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Association of Hepatitis 'C' Virus Infection (HCV) and Liver Enzymes Abnormalities Among Apparently Healthy Individuals in Jos North, Plateau State, Nigeria

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Abstract

Hepatitis C virus (HCV) infection remains a significant global health concern, particularly in resource-limited settings such as Nigeria, where routine screening and early diagnosis are often lacking. This study investigated the seroprevalence of HCV infection and its association with liver enzyme abnormalities among apparently healthy individuals in Jos North, Plateau State. A total of 180 participants were screened for anti-HCV antibodies using rapid diagnostic kits (Labtrust, UK) and confirmed by ELISA (Qingdao Hightop Biotech, China), yielding a seroprevalence rate of 5.0%. Liver function was evaluated through measurement of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels to assess hepatic injury. Among seropositive individuals, 88.9% showed elevated ALT and 77.8% had elevated AST levels. While these elevations were more frequent in HCV-positive participants than in seronegative controls, the differences were not statistically significant (ALT: $p = 0.064$; AST: $p = 0.061$). However, effect size analysis (Glass's $\Delta > 1.4$) indicated clinically meaningful enzyme elevations, suggesting

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subclinical liver injury. Multivariate logistic regression controlling for demographic variables did not reveal a statistically significant predictive relationship between HCV status and elevated liver enzymes, likely due to sample size limitations and potential multicollinearity. These findings underscore the silent progression of HCV-related hepatic damage in asymptomatic individuals and highlight the need for proactive screening and biochemical monitoring. Public health initiatives promoting widespread, cost-free HCV testing and liver function assessment are essential for early detection, reducing disease burden, and preventing long-term complications such as cirrhosis and hepatocellular carcinoma.

Keywords: Hepatitis C virus; Seroprevalence; Alanine aminotransferase (ALT); Aspartate aminotransferase (AST); Liver function abnormalities; Nigeria

INTRODUCTION

Hepatitis C virus (HCV) infection remains a critical public health challenge globally. The World Health Organization (WHO) estimates that approximately 58 million people are chronically infected with HCV worldwide, with a significant burden in developing countries where healthcare access is often limited (WHO, 2022). In Nigeria, the prevalence of HCV varies significantly, with some regions reporting infection rates from 0.40% - 29.6% (Audu et al., 2020; FMOH, 2016; Musa et al., 2018; Okafor et al., 2020).

Hepatitis C Virus is a positive-sense, single-stranded RNA virus belonging to the family *Flaviviridae,* genus *Hepacivirus*(WHO, 2022). It is a blood-borne virus that primarily affects the liver, causing inflammation leading to liver cirrhosis, liver failure, and hepatocellular carcinoma if not properly managed (Karoney&Siika, 2013;Stanaway et al., 2016; WHO, 2022). It is transmitted through exposure to infected blood or blood products, which can occur via sharing needles or sharps objects, unprotected sexual practices that lead to exposure of blood, or from mother to child during childbirth, hazardous healthcare practices, blood or blood products transfusions, injection-drug use, and invasive procedures such as tattoo, tribal marks (CDC, 2020;Mawuli et al., 2022; WHO, 2022).

Following infection with HCV, about 75-85% of people infected remain asymptomatic, and those who are acutely symptomatic may exhibit fever, fatigue, decreased appetite, nausea, vomiting, abdominal pain, dark urine, pale faeces, joint pain, and jaundice

[yellowing of skin and the eye] (CDC, 2020; WHO, 2022). Hepatitis C Virus infection accounts for 27% of all cases of liver cirrhosis and 25% of all cases of hepatocellular carcinoma globally, making it the second most common cause of cancer death worldwide (Agyeman et al., 2016; Bartenschlager et al., 2018; Michael &Maasoumy, 2022; Nwagha et al., 2021).

Risk factors that increase an individual's susceptibility to HCV infection, including: Intravenous drug use, sharing of needles or syringes**,** unprotected sexual contact, especially with multiple partners**,** receiving tattoos or piercings with unsterile equipment**,** receiving improper screened blood or blood products or organ transplants, exposure to infected blood through occupational accidents, such as needle sticks, being born to a mother with HCV infection (CDC, 2020; WHO, 2022)

One of the hallmarks of HCV infection is its association with elevated liver enzymes, particularly alanine aminotransferase (ALT) and aspartate aminotransferase (AST) These enzymes are predominantly found in the liver and are released into the bloodstream when liver cells are damaged or destroyed, and their levels can serve as markers of liver injury (Pratt & Kaplan, 2000; Rana et al., 2020).

Beside serological and molecular methods of HCV diagnosis, the elevation of ALT and AST levels can indicate liver damage, which may be associated with HCV infection (El-Kady et al., 2017; Giannini et al., 2005). However, it is essential to recognize that elevated liver enzymes can also arise from various factors, including alcohol consumption, obesity, and certain medications (Pratt & Kaplan, 2000).

Statement of the Problem

Despite the significant burden of HCV infection in Nigeria, there is a significant gap in comprehensive research focused on the relationship between Hepatitis C Virus (HCV) infection and liver enzyme levels among seemingly healthy individuals in Jos North Plateau State, as most existing research has primarily targeted high-risk groups (Audu et al., 2020; Musa et al., 2018). These result in many people harbouring the virus unknowingly without showing symptoms, which can create a misleading sense of well-being regarding their health status.

The dearth of data on HCV prevalence and its impact on liver enzymes in this population hampers the development of effective public health strategies and policies. This knowledge gap underscores the urgent need for further investigations into the prevalence

of HCV and its effects on liver enzymes within this demographic. Gaining insights into the connection between HCV infection and liver enzyme levels is crucial for formulating effective screening and prevention strategies.

Purpose of the Study

The purpose of this study was to determine the prevalence of HCV infection among apparently healthy individuals in Jos North and to evaluate the association between HCV seropositivity and liver enzyme abnormalities levels.

Research Questions

1. Is there a significant association between HCV seropositivity and liver enzyme abnormalities (ALT and AST levels) among apparently healthy individuals in Jos North?
2. What are the demographic factors (age, sex, marital status, education level) associated with HCV seropositivity among apparently healthy individuals in Jos North?

Objectives of the study

1. To evaluate the association between HCV seropositivity and liver enzyme (ALT and AST level) abnormalities in among seropositive individuals.
2. To identify demographic factors that may be associated with HCV infection in the study population.

Hypotheses

Null Hypothesis (H_0): There is no significant association between HCV seropositivity and liver enzyme abnormalities (ALT and AST levels) among apparently healthy individuals in Jos North.

Alternative Hypothesis (H_1): There is a significant association between HCV seropositivity and liver enzyme abnormalities (ALT and AST levels) among apparently healthy individuals in Jos North.

METHODOLOGY

This research employed a cross-sectional study design which allows for efficient collection of data at a single point in time to determineHCV infection status, Liver function tests and the Socio-demographic data of the participants.

These include apparently healthy individuals (males and females) aged 10 to 65 years, residing in Jos North Local Government Area of Plateau State, Nigeria.

Sample Size determination

The sample size was calculated using the formula described by Thrusfield, 1997 as follows; $n = \frac{(Z)^2 \times Pexp (1-Pexp)}{d^2}$

Where: n = Number of sample, Pexp = expected prevalence, d = desired absolute precision of 5%

Z = normal standard deviation (1.96), corresponds to confidence interval of 95%.Expected prevalence of 10.4 % (Onubi*et al.,* 2023) was adopted.

$$n = \frac{(1.96)^2 \times 0.104 (1-0.104)}{(0.05)^2} = 143.19026176 = 143$$

The expected sample size was 143 samples, 25% was added bringing number to 180. A multistage sampling technique was used to recruit participants. In the first stage, three wards were randomly selected from the 14 wards in Jos North. In the second stage, two communities were randomly selected from each of the selected three wards. In the third stage, simple random samples of 30 participants were selected from each of the selected communities

Ethical approval was obtained from the Plateau State Ministry of Healthprior to study commencement. All eligible subjects, male and female, aged 10-65 years, residing in Jos North, Plateau State, who do not show any symptoms of HCV infection or any known medical condition, and who give informed consent, were included in the study. Individuals with known chronic liver diseases or other hepatic conditions, Pregnant women, due to physiological changes affecting liver enzymes, Individuals currently on medications known to affect liver function tests and those unwilling or unable to provide informed consent.

Data were collected using a structured questionnaire. The questionnaire was pre-tested for clarity and reliability. Blood samples were collected for laboratory analysis of HCV serostatus and liver function tests. Venous blood samples (5mL) were collected aseptically from each participant using sterile needles and vacutainer tubes. Samples were labeled with unique identifiers to maintain confidentiality. Blood was allowed to clot at room temperature, centrifuged to separate serum. Samples were transported under cold

chain to the Plateau State Human Virology Research Centre Jos (PLASVIREC) Institution of Human Virology Nigeria for laboratory analysis. Where analysis was not done immediately, the sera obtained were dispensed into clean, dry cryovial tubes and stored at -20°C prior to analysis to preserve enzyme activity and antibody integrity.

HCV Detection was performed using rapid diagnostic test kits for anti-HCV antibodies. Samples were confirmed by ELISA kits, a highly sensitive and specific method for detecting HCV antibodies.Liver Enzymes and Function Tests: Serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels were measured using standard spectrophotometric enzymatic assays. Additional liver function parameters including total protein, albumin, total bilirubin, conjugated bilirubin, and alkaline phosphatase (ALP) were quantified using automated biochemical analyzers following manufacturer protocols.Quality control measures included running controls and calibrators with each batch to ensure accuracy and reproducibility of results. The chi-square test assessed the association between HCV seropositivity and categorical demographic variables. Independent samples t-tests compared mean liver enzyme levels (ALT, AST) between HCV-positive and negative groups. Pearson's correlation coefficients determined the strength and direction of relationships between ELISA (HCV) status and biochemical parameters. MANOVA tested the overall effect of HCV seropositivity on liver function tests while adjusting for demographic covariates. Statistical significance was set at $p < 0.05$ for all tests. The analyses were conducted using IBM SPSS version 27, ensuring robustness and reliability of results.

RESULTS

Table 1: Prevalence of Hepatitis C Virus Infection among the Study Population in Relation to Gender

Variables	Category	No. Tested	Rapid Test Positive (%)	ELISA Test Positive (%)	P- value
Gender	Male	69	3(4.3)	3(4.3)	P = 0.524
	Female	111	6(5.4)	6(5.4)	
	Total	180	9(5.0)	9(5.0)	

The study analyzed 180 samples of apparently Healthy Individuals in Jos-North area of Plateau State, of which 9(5.0%) tested positive for HCV using both rapid and

ELISA test kits. Of these, 69 were male, while 111 were female with a prevalence of 3(4.3%) and 6(5.4%) respectively. The statistical values $\chi^2 = 0.100$ and $p = 0.524$ are reported in Table 1.

Table 2: Shows Socio-demographic variables of the Study Population

VARIABLES	CATEGORY	FREQNUMBER/(%)
Age	21-30	2(22.2)
	31-40	1(11.1)
	41-50	2(22.2)
	51-65	4(44.4)
Gender	Male	3(33.3)
	Female	6(66.7)
Marital Status	Singles	1(11.1)
	Married	6(66.7)
	Widow	2(22.2)
Educational Status	Informal	1(11.1)
	Primary	3(33.3)
	Secondary	4(44.4)
	Tertiary	1(11.1)
Occupation Status	Business	7(77.8)
	Civil servant	1(11.1)
	Others	1(11.1)
Alanine aminotransferase (ALT)	Normal	1(11.1)
	Elevated	8(88.9)
Aspartate aminotransferase (AST)	Normal	2(22.2)
	Elevated	7(77.8)
Geographical Wards	JentaAdamu	4(44.4)
	Tudun Wada	3(33.3)
	Jos Jarawa	2(22.2)

The Socio-demographic variables of the individuals with ELISA (HCV) positive status are given in Table 2.

Table 3: Shows descriptive Statistics of the Study Population

VARIABLES	N	RANGE		Mean ± SD	NORMAL RANGES		
		Min	Max		Male	Female	Child
Total Protein (g/L)	9	60	67	63.67 ± 2.18	63 – 80 (g/L)		
Albumin (g/L)	9	31	36	33.67 ± 2.00	35 – 50 (g/L)		
Total Bil (umol/L)	9	12	34	16.07 ± 6.83	3.4 -17.0 (umol/L)		
Conj. Bil (umol/L)	9	6	20	8.24 ± 4.49	1.7 -13.9 (umol/L)		
ALP (U/L)	9	53	109	71.44 ± 16.17	21 – 92(U/L)		58 -331
Serum ALT (U/L)	9	40	138	58.78 ± 30.41	0 – 40 (U/L)	0 – 38 (U/L)	

Serum AST (U/L)	9	36	111	53.33 ± 23.12	0 – 40 (U/L)	0 – 36 (U/L)
ELISA (HCV) Status	9	1.03	2.29	1.85 ± 0.41		

Estimated mean ± SD of Total protein was 63.67 ± 2.18, Albumin was 33.67 ± 2.00, Total Bilirubin was 16.07 ± 6.83, Conjugated Bilirubin was 8.24 ± 4.49, Alkaline phosphatase was 71.44 ± 16.17, Alanine aminotransferase was 58.78 ± 30.41 and Aspartate aminotransferase was 53.33 ± 23.12 of ELISA (HCV) positive status are shown in Table 3.

Table 4 : Shows Correlation Analysis between ELISA (HCV) Status and Biochemical Parameters

COMPARISON	**CORRELATION COEFFICIENT (r)**	**p value**	**DIRECTION OF RELATIONSHIP**	**INTERPRETATION**
ELISA (HCV) STATUS vs T. PROTEIN (g/L)	0.047	0.904	Weak positive relationship	No significant correlation
ELISA (HCV) STATUS vs ALBUMIN (g/L)	-0.045	0.909	Weak Negative relationship	No significant correlation
ELISA (HCV) STATUS vs T. BIL (umol/L)	-0.118	0.763	Weak Negative relationship	No significant correlation
ELISA (HCV) STATUS vs C. BIL (umol/L)	-0.123	0.753	Weak Negative relationship	No significant correlation
ELISA (HCV) STATUS vs ALP (U/L)	-0.224	0.563	Weak Negative relationship	No significant correlation
ELISA (HCV) STATUS vs ALT (U/L)	-0.161	0.679	Weak Negative relationship	No significant correlation
ELISA (HCV) STATUS vs AST (U/L)	-0.313	0.413	Weak Negative relationship	No significant correlation

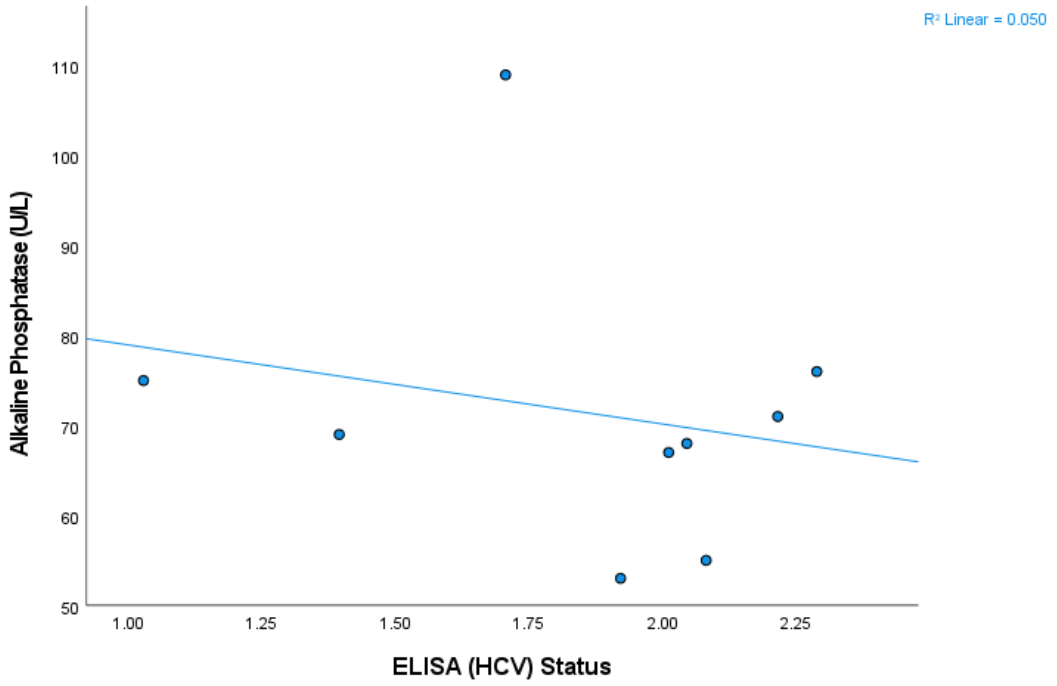

Figure 1 Scatter diagram and regression line showing no significant correlation relationship between ELISA (HCV) infection Status and Alkaline phosphatase (ALP)

(r = -0.22, p = 0.56).

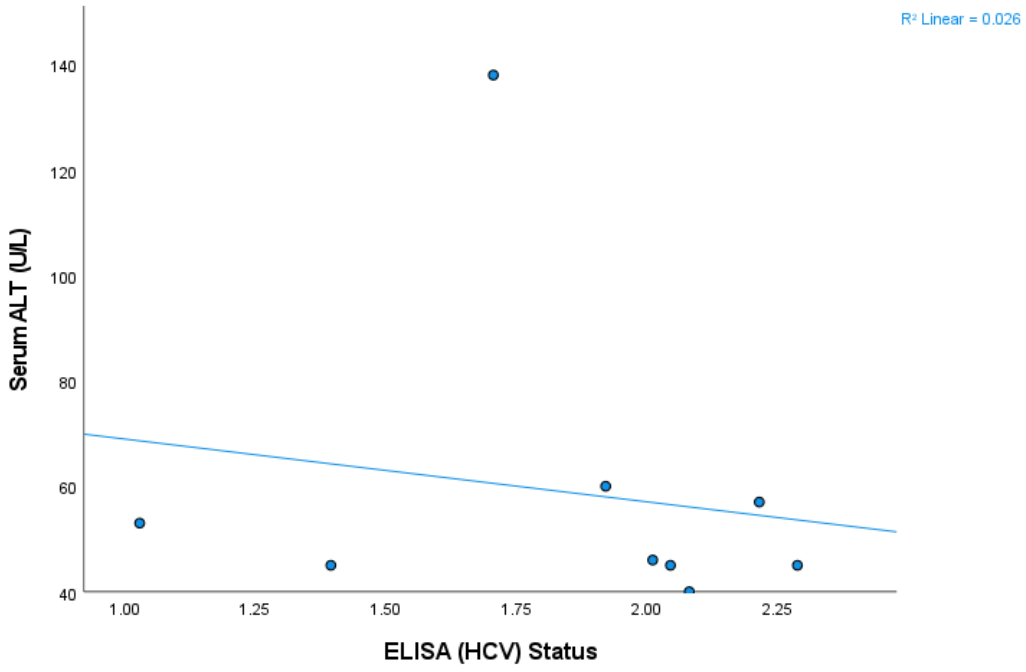

Figure 2 Scatter diagram and regression line showing no significant correlation relationship between ELISA (HCV) infection Status and Alanine aminotransferase (ALT)

(r = -0.16, p = 0.68).

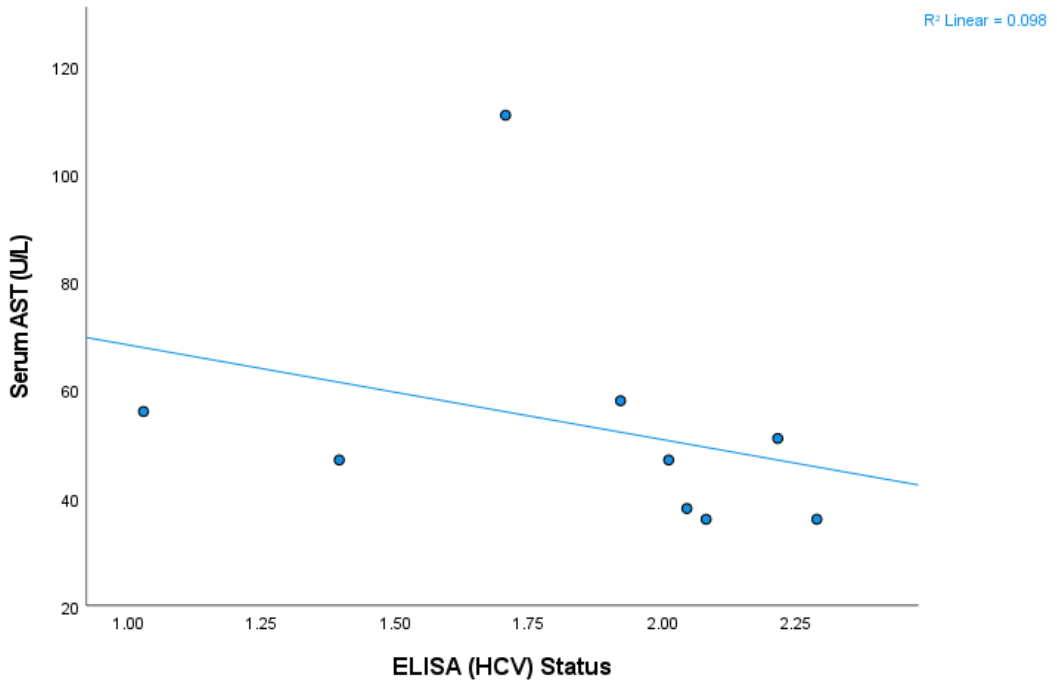

Figure 3 Scatter diagram and regression line showing no significant correlation relationship between ELISA (HCV) infection Status and Aspartate aminotransferase (AST)

(r = -0.31, p = 0.41).

An independent samples t-test was conducted to compare serum ALT (SGPT) and AST (SGOT) levels between HCV-positive (test) and HCV-negative (control) groups, each with 9 participants. The mean ALT level was higher in the HCV-positive group (M = 58.78, SD = 30.41) compared to the control group (M = 38.56, SD = 1.42). The difference approached but did not reach statistical significance, t(16) = 1.99, p = 0.064 (equal variances assumed). Levene's test indicated borderline homogeneity of variance, F(1,16) = 4.44, p = 0.051. The effect size was large (Glass's Δ = 1.42), suggesting a substantial difference despite the non-significant p-value.

Similarly, the mean AST level was higher in the HCV-positive group (M = 53.33, SD = 23.12) than controls (M = 37.78, SD = 1.64). This difference also approached significance, t(16) = 2.01, p = 0.061, with Levene's test indicating unequal variances, F(1,16) = 5.13, p = 0.038. The effect size was large (Glass's Δ = 1.64). Although the differences in ALT and AST levels between groups were not statistically significant at the

conventional alpha level of 0.05, the large effect sizes indicate clinically meaningful elevations in liver enzymes among HCV-positive individuals.

Pearson correlation coefficients were calculated among liver function markers and ELISA status (HCV seropositivity coded as 1 = positive, 2 = negative). ALT and AST levels were strongly positively correlated ($r = 0.979$, $p < 0.001$), indicating that elevations in one enzyme are closely associated with elevations in the other. However, ELISA status was not significantly correlated with ALT ($r = -0.161$, $p = 0.679$) or AST ($r = -0.313$, $p = 0.413$), consistent with the t-test findings of non-significant group differences. Other liver function parameters (total bilirubin, conjugated bilirubin, alkaline phosphatase) showed significant inter-corretions but no significant associations with ELISA status.

A multivariate analysis of variance (MANOVA) was conducted to assess the effect of HCV seropositivity on multiple liver function parameters simultaneously, controlling for covariates such as age, gender, marital status, education, occupation, and ward of residence. The overall model did not find a significant effect of HCV seropositivity on ALT, AST, or other liver function tests (e.g., total protein, albumin, bilirubin) with all p values > 0.05. For example, the effect on ALT was $F(1,10) = 1.97$, $p = 0.169$, and on AST was $F(1,10) = 2.55$, $p = 0.141$. The only significant covariate effect was observed for alkaline phosphatase by ward of residence, $F(1,10) = 6.77$, $p = 0.026$.Adjusted R-squared values for ALT and AST models were low (0.012 and –0.049, respectively), indicating limited explained variance, Table 4 and Figures 1 – 3.

Findings of the Study

1. Prevalence of HCV Infection: Among 180 apparently healthy individuals in Jos North, Plateau State, Nigeria, 9 (5.0%) tested positive for HCV using both rapid and ELISA tests. The prevalence was slightly higher in females (5.4%) than males (4.3%), but this difference was not statistically significant ($\chi^2 = 0.100$, $p = 0.524$).
2. Liver Enzyme Levels: Mean serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels were elevated in HCV-positive individuals (ALT: 58.78 ± 30.41 U/L; AST: 53.33 ± 23.12 U/L) compared to HCV-negative controls (ALT: 38.56 ± 1.42 U/L; AST: 37.78 ± 1.64 U/L). Although these differences approached statistical significance ($p = 0.064$ for ALT and $p = 0.061$ for AST), they did not meet the conventional threshold ($p < 0.05$). Large effect sizes (Glass's $\Delta = 1.42$ for ALT and 1.64 for AST) indicated clinically meaningful elevations.

3. Correlation Analyses: ALT and AST levels were strongly positively correlated ($r = 0.979$, $p < 0.001$). However, no significant correlations were found between HCV seropositivity and ALT ($r = –0.161$, $p = 0.679$), AST ($r = –0.313$, $p = 0.413$), or other liver function parameters such as total protein, albumin, bilirubin, and alkaline phosphatase.
4. Multivariate Analysis: Controlling for demographic covariates, HCV seropositivity did not significantly affect liver enzyme levels or other liver function tests (all $p > 0.05$). The only significant covariate effect was for alkaline phosphatase by ward of residence ($p = 0.026$).

DISCUSSION

The study found an overall HCV seroprevalence of 5.0% among the 180 apparently healthy participants, with 4.3% prevalence in males and 5.4% in females. The difference in prevalence between genders was not statistically significant ($\chi^2 = 0.100$, $p = 0.524$). This prevalence falls within the range reported in Nigeria, where HCV infection rates vary widely from 0.40% to 29.6% depending on the region and population studied (Audu et al., 2020; Musa et al., 2018; Okafor et al., 2020).

The 5.0% prevalence observed aligns closely with national averages reported by the Federal Ministry of Health (2016) and other studies in similar populations (FMOH, 2016; Musa et al., 2018).The lack of significant gender difference is consistent with some Nigerian studies but contrasts with others that report higher prevalence in females, possibly due to differential exposure risks or biological factors (Karoney&Siika, 2013). The study's demographic data showed a higher proportion of females among HCV-positive individuals (66.7%), suggesting that gender-specific risk factors such as healthcare-related exposures or cultural practices may influence infection rates, though this requires further investigation.

Demographic Characteristics and HCV Seropositivity

Age distribution among HCV-positive individuals revealed that the majority (44.4%) were aged between 51 and 65 years, followed by younger age groups with lower prevalence. This trend is consistent with the natural history of HCV infection, where chronic infection often remains asymptomatic for decades before clinical manifestations arise (Westbrook &Dusheiko, 2014). Older age groups are more likely to have accumulated

exposure risks, such as blood transfusions or unsafe medical procedures, which are common transmission routes in Nigeria (CDC, 2020; WHO, 2022).Marital status and educational level did not show strong associations with HCV seropositivity, although most infected individuals were married (66.7%) and had secondary education (44.4%). However, these associations were not statistically tested in the study and warrant further research.

Liver Enzyme Levels in HCV-Positive Individuals

A key focus of this study was the evaluation of liver enzymes-alanine aminotransferase (ALT) and aspartate aminotransferase (AST)-as markers of liver injury in HCV-positive versus HCV-negative participants. The mean ALT and AST levels were elevated in the HCV-positive group (ALT: 58.78 ± 30.41 U/L; AST: 53.33 ± 23.12 U/L) compared to controls (ALT: 38.56 ± 1.42 U/L; AST: 37.78 ± 1.64 U/L). Although these differences approached but did not reach statistical significance ($p = 0.064$ for ALT and $p = 0.061$ for AST), the large effect sizes (Glass's $\Delta = 1.42$ for ALT and 1.64 for AST) suggest clinically meaningful elevations indicative of hepatic inflammation or damage (Giannini et al., 2005; Rana et al., 2020).

The borderline statistical significance may be attributed to the small number of HCV-positive participants ($n = 9$), which limits the power to detect differences. Nonetheless, elevated liver enzymes in HCV infection are well-documented markers of hepatocellular injury and correlate with disease progression risk (El-Kady et al., 2017; Pratt & Kaplan, 2000). The strong positive correlation between ALT and AST levels ($r = 0.979$, $p < 0.001$) further supports their concurrent elevation as a hallmark of liver damage in HCV infection.

Interestingly, the study found no significant correlations between HCV seropositivity and other liver function parameters such as total protein, albumin, total bilirubin, conjugated bilirubin, and alkaline phosphatase (all $p > 0.05$). This may reflect the early or asymptomatic stage of infection in the study population, where liver synthetic function and cholestasis markers remain within normal limits (Karoney&Siika, 2013; Westbrook &Dusheiko, 2014).

Multivariate Analysis and Covariate Effects

The multivariate analysis of variance (MANOVA) controlling for age, gender, marital status, education, occupation, and ward of residence did not reveal a statistically significant effect of HCV seropositivity on liver enzymes or other liver function tests. This

suggests that demographic and socioeconomic factors may not confound the relationship between HCV infection and liver enzyme abnormalities in this sample. However, a significant covariate effect was observed for alkaline phosphatase by ward of residence ($F(1,10) = 6.77$, $p = 0.026$), indicating that geographical or environmental factors might influence liver enzyme levels independently of HCV infection. This finding aligns with previous reports that local healthcare practices, environmental toxins, or endemic infections can affect liver function markers (Mawuli et al., 2022; Okafor et al., 2020).

CONCLUSION

This study reveals a 5.0% prevalence of hepatitis C virus (HCV) infection among apparently healthy individuals in Jos North, Plateau State, underscoring the silent burden of HCV in the general population. The observation of elevated liver enzymes (ALT and AST) among HCV-positive individuals, despite a lack of statistical significance, points to possible subclinical liver injury and highlights the potential for early hepatic involvement even in asymptomatic cases. The absence of significant associations with other liver function parameters further supports the likelihood of early-stage disease within this cohort.

These findings emphasize the critical role of routine HCV screening and biochemical monitoring in facilitating early diagnosis and timely intervention. In doing so, the study contributes to national and global efforts to reduce the long-term health burden of viral hepatitis by informing context-specific prevention strategies. By providing localized epidemiological and biochemical data, the research strengthens the evidence base for targeted health interventions in Nigeria.

Ultimately, this study advances understanding of the hidden dynamics of HCV transmission and liver involvement in apparently healthy populations, reinforcing the imperative for proactive public health policies that integrate screening, surveillance, and early management strategies into broader hepatitis elimination frameworks.

Recommendations

1. Expanded Screening: Implement broader HCV screening programs targeting the general population, not just high-risk groups, to identify asymptomatic carriers early.

2. Liver Function Monitoring: Regular assessment of liver enzymes (ALT, AST) should be integrated into routine health checks, especially for individuals at risk or with confirmed HCV infection.
3. Public Awareness: Increase community education on HCV transmission, risk factors, and the importance of early diagnosis and treatment.Policy Development: Use study data to inform public health policies aimed at HCV control and liver disease prevention in Nigeria.

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