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Associating Liver Enzyme Activity with Obesity and Non-Obesity in Yemeni Adults

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Abstract:-

➢ ***Background:***

Obesity, characterized by excessive body fat accumulation, can trigger inflammation and independently disrupt vital organ functions like the liver. This study aims to assess and compare the impact of obesity on serum liver enzyme activity among obese and non-obese Yemeni adult individuals.

➢ ***Methods:***

A total of 250 healthy Yemeni individuals were divided into two categories: 100 obese (BMI ≥25) and 150 non-obese (BMI <24.9). Data was collected via a standard questionnaire. A semiautomatic instrument was used to measure the activity of serum ALT, AST, and GGT.

➢ ***Results:***

The results revealed that the average age, weight, height, and BMI of obese groups were substantially higher than those of non-obese groups (P < 0.000). The mean levels of ALT, AST, and GGT were higher in obese groups when compared to non-obese groups (P < 0.000). A significantly positive correlation of BMI with ALT, AST, and GGT in obese groups (r = 0.329, P = 0.001, r = 0.280, P = 0.005, r = 0.213, P = 0.033; respectively). In multiple linear regression analysis, obesity was significantly independently associated with liver enzymes of ALT (B=2.05, P = 0.002), AST (B=0.97, P = 0.050), and GGT (B=1.64, P = 0.003) after adjustment for BMI.

➢ ***Conclusion:***

Our study found significant increases in liver enzymes (ALT, AST, GGT) among the obese group, with stronger associations as BMI and obesity severity increased. A comprehensive prospective study is required to validate the interaction between obesity and liver enzymes.

Keywords:- *Liver Enzymes, ALT, AST, GGT, Obesity, BMI*

I. INTRODUCTION

Obesity, characterized by excessive body fat, is a major global health issue [1]. It's linked to metabolic abnormalities caused by high liver enzyme levels as well as hepatic issues such as non-alcoholic fatty liver disease [2]. Furthermore, obesity contributes to metabolic issues that heighten the risk of chronic conditions including diabetes, heart disease, and liver failure [3]. High-calorie diets often lead to adult obesity, reduced physical activity [4], and a rise in sedentary lifestyles [5].

The way body fat is distributed regionally, especially in the abdomen, can strongly predict elevated liver enzymes like alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT). These enzyme levels are influenced by body mass index (BMI) [6, 7]. BMI is the preferred measure for predicting obesity-related metabolic conditions. Characteristics like macrovascular steatosis, steatohepatitis, fibrosis, hepatomegaly, and high liver biochemistry values might cause liver histological changes [8]. Research indicates a strong link between obesity and elevated liver enzymes, with abdominal fat being a more dependable predictor [9, 10].

Changes in liver function can greatly impact overall health as the liver plays a crucial role in regulating metabolism and detoxification [9]. Assessing liver function often involves measuring serum liver enzyme activity, which can indicate cell damage or irritation as these enzymes are released into the bloodstream [3]. While liver enzymes primarily facilitate amino acid interconversion, they are also utilized to assess liver disorders. Abnormal levels of these enzymes in the blood often characterize liver conditions, serving as indicators of damage or dysfunction [11].

Previous studies have associated obesity with increased serum liver enzyme activity, implying a potential link to liver issues [3]. However, research on this aspect, particularly in the Yemeni population, remains limited [12]. For public health initiatives, it is crucial to understand how obesity affects the activity of serum liver enzymes in Yemeni adults [12]. A significant correlation would underscore the importance of targeted prevention and lifestyle adjustments to reduce obesity and improve liver health in Yemen. This research could potentially raise awareness about maintaining a healthy weight and adopting positive lifestyle habits to protect liver function, reaching healthcare professionals, policymakers, and the public [5].

This study aims to assess and compare how obesity affects serum liver enzyme activity in obese and non-obese Yemeni adults. By analyzing and contrasting enzyme activity levels in these groups, we can gain insights into the possible link between obesity and liver health in the Yemeni population.

II. MATERIALS AND METHODS

➢ *Subjects*

Cross-sectional research was conducted between September 2020 and June 2021 at Taiz University in Yemen. The study involved 250 healthy participants aged 20-60 of both sexes. Based on BMI, 100 participants were classified as obese (BMI ≥25) and 150 as non-obesity (BMI <24.9).

Participants were chosen randomly from among healthy non-smokers, excluding those with a history of liver issues, pregnant individuals, and those with chronic conditions like diabetes, cardiac disease, or other medical ailments. All participants provided informed consent.

Data collection utilized a standard questionnaire for demographic details like age, gender, medical history, weight, and height. BMI was calculated for all individuals as weight (kg) divided by height (m2). Obesity classification followed the 2004 WHO guidelines for Asians: underweight (BMI <18.5 kg/m2), non-obese (normal weight) (18.5≤ BMI <25 kg/m2), and obese (BMI ≥25 kg/m2). Our study included healthy adults with BMI <18.5 kg/m2 and 18.5≤ BMI <25 kg/m2 as non-obese and BMI ≥25 kg/m2 as obese. Each participant had approximately 5 ml of venous blood collected into a test tube without anticoagulant. Biochemical analysis of serum ALT, AST, and GGT activity was performed using a semi-automatic analyzer instrument along with SGM company reagents. The liver functions were assessed according to manufacturer specifications as follows:

ALT < 48 U/L in males/ < 36 U/L in females, AST < 38 U/L in males/ < 31 U/L in females, and GGT < 55 U/L in males/ < 38 U/L in females.

➢ *Statistical analyses:*

Statistics were performed using SPSS software (version 21) for Windows and GraphPad software. The Mann-Whitney U test was employed for the continuous variable, and the Chi-square test was used for categorical analysis. The Spearman coefficient was used to assess the correlation between BMI and liver enzyme levels. Multiple Linear Regression was performed to estimate the association of liver enzymes with obesity and other variables. Statistical significance was determined at $P < 0.05$ for the two-tailed p-value.

III. RESULTS

Table 1 summarizes the study subjects clinical characteristics as means ± standard deviation. The results showed that the mean age, weight, height, and BMI in obese groups were substantially greater than that in non-obese groups ($P < 0.000$, $P < 0.000$, $P < 0.010$, $P < 0.000$, respectively). The prevalence of obesity in males was higher than in females ($P < 0.025$).

A comparison of obese and non-obese liver enzyme levels is shown in Table 2. The mean levels of GGT, ALT, and AST were higher in obese groups when compared to non-obese groups ($P < 0.000$, $P < 0.000$, $P < 0.000$, respectively) (Table 2) (Fig. 1).

Table 1 Clinical Characteristics of Study Participants

Parameters	Obese n=100	Non-obese n=150	*P*
Age	36.9±11.1	30.9±10.5	0.000
Weight (kg)	74.9±7.5	54.7±8.4	0.000
Height (cm)	165.5±7.9	162.8±8.6	0.010
BMI (kg/m^2)	27.5±2.1	20.7±2.4	0.000
Sex			
Male	82(82%)	104(69.3%)	0.025
Female	18(18%)	46(30.7%)	

BMI: body mass index

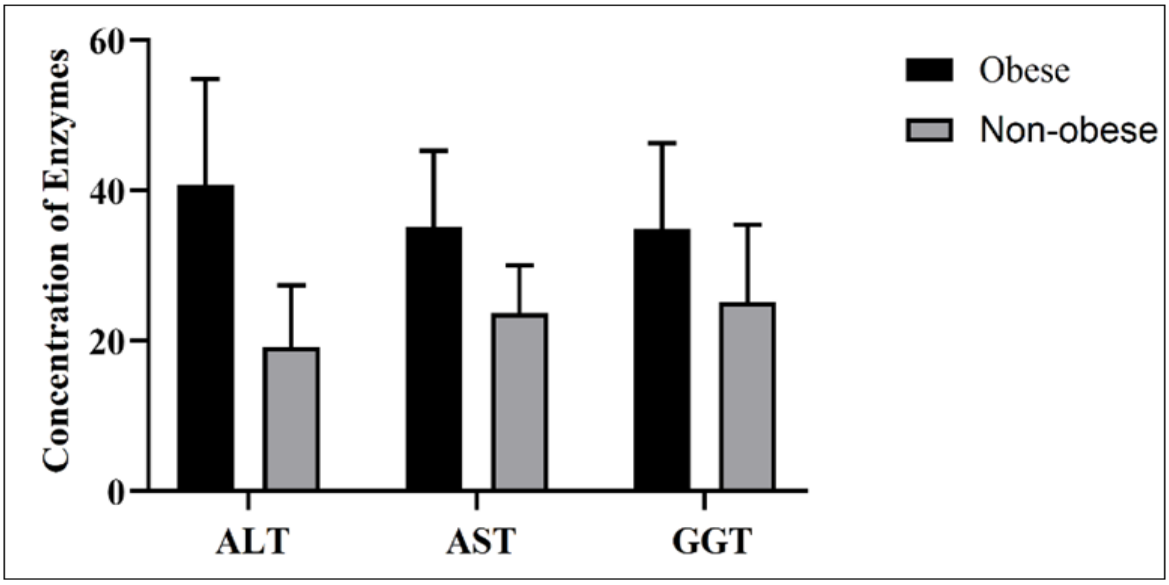

Fig 1 Shows a Comparison of Liver Enzymes between Obese and Non-Obese Groups.

Table 2 Liver Enzyme Levels between Obese and Non-obese Participants

Parameters	Obese n=100	Non-obese n=150	*P*
ALT	40.8±14.0	19.2±8.2	0.000
AST	35.1±10.2	23.7±6.3	0.000
GGT	34.9±11.4	25.1±10.3	0.000

Table 3 and Fig. 2 to 3 showed the correlations between BMI and serum hepatic enzymes. A significantly positive correlation of BMI with ALT, AST, and GGT in obese groups (r = 0.329, P = 0.001, r = 0.280, P =0.005, r = 0.213, P = 0.033; respectively) (Fig. 2).

Table 3 Correlation Coefficient of Liver Enzymes Levels with BMI of Obese Participants

Correlation Coefficient	ALT		AST		GGT	
BMI	r	*P*	r	*P*	r	*P*
	0.329	0.001	0.280	0.005	0.213	0.033

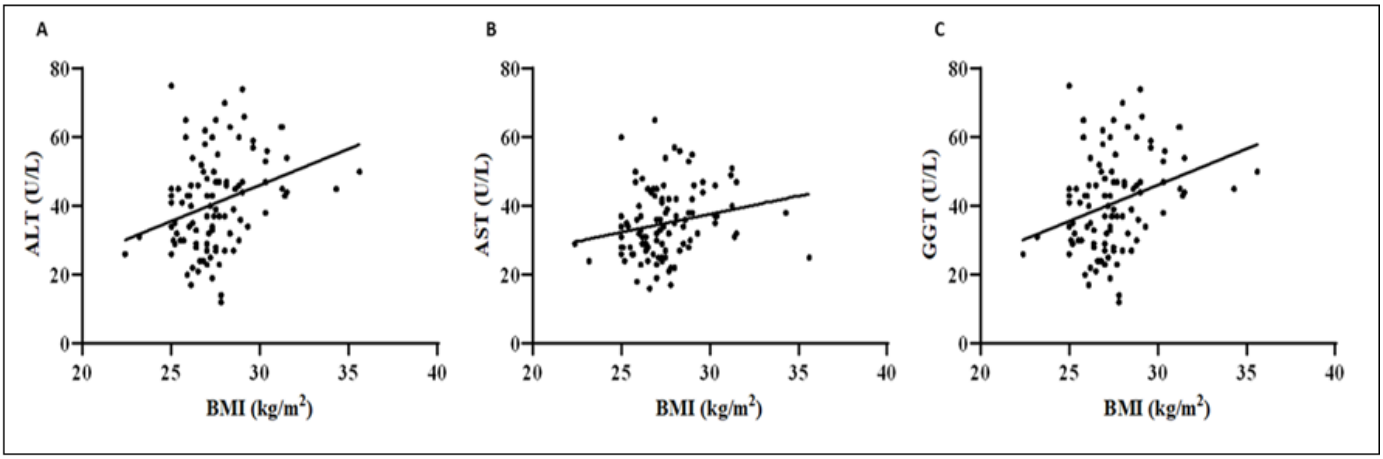

Fig 2 shows the Correlation Coefficient between Liver Enzymes and the BMI of the Obese Group. (A) Positive Correlation of BMI with ALT, (B) Positive Correlation of BMI with ALT. (C) Positive Correlation of BMI with GGT.

In a multiple linear regression analysis, liver enzymes are used as dependent variables to determine the association of level enzymes with obesity and other variables. Obesity was significantly independently associated with liver enzymes of ALT (B=2.05, P = 0.002), AST (B=0.97, P = 0.050), and GGT (B=1.64, P = 0.003) after adjustment for BMI.

There was a significant association between BMI and AST (B=0.18, P = 0.049) and GGT (B=-5.98, P = 0.041) enzymes after adjustment for sex and age. However, there was no association between BMI and GPT (P > 0.05) (Table 4).

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Table 4 Multiple Linear Regression of the Association between Liver Enzymes and Different Variables

Grous	ALT					AST					GGT				
	B	SE	95.0% Confidence Interval		P	B	SE	95.0% Confidence Interval		P	B	SE	95.0% Confidence Interval		*P*
			Lower Bound	Upper Bound				Lower Bound	Upper Bound				Lower Bound	Upper Bound	
Sex	-2.37	3.51	-9.34	4.59	0.501	-0.79	2.62	-5.99	4.42	0.764	-5.98	2.89	-11.71	-0.25	0.041
Age	0.22	0.12	-0.02	0.46	0.073	0.18	0.09	0.01	0.36	0.049	0.019	0.10	-0.18	0.22	0.853
Obese	2.05	0.66	0.74	3.35	0.002	0.97	0.49	0.01	1.95	0.050	1.64	0.54	0.57	2.71	0.003

IV. DISCUSSION

Obesity, defined as abnormal or excessive accumulation of fat in adipose tissue, affects almost one-third of the global population. It includes a significantly elevated risk of many fatal diseases, severe disability, and early mortality in many nations worldwide [13, 14]. Physicians treating obese patients must carefully assess the clinical state of obesity-associated liver disease. [15]. Since it damages liver cells, more intracellular enzymes are released into the bloodstream and are more prevalent in obese individuals. The World Health Organization (WHO) reports that the incidence of obesity has grown frighteningly. The world population's diet is changing due to heightened intake of high-fat and high-carbohydrate meals, coupled with reduced levels of physical activity. This causes obesity to be more prevalent globally, not just in developed but also in emerging nations [16].

To the best of our understanding, this study is the initial investigation that has contributed insights into the correlation between liver enzymes and obesity among the adult population in Yemen. The results of the current investigation demonstrated statistically significant elevations in serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT) levels among individuals classified as obese, in comparison to those classified as non-obesity. These results were similar to the studies by Ali et al. [17] and Elfaki et al. [18]. They reported that the group with obesity had considerably higher mean serum ALT, AST, and GGT levels compared to the group with a normal BMI. Skinner et al., demonstrated a significant rise in the prevalence of severe obesity across all age groups throughout the preceding 18-year period [19]. Lonardo et al. showed that a considerable proportion, approximately 20-30%, of the adult population has non-alcoholic fatty liver disease (NAFLD) [20].

A recent study by Liu et al. with 7066 Chinese participants discovered that obese individuals had higher liver enzyme activity than normal and overweight individuals. [21]. Additionally, research by Rashed et al. in Rajshahi, which involved 66 individuals, indicated that the blood hepatic enzymes, excluding GGT, were considerably higher in overweight and obese individuals in comparison to those with a normal BMI [22]. Elevations in hepatic enzyme levels, widely regarded as the most responsive biochemical indicator of the presence of hepatic steatosis, have been linked to a heightened susceptibility to liver damage resulting from obesity [23]. Obesity is a condition that is known to be exacerbated by oxidative stress [24] and GGT plays a significant role in antioxidant defense mechanisms [25].

Regarding specific markers, a study with 67 participants in the Iraqi population found no appreciable variations in AST and ALT levels between the morbidly obese and the control groups [26]. Another study of 156 healthy Indians revealed no connection between liver enzymes of ALT, AST, and GGT and obesity compared to the normal group [2]. The inconsistent study results may result from sample sizes, ethnicity, and the adjustment for confounding factors, which may represent the disparities between population groups.

Hepatic enzyme levels increased due to predicted increased fatty liver with BMI. Additionally, most of these enzymes are found in other organs, such as the skeletal muscles; therefore, an increase in BMI causes an increase in these enzymes. The correlation coefficients in our study showed a positive correlation between BMI and serum hepatic enzymes of obese groups. After adjusting for BMI, multiple linear regression analysis revealed a significant independent relationship between obesity and the liver enzymes ALT, AST, and GGT. These findings were found to be similar to Liu et al. in China [21]. They supported the role of obesity independently from BMI for identifying increased concentrations of liver enzymes ALT, AST, and GGT after adjusting for age, sex, and BMI. Jalili et al. reported that obesity and serum liver enzyme levels are related. They found a correlation between BMI and serum ALT and GGT levels [27]. A study of 67 subjects in the Iraq population demonstrated a relationship between BMI and serum liver enzyme activity (ALT and GOT) [26].

The precise mechanisms behind the probable association between obesity and serum liver enzyme levels remain incompletely elucidated. According to some published data, non-alcoholic fatty liver disease can generate severe cases that affect the AST levels in the serum [28]. Metabolic syndrome has been linked to non-alcoholic fatty liver disease. The risk of developing hepatic fibrosis rises along with a decline in beta-oxidation and an increase in free fatty acids [28, 29]. Other characteristics such as metabolism, age, and BMI significantly impact ALT levels. [30]. Previous research on the Mexican population has indicated that weight gain is associated with a more than threefold increase in alanine aminotransferase (ALT) activity [31]. Evidence was presented by Jayanta et al. to illustrate the connection between an increase in obesity and NAFLD in developing countries like India [32]. Another study revealed that obesity has the potential to enhance oxidative stress within liver tissue, leading to an elevation in DNA methylation levels and ultimately resulting in liver tissue damage [33]. Visceral adipose tissues emit many chemicals, including adipokines, leptin, and tumor necrosis factor, which have the potential to influence hepatic functionality and induce inflammatory responses, cirrhosis, and hepatocellular cancer [34]. However, many other elements, including nutritional intake, may influence obesity and liver function [35-37]. Other things to consider could also contribute to alterations in liver enzyme levels. In the case of elderly individuals, destruction outweighs the construction, and conversion of carbohydrates into fat due to tranquility, leisure, reduced mobility, physical inactivity, and a lack of exercise. As a result of excessive eating during the youth period and increasing calories, the body produces more fat cells as people age, regardless of their gender, genotype, food, or environment in which they live [16].

Randomly selecting participants from healthy individuals to prevent any potential selection bias is one of the strengths of the current investigation, as the samples did not contain individuals referred for metabolic syndrome. Individuals with illnesses, alcohol consumption, or medication use that is known to affect serum liver enzymes could be excluded. However, there were some limitations. First, due to the cross-sectional design of our research, it was not possible to infer a causal association between obesity and liver enzyme levels. Second, a transitory sequence could not be established because the liver enzymes were analyzed one time, which is not representative of the long-term profile. Third, further biochemical and histological markers of liver function were not investigated. More extensive prospective studies in various populations are needed to support this connection further.

V. CONCLUSION

In conclusion, our study found a significant elevation of liver enzymes ALT, AST, and GGT in the obese group, with stronger connections seen in higher BMI categories. A comprehensive prospective study is needed to understand obesity-liver enzyme alterations processes.

ABBREVIATIONS

Alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), body mass index (BMI), World Health Organization (WHO) and non-alcoholic fatty liver disease (NAFLD)

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