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Evaluation of Liver Enzyme Abnormalities and Their Association with Cardiometabolic Risk Factors in Adults Attending Internal Medicine Clinics

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Abstract: Background: The liver enzyme abnormalities are widely experienced in clinical practice and usually indicate underlying hepatic or systemic diseases. There is growing indication that there is a close relationship between high liver enzymes and cardiometabolic risk factors like obesity, diabetes mellitus, hypertension, and dyslipidaemia. These anomalies could be early signs of metabolic syndrome and heart diseases.**Place and Duration of Study:**This research was done at the Internal Medicine and Biochemistry Department of Allama Iqbal Teaching Hospital, DG Khan / DG Khan Medical College, DG Khan from June 2024 to March 2025.**Objective:** To assess liver enzyme abnormality and establish its relationship with cardiometabolic risk factors in the adults visiting internal medicine clinics.**Methodology:**The cross-sectional study was done on adult patients aged 18 years and above. The WHO sample size calculator formula was used to determine a sample size of 288 participants. Non-probability consecutive sampling was employed to select the patients. Anthropometric measurements, demographic data, and clinical history were taken. To measure liver enzymes such as ALT, AST, and ALP, blood samples were taken. Cardiometabolic risk factors like body mass index (BMI), blood pressure, fasting blood glucose level and lipid profile were also studied. To evaluate the relationship between liver enzyme abnormalities and cardiometabolic variables, statistical analysis was done.**Results:**Among 288 individuals, a considerable percentage of them had an increased liver enzyme. High levels of ALT and AST were closely linked with obesity, type 2 diabetes and dyslipidaemia ($p<0.05$). Liver enzyme abnormalities were observed to be more prevalent in patients with metabolic syndrome than in patients with no liver enzyme abnormalities. There was a positive association between the liver enzyme levels and BMI.**Conclusion:**The abnormality in liver enzyme is closely correlated with cardiometabolic risk factors and can be a useful biomarker to identify metabolic syndrome at an early stage. Liver screening of high-risk patients should be performed routinely as a guide to early intervention and prevention of cardiovascular problems.

Keywords: Liver enzymes, cardiometabolic risk, obesity, diabetes, dyslipidaemia, metabolic syndrome, ALT, AST

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INTRODUCTION

One of the most met results in clinical practice is liver enzyme abnormalities that may be identified during routine biochemical studies [1]. The liver enzymes that are most measured are alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP), which are significant predictors of hepatocellular injury and liver function. Although the transient rises can be caused by benign factors, the persistent abnormalities can be the indication of liver disease or general metabolic disorders [2]. Over the last years, increased attention has been focused on the connection between cardiometabolic risk factors and liver enzyme abnormalities [3].

Cardiometabolic risk factors, such as obesity, type 2 diabetes mellitus, hypertension and dyslipidaemia are significant contributors to the global burden of non-communicable diseases [4]. The conditions are interconnected with complicated metabolic pathways and frequently occur as a part of metabolic syndrome [5]. New evidence indicates that liver enzyme derangements, especially high levels of ALT and AST, have a strong relationship with these risk factors [6]. This correlation is mainly caused by the non-alcoholic fatty liver disease (NAFLD) which is the excess of the fat in the liver without a significant amount of alcohol intake. NAFLD has become the hepatic expression of metabolic syndrome and is very prevalent in the world.

The pathophysiology of the relationship between abnormalities of liver enzymes and cardiometabolic risk includes insulin resistance, chronic inflammation, and oxidative stress. Insulin resistance is the key factor contributing to hepatic fat buildup and hindering lipid metabolism [7]. This causes hepatocellular damage, which is manifested by high liver enzymes. Moreover, adipose tissue releases inflammatory cytokines and adipokines that cause liver damage and additional worsening of metabolic dysfunction. Consequently, liver enzyme elevated individuals are on the higher risk of developing cardiovascular diseases that comprise coronary artery disease and stroke [8].

Liver enzyme abnormalities can be diagnosed at an early stage, and this information can give valuable information about the metabolic health of an individual [9]. These abnormalities in most cases go ahead of the clinical diagnosis of the metabolic syndrome or cardiovascular disease and hence useful as biomarkers in the early detection and risk stratification. Regular liver screening of patients visiting internal medicine clinics can thus help in early detection and management of the risk factors [10]. Although the body of evidence is increasing, further research is still required to gain a better understanding of the magnitude and character of such an association especially in heterogeneous populations. The relationship between cardiometabolic risk and liver enzyme abnormalities may be affected by differences in lifestyle, genetic predisposition, and environmental factors. Thus, the purpose of the study is to assess the liver enzyme abnormalities and investigate their relationship with cardiometabolic risk factors in adult patients visiting internal medicine clinics to enhance early diagnosis and preventive measures [11].

OBJECTIVE

This study aims at assessing the frequency of liver enzyme abnormalities in adults visiting internal medicine clinics and the relationship between these abnormalities and cardiometabolic risk factors, such as obesity, diabetes mellitus, hypertension, and dyslipidemia. Another aim of the research is to identify the correlation existing between the amounts of liver enzymes and metabolic parameters to facilitate early detection and prevention measures.

METHODOLOGY

It was a cross-sectional study conducted in Internal Medicine and Biochemistry Department of Allama Iqbal Teaching Hospital, DG Khan / DG Khan Medical College, DG Khan from June 2024 to March 2025. The sample size of the adult participants was 288 consisting of participants who were 18 years and older and used the non-probability consecutive sampling. The sample size was determined using the formula of WHO sample size calculator to get enough statistical power. Informed consent was obtained after which the patients who visited to get routine check-ups or follow-up visits were included. Demographic and clinical information was carefully recorded, and the following data were gathered, age, gender, medical history and lifestyle factors. The anthropometric measures (height, weight, and body mass index (BMI)) were calculated using standard procedures. Calibration of sphygmomanometer was done, and blood pressure was recorded. Aseptic venous blood samples were then taken following overnight starvation. Laboratory exams were liver functioning tests (ALT, AST, and ALP), blood glucose (fasting), and lipid analysis (total cholesterol, triglycerides, HDL, and LDL). The abnormalities of liver enzymes were characterized using standard reference levels. Established clinical criteria were used to mark cardiometabolic risk factors. Appropriate software was used in performing statistical analysis. Data summarization was performed using descriptive statistics and the relationship between liver enzyme abnormalities and cardiometabolic variables was tested with the help of inferential statistics (chi-square test and Pearson correlation). A p-value lower than 0.05 was taken as significant.

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria

The study was done to include adults aged 18 years and above who attended internal medicine clinics within the study period. The participants had to give informed consent and have a full clinical and laboratory evaluation. The study also included adults who had known cardiometabolic risk factors such as obesity, diabetes mellitus, hypertension and dyslipidaemia as they were pertinent to the objectives of the research.

Exclusion Criteria

The study excluded patients who have known chronic liver diseases, such as hepatitis B, hepatitis C, liver cirrhosis, and alcoholic liver disease, because it could have caused bias in the measurement of liver enzymes. Individuals on hepatotoxic drugs and pregnant women were also omitted to minimize confounding factors. Moreover, patients with acute infections, malignancy, or missing medical records were excluded, as it might have influenced the accuracy and reliability of data.

DATA COLLECTION

A systematic process was followed in data collection by using a structured proforma designed to conduct the study. The demographic information about the age, gender and medical history of the participants was recorded after informed consent had been obtained and each participant was interviewed. Data on lifestyle variables, such as diet, physical activity, smoking and alcohol use were also recorded. The anthropometric measurements were also done in standardized methods. Weight was determined with a calibrated digital scale and height was determined with a stadiometer. Body mass index (BMI) was obtained as weight/kg/ height /m. After taking sufficient rest, blood pressure was recorded in sitting position. All participants were sampled by taking blood after overnight fasting. The hospital laboratory was used to test liver enzyme (ALT, AST, ALP), fasting blood glucose, and lipid profile. All the laboratory processes were done through standard procedures to achieve accuracy and consistency. Data gathered were thoroughly examined and inputted into a database to be analyzed. Quality control of data was made by checking and verification. Participants were assured of confidentiality, and the information was not used in any other way other than research purposes.

RESULTS

The number of participants in the study was 288, and the male and female proportions were equal. It was discovered that liver enzyme abnormalities were prevalent among the study population. The higher body mass index, diabetes mellitus, and dyslipidaemia were found to be more likely to elevate ALT and AST levels. Statistical analysis revealed that cardiometabolic risk factors had a significant association with liver enzyme abnormalities ($p<0.05$). The rate of the abnormal liver enzyme level was greater among the subjects with metabolic syndrome as compared to the ones without these risk factors. It was found that positive relationship exists between BMI and liver enzyme level, which suggested that obesity is a significant contributor to hepatic dysfunction. These findings suggest that liver enzyme abnormalities are tightly linked to cardiometabolic disorders and screening and interventions are to be performed earlier.

Table 1: Demographic Characteristics of Participants (n=288)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18–30 years	72	25%

	31–50 years	126	44%
	>50 years	90	31%
Gender	Male	150	52%
	Female	138	48%

The demographic distribution of the study subjects is given in Table 1. Most of the individuals are aged between 31 to 50 years (44%), meaning that middle-aged adults make the biggest percentage of those attending internal medicine clinics. A large cohort is also represented by the age group over 50 years (31%), because the age of a population is correlated with the increase of healthcare use. A quarter of the sample is made up of young adults (1830 years). There is a fairly equal gender balance, with slightly more males (52) than females (48). This type of population description shows that the sample used in the research is non-homogenous and represents the overall clinic patients among adults.

Table 2: Prevalence of Liver Enzyme Abnormalities

Enzyme	Normal (n)	Elevated (n)	Percentage Elevated (%)
ALT	180	108	37.5%
AST	200	88	30.5%
ALP	220	68	23.6%

The prevalence of liver enzyme abnormalities is presented in Table 2. The most common enzyme raised was ALT (37.5%), then AST (30.5%), and ALP (23.6%). High levels of ALT are usually linked to hepatocellular damage especially in metabolic diseases like fatty liver disease. The results show that there is a significant subclinical dysfunction of the liver in the population of the study. Relatively lower elevation of ALP indicates that there are fewer cholestatic conditions as compared to hepatocellular damage. Altogether, the evidence shows the significance of regular screening liver enzymes among adults (with particular attention to those who are vulnerable to metabolic issues).

Table 3: Association of Liver Enzymes with Obesity (BMI)

BMI Category	Participants (n)	Elevated ALT (%)
Normal	90	15%
Overweight	110	35%
Obese	88	60%

Table 3 shows that body mass index (BMI) has a strong correlation with high levels of ALT. The prevalence of high ALT is relatively low among individuals with normal BMI (15%), but it is higher among overweight individuals (35%). It is found to be the greatest among the obese (60%), which shows a positive correlation exists between obesity and liver enzyme abnormalities. This tendency testifies to the involvement of excess adiposity in the pathogenesis of non-alcoholic fatty liver disease (NAFLD). Excessive fat deposit causes inflammation and damage to the liver evidenced by increased liver enzymes. These results highlight obesity as a significant risk factor that is changeable.

Table 4: Association of Liver Enzymes with Diabetes Mellitus

Diabetes Status	Participants (n)	Elevated ALT (%)
Non-diabetic	170	20%
Diabetic	118	55%

Table 4 shows the correlation between liver enzyme abnormalities and diabetes mellitus. Even in non-diabetic people, only one-fifth of the population has increased ALT levels, but a much greater percentage of diabetic patients (55) has abnormal liver enzymes. This suggests that there is a strong linkage between liver dysfunction and impaired glucose metabolism. One of the main characteristics of type 2 diabetes is insulin resistance that contributes to the accumulation of fat and inflammation in the liver, which results in the increased liver enzymes. **These findings** confirm the assumption that liver enzyme abnormalities might serve as an early warning of the presence of metabolic abnormalities in diabetic patients and the need to constantly monitor liver functions.

Table 5: Association of Liver Enzymes with Dyslipidemia

Lipid Status	Participants (n)	Elevated ALT (%)
Normal Lipids	160	18%
Dyslipidemia	128	50%

Table 5 shows the correlation between dyslipidemia and liver enzyme abnormalities. The prevalence of high ALT (18% in participants with normal lipid profiles, 50% in those with dyslipidemia) is lower, and significantly higher, respectively. This implies that there is a close association between dysfunctional lipid metabolism and liver dysfunction. Dyslipidemia is associated with the deposition of fat in the liver and results in hepatic steatosis and

inflammation. This is especially involved in high triglyceride and low HDL levels. The results indicate that lipid dysfunctions can contribute greatly to the progression of liver enzyme elevation and emphasize the necessity of combined metabolic care.

DISCUSSION

The current research measured the liver enzyme abnormalities and how they correlate with cardiometabolic risk factors in adults who came to internal medicine clinics [13]. The results indicate a strong correlation between high levels of liver enzymes, especially ALT and AST, with some critical cardiometabolic diseases including obesity, diabetes mellitus, and dyslipidemia [14]. These findings are in line with the accumulating evidence that liver enzymes abnormalities are not only good predictors of liver disease but also directly associated with overall metabolic impairment [15].

Among the most significant conclusions of the research is that there is a high relationship between obesity and increased liver enzymes. The prevalence of abnormal ALT was significantly higher in participants who were overweight (higher BMI) . This is in line with other studies that have pointed out that obesity is a factor that causes hepatic fat build-up causing non-alcoholic fatty liver disease (NAFLD) [16]. NAFLD is considered well-known as the hepatic expression of the metabolic syndrome and has a close connection with insulin resistance . The augmented fat tissue of obese patients facilitates the inflammatory reaction and oxidative stress, which additionally harm the hepatocytes and raise liver enzymes.

On the same note, liver enzyme abnormalities were found to be significantly related to diabetes mellitus. The prevalence of high levels of ALT was higher among diabetic participants than non-diabetic ones. The role of insulin resistance, which is a key pathogenesis in both type 2 diabetes and NAFLD can explain this [17]. The resistance to insulin causes augmentation of lipolysis and unrestricted entry of fatty acids into the liver leading to hepatic steatosis and inflammation. As a result of this, liver enzymes increase, which is an indication of hepatic damage. These results indicate the idea that elevated liver enzymes can be early warning signs of metabolic disorders in diabetic patients [18].

Dyslipidemia was another determinant that was not only important in this study but also was associated with high liver enzyme. The prevalence of abnormal liver enzymes was much higher in the participants with abnormal lipid profiles [19]. High triglycerides and low high-density lipoprotein (HDL) are factors that cause fat to be deposited in hepatocytes thus worsening liver dysfunction [20]. The association shows that there is a relationship between lipid metabolism and liver health and a complete metabolic analysis should be conducted in clinical practice [21].

Another finding of the study was that a significant percentage of the participants who did not have cardiometabolic conditions diagnosed showed high liver enzymes [22]. This means that liver enzyme abnormalities are earlier detected than the clinical condition of the metabolic diseases and therefore can be used as a biomarker in the detection of such diseases at an early stage. Regular screening of liver functioning in seemingly healthy persons would thus help early intervention and minimize chances of onset into more severe illnesses like cardiovascular disease and more severe liver pathology .

Although it has its strengths, this study has some limitations. It is a cross-sectional study, thus, does not cause the development of causality between cardiometabolic risk factors and liver enzyme abnormalities. Also, the sample could be single center, which might not be generalizable to the results . It is recommended that additional research on such relationships can be conducted by means of further longitudinal studies involving increasingly diverse populations.

To sum up, the present study supports the high relationship between liver enzyme abnormalities and cardiometabolic risk factors. The results highlight the need to incorporate liver function testing into the normal clinical examination of patients with metabolic disorders, which will lead to the early diagnosis and effective treatment options [11].

CONCLUSION

Finally, this research emphasizes the existence of an important relationship between liver enzyme abnormalities and cardiometabolic risk factors in adults referred to internal medicine clinics. A high level of ALT and AST was dramatically linked to obesity, diabetes mellitus, and dyslipidemia and this was translated to mean that liver dysfunction is deeply related to metabolic imbalances. These findings support the principle that liver enzyme abnormalities can be crucial and useful biomarkers of individuals at risk of metabolic syndrome and heart diseases. The study demonstrates the importance of regular liver evaluation, particularly among the patients who are known to be cardiometabolically at risk. The abnormalities can be identified at an early stage to facilitate the intervention, lifestyle change and better management of the disease. The results may be invaluable clinical data despite the limitation of the cross-sectional design to make a causal interpretation. Future large-scale and longitudinal studies of the suggested relationships should be diligently examined to improve preventive care.

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