

## ORIGINAL ARTICLE

## INFLUENCE OF GENDER, BMI, AND ETHNICITY ON SERUM ALT LEVELS OF HEALTHY STUDENTS OF A MEDICAL SCHOOL

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**Background:** Alanine Aminotransferase (ALT) is an enzyme found in Liver and indicates injury to Hepatocytes. It is influenced by various factors. The objectives of this study were to identify the correlates of ALT activity among healthy medical students of Army Medical College, National University of Sciences and Technology, aged 18–22 years. This was to establish the mean ALT levels of the students and compare them with those in various parts of the world and observe various correlations that exist and factors that may influence ALT levels. **Methods:** This population included 143 volunteer students (93 men and 50 women) selected on the basis of negative answers to a detailed medical questionnaire including past medical history, drug and alcohol consumption, on the absence of clinical signs of liver disease, on the negativity of serological testing for Hepatitis B and C virus. **Results:** The mean ALT level of the entire population was 28.7 IU/L. A major sex-difference in ALT value was observed, the mean ALT value being higher in men than in women ( $32.1 \pm 21.7$  vs.  $22.6 \pm 9.7$  IU/L,  $p < 0.004$ ). According to WHO criteria for Asians, normal BMI was taken from 18.5–23.0 Kg/m<sup>2</sup>. There was a positive significant correlation between serum ALT level and BMI ( $p < 0.002$ ). ALT level strongly correlates with body mass index and gender. There was no significant variation in ALT levels among Punjabis and Sindhis, Balochis, Pathans, and Kashmiris. **Conclusion:** We suggest the need of taking into account these parameters in a clinical interpretation of ALT level.

**Keywords:** ALT, Body Mass Index, BMI

## INTRODUCTION

Alanine Aminotransferase (ALT) is an enzyme found in abundance in the cytosol of the hepatocyte. Liver enzyme tests are commonly used to screen for Liver Diseases such as Fatty Liver and Hepatitis<sup>1-4</sup>, and even a minor elevation of ALT is a good predictor of mortality from liver disease.<sup>5</sup> Other causes of increase in ALT levels can be obesity,<sup>6,7</sup> alcohol intake<sup>8</sup> and drugs. Serum levels of ALT can rise due to extra-hepatic sources as well which include muscle<sup>9</sup>, kidney and Red blood cells.<sup>10</sup> ALT is used very commonly in health check-up programs nationwide in Pakistan. Some studies have testified the correlation of ALT concentration with BMI and its levels also vary reasonably with gender.<sup>11</sup> The present study aimed to assess the normal value of ALT among healthy students of a Medical University aged 18–22 years with no history of Hepatitis & no alcohol intake and to investigate factors associated with variation of ALT levels in this population and the risk it carries.

## MATERIAL AND METHODS

This study was carried out at the Department of Biochemistry and Molecular Biology, Army Medical College, Rawalpindi. A total of 143 students (93 males, 50 females) from the total 750 students studying at Army Medical College, National University of Sciences & Technology, Pakistan who volunteered to

take part in the study were taken to the Army Medical College Pathology Laboratory with an overnight fast. They were informed about the aims and objectives of the study and a written informed consent was obtained. Blood was drawn to measure ALT and Lipid profile levels. Height and weight of all individuals was measured. A questionnaire was filled by each one of them to exclude any drug or alcohol intake, and find out the ethnicity and any family history of liver and heart disease of the individual. All students were screened for Anti-HCV and HBsAg and were negative for it.

All tests were done at Army Medical College Laboratory, National University of Sciences & Technology. Serum ALT levels were measured by Vitalab Selectra-E Chemistry Analyser (Netherlands). The manufacturer has given the values of up to 40 IU/L as normal. BMI was measured by dividing weight (Kg) by the square of the height (in meters). The normal range of BMI was taken as 18.5–23 Kg/m<sup>2</sup> according to the WHO criteria for Asian population.<sup>12</sup> BMI was divided into 3 categories. Underweight (below 18.5), Normal (18.5–23) and Over-weight (above 23).

Statistical Analysis was done using SPSS-14, and  $p < 0.05$  were taken as significant.

## RESULTS

The total students comprised of 93 males and 50 females. The mean ALT of the students was found to be 28.7 IU/L with a standard deviation of 18.9. The mean

ALT activity level for males was 32.1 IU/L with a standard deviation of 21.7 IU/L, while for females the figures were 22.6±9.7 IU/L. The difference observed was statistically significant ( $p<0.004$ ), (Table-1).

Ninety students of the total one hundred and forty three had normal BMI. The remaining had increased BMI except for one student who was found to be underweight. The risk of elevated ALT levels increased with increasing BMI category with students having an increased BMI having ALT levels of 36.7±26.6 as compared to ALT levels of 24.4±10.4 for students with normal BMI. Alanine Aminotransferase levels were positively related with BMI ( $p<0.001$ ).

Majority of the students were Punjabis (96 out of 143). The remaining were Sindhis, Balochis, Pathans and Kashmiris. The mean ALT level of Punjabi students was 28.2±14.4 versus a mean ALT of 29.7±25.9 for non-Punjabi students. ALT levels were not correlated with ethnicity ( $p=0.6$ ).

**Table-1: Serum ALT according to gender, BMI and ethnicity**

Variable	Count	Mean	SD	<i>p</i>
Female	50	22.6	9.7	<0.004
Male	93	32.1	21.7	
All subjects with normal BMI	90	24.2	10.4	<0.001
All subjects with increased BMI	52	36.7	26.6	
Punjabis	96	28.3	14.4	0.6
Non-Punjabis	47	29.7	25.9	

## DISCUSSION

Serum Alanine Aminotransferase (ALT) level is a very popular laboratory parameter as a Liver Function Test and is commonly used as a diagnostic and prognostic predictor of liver diseases. However the ranges for ALT in healthy individuals and the influence of other paraclinical parameters on its serum levels are less well studied. In this study the variation in ALT levels associated with normal variations in BMI, sex and ethnicity were identified and their impact on ALT measurements was determined.

The results of our study showed a strong correlation of ALT with BMI, which corresponds with the findings of previous studies.<sup>13,14</sup> In our study sample the mean ALT was significantly higher in individuals with BMI >23 Kg/m<sup>2</sup>, which is an increased BMI for Asians as classified by the WHO; but we did not find ALT levels to be directly proportional to BMI of the subjects.<sup>4</sup> The mean ALT in persons with increased BMI was 52% higher than those with normal BMI. This probably reflects the association of liver steatosis and obesity with ALT. Obesity being the leading cause of Non-Alcoholic Fatty Liver Disease (NAFLD) in the youth; is commonly associated with steatosis. Concurrent with the rise in obesity, NAFLD is considered the most common reason for serum ALT elevation in obese

individuals and is the leading cause of unexplained abnormal liver function tests in children.<sup>15</sup>

Similar to other studies a significant variation was found in ALT activity in association with gender.<sup>11</sup> Males in our study population had higher ALT levels than the females, with a mean ALT level of 32.1 IU/L in contrast to a mean ALT of 22.6 IU/L in the females. This depicts a 42% elevation in the ALT in males in relation to females. This disparity in ALT levels could be correlated to a higher mean BMI in the males than the females in our study population, with the mean BMI being 23.16 Kg/m<sup>2</sup> in the males as compared to 21.06 Kg/m<sup>2</sup> in females. Furthermore it may be due to the fact that Non-Alcoholic Fatty Liver Disease is associated more with central obesity and a higher waist to hip ratio (WHR), which is more in men than in women.<sup>16</sup> The liver receives a rich supply of potentially injurious fatty acids from the visceral adipose tissue, which has been observed to be related to WHR.<sup>17</sup>

In contrast to earlier studies, no significant difference was observed in ALT activity in relation to ethnicity.<sup>18</sup> Both the ethnic groups in our study, Punjabis and Non-Punjabis; had similar ALT levels and no variation was seen. This can be because previous studies took into account both race and ethnicity, and categorised the subjects accordingly, e.g., Caucasian, Hispanic, Black, etc. in our study however only ethnicity was considered.<sup>18</sup> In addition the ethnic groups were divided into two broad categories, Punjabis and Non-Punjabis which may account for discrepancies.

This study had several limitations which are worth mentioning here. The study population was apparently healthy individuals and the health status was assessed only on the basis of interview data from the subjects, but no tests were carried out to rule out any diseases. Screening for viral hepatitis was not done, which can strongly influence serum ALT levels and is quite prevalent in the Pakistani population. Secondly the sample size was small and was taken at convenience from a selected population; and thus may not be representative of the general population. Moreover we could not evaluate other factors which can influence ALT such as triglycerides, cholesterol and serum glucose levels.<sup>13,16</sup>

## CONCLUSIONS

There is a strong influence of BMI and gender on serum ALT level in apparently healthy individuals. These factors must be taken into account for clinical interpretation of ALT. There is a need for a large population based study in Pakistan for determining the implications on both disease screening and studies of liver pathology.

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