domain distribution did not differ significantly. On multivariable adjustment, hypertension (adjusted OR=0.180, $p<0.001$), age (adjusted OR=0.966, $p=0.003$), and BMI (adjusted OR=1.079, $p=0.004$) remained independently associated with hepatitis type, while diabetes lost significance ($p=0.064$), indicating confounding.

Conclusion

HBV and HCV patients exhibit distinct cardiometabolic risk profiles despite comparable symptom presentation. Hypertension emerged as the strongest independent correlate of hepatitis type, underscoring the value of adjusted analysis in hepatitis comorbidity research.

Introduction

Hepatitis B and Hepatitis C are large-scale public health problems worldwide. An estimated 254 million people worldwide were infected with the chronic Hepatitis B virus (HBV) and 50 million with the chronic Hepatitis C virus (HCV) by 2022. These statistics represent over 2.2 million new infections that year [1].

Both viruses play important roles as causes of chronic liver infection, with HBV being the most important cause of cirrhosis and hepatocellular carcinoma (HCC) worldwide [2].

Pakistan is bearing an undue burden of this global burden. The estimated prevalence of Hepatitis B and Hepatitis C in Pakistan is approximately 2.5% and 4.9%, respectively, and is significantly higher among high risk transfusion dependent population like beta thalassemia major, with a pooled prevalence of HBV being 4.13% and HCV being 29.79% [3]. A national-level household survey and a systematic review combining all available prevalence data from Pakistan confirmed the prevalence of HCV antibody in the general population to be 6.2%, and for people who inject drugs and the population with liver disease-related condition, it was 53.6% and 55.9%, respectively, indicating that Pakistan is suffering from an HCV epidemic of unprecedented scale [4]. Unsafe medical and injection practices have consistently been noted as significant risk factors for transmission within Pakistan and the laboratory records of general practice attenders attending a rural area of Sindh were analysed to determine the prevalence of Hepatitis B and Hepatitis C infections among adults, with significantly more adults testing positive for Hepatitis C (17%), compared with Hepatitis B (8%), whilst the prevalence was higher in older adults and males [5].

Despite this burden, there is still limited knowledge of the Pakistani populations about the transmission, prevention, and screening of hepatitis. A cross-sectional Knowledge Attitude Practice (KAP) study among 390 Hepatitis B patients showed that 76.4% of patients lacked good knowledge about hepatitis B and 66.9% showed poor preventive practices, i.e. majority had never screened before getting diagnosed with Hepatitis B [6]. A systematic review on epidemiology of Hepatitis B Virus (HBV) conducted in parallel across Pakistan also reinforced the lack of public awareness and the high prevalence of HBV in Pakistan compared to other countries of the world [7]. Comparable KAP assessments among hepatitis clinic attendees in Rawalpindi [8] and among 432 Hepatitis B-positive patients evaluating the interplay between disease knowledge, self-management, internalized stigma, and quality of life [9] have reinforced that knowledge deficits and psychosocial burden remain significant, unresolved challenges in hepatitis care across the country.

While this population-level KAP evidence is valuable for guiding prevention policy, it addresses public knowledge and behavior rather than the clinical characteristics of patients who are already infected. A separate and clinically important question, therefore, remains open: among patients already diagnosed, how do those with Hepatitis B differ from those with Hepatitis C in demographic characteristics, cardiometabolic comorbidity burden, and predominant presenting symptoms. Large international cohort studies have shown that the baseline demographic and clinical features of HBV- and HCV-infected patients are very different; for instance, the Chronic Hepatitis Cohort Study compared 2,202 HBV-positive and 8,810 HCV-positive patients and found that there are significant differences in age, sex, and insurance or hospitalization rates between the two groups [10]. Hospital-based cohorts evaluating chronic liver disease have similarly found that HBV- and HCV-related presentations differ in demographic distribution and seroprevalence pattern [11]. Comparative analyses of hepatocellular carcinoma have further demonstrated that HBV-related disease tends to occur at a significantly younger age than HCV-

related disease (53.9 ± 9.7 vs. 65.4 ± 8.8, P < 0.01), with distinct tumor characteristics, staging, and survival outcomes between the two viral etiologies [12].

Although there exists already an international evidence base regarding comparative clinical and demographic parameters of HBV and HCV positive patients, very little such evidence exists in the regional context of Khyber Pakhtunkhwa, where the previous studies conducted by the researchers had been mostly focused on the knowledge and awareness of the general population or only on individual patients. This study thus aims to address this gap in evidence by comparing the demographic characteristics, cardiometabolic comorbidity profile (hypertension and diabetes mellitus), Hepatitis B vaccination history and predominant symptom domains at presentation of confirmed Hepatitis B positive and Hepatitis C positive individuals, using both bivariate and multivariable logistic regression to identify which characteristics remain independently associated with hepatitis type after adjustment for confounding.

Methodology

Study Design

This was a comparative cross-sectional study conducted to evaluate demographic, cardiometabolic, and clinical symptom differences between confirmed Hepatitis B-positive and Hepatitis C-positive patients in Khyber Pakhtunkhwa, Pakistan. The overall study workflow, from patient screening through final statistical synthesis, is summarized in **Figure 1**.

Study Setting and Period

The study was conducted in Khyber Pakhtunkhwa, Pakistan, with data collection carried out between Jan 15, 2026 to June 30,2026. Patients with laboratory-confirmed Hepatitis B (HBsAg-positive) or Hepatitis C (anti-HCV-positive) infection were recruited from general population.

Sample Size

As shown in **Figure 1**, 550 patients with confirmed HBV or HCV infection were initially assessed for eligibility. Following exclusion of one incomplete clinical record (n=1), 549 patients were included in the final analysis, comprising 249 Hepatitis B-positive and 300 Hepatitis C-positive patients.

Inclusion and Exclusion Criteria

Inclusion Criteria: Adults who live in Khyber Pakhtunkhwa and are at least eighteen years old are eligible to participate in this study. Patients will only be included if their diagnosis of Hepatitis B or Hepatitis C has been confirmed by laboratory reports or medical records. Prior to enrollment, each participant must be willing to take part in the study and give their informed consent.

Exclusion Criteria: Participants under the age of eighteen will not be allowed to participate in this study. To enable a clear comparison between the two disease groups, patients who have both Hepatitis B and Hepatitis C will also be excluded.Additionally, in order to reduce potential confounding effects on the clinical and cardiometabolic profiles, patients with chronic liver diseases unrelated to Hepatitis B or Hepatitis C, such as autoimmune hepatitis, alcoholic liver disease, or Wilson's disease, will be excluded. The study will also exclude participants with incomplete clinical or medical records, as well as those who are unable or unwilling to give informed consent.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the National Institute of Health & Management Sciences (NIHMS), Peshawar (IRB number: 26/07/02-EL/31). Confidentiality and anonymity of patient records were maintained throughout.

Data Collection and Variable Definitions

Demographic, anthropometric, cardiometabolic, and symptom data were extracted from patient clinical records. Body mass index (BMI) was calculated from recorded height and weight. Hypertension was defined using the 2017 ACC/AHA threshold (systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥80 mmHg) [13]. Presenting symptoms were grouped into seven clinically coherent domains — Constitutional, Gastrointestinal, Respiratory, Cardiovascular, Musculoskeletal, Dermatologic, and Neuropsychiatric — to enable valid statistical comparison (**Figure 3**).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (version 27). Normality was assessed using the Shapiro-Wilk test; as all continuous variables showed non-normal distribution ($p<0.001$ for all), between-group comparisons used the Mann-Whitney U test. Categorical variables were compared using the Pearson Chi-square test with Cramér's V as effect size. Multivariable binary logistic regression was performed to identify factors independently associated with hepatitis type, with model fit assessed via the Hosmer-Lemeshow goodness-of-fit test and Nagelkerke R^2 (**Table 3**, **Figure 4**). A p-value <0.05 was considered statistically significant.

Results

Study Population and Baseline Characteristics

A total of 549 patients with laboratory-confirmed viral hepatitis were included, comprising 249 Hepatitis B-positive patients (45.4%) and 300 Hepatitis C-positive patients (54.6%). Baseline demographic, anthropometric, and clinical characteristics of both groups are summarized in **Table 1**.

Hepatitis B patients were significantly older than Hepatitis C patients (mean age 41.03±10.61 years vs. 36.64±10.35 years; Mann-Whitney U, $p<0.001$), indicating a distinct age profile between the two viral

hepatitis cohorts. No significant differences were observed between groups for height (172.29±6.64 cm vs. 171.64±6.57 cm, p=0.270), weight (69.18±10.25 kg vs. 70.23±10.12 kg, p=0.220), or body mass index (23.41±3.90 kg/m² vs. 23.88±3.65 kg/m², p=0.144), confirming that anthropometric profile does not meaningfully distinguish the two patient populations. Sex distribution was also comparable between groups (χ^2=0.056, p=0.813, Cramér's V=0.010).

Table 1. Baseline Demographic, Anthropometric, and Cardiometabolic Characteristics of Hepatitis B and Hepatitis C Patients

Characteristic	Hepatitis B (n=249)	Hepatitis C (n=300)	Test	p-value
Continuous variables — Mean±SD				
Age (years)	41.03±10.61	36.64±10.35	Mann-Whitney U	<0.001*
Height (cm)	172.29±6.64	171.64±6.57	Mann-Whitney U	0.270
Weight (kg)	69.18±10.25	70.23±10.12	Mann-Whitney U	0.220
BMI (kg/m²)	23.41±3.90	23.88±3.65	Mann-Whitney U	0.144
Systolic BP (mmHg)	135.03±11.96	131.95±11.31	Mann-Whitney U	<0.001*
Diastolic BP (mmHg)	83.97±8.12	84.37±5.90	Mann-Whitney U	0.683
Categorical variables — n (%)				
Sex — Male, n(%)	156 (62.7%)	185 (61.7%)	Chi-square	0.813
Diabetes Mellitus — Yes, n(%)	128 (51.4%)	109 (36.3%)	Chi-square	<0.001*
Hypertension (AHA) — Yes, n(%)	216 (86.7%)	290 (96.7%)	Chi-square	<0.001*
Vaccination history — Yes, n(%)	73 (29.3%)	93 (31.0%)	Chi-square	0.669

*Statistically significant at p<0.05. BP=blood pressure; BMI=body mass index; AHA=American Heart Association

Cardiovascular and Metabolic Comorbidity Profile

Hepatitis B patients displayed considerably higher mean systolic blood pressure than Hepatitis C patients (135.03±11.96 mmHg vs. 131.95±11.31 mmHg; p<0.001), whereas diastolic blood pressure did

not vary significantly (83.97±8.12 mmHg vs. 84.37±5.90 mmHg; p=0.683). Using the 2017 ACC/AHA threshold, hypertension prevalence was significantly more frequent among Hepatitis C patients (290/300, 96.7%) than Hepatitis B patients (216/249, 86.7%; χ^2=18.547, df=1, p<0.001, Cramér's V=0.184). Diabetes mellitus showed an inverse pattern: Hepatitis B patients showed a considerably greater prevalence of diabetes (128/249, 51.4%) compared with Hepatitis C patients (109/300, 36.3%; χ^2=12.599, df=1, p<0.001). These patterns are seen in **Figure 2.**The divergence in direction between the hypertension and diabetes findings — hypertension more prevalent in Hepatitis C yet diabetes more prevalent in Hepatitis B — suggested potential confounding by the age difference between groups, prompting multivariable adjustment.

Vaccination History and Symptom Profile

Vaccination history did not differ significantly between groups (overall 30.2%; χ^2=0.183, df=1, p=0.669, Cramér's V=0.018), indicating comparable historical vaccine exposure irrespective of eventual infection type. Predominant presenting symptom domain distribution is summarized in **Table 2** and illustrated in **Figure 3**.

Neuropsychiatric symptoms were the most frequently reported domain in both cohorts (Hepatitis B: 97/249, 39.0%; Hepatitis C: 129/300, 43.0%), followed by Cardiovascular (19.7% vs. 18.7%) and Constitutional (14.1% vs. 14.0%) symptoms. No statistically significant difference was observed in the overall distribution of symptom domains between groups (χ^2=1.691, df=6, p=0.946, Cramér's V=0.055).

Table 2. Predominant Symptom Domain Distribution in Hepatitis B and Hepatitis C Patients

Symptom Domain	Hepatitis B n(%)	Hepatitis C n(%)	Total n(%)
Neuropsychiatric	97 (39.0%)	129 (43.0%)	226 (41.2%)
Cardiovascular	49 (19.7%)	56 (18.7%)	105 (19.1%)
Constitutional	35 (14.1%)	42 (14.0%)	77 (14.0%)
Respiratory	26 (10.4%)	24 (8.0%)	50 (9.1%)
Gastrointestinal	21 (8.4%)	24 (8.0%)	45 (8.2%)
Musculoskeletal	14 (5.6%)	18 (6.0%)	32 (5.8%)
Dermatologic	7 (2.8%)	7 (2.3%)	14 (2.6%)
Total	**249 (100%)**	**300 (100%)**	**549 (100%)**
Chi-square=1.691, df=6, p=0.946, Cramér's V=0.055			

Multivariable Analysis

Multivariable binary logistic regression results are presented in **Table 3** and **Figure 4**. The overall model was statistically significant (Omnibus χ^2=55.871, df=6, p<0.001) with adequate calibration confirmed by

the Hosmer-Lemeshow goodness-of-fit test (χ^2=9.908, df=8, p=0.272). The model explained 12.9% of the variance in hepatitis type (Nagelkerke R^2=0.129) and correctly classified 61.9% of cases overall. Three variables remained independently and significantly associated with hepatitis type after adjustment. Hypertension demonstrated the strongest independent association (adjusted OR=0.180, 95% CI: 0.085–0.384, p<0.001), indicating that hypertensive patients had markedly lower adjusted odds of being Hepatitis C-positive relative to Hepatitis B-positive — notably diverging from the unadjusted bivariate finding in which hypertension prevalence was numerically higher in the Hepatitis C cohort (96.7% vs. 86.7%), suggesting substantial age-mediated confounding. Age was independently associated (adjusted OR=0.966, 95% CI: 0.944–0.988, p=0.003), with each additional year of age reducing the odds of Hepatitis C relative to Hepatitis B by approximately 3.4%. BMI showed a smaller but significant independent association (adjusted OR=1.079, 95% CI: 1.024–1.137, p=0.004). Notably, the strong unadjusted association between diabetes mellitus and hepatitis type (p<0.001) was substantially attenuated after multivariable adjustment (adjusted OR=1.629, 95% CI: 0.971–2.733, p=0.064), suggesting this association was confounded by age and hypertension status rather than reflecting an independent biological relationship. Sex (adjusted OR=1.069, p=0.721) and vaccination history (adjusted OR=0.858, p=0.440) were not independently associated with hepatitis type.

Table 3. Multivariable Binary Logistic Regression — Factors Independently Associated with Hepatitis Type

Variable	B	SE	Wald	OR (Exp B)	95% CI	p-value
Age (years)	-0.035	0.012	8.916	0.966	0.944–0.988	0.003*
BMI (kg/m²)	0.076	0.027	8.120	1.079	1.024–1.137	0.004*
Sex (Female vs Male)	0.067	0.188	0.128	1.069	0.740–1.544	0.721
Diabetes Mellitus	0.488	0.264	3.419	1.629	0.971–2.733	0.064
Hypertension (AHA)	-1.712	0.385	19.785	0.180	0.085–0.384	<0.001*
vaccination history	-0.153	0.198	0.597	0.858	0.583–1.265	0.440
Model statistics: Omnibus χ^2=55.871 (df=6, p<0.001); Nagelkerke R^2=0.129; Hosmer-Lemeshow χ^2=9.908 (df=8, p=0.272); Classification accuracy=61.9%						

*Statistically significant at p<0.05. OR=odds ratio; CI=confidence interval; SE=standard error; AHA=American Heart Association; BMI=body mass index

Discussion

In this comparative cross-sectional study we tried to determine whether patients with Hepatitis B and Hepatitis C in Khyber Pakhtunkhwa represent clinically distinct populations with respect to demographic characteristics, cardio-metabolic comorbidities, vaccination history, and presenting symptom patterns. Regarding this several important finding were observed. Hepatitis B patients were significantly older than Hepatitis C patients. There was no significant differences were observed between the two groups for height, weight and BMI; which confirms that anthropometric profile does not meaningfully distinguish the two patient populations from one another. Sex distribution was also comparable between the two groups. Hypertension prevalence was significantly more frequent among Hepatitis C patients than Hepatitis B patients. Hepatitis B patients had a significantly higher prevalence of diabetes compared with Hepatitis C patients. Vaccination history did not differ significantly between groups. Neuropsychiatric symptoms were the most frequently reported domain in both cohorts, followed by Cardiovascular and Constitutional symptoms. No statistically significant difference was observed in the overall distribution of symptom domains between groups.

We observed a significant age difference between the two groups; HBV patients were older than HCV patients. This finding is different from the finding of other studies that have reported that HCV mostly occur in older population due to cumulative effect whereby the exposure to multiple risks factors increase with age [14,15,16,17]. However, the regional differences in transmission pattern of HBV and HCV may explain this finding. In Pakistan the HBV transmission is mostly through vertical transmission, Household exposure and unsafe health practices; whereas HCV transmission is mostly due to repetitive use of therapeutic injections and invasive procedures [18,19,20]. The differences in the healthcare access to general population, screening practices for HBV and HCV, and local epidemiological patterns may therefore have produced an age distribution that is different from that observed in other populations.

No significant difference was observed between HBV and HCV patients regarding sex distribution, height or weight, or body mass index. These findings suggest that the anthropometric characteristics alone do not meaningfully distinguish the HBV from HCV infection in this population. Studies in literature have also reported different results about association of sex, weight, and BMI with the type of HBV and HCV infection [21,22,23,24,25,26,27,28,29].

Hypertension prevalence was significantly more frequent among Hepatitis C patients than Hepatitis B patients, the same results have been reported by studies in literature [30,31,32,33]. However, when we did multivariable binary logistic regression analysis hypertension demonstrated the strongest independent association, indicating that hypertensive patients had markedly lower adjusted odds of being Hepatitis C-positive relative to Hepatitis B-positive. This reversal strongly suggests that the presence of confounding factors like age etc. have been included in the model. The finding highlights the importance of multivariable analyses in observational studies because the crude prevalence estimates may not accurately reflect independent associations of the two variables. Previous studies investigating

cardio-metabolic manifestations of chronic hepatitis have also reported complex relationships between HCV infection and blood pressure, with some studies have demonstrated lower adjusted odds of hypertension among HCV-infected individuals despite differing unadjusted patterns [34,35,36].

Diabetes mellitus was significantly more prevalent among the HBV patients than the HCV patients in the bivariate analysis, but this association lost its statistical significance after the adjustment for the confounding factors. Many studies in literature has reported an association between HCV infection and insulin resistance and type 2 diabetes mellitus which suggest that chronic HCV infection may contribute to the metabolic dysfunction through inflammatory and molecular mechanisms [37,38,39,40,41,42]. However, there are some studies that have reported different results regarding the association between diabetes mellitus and type of hepatitis infection [43,44,45,46,47,48,49,50]. Our findings indicate that the apparent relationship between diabetes and hepatitis type in this cohort may be largely explained by differences in age and cardio-metabolic characteristics of the patients rather than by an independent effect of viral infection itself. This observation shows us the importance of considering confounding factors when examining metabolic comorbidities in chronic hepatitis populations.

We also observed remarkably similar symptom profiles between the HBV- and HCV-positive patients. Neuropsychiatric symptoms were the most commonly reported symptom domain in both HBV and HCV patients, followed by cardiovascular and constitutional symptoms [51,52,53,54]. The overall distribution of the symptoms did not differ significantly between HBV and HCV patients. This finding is consistent with the fact that chronic HBV and HCV infections frequently share nonspecific clinical manifestations and may remain asymptomatic for prolonged periods [55]. Therefore, the symptom patterns alone may have limited value in differentiating the underlying viral etiology. This emphasize on the continued importance of laboratory-based diagnosis.

Since hepatitis B vaccination does not provide protection against Hepatitis C, the lack of a substantial vaccination difference between groups is predicted. The very low total vaccination coverage in our group, which falls well short of Pakistan's national hepatitis B immunization objectives, is more clinically significant [56]. This stands in stark contrast to the far greater vaccination coverage among Pakistani healthcare professionals, where it has been demonstrated that workplace access and occupational requirements considerably improve uptake [57].The This discrepancy highlights the fact that vaccination in Pakistan is still mostly driven by access and incentives rather than being provided uniformly, making general patient populations far more vulnerable than groups with professional protection. With no vaccine available against Hepatitis C, extending structured hepatitis B immunization strategies — such as job-entry-style requirements or targeted outreach — beyond healthcare settings into general community and adult populations remains a critical, actionable priority for hepatitis control in Pakistan.

Strengths and limitations

Strengths: This study benefits from a comparatively large sample size and the simultaneous evaluation of demographic, anthropometric, cardiometabolic, and symptomatic characteristics across both Hepatitis B and Hepatitis C patient populations. A key methodological strength is the combined use of

bivariate and multivariable analytical approaches, allowing identification of factors independently associated with hepatitis type rather than relying on unadjusted comparisons alone.

Limitations: Several limitations should be acknowledged. As a cross-sectional, single-center study, the design precludes causal inference, and findings may not be fully generalizable to the wider general population. Data on duration of infection, viral load, HBV/HCV genotype, liver function tests, socioeconomic status, transmission route, and antiviral treatment history were unavailable, and the observed associations may be influenced by these unmeasured factors. The multivariable model explained a modest proportion of variance in hepatitis type (Nagelkerke R^2=0.129), reflecting the expected limitation that demographic and comorbidity variables alone cannot fully account for hepatitis type, which is fundamentally determined by viral transmission route rather than host clinical characteristics.

Conclusion

HBV patients were considerably older than HCV patients. After multivariable correction, BMI became an independent predictor of hepatitis type even though it was similar across groups in bivariate analysis. After adjustment, the strongest independent predictor of hepatitis type was still hypertension. The groups were comparable in terms of sex, immunization history, and presenting symptom profile. Diabetes showed a significant bivariate association that did not persist after multivariable adjustment, indicating confounding by age and hypertension rather than a true independent relationship. Future research should incorporate longitudinal, multi-center designs with viral load, genotype, and liver function data to clarify the causal and prognostic significance of these cardiometabolic associations across hepatitis types.

Declarations

Ethics Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of the National Institute of Health & Management Sciences (NIHMS), Peshawar (IRB number: 26/07/02-EL/31). Informed consent to participate was obtained from all participants before enrollment. Confidentiality and anonymity of all patient records were maintained throughout the study.

Consent for Publication

Not applicable. This manuscript does not contain any individual person's identifiable data, images, or videos.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Authors' Contributions

TU, MTS and HN conceived and designed the study, collected data, performed the statistical analysis, and drafted the manuscript. AQK and MA contributed to data interpretation and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Figures

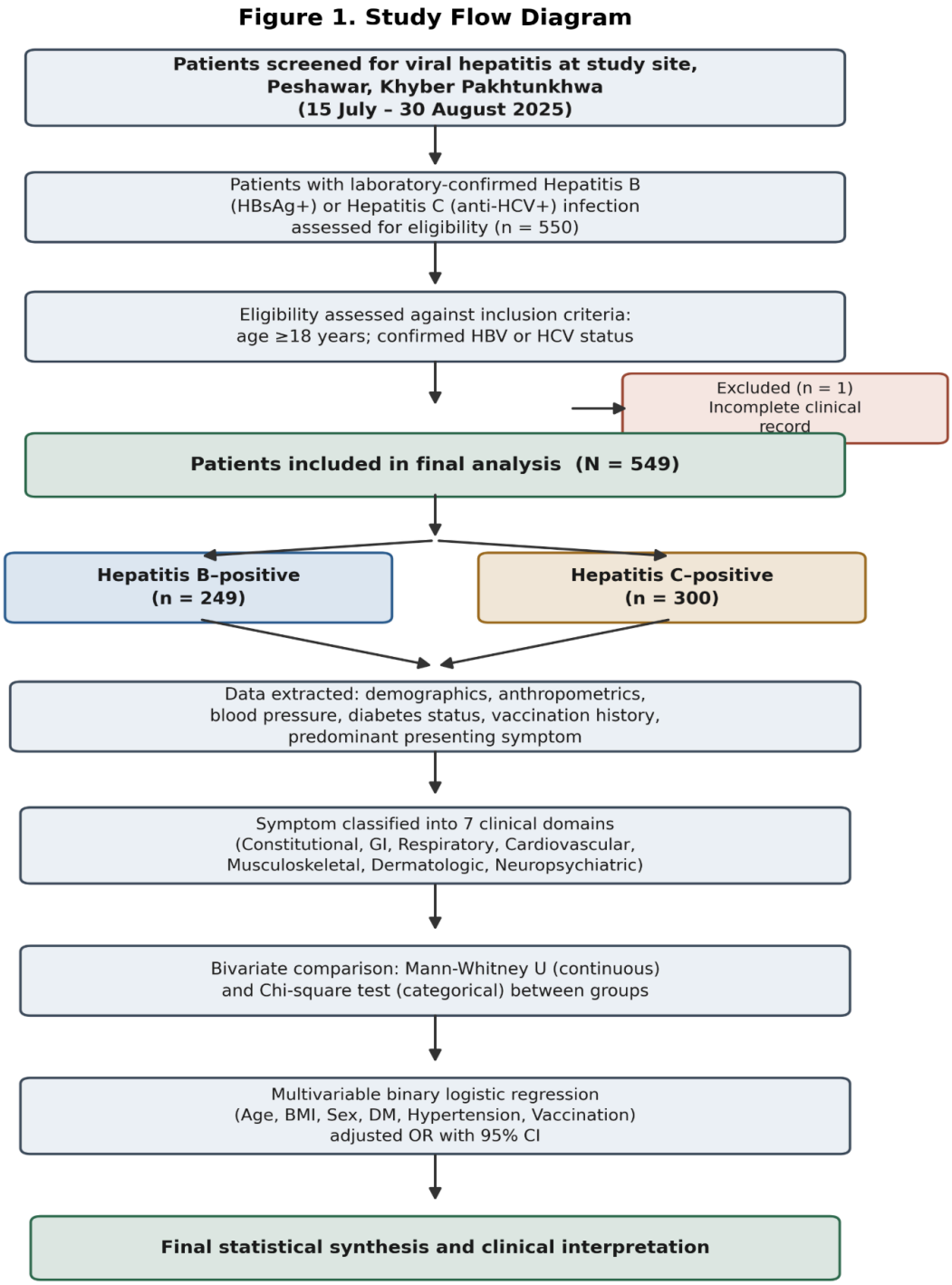


Figure 1

Study Flow Diagram showing patient enrollment, group allocation, and analytical pathway.

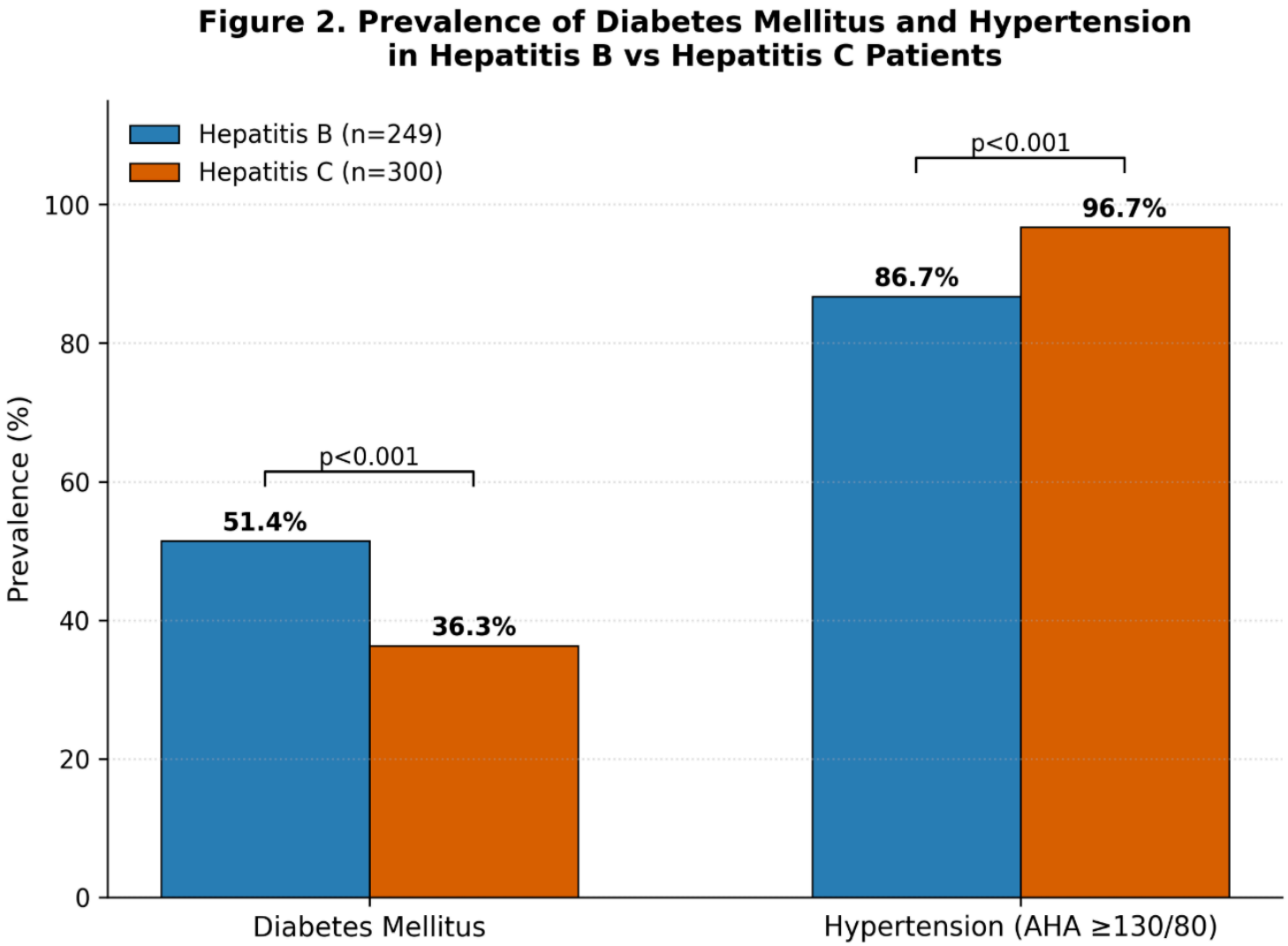


Figure 2

Prevalence of Diabetes Mellitus and Hypertension (AHA criteria) in Hepatitis B vs Hepatitis C Patients. *p<0.001 for both comparisons.

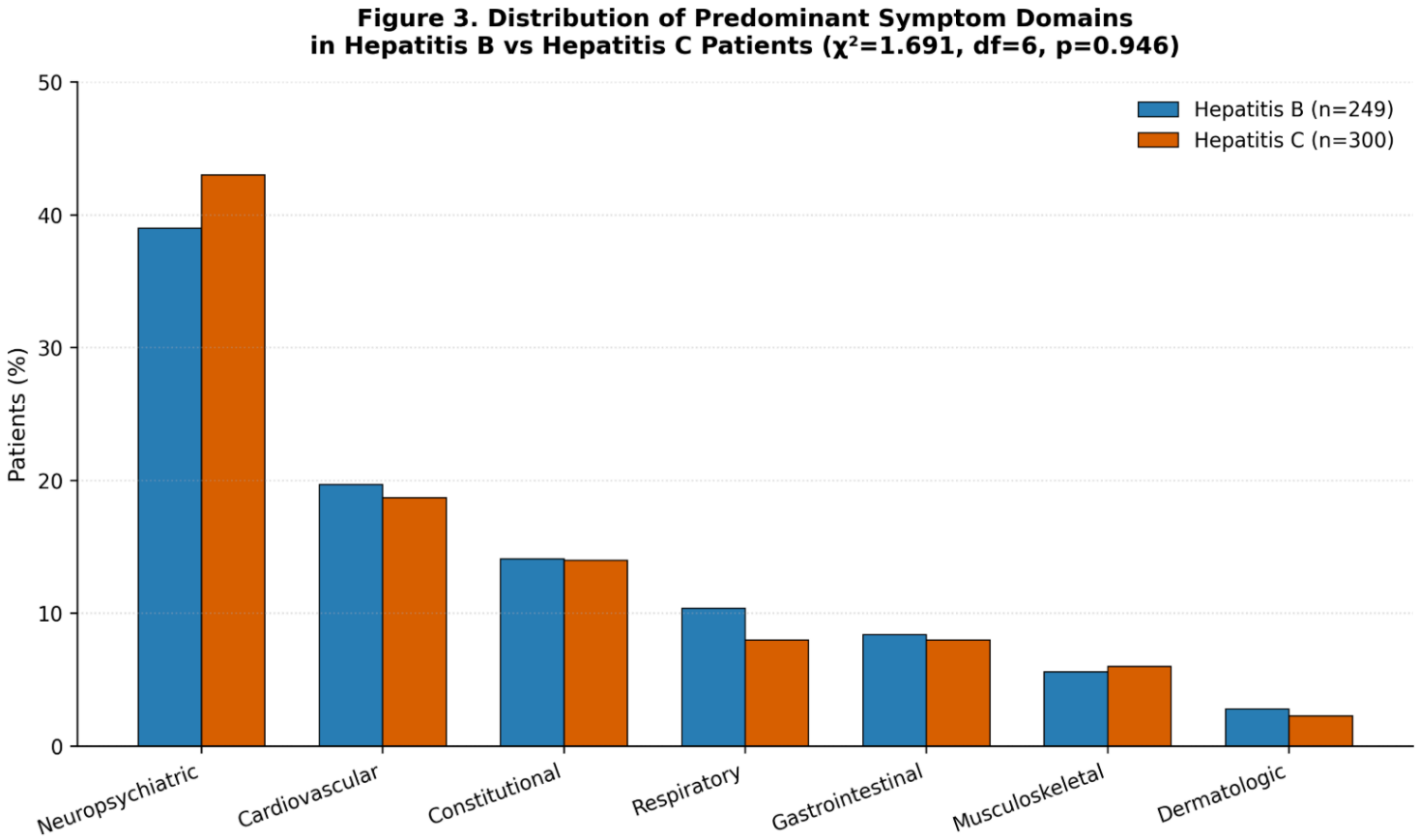


Figure 3

Distribution of Predominant Symptom Domains in Hepatitis B vs Hepatitis C Patients. Neuropsychiatric symptoms predominated in both groups. No significant between-group difference was observed (χ²=1.691, df=6, p=0.946).

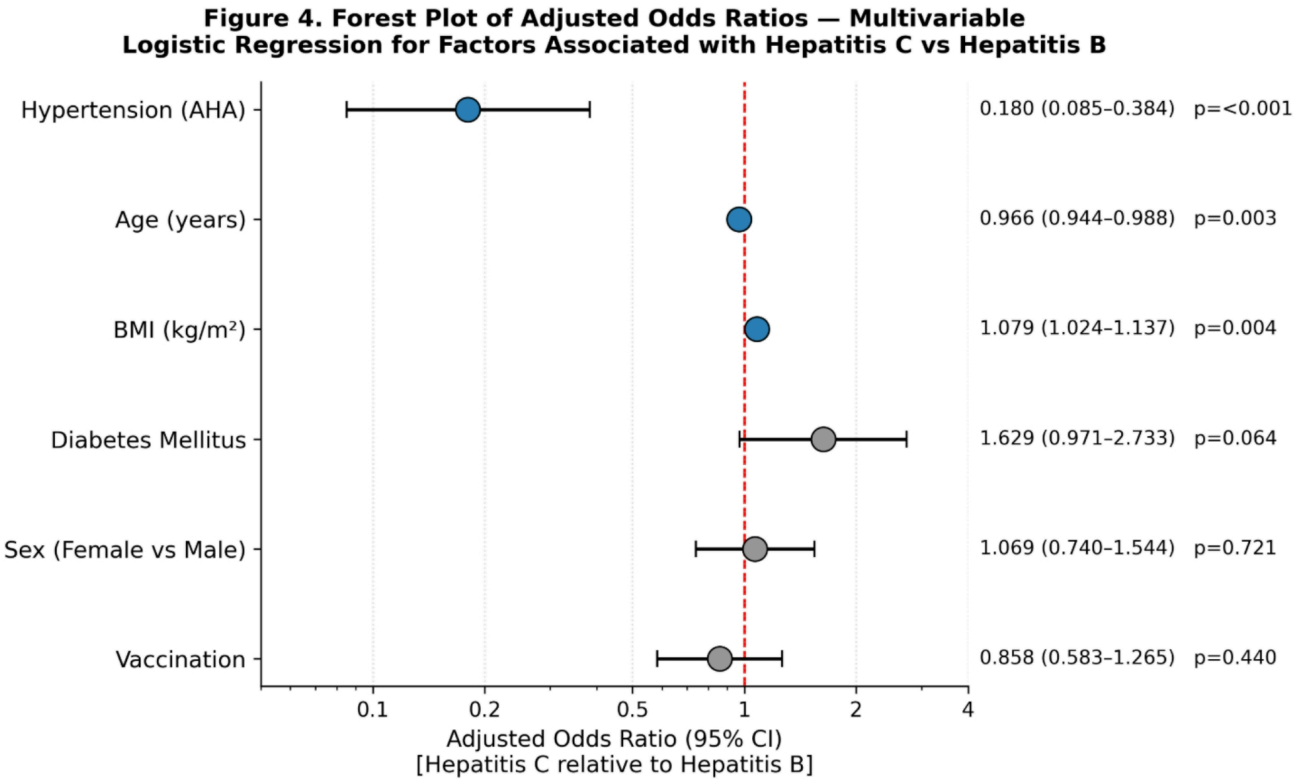


Figure 4

Forest Plot of Adjusted Odds Ratios from Multivariable Binary Logistic Regression. Blue dots indicate statistically significant associations (p<0.05); grey dots indicate non-significant associations. Dashed red line represents OR=1 (no effect). OR: odds ratio; CI: confidence interval.