Comparison of serum Alanine Aminotransferase and Aspartate Aminotransferase among Obese and Non-obese Adults

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Obesity is a major global health issue and WHO points out that 1 in 3 people globally is clinically obese. Obesity is a condition of having an excessive amount of body fat and is linked with several health disorders that include metabolic syndrome, cardiovascular diseases as well as liver diseases. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are usually used to assess liver function. It is established that obesity results in many cases of liver disorders known as steatosis or non-alcoholic fatty liver disease (NAFLD). It is the excessive deposit of fat within the liver cells that may result in inflammation, fibrosis and cirrhosis. Studies on obesity have established that obese subjects significantly tend to have higher liver enzymes like ALT and AST than non-obese adults. This study aims to compare these two liver enzymes between these two groups in the hopes of shedding light on how obesity impacts the liver and offers these biomarkers for NAFLD. The study was designed to assess the status of liver function in adult obese individuals by examining key markers, including serum Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST), and to compare them with non-obese adults. The present cross-sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College, Mymensingh, in collaboration with the Department of Endocrinology and Medicine, Mymensingh Medical College Hospital, from July 2023 to June 2024. The subjects were selected based on inclusion and exclusion criteria by purposive non-random sampling. A total of 200 participants took part in this study. Out of them, 100 were selected as case (obese adults) and another 100 non-obese adults were selected as control. In this study, serum ALT and AST levels were measured for analytical study. All the values were expressed as mean±SD. Statistical analysis was done using by using SPSS Windows package version 26.0. The statistical significance of the difference between the case and control was calculated using Student's unpaired 't'- test. Pearson's correlation is done to see the level of significance. After careful evaluation, the mean±SD values of serum ALT were 37.14±15.18 U/L and 21.92±5.10 U/L in case and control groups respectively, and mean±SD values of serum AST were 41.15±15.24 U/L and 25.01±6.65 U/L in case and control group respectively. This study revealed that mean serum ALT and AST levels were significantly increased in obese adults. There was a significant positive correlation found between BMI with serum ALT and AST levels. Analyzing the findings of this cross-sectional study, significant alterations in serum ALT and AST levels were observed among obese adults.

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Key words: Obesity, BMI, Liver function test, Serum Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST)

Introduction

Obesity has surfaced as a worldwide epidemic with significant consequences for public health[1]. Obesity is the term used to describe abnormally increased body fat due to excessive energy intake compared to energy expenditure[2]. In the framework established by the World Health Organization (WHO, 2014), the obesity epidemic is characterized as an excessive accumulation of fat that negatively impacts health. This may also refer to the abnormal growth of a significant amount of adipose tissue due to an enlargement of fat cell size or the increase in fat cell number[3]. The World Obesity Federation's 2023 Atlas forecasts that by 2030, 51.0% of the global population- over 4 billion people- will be classified as obese or overweight. Additionally, it predicts that one in five women and one in seven men will be affected by obesity by 2030.

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The obesity rate in the United States continued to rise during the Covid-19 pandemic, increasing by 3.0% from March 2020 to March 2021. The total prevalence of general obesity is 26.7% in Bangladesh[4]. The overall level of obesity was 18.2% and abdominal obesity was 41.9% in both rural and urban areas in Bangladesh[4]. In comparison, women show a higher prevalence of general obesity (25.2%) and abdominal obesity (56.1%). A higher prevalence of general obesity (21.7%) and abdominal obesity (46.6%) is noticed in urban people compared to rural people[5]. Obesity is widely acknowledged to increase the risk of hypertension, heart disease and diabetes mellitus[2]. Obesity is determined by the Body Mass Index (BMI). The calculation of an individual's BMI is derived from their weight in kilograms (kg) divided by their height in meters (m) squared[6]. Obese patients with a BMI of at least 30 kg/m^2 had a mortality rate that was assessed to be over 80.0% due to co-morbidities[7]. The BMI of more than 23 kg/m^2 is measured in the population living in South and Southeast Asia; it is usually taken as a sign of obesity. Certain studies use threshold values of BMI $\geq$23 kg/m^2 to classify individuals as overweight, and BMI $\geq$25 or $\geq$27.5 kg/m^2 to categorize them as obese in this region[8]. There is an imbalance between energy consumption and energy expenditure because people do not exercise enough or lead a sedentary lifestyle that leads to an accumulation of fat as a result of this. Genetics, environmental factors, including limited access to nutritious food, sedentary behaviors and socio-cultural activities like food advertising, lead to worsen the situation with obesity. Moreover, illnesses such as hypothyroidism and Cushing's syndrome along with medications including steroids and antidepressants can bring about obesity. Overall, the causes of obesity are many and they are all interconnected, thus forming a complex issue that contributes to the increased occurrence of obesity[9]. In the long run, obesity has various serious health consequences like hypertension, heart diseases, liver diseases, diabetes, stroke, osteoarthritis, pulmonary conditions, sleep disorders, digestive disorders, gallbladder problems, cancer, depression, venous thrombosis, osteoarthritis, mental decline and reduced lifespan[10]. The liver is accountable for numerous functions, including metabolism, synthesis of plasma proteins, formation and secretion of bile, detoxification of various metabolites, excretory, storage or hematopoietic function. The liver is severely impacted by obesity, which may be linked to hepatomegaly and an alteration in liver biochemistry values, and alterations in liver histology like macrovesicular steatosis, steatohepatitis, fibrosis and cirrhosis[11]. Surprisingly, some obese people have a normal metabolism, which is defined as metabolically healthy obesity (MHO)[12]. Obese adults and liver problems in Bangladesh play an important role in each other, as a high prevalence of NAFLD in that population. In both urban and rural areas of Bangladesh, one-third of the population has NAFLD. Risk factors, such as higher age, diabetes and elevated BMI were found to be significantly associated with NAFLD. Subjects with more than normal BMI, diabetes and hypertension have more likely chances to develop NAFLD and overweight and obese individuals have statistically greater odds for NAFLD compared with normal-weight participants. NAFLD seems to be remarkably high among adults in midlife, notably in the context of women and those residing in rural areas[13]. Such findings are a reflection of the importance of obesity to liver health and reinforce the need to offer targeted interventions regarding the issue under consideration. The ratio of liver dysfunction found in the obese adult population of Bangladesh is fairly high. According to the findings, the disease called NAFLD affects almost one-third of the population of Bangladesh which includes more among those having high BMI, diabetes, and hypertension. The present state of NAFLD in Bangladesh is more than 33.86% and the people with BMI $\geq$25 have a 1.60-fold times higher chance of suffering NAFLD than the normal weight group. This underscores the issue reminding us that obesity is a structural component of liver disease among Bangladeshis, thus the need to come in with specific interventions in this regard[14]. Symptoms of liver dysfunction in obese adults are diverse but may include fatigue and weakness, yellowish skin and eyes, abdominal pain and swelling, swelling in the legs and ankles, itchy skin, dark urine, pale-colored stools, nausea or vomiting, and loss of appetite. Liver problems in obesity can develop into NAFLD which can even progress to more serious liver disease without proper management. All overweight adults with any of these symptoms need to see a doctor and ensure a precise diagnosis and treatment plan[15]. Central to understanding the relationship between obesity and liver health are the liver function tests, encompassing serum Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) levels. These markers reflect the liver's ability to maintain its essential functions and offer valuable insights into the hepatic consequences of excess adiposity. The serum enzymes that are most commonly used in evaluating liver function are ALT and AST[16]. ALT and AST are non-functional plasma enzymes of hepatocytes. Normally they are present in plasma in very low concentrations. These enzymes are released excessively during liver injury. Elevations of these enzymes and a bright liver at ultrasound are the hallmarks of NAFLD, which are common in obesity, and their prevalence increases progressively with increasing BMI[17]. This study seeks to address the pressing need to understand the intricate relationship between obesity and liver function, with a specific focus on key markers, namely serum ALT and AST. The early detection and monitoring of liver function in obese individuals is of paramount importance, as it can facilitate timely interventions, risk stratification, and the development of personalized treatment strategies. Further, the study may provide baseline information for future research on obesity in our country.

Methods

This cross-sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College. All biochemical investigations were done at the laboratory of the Biochemistry department. Subjects were collected from the Medicine and Endocrine outpatients department of Mymensingh Medical College Hospital, Mymensingh, Bangladesh during the period from July 2023 to June 2024 and the ethical clearance Memo no.: MMC/IRB/2024/632 dated: 30/11/2023. A total of 200 subjects were included in this study. Out of them 100 were case (Group I) and 100 were control (Group II). Sample was done purposely (nonrandom). For cases (Group I): Consists of 100 obese persons (both male and female) whose BMI is equal to or greater than 27.5 ranging from 18 to 60 years. For control (Group II): Consists of 100 non-obese apparently healthy volunteers whose BMI 18.5 to 23 in the same age group were selected. Persons taking drugs (corticosteroids, hormonal contraceptives, antidepressants and anticonvulsants) for last 5 months or persons having diabetes and thyroid disorders or other serious comorbidities (liver or renal diseases) or persons consuming alcohol were excluded from the study. Study variables were alanine aminotransferase (ALT) and aspartate aminotransferase (AST): serum ALT is estimated by the enzymatic method based on the production of pyruvate by enzymatic reaction[22] and serum AST is estimated by the enzymatic method based on the formation of oxaloacetate by enzymatic reaction[22]. All data were recorded in a predesigned case record form. Statistical analysis was done using SPSS version 26.0 Windows package. All biochemical values were expressed as mean±SD (standard deviation) and compared between groups of subjects by using Student's unpaired 't'-test. The level of significance was defined as p-value <0.05 at the level of 95% confidence interval (CI). The correlation was done by using Pearson's correlation coefficient test.

Results

A total of 200 participants took part in the current investigation. There were two groups of subjects: case (Group I) and control (Group II). Of these, 100 obese persons (both male and female) whose BMI is equal to or greater than 27.5 ranging from 18 to 60 years chosen as the case (Group I) and 100 non-obese apparently healthy volunteers whose BMI 18.5 to 23 in the same age group were chosen as the control (Group II). 200 subjects' blood samples were taken, and measurements of the serum levels of alanine aminotransferase and aspartate aminotransferase were made. Age and BMI were two physical characteristics that were measured. Alanine aminotransferase and aspartate aminotransferase levels in serum were represented in U/L. The BMI result was represented as height in meters and body weight in kg. The age was given in years. The statistical significance of differences between groups was determined using Student's unpaired 't' test using data expressed as mean±SD. The age of the subjects was ranged from 18 to 60 years, with a mean age of 38.58±10.22 for case (Group I) and 41.56±11.10 for control (Group II). The difference in mean value of age between control and case groups were statistically not significant. The mean±SD of body mass index in case (Group I) was 30.30±2.03 and in control (Group II) was

22.88±3.01. Unpaired 't' test was done between case (Group-I) and control (Group II). Mean values of BMI were highly significant (p<0.001). Table I provides an analysis of the study population's age and BMI.

Table I: Mean±SD of age and BMI of the study population

Variables	Case (Group I)	Control (Group II)	p value
	Mean±SD	Mean±SD	
Age (years)	38.58±10.22	41.56±11.10	>0.05
BMI (Kg/m^2)	30.30±2.03	22.88±3.01	<0.001

In this investigation, it was shown that the Mean±SD serum ALT levels in Group I (the case) and Group II (the control) were 37.14 ± 15.18 and 8.860.64 U/L, respectively. The difference in mean serum ALT levels between the two groups was highly significant (p<0.001).

Table II: Comparison of mean serum ALT levels in the study population

Variable	Case (Group I)	Control (Group II)	p value
	Mean±SD	Mean±SD	
Serum ALT (U/L)	37.14 ± 15.18	21.92±5.10	<0.001

In this study, the Mean±SD values of serum AST were 41.15±15.24 U/l and 25.01±6.65 U/L in Group I and Group II respectively. The analysis showed that, the difference in mean serum AST levels between two groups was highly significant (p<0.001).

Table III: Comparison of mean serum AST levels in the study population

Variables	Case(Group I)	Control (Group II)	p value
	Mean±SD	Mean±SD	
Serum AST (U/L)	41.15±15.24	25.01±6.65	<0.001

In this study, significant positive correlations were found between BMI with serum ALT and AST.

Table IV: Correlation of serum ALT and AST with BMI

Dependent variable	Independent variable	Co-efficient (r) Value	p value
BMI	ALT(U/L)	0.517	<0.001
	AST(U/L)	0.598	<0.001

Discussion

In this study, the mean age of Group I and Group II were 38.58±10.22 and 41.56±11.10 years respectively. The difference in the mean value of age between Group I and Group II was statistically not significant. In this study, the mean±SD of BMI in Group I was 30.30±2.03 and in Group II was 22.88±3.01. Unpaired 't' test was done between Group I and Group II. The difference in mean BMI was highly significant. In this study, serum ALT levels of Group I and Group II were estimated. The mean values of serum ALT were 37.14±15.18 U/L and 21.92±5.10 U/L in Group I and Group II respectively. The study revealed that, serum ALT was significantly higher in Group I than that of Group II. The analysis showed that, the difference in mean serum ALT levels between two groups was highly significant (p<0.001). This study accords with the previous studies Ali et al.[4], Rahman et al.[14], Marchesini et al.[17], Bekkelund and Jorde[18], Das et al.[19], Kim and Jo[20], Adams et al.[21] and Stranges et al.[22]. Recent studies have consistently demonstrated a positive correlation between serum ALT level and BMI in obese individuals. This correlation is significant, indicating that as BMI increases, so does the risk of elevated ALT level. A study published in 2019 found that the odds ratio for elevated ALT in obese subjects was 5.0 in men and 3.9 in women, highlighting the strong association between obesity and elevated ALT level[23]. This is consistent with this study. However, one study notes that lean mass index was inversely and independently associated with serum ALT when adjusted for covariates in men, suggesting that muscle mass may also play a role in the relationship between ALT and obesity. This finding implies that the correlation between ALT and BMI may be influenced by factors beyond just general obesity, such as body composition[18]. The mean values of serum AST were 41.15±15.24 U/L and 25.01±6.65 U/L in Group I and Group II respectively. The study revealed that, serum AST was significantly higher in Group I than that of Group II. The analysis showed that, the difference in mean serum AST levels between two groups was highly significant ($p<0.001$). This study accords with the previous studies Dilhara et al.[24], Jalili et al.[25], Ahn et al.[26] and Loomba et al.[27]. Dilhara et al.[24] found that the median serum AST levels in females of underweight, normal weight, overweight and obese groups were 17.8, 19.2, 18.1 and 20.1 U/L, respectively, while in males, the median serum AST levels were 18.1, 21.9, 23.5 and 28.2 U/L respectively. This indicates that underweight individuals had the lowest median AST levels, while obese individuals had the highest median AST levels in both females and males. Additionally, males had higher median serum AST levels than females in each BMI category. Some current research showed that obesity is linked to liver disease and pervasive deterioration of hepatic function and it has been conclusively determined that obesity can damage liver function in numerous ways[28]. In obesity, cytokines like IL-6 and CRP may affect hepcidin synthesis or inhibit liver functions in the production of hepcidin, which results in iron deficiency anemia and rarely some types of liver diseases like NAFLD and liver cancer in some patients[29]. Further research is needed to fully understand the mechanisms underlying this correlation and to determine the clinical implications of elevated ALT and AST levels in obese individuals with broad scale sample size.

Conclusion

Abnormal Liver enzymes in adult obesity are a major factor related to NAFLD. Obesity is a major risk factor for LFT alterations, especially for the raised level of the liver enzymes i.e. ALT and AST. These abnormalities are usually associated with the high rate of obesity which happens alongside NAFLD and its severe complications. Impaired liver tests are more commonly found in obese, apparently healthy adults. More extensive analyses are usually required to identify the roots of abnormal LFTs in obesity, as these abnormalities may imply liver injury and need to be treated to avoid future complications. Serum ALT and AST was increased significantly when compared with non obese adults. There is a significant positive correlation between serum ALT and AST with BMI. Obese adults with abnormal serum enzymes should emphasize lifestyle changes, weight loss and control of underlying conditions such as diabetes and hypertension. It is important to frequently check the liver enzymes and ensure that the obese individual meets the referral criteria for specialized care.

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