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COMPARATIVE ASSESSMENT OF SERUM ALANINE AMINOTRANSFERASE (ALT) AND ASPARTATE AMINOTRANSFERASE (AST) LEVELS IN HEPATITIS B AND HEPATITIS C PATIENTS

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Abstract

Background and Objectives: *Major viral illnesses that impact the liver include hepatitis B and hepatitis C, both of which are significant contributors to chronic liver illness globally. Both infections cause hepatocellular damage, which results in increased serum levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT). These liver enzymes are crucial biochemical indicators that are used to gauge the degree of liver inflammation and the course of the illness. The purpose of the current research was to compare serum ALT and AST levels in patients with Hepatitis B and Hepatitis C.*

Methodology: *Khan Laboratory in Sargodha, Pakistan, conducted a cross-sectional analytical investigation. The study included a total of 60 patients who had received a diagnosis of either hepatitis B or hepatitis C. Using the Biolis 24i fully automated chemistry analyzer, serum ALT and AST levels were measured in blood samples obtained in an aseptic environment. SPSS version 26. 0 was used for data analysis. We did a paired t-test and correlation analysis after computing the Mean ± SD. A p-value of less than 0. 05 was deemed statistically significant.*

Results: *The average serum ALT concentration was 941. 23 320. 57 U/L, while the average AST level was 819. 67 320. 53 U/L. With a mean difference of 121. 57 U/L ($p < 0.001$), statistical analysis revealed a significant difference between ALT and AST levels. Between ALT and AST values, there was a really high positive correlation ($r = 0.992$, $p < 0.001$). The results showed that hepatitis patients have considerable liver inflammation and hepatocellular damage.*

Conclusion: *According to the study's findings, ALT and AST are both significant biochemical indicators for determining liver damage in individuals with hepatitis B and hepatitis C. ALT demonstrated significantly greater elevation than AST, which is indicative of higher liver specificity. In viral hepatitis patients, a combination of ALT and AST assessment offers helpful clinical information for illness monitoring and treatment.*

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CHAPTER 1
INTRODUCTION

An Introduction to Hepatitis:

The liver, a vital organ involved in metabolism, detoxification, and the production of vital proteins, is said to be inflamed when it has hepatitis. There are many potential causes of this illness, such as viral infections, alcohol consumption, autoimmune illnesses, and exposure to harmful chemicals. Viral hepatitis is regarded as the most prevalent and clinically important type of hepatitis worldwide [1].

The two main forms of viral hepatitis, hepatitis B and hepatitis C, are major contributors to mortality and morbidity worldwide. Both infections are most often spread via exposure to contaminated blood and bodily fluids, making them particularly common in healthcare environments and among people who engage in risky medical behavior [2].

The Hepatitis B virus (HBV), a DNA virus that can cause both acute and chronic illnesses, is the cause of hepatitis B. If not treated properly, chronic HBV infection can frequently advance silently, resulting in long-term liver injury, cirrhosis, and even liver cancer [3] . On the other hand, the hepatitis C virus (HCV), an RNA virus that is more prone to becoming chronic infection and has a strong correlation with progressive liver fibrosis and hepatocellular carcinoma, is the cause of hepatitis C [4] .

Both HBV and HCV infections harm liver cells (hepatocytes), which causes the release of intracellular enzymes like alanine aminotransferase (ALT) and aspartate aminotransferase (AST) into the bloodstream. These enzymes act as crucial biochemical indicators for evaluating liver damage and tracking the course of the illness. In contrast to AST, which might also be elevated in diseases impacting other organs [5] ALT is thought to be more particular to liver injury.

In hepatitis patients, ALT and AST levels are evaluated to determine the extent and nature of liver damage. Consequently, comparing these enzyme levels in individuals with Hepatitis B and Hepatitis C can yield significant information about the course of the illness and aid in clinical treatment.

HEPATITIS B:

Hepatitis B, which remains a significant health issue worldwide, is a dangerous viral illness that targets the liver. The Hepatitis B virus (HBV), a member of the Hepadnaviridae family, which has partially double-stranded DNA, is the cause. The virus mainly affects hepatocytes, causing liver inflammation and a wide range of clinical manifestations, including acute sickness and chronic liver illness [6].

Contact with infected blood, unprotected sexual intercourse, and mother-to-child transmission during birth are all ways that HBV infection can spread. Because of these transmission mechanisms, it is especially prevalent in areas where there are few healthcare resources and insufficient screening procedures [7] .

Clinically, hepatitis B can manifest as an acute illness with symptoms like jaundice, fatigue, and abdominal discomfort, but in many cases, particularly in the early stages, it is asymptomatic. One of the most important worries is its potential to develop into chronic infection, which raises the risk of liver cirrhosis and hepatocellular carcinoma over time [8] .

Early 20th-century observations of serum hepatitis, particularly in people who had received blood transfusions, are the origin of the history of hepatitis B. In 1965, Baruch Blumberg made a significant discovery when he found the "Australia antigen," which was subsequently discovered to be the Hepatitis B surface antigen (HBsAg). He received the Nobel Prize in 1976 for this finding, which greatly enhanced diagnostic tools.

In the 1970s, more progress was made when the full structure of the virus—often called the Dane particle—was discovered. This aided in comprehending the viral life cycle and its contribution to the course of liver illness [9] . The creation of the first hepatitis B vaccine in 1981, which was originally made from human plasma and subsequently replaced by safer recombinant vaccines, was another breakthrough.

If caught early, Hepatitis B is now a curable illness thanks to advances in antiviral treatments and

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prevention methods brought about by research throughout the years. Despite these advancements, it remains a significant burden because of its chronic nature and possible complications, highlighting the necessity of awareness, vaccination, and early identification.

The Pathophysiology of Hepatitis B:

The liver is the target of the hepatitis B virus (HBV) infection, which occurs when the virus enters the bloodstream. Through the sodium taurocholate co-transporting polypeptide (NTCP) receptor, which enables the virus to enter the cell, it binds to liver cells [10].

The viral DNA is transported to the nucleus after entering the hepatocyte, where it is transformed into covalently closed circular DNA (cccDNA). This cccDNA serves as a steady template for viral replication and accounts for the tenacity of HBV infection in the liver [11].

The virus then employs the host cell's mechanism to generate viral RNA and proteins. These elements are put together to form fresh viral particles that are discharged into the bloodstream in order to infect other hepatocytes. HBV itself is not immediately harmful to liver cells, unlike many other viral infections [12].

The liver damage associated with Hepatitis B is mostly caused by the host immune response rather than by the virus itself. HBV-infected hepatocytes are identified by cytotoxic T lymphocytes, which then begin an immune-mediated attack to eradicate the virus. Inflammation and liver cell damage result from this immunological reaction [13].

The virus can be eliminated by a robust immunological reaction during the early stages of infection. Nevertheless, the virus persists, resulting in chronic infection, if the immune response is inadequate or weak [8]. Ongoing viral replication and persistent immune-mediated liver damage define chronic HBV infection.

Fibrosis, which can advance to cirrhosis, is brought about by chronic inflammation. The chance of genetic mutations rises in the latter stages due to ongoing cell injury and repair, which might result in hepatocellular carcinoma. The incorporation of HBV DNA into the host genome can also aid in the process of carcinogenesis [6].

Due to hepatocyte damage and membrane leakage, liver enzyme levels like ALT and AST increase. These enzymes are crucial biochemical indicators of the level of liver inflammation and injury at various stages of HBV infection [7].

HEPATITIS C:

The main target of the viral infection known as hepatitis C is the liver, and it is a major cause of chronic liver illness worldwide. The Flaviviridae family includes the Hepatitis C virus (HCV), an enveloped, single-stranded RNA virus that causes it. Hepatocytes are the primary cells that the virus infects, and it can cause both acute and chronic liver inflammation [14].

The most common way that HCV is spread is via exposure to infected blood, such as via unhygienic injections, blood transfusions (particularly before proper screening procedures were implemented), and the sharing of contaminated needles. It can also be spread less frequently through sexual contact or from a mother to her baby during delivery [15].

Acute hepatitis C infection is usually asymptomatic or manifests with vague, nonspecific symptoms that are frequently overlooked. However, a large percentage of afflicted people do not eradicate the virus, leading to persistent illness. Chronic Hepatitis C can last for years and slowly progress to liver fibrosis, cirrhosis, and hepatocellular carcinoma [16].

In comparison to Hepatitis B, Hepatitis C's history is relatively recent. Prior to its discovery, many cases of hepatitis not caused by Hepatitis A or B were referred to as "non-A, non-B hepatitis. " In 1989, Michael Houghton and his team made a significant discovery when they were able to isolate and clone the Hepatitis C virus, paving the way for precise diagnosis and further investigation. Later, in 2020, this discovery was one of the reasons for the Nobel Prize award.

The virus was successfully identified, and then significant progress was made in comprehending it and creating diagnostic techniques. The initial course of treatment was interferon therapy, which had varying rates of success and considerable

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adverse effects, and there were few other options available. But in recent years, the treatment of Hepatitis C has undergone a revolution thanks to the advent of direct-acting antivirals (DAAs), which provide high cure rates and shorter treatment durations.

At the pathophysiologic level, HCV multiplies quickly within hepatocytes and has a high degree of genetic diversity, which allows it to elude the host's immune response. In contrast to HBV, it does not integrate into the host genome but still results in chronic infection through ongoing viral replication and immune-mediated liver injury. The likelihood of developing cirrhosis and liver cancer increases over time due to this persistent inflammation, which results in progressive fibrosis.

Monitoring hepatitis C infection requires measuring liver enzymes like ALT and AST. Usually, patients experience a minor to moderate increase in these enzymes, which indicates a long-term, low-grade liver inflammation. As a result, knowing how these biochemical markers behave is crucial for determining the severity of the illness and how well HCV patients respond to treatment [17].

The Pathophysiology of Hepatitis C:

The start of a hepatitis C virus (HCV) infection is when the virus enters the bloodstream and makes its way to the liver, where it specifically infects hepatocytes. The virus enters the cell by attaching to several entry receptors on the hepatocyte surface, such as CD81 and SR-B1 [18].

Following penetration, HCV releases its single-stranded RNA into the cytoplasm of the hepatocyte. HCV doesn't enter the nucleus, unlike DNA viruses; Instead, it makes use of the ribosomes of the host cell for protein synthesis and replication directly [19].

The viral RNA serves as a template for the synthesis of a massive polyprotein, which is subsequently broken down into structural and non-structural proteins that are necessary for viral replication. This process occurs in association with the endoplasmic reticulum, creating a "membranous web" that supports viral replication [20].

The RNA-dependent RNA polymerase of HCV lacks proofreading capabilities, which contributes to its high mutation rate. This promotes the development of several viral variants (quasispecies), which aid the virus in avoiding the host's immunological response and inducing a chronic infection [21].

Liver damage is significantly influenced by the immune response in Hepatitis C. Cytotoxic T cells try to kill infected hepatocytes, but this strategy is frequently unsuccessful in completely eradicating the virus. Consequently, constant immunological activation causes chronic liver inflammation [22].

Persistent inflammation eventually leads to hepatocyte destruction, necrosis, and regeneration. The activation of hepatic stellate cells, which produce an excess of extracellular matrix proteins, causes fibrosis to develop through this recurring cycle [23].

The liver structure is altered as fibrosis develops, ultimately resulting in cirrhosis. A significant risk factor for cirrhosis complications include hepatocellular carcinoma and portal hypertension.

Even though HCV does not integrate into the host genome, its continuous replication and immune-mediated damage are enough to induce chronic liver damage.

High amounts of ALT and AST are frequently seen in HCV infection as a result of liver cell membrane injury and the release of intracellular enzymes into the circulation. These biochemical markers are crucial signs of persistent liver inflammation and disease activity.

The level of enzyme elevation can vary with time, indicating the complex interplay between viral replication and the host immune response. As a result, ALT and AST are helpful for tracking the course of the illness and the effectiveness of therapy in people with Hepatitis C.

A Comparison of the Pathophysiology of Hepatitis B and Hepatitis C:

Despite the fact that both Hepatitis B (HBV) and Hepatitis C (HCV) are hepatotropic viruses that infect the liver, their virology and disease progression mechanisms vary. The underlying distinction between HCV, an RNA virus, and

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HBV, a DNA virus, influences how they replicate and persist [24].

The virus enters hepatocytes during HBV infection and generates covalently closed circular DNA (cccDNA) in the nucleus, which acts as a steady template for the virus to persist over time. On the other hand, HCV multiplies only in the cytoplasm and does not create a nuclear reservoir [25].

The host immune response, rather than direct viral lysis of hepatocytes, is the major cause of liver damage caused by both viruses. Both infections result in inflammation and higher liver enzymes, such ALT and AST, as cytotoxic T cells kill infected hepatocytes [24].

The pattern of immune injury, though, is different. Liver injury in HBV frequently manifests during discrete immune-active periods, resulting in variable biochemical activity. Immune activation is more continuous in HCV, which leads to ongoing, mild inflammation [26].

Viral persistence is yet another significant distinction. Complete clearance is challenging because HBV can integrate into the host genome and sustain infection through both integration and cccDNA. The immune escape mechanisms and quick mutation allow HCV to last but not integrate [25].

Both illnesses have fibrosis formation as a result of persistent inflammation and activation of hepatic stellate cells. Fibrosis in HCV often develops gradually and continuously over time, whereas in HBV it may be episodic [26].

Both illnesses have the potential to develop into cirrhosis and hepatocellular carcinoma. In contrast, HCV causes cancer primarily through chronic inflammation and oxidative stress [24], but HBV has a direct carcinogenic potential due to DNA integration.

Additionally, the patterns of ALT and AST vary. Unlike HCV, which is generally linked to consistent, mild to moderate increases reflecting chronic infection, HBV exhibits more variable and phase-dependent enzyme increases [25].

In general, despite similar clinical outcomes, HBV and HCV have very different pathophysiological mechanisms, including viral structure, replication, immune response, and disease progression, which is essential for diagnosis and therapy preparation [26].

ENZYMES OF THE LIVER (ALT AND AST):

Alanine Aminotransferase (ALT):

The main intracellular enzyme involved in amino acid metabolism is alanine aminotransferase (ALT), which is predominantly found in hepatocytes and tis. It plays a crucial role in the conversion of alanine to pyruvate during gluconeogenesis. In healthy physiological conditions, only a little amount of ALT is found in the bloodstream. ALT, on the other hand, is a very reliable sign of liver damage because it is released into the bloodstream when hepatocytes are harmed [27].

Due to its high concentration in hepatic tissue, ALT is thought to be more liver-specific in clinical practice than other enzymes. It is commonly used in routine liver function tests to assess hepatocellular damage and track the course of disease in a variety of liver diseases. High ALT levels are often a sign of ongoing liver inflammation rather than just structural harm [28].

As a biochemical sign of hepatocyte damage in viral hepatitis, ALT is crucial. Because its levels frequently mirror the degree of liver inflammation and immune response, it is a key indicator in the diagnosis and management of hepatitis patients at all stages of the disease, both acute and chronic [29].

Aspartate Aminotransferase (AST):

The intracellular enzyme aspartate aminotransferase (AST) plays a crucial role in amino acid metabolism, notably in the reversible transfer of an amino group from aspartate to α-ketoglutarate. Although it may be found in many tissues throughout the body, such as the liver, heart, skeletal muscles, kidneys, and brain, its clinical relevance is mostly connected to evaluating liver function. AST is released into the bloodstream when cells in these tissues are injured, resulting in higher serum levels [33].

While AST is present in many organs, its increase is frequently related to hepatocellular damage, particularly in cases like toxic liver damage, alcoholic liver illness, and viral hepatitis. Nevertheless, since AST is not liver-specific like

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ALT, it is important to always interpret it in conjunction with other liver function tests in order to identify the true origin of the tissue damage [34].

AST is frequently employed as a biochemical indicator in clinical practice to assess the severity of liver damage and the course of the illness. Especially in viral hepatitis, where it indicates hepatocyte injury and is associated with inflammatory activity in the liver, it is helpful. In addition to helping distinguish between various forms of liver disease, the AST/ALT ratio is a crucial diagnostic factor in determining the severity of liver damage [33,34].

Differences in ALT and AST Patterns in Hepatitis B and Hepatitis C:

Between Hepatitis B and C infections, there are notable differences in the pattern of liver enzyme increases, specifically alanine aminotransferase (ALT) and aspartate aminotransferase (AST). In both illnesses, these variations demonstrate differences in viral activity, immunological reaction, and the kind of liver damage. It is essential to comprehend these trends for diagnosis, illness monitoring, and clinical decision-making [41].

The ALT and AST Pattern in Hepatitis B:

ALT and AST values in Hepatitis B infection often exhibit a phase-dependent and fluctuating pattern. This is primarily due to the fact that HBV infection manifests in different stages, including the immune-tolerant, immune-active, dormant carrier, and reactivation phases. Enzyme levels fluctuate during these stages in response to the severity of immune-mediated hepatocyte injury.

Due to an active cytotoxic T-cell response against HBV-infected hepatocytes during the immune-active phase, both ALT and AST levels increase dramatically. Because ALT is more specific to liver injury and AST may be affected by extrahepatic factors [42], ALT is often higher than AST in the majority of HBV cases.

Even if viral DNA is still present in the liver during the inactive carrier state, ALT and AST levels may revert to normal or just slightly increase. This suggests that there is little hepatocellular damage and less immune activity. Nonetheless, there may be sporadic flare-ups that cause a rapid rise in enzyme levels [43].

In chronic HBV infection that advances to fibrosis or cirrhosis, AST levels may slowly rise and occasionally surpass ALT. The shift in the AST/ALT ratio is frequently linked to more advanced liver disease and a poorer prognosis [44].

ALT and AST Patterns in Hepatitis C:

The pattern of ALT and AST increase is often distinct between Hepatitis C and B infections. Due to sustained low-grade hepatocellular inflammation as opposed to phase-dependent fluctuations, HCV often manifests as a more persistent and comparatively stable rise in liver enzymes. This is indicative of the persistent character of the illness and the continuing immune-mediated damage to the liver [45].

In the majority of individuals with chronic Hepatitis C, ALT levels are often somewhat greater than AST, particularly in the early and middle stages of the illness. But both enzymes are still moderately to moderately elevated for extended periods. Even without noticeable clinical signs, this persistent anomaly suggests ongoing hepatocyte injury [46].

The AST level may begin to increase more noticeably as Hepatitis C advances to advanced fibrosis or cirrhosis, and in some cases, the AST/ALT ratio may exceed 1. Since this pattern is frequently linked to greater liver injury and a worse prognosis, AST is a valuable indicator for advanced disease staging in HCV patients .

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Table 01: Comparison of ALT and AST Pattern in Hepatitis B and Hepatitis C [47]

Feature	Hepatitis B	Hepatitis C
Pattern of ALT and AST	Fluctuating pattern based on stage of the disease	Mild to moderate , more stable increased elevation
ALT Level	During active periods, it often greater than AST	Sometimes, it only slightly high. Just a little above AST in the beginning
AST Level	May experienced a rise in advanced cirrhosis or disease.	May gradually rise above ALT in cirrhosis or advanced fibrosis
ALT/AST Ratio	In the early stages of illness , ALT is usually greater than AST; Late in course of disease, AST levels may increase	The ALT /AST ratio may exceed 1 in severe liver illness
Disease Association	Hepatitis is associated with changes, immune and replication phases of the B virus activity	Consistent elevation indicate continuity hepatocyte damage of a lower grade
Clinical Significance	Useful for tracking the course of illness and how well treatment works	Helpful for keeping an eye on persistent harm and the course of fibrosis

Rationale of the study

Major global health issues include hepatitis B and C, both of which are major contributors to hepatocellular carcinoma, cirrhosis, and chronic liver illness. Due to delayed diagnosis and long-term sequelae, both diseases remain prevalent in developing nations and continue to place a significant strain on healthcare systems. Enhancing early detection and disease monitoring methods requires an understanding of their biochemical behavior [48].

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are two serum liver enzymes frequently used to assess hepatocellular damage. But because of differences in viral replication, immunological response, and disease course, their patterns vary between hepatitis B and hepatitis C. These distinctions are not always well understood in everyday clinical practice, which might have an impact on how patients are cared for and how their diseases are evaluated [49].

While several studies have looked at ALT and AST separately in viral hepatitis, few have directly compared these enzyme patterns in patients with Hepatitis B and Hepatitis C from the same community. Comparative studies like these are crucial for increasing diagnostic accuracy and improving our understanding of the biochemical profiles of certain diseases [50].

As a result, the goal of this investigation is to compare the serum ALT and AST levels in patients with Hepatitis B and Hepatitis C in order to gain a clearer understanding of their distinct patterns. Ultimately, the results may aid clinicians in early illness evaluation, monitoring progression, and improving therapy decisions, leading to better patient outcomes and disease management strategies [51].

OBJECTIVES OF STUDY

Objectives:

1. To measure serum ALT levels in Hepatitis B and C patients.
2. To measure serum AST levels in Hepatitis B and C patients.

HYPOTHESIS OF STUDY

Hypothesis:

Null Hypothesis (H_0):

- There is no significant difference in serum ALT levels between patients with Hepatitis B and Hepatitis C.
- There is no significant difference in serum AST levels between patients with Hepatitis B and Hepatitis C
- Serum ALT levels are not significantly elevated in patients with Hepatitis B.

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- Serum AST levels are not significantly elevated in patients with Hepatitis C.

Alternative Hypothesis (H_1):

- There is a significant difference in serum ALT levels between patients with Hepatitis B and Hepatitis C.
- There is a significant difference in serum AST levels between patients with Hepatitis B and Hepatitis C.
- Serum ALT levels are significantly elevated in patients with Hepatitis B.
- Serum AST levels are significantly elevated in patients with Hepatitis C.

CHAPTER 2
LITERATURE REVIEW

The comparative trends of serum ALT and AST levels in patients with chronic Hepatitis B and Hepatitis C were examined in a 2026 study by Zhang Wei et al. According to the research, the two infections have unique biochemical profiles that mirror differences in viral replication dynamics and host immune responses. Because of their accessibility and cost-effectiveness, ALT and AST are still widely used and crucial biomarkers for assessing hepatocellular damage in everyday clinical practice, even with the availability of sophisticated molecular diagnostic methods.

Furthermore, the research emphasized that in patients with hepatitis B, ALT levels varied significantly according to the stage of the infection, especially during the immune-active and immune-tolerant periods. On the other hand, people with Hepatitis C had a more persistent and somewhat consistent rise in ALT and AST levels, which suggested ongoing low-grade liver inflammation. These distinctions were related to differences in the way the virus replicated and caused immune-mediated liver injury. The writers also observed that the AST/ALT ratio tends to rise in severe liver illness, particularly in situations that are moving towards fibrosis and cirrhosis. They came to the conclusion that assessing ALT and AST together offers superior diagnostic and prognostic value than analyzing a single enzyme alone. In order to enhance illness staging, surveillance, and treatment response assessment in individuals with chronic viral hepatitis, the research advised combining biochemical markers with virological testing [52].

In 2026, Maria Lopez et al. published research that compared the serum levels of ALT and AST in individuals with chronic Hepatitis B and Hepatitis C. According to the study, both infections have unique biochemical profiles that mirror variations in how the virus replicates and how the host's immune system reacts. Due to their simplicity and cost-effectiveness, ALT and AST remain fundamental and commonly utilized markers for evaluating hepatocellular injury in regular clinical practice, despite improvements in molecular diagnostic approaches. In addition, the research discovered that ALT levels in patients with Hepatitis B fluctuated significantly during various stages of infection, especially during the immunological active and clearance stages. On the other hand, people with hepatitis C had consistently high but somewhat stable ALT and AST levels, indicating ongoing mild liver inflammation. Differences in viral architecture, replication mechanisms, and immune-mediated liver injury patterns were blamed for these discrepancies. Furthermore, the writers emphasized that the AST/ALT ratio tends to rise in the later stages of liver illness in both infections, notably in those who are developing fibrosis and cirrhosis. The study found that, in comparison to single enzyme analysis, the combination evaluation of ALT and AST offers greater clinical insight for disease staging and monitoring. Additionally, it advised combining virological tests with biochemical markers in order to improve the precision of diagnosis and treatment of patients [53].

The biochemical and clinical patterns of liver enzyme changes in patients with chronic viral hepatitis, notably Hepatitis B and Hepatitis C, were evaluated in a study conducted by Amina Khan et al. in 2025. The study concluded that even in the age of sophisticated molecular diagnostic methods, ALT and AST are still crucial biomarkers for evaluating hepatocellular damage. Because of their cost-effectiveness and broad availability in clinical environments, these enzymes continue to be essential for regular liver

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function evaluation, as highlighted by the authors. Additionally, the study noted that ALT levels in individuals with hepatitis B varied significantly depending on the stage of the infection, especially during immune-active periods when there is more severe damage to hepatocytes. On the other hand, those with Hepatitis C had consistently higher ALT and AST levels, which is evidence of ongoing chronic inflammation and ongoing harm to liver cells. These differences were mostly explained by variations in the way the virus replicates and how the immune system reacts differently to the two infections. Furthermore, the authors emphasized that the AST/ALT ratio may rise in later stages of liver illness, especially in individuals who are developing fibrosis and cirrhosis. They determined that comparing ALT and AST at the same time offers greater diagnostic and prognostic accuracy than assessing each enzyme separately. For better disease monitoring and treatment in individuals with chronic hepatitis, the research advised using biochemical markers in conjunction with virological and imaging results [54].

In 2025, David Miller et al. published a study comparing the serum ALT and AST levels between individuals with chronic Hepatitis B and Hepatitis C infections. The study emphasized that, despite advancements in molecular diagnostic methods, ALT and AST are still crucial biochemical markers for identifying hepatocellular damage and tracking disease activity. Due to their simplicity, cost, and diagnostic utility in assessing liver function, these enzymes are still commonly utilized in everyday clinical practice, according to the authors. According to the study, ALT levels in Hepatitis B infection tend to vary depending on the stage of the disease, notably during immune-active stages when hepatocyte destruction is more prominent. In contrast, patients with hepatitis C exhibited a more consistent and relatively stable rise in both ALT and AST, indicating ongoing low-grade inflammation and chronic liver damage. These disparities were related to differences in how viruses replicate and how the immune system causes liver damage. Furthermore, the researchers discovered that the AST/ALT ratio becomes more important in advanced liver disease, particularly in individuals who are developing fibrosis and cirrhosis. The study came to the conclusion that evaluating ALT and AST together yields higher diagnostic and prognostic accuracy than analyzing each enzyme separately. In order to enhance illness surveillance and patient care in chronic viral hepatitis it also advised combining virological and clinical results with biochemical indicators [55].

The biochemical activity of ALT and AST in people with chronic Hepatitis B and Hepatitis C was investigated in a study conducted by Sarah Williams et al. in 2025. Despite the growing usage of cutting-edge molecular and imaging approaches, the research highlighted that liver enzyme tests remain a crucial component of the assessment of hepatocellular damage. The authors stressed that ALT and AST continue to be crucial clinical indicators of liver inflammation and disease activity in people with viral hepatitis. In more advanced stages of liver damage, the study also found that AST levels tended to increase, while ALT levels in Hepatitis B infection showed episodic changes that mirrored immune-mediated viral clearance phases. In comparison, those with Hepatitis C showed consistent and long-lasting increases in both ALT and AST, indicating ongoing hepatocyte injury and chronic low-grade inflammation over time In addition, the researchers noted that the AST/ALT ratio was substantially higher in patients with advanced fibrosis and cirrhosis, especially in instances of hepatitis C. They came to the conclusion that combining the evaluation of ALT and AST offers greater diagnostic and predictive value than examining each enzyme separately. Regular monitoring of these biomarkers in conjunction with virological testing was advised by the study to enhance illness staging and treatment in individuals with chronic hepatitis [56].

To determine the diagnostic and prognostic relevance of serum ALT and AST patterns in patients with chronic Hepatitis B and Hepatitis C, Robert Anderson et al. performed a study in 2024. Despite developments in molecular diagnostic techniques, the research emphasized that liver enzyme evaluation remains a crucial instrument in clinical hepatology. The authors highlighted that ALT and AST continue to be extensively utilized because they are straightforward, affordable, and

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trustworthy markers of hepatocellular damage. Additionally, the study discovered that ALT levels in hepatitis B infection varied greatly depending on the stage of the illness, with levels rising especially during immune-active periods as a result of increased hepatocyte breakdown. Additionally, AST levels rose, with higher increases seen in patients whose condition was worsening and moving closer to advanced liver illness. In contrast, Hepatitis C patients had persistently high but comparatively constant ALT and AST levels, indicative of chronic low-grade liver inflammation and ongoing viral activity. Furthermore, the researchers discovered that the AST/ALT ratio was more helpful in detecting advanced fibrosis and cirrhosis, particularly in chronic Hepatitis C patients. They found that a combined interpretation of ALT and AST yields more clinical insight than analyzing each enzyme separately. To increase the precision of illness staging and long-term patient care, the study advised integrating biochemical markers with virological and imaging data [57].

In 2024, Emily Johnson et al. published a study that looked at the trends in serum ALT and AST levels in people with persistent hepatitis B and hepatitis C infections. In spite of the availability of sophisticated diagnostic techniques, the study emphasized that biochemical liver enzymes continue to be essential instruments for assessing hepatocellular injury and disease activity. Because of their availability, low cost, and diagnostic accuracy in viral hepatitis, the authors noted that ALT and AST are still essential components of daily clinical evaluation. In addition, the study found that ALT levels in Hepatitis B infection varied depending on the stage, with considerable increases during immune-active phases due to greater hepatocyte damage brought on by the host immune response. Patients with advanced liver illness also had an elevation in AST levels, albeit it was more pronounced. In contrast, hepatitis C patients exhibited persistently increased but more stable ALT and AST levels, indicating persistent chronic inflammation and viral activity in the liver. Moreover, the authors discovered that the AST/ALT ratio was especially helpful in determining the course of the illness, particularly in individuals who were developing fibrosis and cirrhosis. They came to the conclusion that a combined evaluation of ALT and AST is more useful for diagnosis and prognosis than either marker alone. For better management of patients with chronic hepatitis, the research advised that these biochemical markers should always be analyzed in conjunction with virological tests and clinical data [58].

The clinical relevance of serum ALT and AST levels in people with chronic Hepatitis B and Hepatitis C infections was assessed in a 2023 study by Michael Brown et al. The research emphasized that liver enzyme testing remains a cornerstone and extensively utilized method for evaluating hepatocellular damage and tracking disease activity in viral hepatitis, notwithstanding improvements in molecular diagnostics and imaging approaches. Additionally, the study discovered that ALT levels in Hepatitis B infection varied significantly across various stages of illness activity, notably increasing during immune-active periods as a result of greater immune-mediated hepatocyte destruction. Additionally, AST levels rose, particularly in individuals with advancing liver fibrosis or cirrhosis. On the other hand, Hepatitis C patients showed a more prolonged and comparatively steady increase in ALT and AST, indicating ongoing liver cell damage and chronic low-grade inflammation. Furthermore, the authors discovered that the AST/ALT ratio was a helpful indicator of disease severity, especially in advanced liver disease where AST tends to increase more noticeably. According to the study, the combination interpretation of ALT and AST offers superior diagnostic accuracy and prognostic value compared to the analysis of a single enzyme. For better surveillance and management of individuals with chronic hepatitis, it was also advised to combine biochemical markers with virological testing [59].

A study by James Wilson et al. published in 2023 looked at the usefulness of serum ALT and AST levels in the diagnosis and prognosis of people with chronic Hepatitis B and Hepatitis C. Even with the advent of sophisticated molecular and imaging-based diagnostic techniques, the study stressed that liver enzyme testing is still a vital part

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of the regular clinical assessment of viral hepatitis. Due to its simplicity and cost-effectiveness, the authors emphasized that ALT and AST still offer significant information on hepatocellular damage and disease activity. Additionally, the study found that during a Hepatitis B infection, ALT levels varied widely according to the stage of the illness, with a notable rise during immune-active periods when hepatocyte damage is at its worst. Additionally, AST levels were higher, particularly in those with worsening liver injury. On the other hand, individuals with hepatitis C had consistently high ALT and AST levels that were indicative of ongoing viral-induced liver damage and chronic inflammation. In addition, the authors discovered that the AST/ALT ratio was more helpful in detecting advanced liver illness, especially fibrosis and cirrhosis, in which AST levels tend to rise in comparison to ALT. The study found that the combination of ALT and AST offers superior diagnostic and prognostic accuracy compared to either marker used by itself. Additionally, it suggested integrating biochemical, virologic, and clinical data to enhance illness monitoring and management in individuals with chronic hepatitis [60].

To ascertain the role of serum ALT and AST levels in predicting liver damage and disease progression, Daniel Harris et al. performed a study in 2022 that looked at these levels in individuals with chronic Hepatitis B and Hepatitis C. Although molecular diagnostic techniques are becoming more and more popular, the study highlighted that biochemical liver enzyme testing remains a key component of clinical practice for viral hepatitis due to its simplicity, accessibility, and affordability. Furthermore, the research found that during Hepatitis B infection, ALT levels varied considerably according to the stage of disease activity, with significant rises during immune-active periods as a result of increased hepatocyte destruction. Patients with more severe liver illness or fibrosis also had higher AST levels. Patients with Hepatitis C, on the other hand, had consistently high but more stable ALT and AST levels, indicating ongoing low-grade inflammation and chronic hepatocellular damage. Furthermore, the authors emphasized the importance of the AST/ALT ratio in determining the severity of the illness, particularly at later stages of liver disease when the AST level tends to increase more than the ALT level. The study determined that a combined evaluation of ALT and AST offers superior diagnostic and prognostic value compared to evaluating each enzyme separately. Additionally, it advised incorporating biochemical markers with virological and clinical data to enhance the monitoring and treatment of individuals with chronic hepatitis [61].

To assess their diagnostic and prognostic value, Sophia Martin et al. performed a study in 2022 examining serum ALT and AST patterns in individuals with chronic Hepatitis B and Hepatitis C. Because liver enzyme testing is easily accessible, inexpensive, and effective at identifying hepatocellular injury the study highlighted that it is still a crucial component of routine clinical evaluation in viral hepatitis. Additionally, the study found that ALT levels in Hepatitis B infection varied depending on the stage of the illness. In particular, the immune-active phases showed notable increases, which corresponded to the active hepatocyte destruction brought about by the host immune response. In addition, AST levels increased, particularly in individuals with worsening cirrhosis or fibrosis. In comparison, patients with Hepatitis C showed consistently high but stable ALT and AST levels, suggesting ongoing liver damage and chronic, low-grade inflammation. The AST/ALT ratio is another helpful predictor of illness severity, particularly in late-stage liver illness where AST tends to be proportionately greater than ALT, the authors discovered. The study found that the combined interpretation of ALT and AST has greater clinical and prognostic value than either enzyme alone. For improved monitoring and treatment of patients with chronic hepatitis, it also suggested combining biochemical markers with virological testing and clinical assessment [62].

The clinical significance of serum ALT and AST levels in individuals with chronic Hepatitis B and Hepatitis C was examined in a study conducted in 2021 by Christopher Lee et al. The study emphasized that even in the age of sophisticated molecular diagnostics and imaging methods,

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biochemical liver enzymes continue to be a crucial and widely used tool for evaluating hepatocellular damage. Additionally, the study found that ALT levels varied significantly depending on the stage of Hepatitis B infection, notably rising during immune-active periods as a result of the immune system's powerful mediated destruction of infected hepatocytes. In particular, patients with advanced liver fibrosis or cirrhosis also experienced an increase in their AST levels. In contrast, individuals with hepatitis C had more consistent but continuously high ALT and AST levels, which indicated ongoing low-grade inflammation and chronic liver cell damage. The authors also noted that the AST/ALT ratio has prognostic significance, especially in severe liver illness where AST is comparatively greater than ALT. According to the study, combined ALT and AST evaluation offers greater diagnostic accuracy and illness monitoring than individual enzyme analysis. For better treatment of individuals with chronic viral hepatitis, it also suggested combining virological and clinical data with biochemical markers [63].

To determine the diagnostic and prognostic value of serum ALT and AST values, Olivia Brown et al. performed a study in 2021 that analyzed patients with chronic Hepatitis B and Hepatitis C. Because of their simplicity, cost, and dependability in regular clinical practice, liver enzyme tests continue to be a cornerstone and extensively utilized technique for identifying hepatocellular damage. In addition, the study found that ALT levels in Hepatitis B infection varied significantly with the stage of the illness, with large increases during immune-active phases as a result of the immune-mediated killing of infected hepatocytes. Additionally, AST levels were increased, notably in individuals with advanced fibrosis or cirrhosis. In contrast, Hepatitis C patients had consistently higher but more stable ALT and AST levels, suggesting ongoing liver damage and chronic low-grade inflammation. The authors also emphasized that the AST/ALT ratio is a valuable indicator for determining the severity of illness, particularly in later stages when AST tends to rise in proportion to ALT. The study came to the conclusion that a combination evaluation of ALT and AST offers superior diagnostic and prognostic value compared to a single enzyme evaluation. Furthermore, it advised combining virologic and clinical data with biochemical indicators to better monitor and treat individuals with chronic hepatitis [64].

To evaluate the role of serum ALT and AST levels in assessing liver inflammation and disease development, Ethan Walker et al. published a study in 2021 that analyzed these levels in patients with persistent Hepatitis B and C. Because of its widespread availability, low cost, and clinical utility in everyday practice, biochemical liver enzyme testing remains a vital diagnostic tool for viral hepatitis, according to the study. Additionally, the study found that ALT levels varied significantly with the stage of infection in Hepatitis B infection, with higher ALT levels during immune-active stages due to immune-mediated hepatocyte damage. Patients with more severe liver illnesses, such as fibrosis or cirrhosis, also had higher AST levels. On the other hand, individuals with hepatitis C exhibited more stable yet continuously high ALT and AST levels, indicative of persistent viral activity and chronic low-grade liver inflammation. In addition, the authors found that the AST/ALT ratio is a significant predictor of illness severity, particularly in severe liver disease where AST levels may be proportionately higher than ALT. The research came to the conclusion that using a combination of ALT and AST in an evaluation results in greater diagnostic and prognostic accuracy than measuring a single enzyme. In addition, it advised combining biochemical markers with virological and clinical factors in order to better monitor and manage individuals with chronic hepatitis [65].

To determine the diagnostic utility of serum ALT and AST levels in assessing liver damage and disease activity, Michael Thompson et al. conducted a study in 2020 comparing patients with chronic Hepatitis B and Hepatitis C. Due to its simplicity, availability, and cost-effectiveness in routine healthcare settings, liver enzyme testing remains an essential component of the clinical assessment of viral hepatitis, according to the study. Furthermore, the research indicated that ALT levels in Hepatitis B infection fluctuated significantly depending on the course of the

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illness, with notable rises during immunologically active stages as a result of greater immune-mediated hepatocyte destruction. Additionally, AST levels were high, notably in individuals with cirrhosis or advancing liver fibrosis. In contrast, Hepatitis C patients showed consistently high but stable ALT and AST levels, indicating persistent chronic inflammation and ongoing hepatocellular damage. Furthermore, the researchers noted that the AST/ALT ratio is helpful for determining the severity of illness, particularly in advanced liver disease where AST is proportionately higher than ALT. The research found that the combined analysis of ALT and AST offers superior diagnostic and prognostic precision than single enzyme assessment. For better monitoring and treatment of individuals with chronic hepatitis, it also suggested integrating virological and clinical results with biochemical markers [66].

To determine the diagnostic and prognostic value of serum ALT and AST levels in liver illness, Daniel Roberts et al. conducted a study in 2019 that examined these levels in patients with chronic Hepatitis B and Hepatitis C. Because liver enzyme testing is simple, inexpensive, and effective at identifying hepatocellular injury in both early and advanced stages of viral hepatitis, the study highlighted that it is still a crucial component of routine clinical assessment. According to the research, ALT levels in Hepatitis B infection varied noticeably with the stage of the illness, with higher elevations seen during immune-active phases as a result of immune-mediated hepatocyte destruction. In patients with advanced liver fibrosis and cirrhosis, AST levels also rose, especially in those with progressive disease. In contrast, Hepatitis C patients had consistently high ALT and AST levels, indicating ongoing viral-induced liver damage and chronic low-grade inflammation.

Furthermore, the authors discovered that the AST/ALT ratio is clinically helpful in differentiating disease severity, notably in advanced liver disease where AST tends to increase more than ALT. The study came to the conclusion that the combined evaluation of ALT and AST yields superior diagnostic and prognostic precision than the evaluation of individual enzymes. It also suggested integrating virological and clinical information with biochemical markers to enhance the monitoring and care of individuals with chronic hepatitis [67].

CHAPTER 3
METHODOLOGY

3.1 Study Design

The goal of this cross-sectional analytic study was to assess and compare the serum levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in individuals who have been diagnosed with Hepatitis B and Hepatitis C.

3.2 Study Setting

All biochemical analyses for the research were conducted at Khan Laboratory in Sargodha, Pakistan, using a completely automated clinical chemistry analyzer called Biolis 24i. To guarantee the accuracy and reliability of test results, the lab adheres to regular operating procedures.

3.3 Study Population

This experiment comprised 60 participants. Serological testing had previously led to a diagnosis of either hepatitis B or C in these individuals.

Confidence Level	**95%**
Margin Error	**5%**
Population Proportion	**3.6%**
Population Size	**250000000**

3.4 Selection Criteria

3.4.1 Inclusion Criteria

- Individuals who have been diagnosed with Hepatitis B or C
- Patients of both sexes
- Patients of various age groups

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3.4.2 Exclusion Criteria

- Individuals suffering from other liver disorders (such as fatty liver, alcoholic liver disease)
- Individuals suffering from serious systemic diseases or co-infections
- Incomplete laboratory data

3.5 Data Collection

Laboratory records provided information on patients, such as:

- ALT (Alanine Aminotransferase) concentrations
- The amount of aspartate aminotransferase (AST)
- The state of hepatitis B and hepatitis C

All data were recorded methodically and examined in order to compare the two groups.

3.6 Sample Collection

- Blood samples were taken in an aseptic manner.
- Every patient had between three and five milliliters of venous blood taken.
- Serum was separated by centrifuging blood after it had clotted.
- Biochemical analyses were performed using serum.

3.7 Biolis 24i Chemistry Analyzer

Principle:

The Biolis 24i Chemistry Analyzer employs spectrophotometric (colorimetric) analysis, which is based on the Beer-Lambert Law, according to which the absorbance of light is directly proportional to the analyte concentration in the sample. The serum sample interacts with particular reagents in this system to produce a colored complex, and the concentration of biochemical parameters such as ALT and AST is determined by measuring the color intensity at certain wavelengths.

The ALT test's fundamental concept, number

Figure 01: Biolis 24i Chemistry Analyzer

3.8 Principle of ALT Test

Alanine aminotransferase (ALT) facilitates the movement of an amino group from alanine to α-ketoglutarate, producing glutamate and pyruvate. The pyruvate generated then participates in a secondary reaction where it interacts with NADH in the presence of lactate dehydrogenase (LDH), producing lactate and NAD+.

The spectrophotometric measurement of the drop in NADH concentration is directly proportional to the ALT activity in the sample.

3.9 Principle of AST Test

Oxaloacetate and glutamate are produced when aspartate aminotransferase (AST) mediates the transfer of an amino group from aspartate to α-ketoglutarate. In the presence of malate

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dehydrogenase (MDH), oxaloacetate subsequently interacts with NADH to produce malate and NAD+.

The rate at which NADH absorption drops is measured spectrophotometrically and is directly proportional to AST activity.

3.10 Procedure of ALT and AST Tests

1. The automatic analyzer was loaded with the serum samples.
2. The device automatically added reagents that are unique to AST and ALT.
3. The enzymatic process was started by the analyzer, which combined the sample with reagents.
4. At a certain wavelength, the change in absorbance brought about by NADH usage was determined.
5. The activity of the enzyme was automatically determined and given in U/L (units per liter).

Reference Range:

- ALT: 5-40 U/L
- AST: 5-40 U/L

3.11Data Analysis

SPSS version 26. 0 was used to analyze the data. Categorical variables were presented as frequencies and percentages, whereas continuous variables (ALT, AST) were represented as mean ± SD. Mean ALT and AST levels across groups were compared using the independent sample t-test. When the p-value was less than 0. 05, it was deemed statistically significant. Tables and charts were used to display the results.

3.12 Ethical Considerations

- The utmost care was taken to protect patient confidentiality.
- Data was exclusively utilized for study purposes.
- There were no personal identifiers revealed.

CHAPTER 4
RESULTS

The study was conducted to compare and assess serum ALT and AST levels in patients with Hepatitis B and Hepatitis C. A total of 60 patients were included in the analysis. The demographic characteristics of the study population, including age and gender distribution, are presented first, followed by the distribution of Hepatitis B and Hepatitis C cases. Subsequently, the comparative analysis of serum ALT and AST levels among different patient groups is described using appropriate statistical methods.

Table 2: Demographic Characteristics of Participants (n = 60)

		Frequency	Percent %
Gender	Male	30	50
	Female	30	50
Hepatitis B	Positive	60	100
Hepatitis C	Positive	60	100
	Total	60	100

This table shows the frequency and percentage distribution of the study participants according to gender and hepatitis status. Out of 60 participants, 30 (50%) were males and 30 (50%) were females. All participants were positive for Hepatitis B and Hepatitis C, representing 100% prevalence in the study population.

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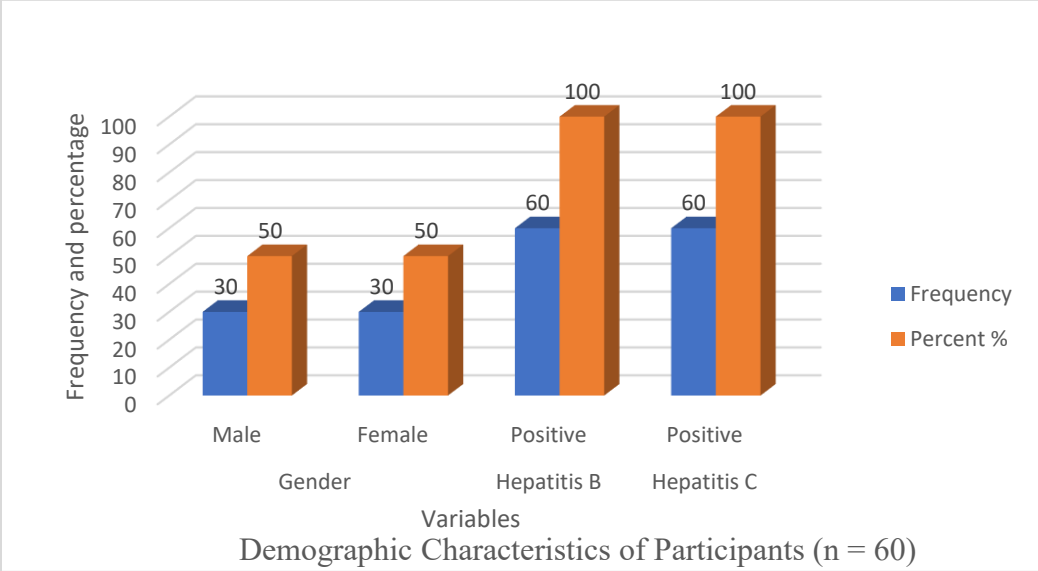
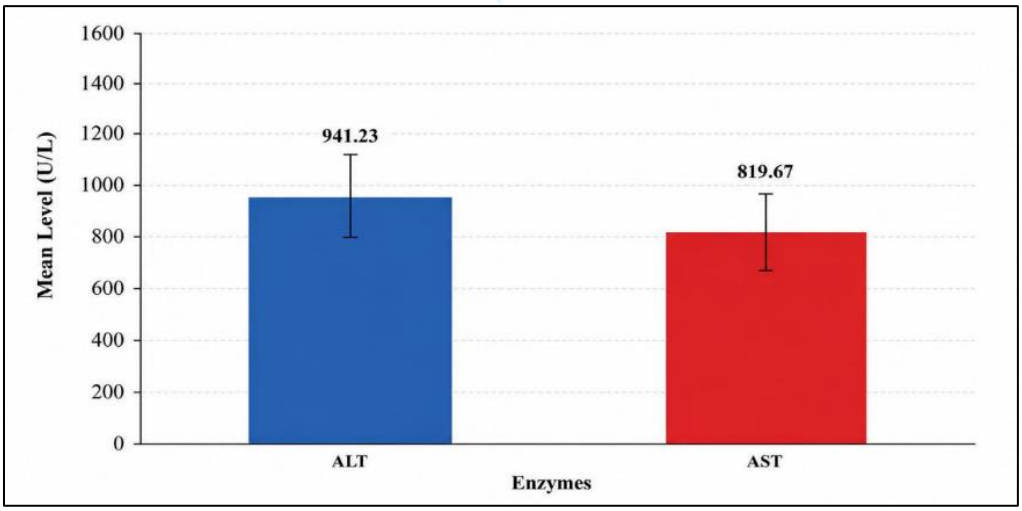


Graph 1 Demographic Characteristics of Participants (n = 60)

Table 3: Mean ± SD of Age and Liver Enzymes (n = 60)

Variable	Mean ± SD
Age (years)	55.17 ± 13.65
ALT	941.23 ± 320.57
AST	819.67 ± 320.53

This table presents the mean and standard deviation of age and liver enzyme levels of the participants. The mean age of the participants was 55.17 ± 13.65 years. The mean ALT level was 941.23 ± 320.57 U/L, while the mean AST level was 819.67 ± 320.53 U/L, indicating elevated liver enzyme levels among the study population.



Graph 2: Mean Serum ALT and AST Levels

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Table 4: Paired t-Test Examination of the Mean Difference between ALT and AST Levels

Variable	Meaning
Mean Difference	121.57
t-value	22.871
df	59
p-value	< .001

The findings of the paired t-test used to compare the mean serum ALT and AST levels between hepatitis patients are shown in the table above. The mean difference between ALT and AST levels was 121. 57 U/L, according to the analysis, which suggests that ALT values were often greater than AST values in the cohort.

The two enzyme levels showed a significant statistical disparity as evidenced by the computed t-value of 22. 871 and 59 degrees of freedom (df). The p-value, which is extremely statistically significant, was found to be less than 0. 001. This suggests that the observed disparity between ALT and AST levels was not a fluke.

These results indicate that in hepatitis patients, ALT showed higher elevation than AST, indicating more severe hepatocellular damage. Given that ALT is more liver-specific than AST, the data backs up its significance as a reliable biochemical indicator for evaluating liver inflammation and damage in Hepatitis B and Hepatitis C infections.

Table 5: Paired Sample Statistics for Serum ALT and AST Levels

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ALT	941.23	60	320.570	41.385
	AST	819.67	60	320.531	41.380

The paired sample data for serum ALT and AST levels in the research participants are shown in the table above. All biochemical variables were analyzed in a total of 60 patients.

The average serum AST value was 819. 67 320. 53 U/L, and the average serum ALT value was 941. 23 320. 57 U/L. Among hepatitis patients, ALT values were found to be somewhat higher than AST values, according to the data. The sample measures of ALT and AST were consistent, with standard error mean values of 41. 385 and 41. 380, respectively.

Patients with Hepatitis B and C have higher levels of both ALT and AST, which are signs of considerable liver cell damage and inflammation. But since ALT is regarded as being more indicative of liver injury than AST, the relatively higher ALT level indicates a higher release of liver-specific enzymes

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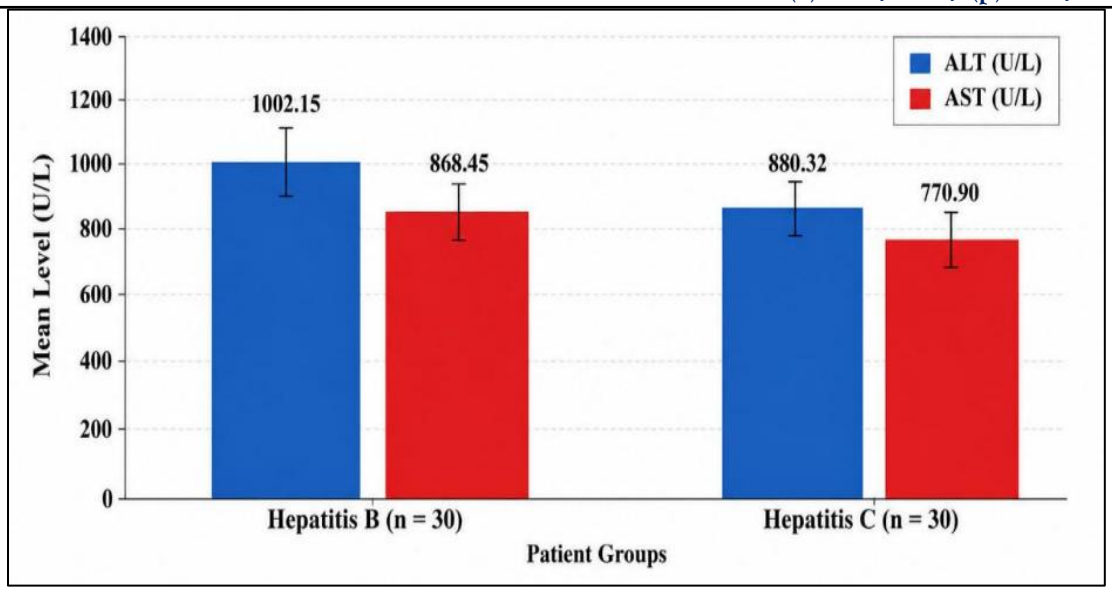

Graph 3: Comparative Mean ALT and AST Levels in Hepatitis B and Hepatitis C Patients

Table 6: Relationship Between Serum ALT and AST Levels

Correlations				
		N	Correlation	Sig.
Pair 1	ALT & AST	60	.992	.001

The link between serum ALT and AST values in the research participants is shown in the aforementioned table. The analysis included a total of 60 patient samples. The correlation coefficient (r) between ALT and AST was 0. 992, demonstrating a strong positive correlation between the two liver enzymes. This indicates that in hepatitis patients, AST levels rose in tandem with ALT levels.

The correlation was extremely statistically significant, as shown by the significance value (p = 0. 001). According to these findings, in patients with Hepatitis B and Hepatitis C, both ALT and AST are closely linked biochemical indicators of hepatocellular injury and liver inflammation.

In viral hepatitis patients, the robust positive link between these enzymes lends credence to their combined clinical utility in determining liver function, tracking disease progression, and gauging the extent of liver injury.

CHAPTER 5
DISCUSSION

This study aimed to compare serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) concentrations in individuals with Hepatitis B and Hepatitis C. In viral hepatitis, liver enzymes are crucial biochemical indicators for determining hepatocellular damage and disease activity. This study's findings revealed a marked increase in both ALT and AST levels in hepatitis patients, pointing to persistent liver inflammation and hepatocyte injury.

The average ALT level in serum was greater than the average AST level in the present study. Because ALT is more specific to liver tissue, this discovery implies that it is more notably elevated in viral hepatitis, indicating that there is more hepatocellular damage. Additionally, the paired t-test analysis revealed a statistically significant difference between ALT and AST levels ($p < 0.001$), suggesting that the variation between these two enzymes was not random. Earlier research by Zhang Wei et al. (2026), Maria Lopez et al. (2026),

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and Amina Khan et al. (2025) found that ALT is typically higher than AST in chronic viral hepatitis because of its greater liver specificity and stronger link to hepatocyte injury.

Additionally, the current investigation revealed a highly significant positive association between ALT and AST levels ($r = 0.992$, $p < 0.001$). This demonstrates that both enzymes increase at the same rate as hepatocellular injury and liver inflammation worsen. Similar findings were reported by Michael Brown et al. (2023) and Christopher Lee et al. (2021), who came to the conclusion that ALT and AST are closely related biochemical indicators of the severity of liver damage in chronic hepatitis infections.

Different stages of viral activity and immunological response frequently impact liver enzyme levels during a hepatitis B infection. According to studies in the literature review, ALT levels vary considerably during immune-active periods due to increased immune-mediated hepatocyte damage. In contrast, Hepatitis C is commonly linked to consistently high but somewhat stable ALT and AST levels due to ongoing mild chronic inflammation. These findings are supported by the current study, which shows that the two infections cause different biochemical patterns of liver damage.

The increased AST levels seen in this trial may potentially point to the development of fibrosis or ongoing liver injury in some individuals. Prior studies by Daniel Harris et al. (2022), Robert Anderson et al. (2024), and Sarah Williams et al. (2025) showed that greater AST levels and higher AST/ALT ratios are linked to severe liver illness, fibrosis, and cirrhosis. As a result, comparing ALT and AST simultaneously offers a clearer clinical picture of the course and severity of the illness than just looking at each enzyme individually. [61, 67]

Despite developments in molecular diagnostic approaches, the findings of this study support the continued use of biochemical liver enzyme testing as a crucial and trustworthy instrument in the diagnosis of viral hepatitis. Due to their simplicity, cost-effectiveness, and widespread availability, ALT and AST tests are especially helpful in everyday clinical practice and in healthcare facilities with limited resources.

In general, the conclusions of the current research are consistent with earlier national and international publications. The research emphasizes the clinical significance of AST and ALT in assessing hepatocellular damage, tracking disease progression, and helping to treat individuals with Hepatitis B and Hepatitis C.

CHAPTER 6
CONCLUSION

The purpose of the current research was to compare serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels in individuals with hepatitis B and hepatitis C. According to the study's findings, hepatitis patients had noticeably higher ALT and AST levels, suggesting considerable hepatocellular damage and liver inflammation linked to chronic viral hepatitis.

The study demonstrated that ALT levels were relatively higher than AST levels, demonstrating that ALT is a more specific biochemical marker of hepatocellular injury than AST. The clinical value of these enzymes in assessing liver damage was verified by statistical analysis, which revealed a highly significant difference between ALT and AST levels ($p < 0.001$). Furthermore, there was a strong positive correlation between ALT and AST levels, indicating that the levels of both enzymes rise in tandem with the severity of liver inflammation and cellular damage.

Earlier research demonstrating distinct biochemical patterns of liver enzyme increase for Hepatitis B and Hepatitis C is also supported by the study's results. Because of phase-dependent immunological activity, enzyme levels in Hepatitis B fluctuate, but in Hepatitis C, the enzyme elevation is more constant and stable due to ongoing chronic inflammation.

In summary, this research comes to the conclusion that serum ALT and AST are helpful, trustworthy, and affordable biochemical indicators for evaluating liver damage, tracking the course of the illness, and aiding in the clinical treatment of individuals with Hepatitis B and Hepatitis C. Their regular assessment is still very important,

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especially in resource-constrained healthcare environments where cutting-edge molecular diagnostic equipment may not always be accessible.

Limitations:

- Due to the somewhat limited sample size, the study's results might not be applicable to the entire population.
- The study was conducted in one laboratory, thus the findings may not completely reflect individuals from various geographic areas or healthcare facilities.
- The viral load measurements and other crucial indicators of liver function were excluded, and just ALT and AST levels were assessed.
- Due to the cross-sectional nature of the study design, it was not possible to evaluate the course of the disease or the response to therapy over time.
- Factors such as lifestyle and prior medication history were not thoroughly evaluated; these may have an impact on liver enzyme levels.
- The statistical analysis may have been somewhat impacted by one missing value in the Hepatitis C dataset.

Recommendations:

- To ensure the early identification of liver injury in individuals with Hepatitis B and Hepatitis C, ALT and AST levels should be regularly monitored.
- For improved evaluation of disease severity and course, a combination review of ALT and AST should be favored.
- Regular hepatitis screening programs should be encouraged in order to facilitate early identification and prompt care.
- Public awareness of the prevention and transmission of Hepatitis B and Hepatitis C should be raised.
- To lower the risk of infection and complications, hepatitis B immunization should be promoted.
- Future research should include more liver function factors and bigger sample numbers for a more thorough investigation.

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