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Relationship Analyses of Overweight and Obesity with Liver Function

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ABSTRACT: *Obesity is a treatable medical condition marked by a high accumulation of fats in the body, a result of food intake or lowered bodily exercise. Obesity is one of the widespread causative factors for liver health. The liver performs a central function in carbohydrate, protein, fats metabolism and detoxification. This research aims to examine the impact of overweight and obesity on female liver functions and to exhibit the correlation of BMI with liver enzymes in normal, overweight and obese subjects. In this cross-sectional study, a complete of 75 subjects was enrolled. Sampling was carried out from Lahore College for Women University, Lahore. Liver enzymes Alanine aminotransaminase (ALT), Aspartate aminotransferase (AST) and Alkaline phosphatase (ALP) had been analyzed through a chemistry analyzer. The enrolled subjects were classified into three groups based on BMI i.e. Normal weight (n=25), overweight (n=25) and obese (n=25), following the WHO criteria. Correlation analysis of BMI with liver enzymes demonstrated that ALP was positively correlated with BMI in obese (r= 0.328) and overweight (r=0.198) subjects. A significant relationship was observed between ALT and BMI in obese subjects(r=0.467). AST and BMI (r=0.074) showed a direct correlation in overweight subjects. So it was concluded that obese and weight problems significantly affect liver function and may result in further complications of the liver.*

Key words: *Alanine Aminotransaminase (ALT), Aspartate Aminotransferase (AST) and Alkaline Phosphatase (ALP), Body Mass Index (BMI), World Health Organization (WHO).*

INTRODUCTION

Obesity is a curable medical issue characterized by using extended deposition of fats in the body as a result of increased calorie consumption and diminished body activity. Internationally, the World Health

Organization (WHO) classifies the obesity and weight issues on the foundation of body mass index (BMI) (James et al., 2001). Pakistan was ranked 9thamong 188 countries in carrying the obese population (Marie et al., 2014). As weight problems are growing in all age groups of Pakistan due to sluggish mode of life and a high number of individuals which seems healthy and they are struggling with overweight and obesity. At the same time, they are unaware of problems that can be a possible source of various relevant diseases. There has been a significant increase in the prevalence rates of overweight and obesity in many nations around the world in recent decades (Alan and Alam, 2004).

Body mass index (BMI) is regarded as a convenient, acceptable, accurate, and low-priced measurement for estimating the occurrence of obesity, while waist circumference (WC) is advocated as the most correct and realistic measure of abdominal adiposity (WHO, 2005). Obesity is a necessary predictor of various diseases as well as one of the hazard elements most often related to expanded liver enzymes. The liver is a large abdominal organ with a central role in metabolism (Straus et al., 2000).

Hepatocytes function a variety of essential immunological roles, in addition to their vital metabolic roles (Giannini et al., 2005). Fatty liver is the most vital disorder of the liver cells and a reversible disease created by large storage of fats (triglycerides) in liver cells. Fats make up more than 5% of the liver's weight in fatty liver (Sherlock and Dooley, 2008).

For instance, a research study in Korea aimed to make clear whether or not precise health behaviors had been related to liver function in obese adolescents. Students have been examined for liver enzymes and health behavior (Lee et al., 2018). Abnormalities of Non-alcoholic fatty liver disease (NAFLD), together with an advanced stage of fibrosis can be viewed in teenagers with ordinary or mildly improved ALT levels. Pasanta et al. (2018) assess the association between liver fat content (LFC) and weight status in young adults using proton magnetic resonance spectroscopy (1H MRS) technique. A total of 78 healthy subjects in the young adult age group (19-30 years old) participated in this study. Blood biochemical quantity and 1H MRS was performed for LFC assessment.

Johansen et al. (2020) determined the concentration of ALT, AST, LDH and ALP decreased with age in both females and males, while GGT and bilirubin were comparable across age groups in females and increased slightly with age in males. Children and adolescents with overweight or obesity exhibited higher concentration of ALT in all age groups. Elevated plasma concentration of liver enzymes are routinely used as markers of liver injury in adults and children.

The present study was aimed to identify the impact of weight problems on liver functions and to illustrate the correlation between BMI and waist circumference with liver enzymes in obese, overweight and normal females.

MATERIALS AND METHODS

Study Design and Bio data Collection

A group of 75 healthy females of age 16- 35 years was randomly chosen for the study. This cross-sectional study was accompanied at the Department of Zoology at Lahore College for Women's University, Lahore, to measure liver characteristics of 75 female serum samples. The subjects were divided into three groups based on BMI i.e. normal weight (<25Kg/m^2), overweight (25.1-30Kg/m^2) and obese subjects (>30 Kg/m^2). Anthropometrical measurements consisting of age, height, weight, BMI and waist circumference were recorded.

A questionnaire had been specifically designed to obtain information on socio-demographic data (age, sex, socioeconomic status) and medical history of subjects (health status, family history of liver disease, family history of obesity, family history of diabetes, alcohol consumption and passive smoking). Data collected about physical activity, life style and fast food intake. Physical activity categorized into active subjects, moderately active subjects and sedentary subjects. All procedures for the study have been permitted and approved through the Ethical Review Committee of the Department of Zoology at Lahore College for Women University.

Measurement of Liver Enzymes

Venous blood (5ml) was drawn from each person. Serum was then stored at freezing temperature of -20°Cfor future analysis. Liver function tests of serum Alanine transaminase (ALT), Aspartate aminotransferase (AST) and Alkaline phosphatase (ALP) were then analyzed in the laboratory using a chemical analyzer (Chem-7 Erba Mannheim). For the measurement of ALP (U/L), ALT(U/L) and AST(U/L), commercially available kits (1003 LOT, 2006), (Cat No. CZ 902-L) and (AFO1 3010-051) were used respectively.

STATISTICAL ANALYSIS

Statistical analysis was done by using SPSS (Version 22.0). Data was statistically investigated and was presented in the form of graphs, charts and tables. Mean values were calculated and expressed as ±SEM. One way ANOVA was performed to reveal the significant difference among the groups. Data were statistically analyzed and presented in the form of graphs, charts and tables. Mean values have been calculated and expressed as ±SEM. The variance analysis (ANOVA) test was performed to detect a significant difference between the groups. The correlation was completed to determine the association between BMI and liver enzymes in the groups studied.

RESULTS

The prevalence percentage of the family history of liver disease, obesity, diabetes, alcohol intake and lifestyle was recorded (Table 1).

The mean age of the studied groups for normal, overweight and obese group was recorded as 22.7±1.89 years, 21.4±0.63 years and 29.28± 2.0 years respectively. The mean BMI of normal, overweight and obese subjects was 21.49±0.36 kg/m2,26.73±0.21 kg/m2and35.73±1.39kg/m2 with a greatly significant difference ($p<0.05$) among the groups respectively. Mean waist circumference of normal subjects was 78.2±1.35. The mean waist circumference of overweight subjects was 86.64±1.31. The suggested waist circumference of obese subjects was 101.32±2.151 compared by ANOVA and a very high significant difference among the groups was recorded (p-value ? 0.01) Table 2.

Non-significant difference in mean values of liver enzymes was observed when compared with different classes of obesity (Table 3).

Pearson correlation revealed that relation between BMI and ALP In normal subjects is (r=0.016). Direct significant in overweight subjects (r=0.198) and obese subjects (r=0.328).In normal subjects, it was detected that ALT was slightly correlated with BMI (r= 0.223). In overweight subjects an indirect relation (r=-0.258) was observed and in obese subjects relation between the BMI and ALT was direct and highly significant(r=0.467*). In normal subjects, AST was slightly correlated with BMI (r=0.164) and positively, correlated with BMI (r=0.074) in overweight subjects. While, in obese subjects, AST was negative correlated with BMI (r= -0.162) (Table 4).

Table 1: Frequency Distribution of Risk Factors and Lifestyle in Studied Subjects

Risk Factors	Frequency (n)	Percent%
Family History of Liver Disease		
Yes	**34**	**54.67**
No	**41**	**45.33**
Family History of Obesity		
Yes	**53**	**70.67**
No	**22**	**29.33**
Family History of Diabetes		
Yes	**49**	**65.33**
No	**26**	**34.67**
Passive Smoking		
Yes	**27**	**36**
No	**48**	**64**
Alcohol Intake		
Yes	**14**	**18.67**
No	**61**	**81.33**
Lifestyle		
Physical Activity		
Active Subjects	**15**	**20**
Moderately active subjects	**33**	**44**
Least active subjects	**27**	**36**
Fast food intake		
Daily	**18**	**24**
Sometimes	**45**	**60**
Don't eat	**12**	**16**

Table 2: Demographic Characteristics and Mean Liver Enzymes ± S.E.M in studied groups

Serial No	Variables	Normal Group (n=25) Mean± SEM	Overweight Group (n=25) Mean± SEM	Obese Group (n=25) Mean± SEM	P value ANOVA test
1.	**Age (Years)**	22.7±1.89	21.4±0.63	29.28±2.10	0.002**
2.	**Height (m)**	2.56±0.48	2.53±0.54	2.39±0.05	0.036*
3.	**Weight (Kg)**	54.4±1.23	66.2±1.51	83.9±2.72	0.001***
4.	**Waist circumference (cm)**	78.2±1.35	86.64±1.31	101.32±2.15	0.001***
5.	BMI (Kg/m²)	21.49±0.364	26.73±0.213	35.73±1.393	0.001***
6.	**Alkaline Phosphatase ALP (U/L)**	138.52±19.65	148.60±16.36	158.5±18.72	0.743[ns]
7.	**Alanine Transaminase ALT(U/L)**	66±17.37	57.0±10.74	138.2±26.89	0.008**
8.	**Aspartate Transaminase AST(U/L)**	41.5±6.60	62.38±8.74	99.34±16.14	0.002**

Abbreviation:

P > 0.05----Non Significant

*P-value = 0.05---significant

**P-value=0.01---Highly significant

***P-value=0.001---Highly-significant

Table 3: Mean Values of Demographic Characteristics, and Liver Enzymes ±SEM in Obese Subjects.

Variables	Obese class I	Obese class II	Obese class III	ANOVA Test
Age (yrs)	26.27±2.41	30.0±6.36	31.0±4.0	0.124^{ns}
BMI(kg/m²)	31.11±0.32	36.72±0.71	46.71±1.81	0.000***
Waist Circumference (cm)	96.27±1.45	102.0± 1.08	113.5±5.91	0.001**
ALP (U/L)	126.5±18.95	199.5±67.38	210.9±37.3	0.108^{ns}
ALT (U/L)	90.18±20.0	189.5±110.3	224.2±61.6	0.079^{ns}
AST (U/L)	112.9±25.0	69.32±21.4	85.43±19.5	0.581^{ns}

Abbreviation:

P > 0.05----Non Significant

*P-value = 0.05---significant

**P-value=0.01---Highly significant

***P-value=0.001---Highly-significant

Table 4: Correlation Analysis of Liver Function Test with BMI in Normal, Overweight and Obese subjects.

Correlation of Liver enzymes with BMI	Normal weight (n=25)	Overweight (n=25)	Obese (n=25)
Alkaline phosphatase (U/L)	r=0.016 p= 0.940	r= 0.198 p= 0.342	r=0.328 p=0.110
Alanine transaminase (U/L)	r= 0.223 p=0.285	r=-0.258 p=0.213	r=0.467* p= 0.018
Aspartate transaminase (U/L)	r=0.164 p= 0.433	r=0.074 p=0.726	r=-0.162 p=0.439

Abbreviation:

P > 0.05----Non Significant

*P-value = 0.05---significant

**P-value=0.01---Highly significant

***P-value=0.001---Highly-significant

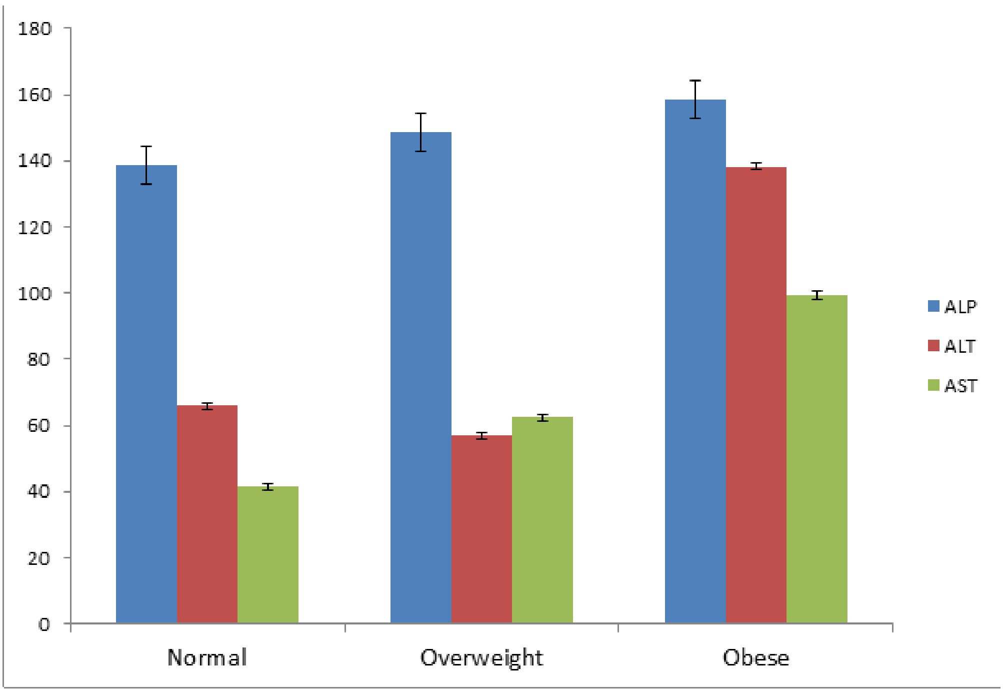

Fig. 1: Comparison of Mean liver enzymes (U/L)±S.E.M in Normal, Overweight and Obese Subject

DISCUSSION

The study of impact of overweight and obesity on liver function test was designed to determine and to correlate the effect of BMI with liver enzymes. This study shows that, in a cohort of individuals, obesity was significantly associated with liver enzymes.

In our study, 75 females were included, in which n= 25 were normal, n=25 were overweight and n=25 were obese. They were divided into three classes in accordance to BMI, which are: Group I (Normal), group II(Overweight), Group III (Obese).

In this study, several questions were included such as family history of liver disease 54.7% (n=41), family history of obesity 70.67% (n=53), family history of diabetes 65.33% (n=49), alcohol intake 18.67 (n=14), passive smoking 36% (n=27) as well as about lifestyle such as physical activity (n=15) 20%and fast food intake (n=18) 24% included in studied subjects. In our study percentage of fast food intake who daily eat was 24% and people who eat once or twice in a week was 60% and people who has sedentary lifestyle was 36% in studied subjects.

Our study is same as Gu et al. (2009) a questionnaire was used to acquire demographic data, lifestyle factors (smoking and physical activity), clinical history, and family history of obesity, smoking, alcohol consumption, and physical activity and family history of chronic diseases), the association of overweight and obesity with liver disease was decreased but still significant for both sexes.

Lee et al. (2018) aimed clarify whether or not accurate healthy habits have been related with the elevation of liver enzymes among obese adolescents in Korea. First, among all subjects studied, body shape self-image and weekly frequency of ingestion of fast food were positively associated with accelerated levels of AST and ALT (Lee et al., 2018).

In our study, one way ANOVA was applied to assess the differences in anthropometric variables and liver enzymes. The p-value (typically ? 0.05) in ALP showed the non-significant difference between the groups, (0.743ns) because ALP was not affecting in normal group. The p value of ALT between the groups was (p=0.008**) showed high significant difference among the groups. p-value (0.05) and p-value of AST among the groups was (0.002**) showing highly significant difference.

Our study is same as that of Qureshi et al. (2006). By using one way ANOVA Comparison among obese, overweight and normal subjects were made. A probability p value less than 0.05 was well-thought-out significant difference and values of ALT, AST, and ALP were significant with BMI. The p-value (typically 0.05) is significant.

In our study, ALP were positively correlated with BMI (r= 0.328) in obese subjects. ALT was found noticeably significant which correlated with BMI (r=0.467*). AST was shown a negative correlation with BMI (r= -0.162). In group ii, ALP was also positively correlated, (r=0.198) in overweight subjects. ALT with BMI was negatively correlated in overweight subjects. (r=-0.258). AST was positively correlated with BMI (r=0.074). In normal subjects (Group iii), BMI was not effecting on ALP in normal subjects. ALT was barely correlated with BMI (r= 0.223). AST was slightly correlated with BMI (r=0.164).

Adams et al. (2008) in their study determined that the majority of the subjects had been either overweight (41%) or obese (17%). A minority of subjects were average (25%) or heavy drinkers (4%). With liver enzymes, BMI and waist circumference have been strongly associated (Adams et al., 2008).

In another study of Das et al. (2014) individuals have been divided into three groups on the basis of BMI. In Group I, Total no. of people was 72, in Group II, subjects were 39 and in Group III they were 45. From their study it was considered that the range of female subjects was greater as in contrast to adult males in Group II and III. In all the three group values of ALT, AST was within the normal reference range. However, there was an increase trend in the values from normal to obese. ALT, AST showed no significant relation and GGT and weight problems as the p value was> 0.01 when in contrast between Group II and Group III.

In our study of 75 females out of which n=25 were obese according to BMI and their p value is (0.001**) which shows highly significant difference between the groups. Overall BMI was high in obese females and 36% (n=27) was passive smoker and (n= 14) 18.67% was alcoholic and tobacco user.

Pasanta et al. (2018) assessed the association between liver fat content (LFC) and body mass index in young adults. Our findings was same as (Pasanta et al. 2018) and we determined the association of liver enzymes with BMI. Johansen et al. (2020) determined the concentration of ALT, AST, LDH and ALP decreased with age in both girls and boys, while GGT and bilirubin were comparable across age groups in girls and increased slightly with age in boys. In our study, we determined the concentration of ALT, AST, ALP with normal, overweight and obese subjects. Our study was same as Diehl (2004), he reported joined outcomes of BMI and alcohol consumption on liver. Both elements have been associated to liver disease and, more importantly, they mentioned a supra-additive interaction between the two.

In the other study, the relationship between BMI and alcohol consumption and the prevalence and incidence of abnormal serum liver enzyme activity in each cross-section and potential pattern was investigated by Lee et al. (2001).

In conclusion, the present analysis suggests that obesity is virtually one of the most serious reasons of excessive serum activities of the hepatic enzymes in subjects examined throughout study, and this study about it suggests that extended BMI is related with extended serum ALT, AST, and ALP activities in females. Elevated serum hepatic enzyme activities are related with the excessive prevalence of fatty liver, which was regularly determined in subjects with excessive BMI.

CONCLUSION

The correlation analysis revealed the direct association of liver enzymes with BMI. The present analysis suggests that obesity is undoubtedly one of the most significant causes of the hepatic enzyme's elevated serum activity.

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