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Original Research Article

Frequency of Metabolic Syndrome in Patients with Hepatitis C Virus Infection

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Abstract: *Hepatitis C virus (HCV) infection is a major global health burden, traditionally associated with chronic liver disease.* ***Objective:*** *To determine the frequency of metabolic syndrome in patients with chronic hepatitis C virus infection and assess its association with demographic and clinical variables.* ***Methods:*** *This cross-sectional observational study was conducted at the Department of General Medicine, AIMC/Jinnah Hospital, Lahore, from March 2025 to May 2025. A total of 220 patients aged 20–60 years with confirmed HCV infection were enrolled using non-probability consecutive sampling. Demographic data, clinical examination findings, and laboratory results, including fasting blood glucose, triglycerides, HDL cholesterol, and blood pressure, were recorded.* ***Results:*** *The mean age of patients was 42.7 ± 10.2 years; 124 (56.4%) were male and 96 (43.6%) were female. Metabolic syndrome was identified in 49 patients (22.3%). Significant associations were found between MetS and age ≥45 years ($p = 0.04$) as well as BMI ≥25 kg/m² ($p < 0.001$). No significant association was observed between MetS and duration of HCV infection ($p = 0.12$).* ***Conclusion:*** *It is concluded that metabolic syndrome is a frequent comorbidity in patients with chronic HCV infection, particularly among older and overweight individuals. Routine screening for metabolic risk factors in HCV patients is recommended to facilitate early intervention and reduce associated cardiovascular and hepatic complications.*

Keywords: Blood Glucose, Hepatitis C, Chronic, Metabolic Syndrome, Obesity, Risk Factors

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Introduction

The frequent cause of liver disease in the world is due to the Hepatitis C virus. According to the estimate, the worldwide infection due to the hepatitis C virus ranges from 150 to 200 million cases. Among these cases, chronic infections are found in about 85% of cases. (1) In the globe, the most important cause of mortality and morbidity is the Hepatitis C virus. In the whole world, Chronic Liver disease and hepatocellular carcinoma in about 25% is due to the hepatitis C virus. (2) According to the study done in Pakistan on the general population, the hepatitis C virus infection prevalence was observed to be 4.7% and is increasing. (3) While HCV is hepatotropic, it is also well-known to affect the metabolic system and the metabolic disturbance caused by hepatitis C virus is called HCV-associated dysmetabolic syndrome (HCADS). Steatosis, insulin resistance, IR/Diabetes and hypercholesterolemia describe this syndrome caused by metabolic disturbance due to the hepatitis C virus. (4)

In about 80% of cases, the HCV infection-associated insulin resistance has been reported. Impaired fasting glucose tolerance and a higher prevalence of DM have been observed in patients infected with HCV genotype-1. Viral RNA level replication is associated with insulin resistance. In patients infected with HCV genotype one, increased TNF-α levels, suppression of cytokine signalling, and a reduction in substrate protein insulin receptor substrate-1 and -2 are observed. Additionally, the HCV infection is also observed to downregulate insulin receptor and glucose transporter-4 gene, peroxisome proliferator-activated receptors, and hypoadiponectinemia. (5) Chronic viral hepatitis is revealed to be linked with an amplified risk of diabetes mellitus due to glucose metabolism impairment. Insulin resistance is observed to have an association with fatty degeneration of hepatocytes. In liver tissue, the virus's core protein inhibits low-density lipoprotein secretion, leading to fatty degeneration. In susceptible individuals, HCV also causes the activation of the autoimmune response against the beta cells that produce insulin. (6)

A recent study suggests the relationship between HCV infection and metabolic syndrome. (7) Fatty liver disease can be caused by HCV infection, which is a sign of hepatic steatosis, and is an acknowledged element of metabolic syndrome. (7) In patients having chronic liver disease, autonomous mortality predictors are the discrete constituents of metabolic syndrome. (8) In patients infected with HCV, metabolic disorders accord with the HCV treatment. On the other hand, in patients having concerns of HCV-associated insulin resistance, the antiviral treatment shows impaired response. (9) In patients infected with HCV, the metabolic syndrome is observed to be about 25%. (10) In another study, the frequency of metabolic syndrome was 17.78%. (11) Different Studies have been conducted in different parts of the globe to display the frequencies of metabolic syndrome in patients with hepatitis C infection. Keeping this in mind, we aim to conduct a study to observe the frequency of metabolic syndrome in patients with chronic hepatitis C virus infection in Pakistan. Thus, this study was designed to determine the frequency of metabolic syndrome in patients with hepatitis C virus infection.

Methodology

This cross-sectional observation study was conducted at the Department of General Medicine, AIMC/ Jinnah Hospital, Lahore, from March 2025 to May 2025. A total of 220 patients were included in the study. The sample size was calculated using a 95% confidence level, 5% margin of error, and an expected frequency of metabolic syndrome of 17.78% based on prior literature (11). Non-probability consecutive sampling was used to recruit eligible participants.

Inclusion Criteria:

- Patients aged between 20 and 60 years.
- Both male and female patients.

- Patients diagnosed with hepatitis C infection as per the operational definition.

Exclusion Criteria:

- Patients with decompensated liver disease.
- Pregnant women.
- Patients co-infected with hepatitis B virus (HBV) or human immunodeficiency virus (HIV).

Ethical approval was obtained from the institutional review and ethics committee before the commencement of the study. Patients fulfilling the inclusion criteria and presenting with hepatitis C infection were recruited from the outpatient department of Medicine, AIMC/Jinnah Hospital, Lahore. Written informed consent was obtained from all participants. For each enrolled patient, a detailed history and clinical examination were conducted. Measurements taken included waist circumference, height, weight, and calculation of body mass index (BMI). Blood samples were collected and sent to the hospital laboratory for analysis of anti-HCV antibodies, hepatitis B surface antigen (HBsAg), fasting blood glucose, high-density lipoprotein (HDL), and triglycerides. Standardised methods were employed for measuring blood pressure, weight, height, and BMI. Metabolic syndrome was diagnosed according to the operational definition applied in this study. All data were recorded on a pre-designed proforma.

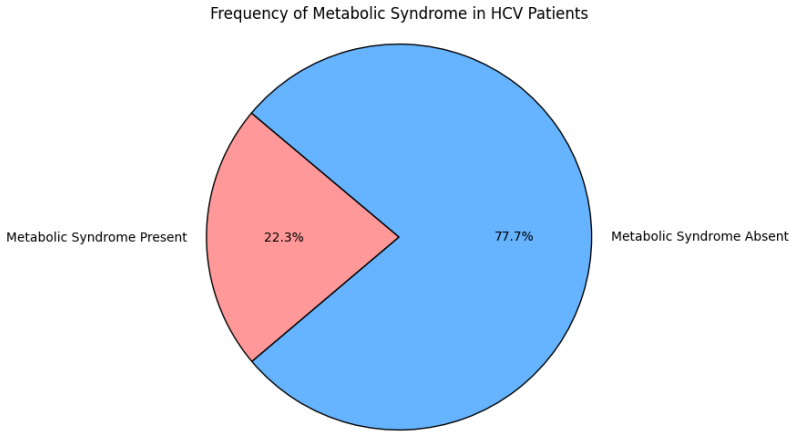
Data were entered and analysed using SPSS version 26. Quantitative variables such as age, BMI, waist circumference, fasting blood glucose, lipid profile, and duration of HCV infection were reported as mean ± standard deviation (SD). Qualitative variables such as gender and presence of metabolic syndrome were expressed as frequency and percentage. Data were stratified by age, gender, BMI, and duration of HCV infection. Post-stratification, the chi-square test was applied to determine statistical significance, with a p-value ≤ 0.05 considered significant.

Results

Data were collected from 220 patients; the patients had a mean age of 42.7 ± 10.2 years and a slight male predominance (56.4% males vs. 43.6% females). The average BMI was 27.1 ± 3.8 kg/m², indicating that most patients were overweight. Mean waist circumference (94.5 cm), fasting glucose (106.3 mg/dL), and triglycerides (168.7 mg/dL) were elevated above normal ranges, while HDL cholesterol levels were low (mean 39.2 mg/dL). Regarding HCV duration, 59.1% had infection for less than 5 years. Metabolic syndrome was present in 22.3% of the population.

Table 1: Demographic and Baseline Characteristics of Study Participants (n = 220)

Characteristic	Value
Age (years)	42.7 ± 10.2
Gender	
– Male	124 (56.4%)
– Female	96 (43.6%)
BMI (kg/m²)	27.1 ± 3.8
Waist Circumference (cm)	94.5 ± 8.7
Fasting Blood Glucose (mg/dL)	106.3 ± 14.2
Triglycerides (mg/dL)	168.7 ± 35.4
HDL Cholesterol (mg/dL)	39.2 ± 7.6
Systolic BP (mmHg)	128.5 ± 12.1
Diastolic BP (mmHg)	82.7 ± 8.4
Duration of HCV Infection	
– < 5 years	130 (59.1%)
– ≥ 5 years	90 (40.9%)
Metabolic Syndrome Status	
Present	49 (22.3%)
Absent	171 (77.7%)



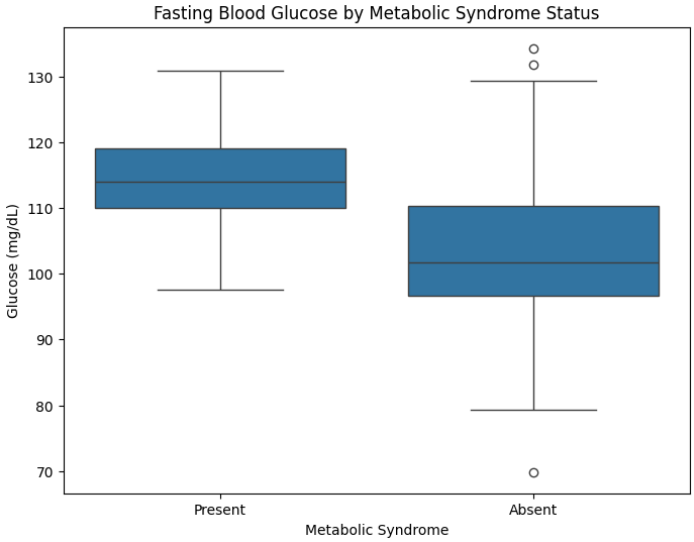
There was no significant gender difference in the prevalence of metabolic syndrome (p = 0.88), with similar proportions in males (22.6%) and females (21.9%). However, patients aged ≥45 years showed a significantly higher frequency of metabolic syndrome

(26.4%) compared to those <45 years (18.2%), p = 0.04. BMI ≥25 kg/m² was strongly associated with metabolic syndrome (34.5% vs. 10.0%, p < 0.001). Duration of HCV infection did not show a statistically significant association with metabolic syndrome (p = 0.12).

Table 2: Stratification of Metabolic Syndrome by Gender and Age

Variable	Metabolic Syndrome Present (n=49)	Metabolic Syndrome Absent (n=171)	p-value
Male (n = 124)	28 (22.6%)	96 (77.4%)	0.88
Female (n = 96)	21 (21.9%)	75 (78.1%)	
Age ≥ 45 (n = 110)	29 (26.4%)	81 (73.6%)	0.04*
Age < 45 (n = 110)	20 (18.2%)	90 (81.8%)	
BMI Category			
BMI ≥ 25 kg/m² (n = 110)	38 (34.5%)	72 (65.5%)	<0.001*
BMI < 25 kg/m² (n = 110)	11 (10.0%)	99 (90.0%)	
Duration of HCV Infection			
< 5 years (n = 130)	27 (20.8%)	103 (79.2%)	0.12
≥ 5 years (n = 90)	22 (24.4%)	68 (75.6%)	

***Significant at p ≤ 0.05**



The laboratory findings showed that the average fasting blood glucose level was 106.3 mg/dL, which exceeds the normal upper limit of 100 mg/dL. Triglyceride levels were also elevated, with a mean of 168.7 mg/dL compared to the normal threshold of 150 mg/dL. HDL cholesterol was suboptimal, averaging 39.2 mg/dL, below the desirable levels for both men and women. The mean waist circumference was 94.5 cm, indicating a high prevalence of central obesity. The mean BMI was 27.1 kg/m², categorising most patients as overweight.

Table 3: Laboratory Parameters of Study Population (n = 220)

Parameter	Mean ± SD	Normal Range
Fasting Blood Glucose (mg/dL)	106.3 ± 14.2	70 – 100 mg/dL
Triglycerides (mg/dL)	168.7 ± 35.4	< 150 mg/dL
HDL Cholesterol (mg/dL)	39.2 ± 7.6	> 40 mg/dL (men), > 50 (women)
Waist Circumference (cm)	94.5 ± 8.7	< 90 (men), < 80 (women)
BMI (kg/m²)	27.1 ± 3.8	18.5 – 24.9 kg/m²
Systolic BP (mmHg)	128.5 ± 12.1	< 120 mmHg
Diastolic BP (mmHg)	82.7 ± 8.4	< 80 mmHg

Discussion

The present study aimed to determine the frequency of metabolic syndrome (MetS) in patients with chronic hepatitis C virus (HCV) infection and to explore its association with demographic and clinical parameters. We found out that 22.3% of the patients with HCV were classified to meet the diagnostic criteria of MetS. This incidence is comparable with other studies that have been undertaken within a similar population. Although there is some variation, it can be attributed to geographical location, diagnostic criteria and selection of the patients. Another example can be cited based on a study done in Pakistan by Asghar et al. on the prevalence of MetS among HCV patients, that were

reported to be about 17.8%, comparable to our findings, and substantiates the importance of this comorbidity to public health in the HCV-endemic zones (12). The significant relationship between age and the occurrence of MetS was an outstanding fact of the study among patients in the age group of 45 years and above. The latter age-related trend is well described in the literature. It can be explained by the number of metabolic disturbances that accumulate with age and slow insulin resistance at older ages. On the same note, metabolic syndrome was prevalent with high body mass index (BMI = 25 kg/m2 and above), which is an indication of the fact that obesity and central adiposity are very critical players in the pathogenesis of MetS in HCV-infected patients (13). These findings also support the evidence of previous reports that have shown that the synergistic action of viral-induced liver inflammation and adiposity-related metabolic abnormalities promotes the development of insulin resistance syndrome, dyslipidemia, and hypertension (14). Interestingly, however, there was no generic connection between tenure of HCV and the prevalence of MetS. This is an indication that the alterations in metabolic modifications can occur regardless of the exposure time of the virus, but under the influence of host factors, including age, BMI, and lifestyle (15). There is also a chance that HCV itself has early metabolic effects, especially those of hepatic steatosis and impaired glucose metabolism, which do not have to appear clinically only when the patient has had the infection for a long time. Mechanically, HCV, especially types 1 and 3, has been mentioned in enhancing insulin resistance with direct interference in the insulin signal pathways as well as increasing the pro-inflammatory cytokines (16). This disruption of the metabolism not only predisposes patients to MetS but also increases the progression of hepatic fibrosis, which makes it even more difficult to deal with the disease. Additionally, the coexistence of MetS can have a negative outcome on the effectiveness of antiviral treatment and lead to lower clinical responses, such as high risks of cardiovascular disease, hepatic decompensation, and hepatocellular carcinoma (17). In a clinical and public health perspective, our results support the significance of routine metabolic screening among HCV-positive patients, especially older patients or overweight patients (18). Recognising and treating the components of MetS at an early stage might reduce the development of complications over the long term and lead to a better prognosis in HCV-infected people. Lifestyle change, weight loss, and pharmacological management of dyslipidemia and insulin resistance are the forms of intervention that should be included in the normal treatment of these patients. Some of the strengths of this study are that the sample size is reasonable, and there was application of standardized measurement protocols. Nevertheless, some weaknesses should be considered. The study employs a cross-sectional design, which limits its ability to establish causation. Furthermore, the sample was obtained using non-probability techniques, which may limit the generalizability of the results. Furthermore, the study was carried out at one of the tertiary centres, and multiple factors, including HCV genotype, lifestyles, and food habits, were not measured, which may also have their implications for metabolic risk.

Conclusion

It is concluded that metabolic syndrome is a common comorbidity among patients with chronic hepatitis C virus infection, with a frequency of 22.3% observed in this study. Increasing age and higher body mass index were significantly associated with the presence of metabolic syndrome, underscoring the influence of host metabolic factors in these patients. These findings emphasise the need for routine metabolic assessment and early management of modifiable risk factors in HCV-infected individuals to reduce the risk of cardiovascular and hepatic complications and improve overall clinical outcomes.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-24)

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Conception of Study, Development of Research Methodology Design,
SMR (Senior Medical Officer)
Study Design, manuscript review, and critical input.
NA (Resident),
Manuscript drafting, Study Design,
AK (Resident)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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