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Evaluation of Gamma-Glutamine Transferase (γ-GT) as a Marker of Alcohol Abuse

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Biological markers for alcohol consumption are used in clinical settings to detect and monitor alcohol consumption due to variability in verbal reporting. Alcohol consumption increases serum GGT, a widely used laboratory parameter, with gamma-glutamyl transferase sensitivity being higher than other commonly used markers, as it is known to induce a rise in serum GGT. This study aimed to investigate the role of gamma-glutamyl transferase (GGT) activity in heavy and moderate alcoholic male drinkers and controls, categorized by age group. In this cross-sectional study, we analyzed GGT levels in 100 participants, divided into two groups based on alcohol consumption. The first group consumed alcohol for over five years in different amounts (heavy < 280-gram ethanol per week, moderate >280-gram ethanol per week), while the second group consisted of 50 healthy non-alcoholics as a control. Subjects who consumed alcohol had blood GGT levels that were more than three times higher than those of non-drinking subjects (mean 78.06±11.01 U/L), demonstrating a substantial significance with p<0.001 and student t=4.761. the mean serum GGT levels in heavy drinkers was 125.89±109.96 U/L, higher than the mean of moderate drinkers (51.16±29.82) and abstainers (25.12±10.61 U/L), with a strong statistical significance at p<0.001 and F=27. 318. The serum GGT levels were significantly increased in subjects who had alcohol consumption to more than 3 folds when compared with non-alcoholic controls. Hence measurement of GGT in serum appears to be a sensitive index in the diagnosis of alcoholics.

Keywords: Alcohol Abuse; Abstainers GGT; Gamma-glutamyl transferase enzyme; Sensitive index.

Gamma-glutamyl transferase (GGT) is an enzyme that is compared with ALP levels to distinguish between skeletal disease and liver disease. Elevations of this enzyme occur in several disparate clinical situations, including all manners of liver disease fatty liver, viral hepatitis, bile duct obstruction, and most drug reactions involving the liver.[1] The World Health Organization reports that 2 billion global alcoholics and 76.3 million with alcohol use disorders, causing significant morbidity

and mortality worldwide[2]. Alcoholic beverages have been a staple in human societies since the beginning of recorded history[3]. Experimental studies support a causal relation between heavy alcohol use and increased GGT levels, but also in experimental settings response of GGT to alcohol varies depending on individual characteristics, such as sex, age, and previous drinking habits[4]. Alcohol consumption is linked to increased mortality rates from cardiovascular disease, cirrhosis, suicide, accidental death, and certain cancers in the oropharynx, larynx, esophagus, liver, lungs, colon, and rectum[5]. Chronic alcohol consumption may negatively impact the peripheral immune system, potentially leading to increased cytokine production and difficulty in adherence to antiretroviral treatment regimens[6]. Alcohol consumption among young people poses serious health, welfare, and life hazards, attracting public, policy, and research attention[7]. Ethanol may reduce coronary heart disease risk, but benefits are limited to middle-aged and older individuals in high-risk populations and may be confined to specific subgroups[8].

Alcoholism and related medical disorders are increasing globally, but patients with hazardous drinking practices often go unnoticed. Objective laboratory tests are needed to respond sensitively to excessive alcohol intake, but none have provided enough diagnostic accuracy[9]. Gamma-glutamyl transferase (ã-GT), a microsomal enzyme, has been found to be useful in detecting alcohol abuse by measuring its activity in serum[10].

Gamma-glutamyl transferase, a membrane-bound glycoprotein enzyme, is used to measure excessive alcohol intake, with reported sensitivities ranging from 15% to 85%. Studies show a positive correlation between alcohol consumption and GGT activities[11].

Alcohol abuse monitoring and rehabilitation programs rely on biomarkers such as chemical, hematological, and clinical markers. These markers, including methanol level, reticulocyte count, and CDT (carbohydrate-deficient transferrin), indicate alcohol intake and liver enzyme activity, as well as non-enzymatic clinical markers like uric acid and HDL. Common markers have modest sensitivity and specificity, limited specificity due to their impact on common medications and conditions like non-alcoholic liver disease, hepatic congestion, and biliary disease[12].

Chronic disease epidemiologists and researchers outside alcohol epidemiology may misinterpret studies on alcohol consumption and health outcomes, as they may not understand the methodological subtleties involved in measuring alcohol consumption[13].

The study aims to investigate the role of gamma-glutamyl transferase (GGT) activity in heavy and moderate alcoholic male drinkers and controls, categorized by age group.

MATERIALS AND METHODS

The study, conducted in Karnataka, India, was a prospective cross-sectional study conducted from November 2009 to April 2010 at Padmashree Diagnostic Centre, Vijayanagar, Bangalore and Sneha Mano Vikasa Kendra De-Addiction Center, Tumkur. The study involved 100 participants, divided into two groups based on alcohol consumption: group A, 50 alcohol abuse cases admitted for detoxification at Sneha Mano Vikasa Kendra De-addiction Center, Tumkur, and group B, 50 healthy male volunteers.

Group A consisted of individuals aged 40-80 with over 5 years of alcohol consumption, classified as heavy or moderate drinkers, and Group B consisted of non-alcoholics.

Serum GGT was measured for both heavy and moderate drinkers. Heavy drinkers had a history of continuous alcohol consumption or binge drinking, with a mean consumption of over 280 grams per week or 4-6 standard drinks on one occasion. Moderate drinkers had a mean consumption of <280 grams per week. The study excluded patients with hormonal treatment, liver disease, or jaundice due to potential effects on serum GGT levels.

Patients' venous blood samples were collected, centrifuged, stored at -80C, and analyzed using a BS-300 automated chemistry analyzer (Mindray) to detect GGT concentration and the values were documented for statistical analysis.

As this study involves human subjects, the clearance has been obtained from the ethical committee of Padmashree Institute of Medical Laboratory Technology, Nagarbhavi, Bangalore

– 560 072 as per ethical guidelines research from biomedical research on human subject, 2000; ICMR, New Delhi and Informed consent was obtained from all the participants.

RESULTS

The study conducted a prospective cross-sectional analysis of age, alcohol intake, and GGT levels in alcoholic and non-alcoholic healthy subjects, comparing and correlating these findings.

After selecting all participants between the ages of 40 and 80, they are divided into four class intervals: 40–49, 50–59, 60–69, and 70–80. The age distribution Figure 1 indicates that the mean age in the alcoholic case group was 51.86±12.38, while the mean age in the control group of healthy, non-alcoholic participants was 52.30±12.52, with a p-value of 0.860. Thus, implying that the age groups in the study were distributed equally.

Depending on their level of alcohol consumption, the Group A alcoholic case subjects were further separated into two subgroups: moderate and strong alcohol abusers. Figure 2 presents the distribution of alcoholics in group A: 36% were heavy alcohol users and 64% were moderate users.

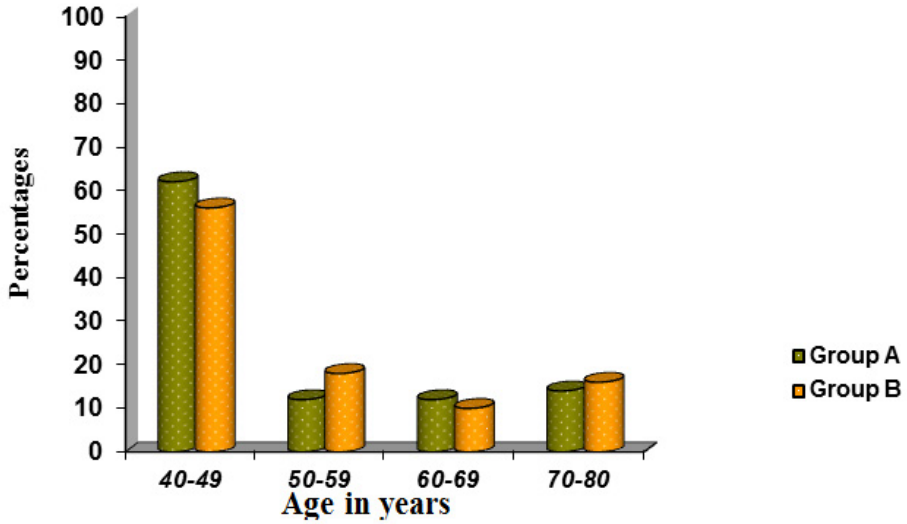

Fig. 1. Age distribution of the participants

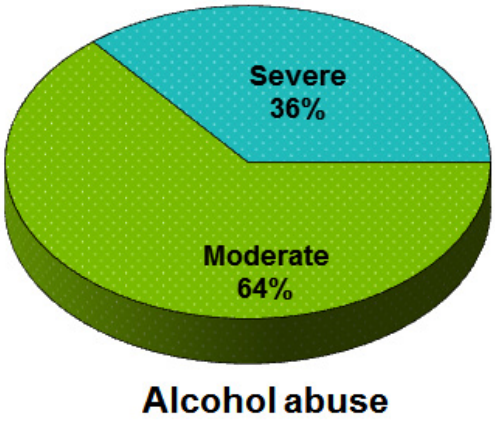

Fig. 2. Alcohol abuse of group A participants

As shown in Figure 3 subjects who consumed alcohol had blood GGT levels that were more than three times higher than those of non-drinking subjects (mean 78.06±11.01 U/L), demonstrating a substantial significance with $p<0.001$ and student $t=4.761$.

Compared to Group B, the association between age and GGT is skewed in Group A as a result of alcohol addiction. In group A, there is a negative connection ($r = -0.076$, $p = 0.600$) between age and GGT on alcohol use as shown in Table 1.

GGT is increased when the Patients had severe alcohol abuse with $t=3.639$; $P=0.001^{**}$ as shown in Table 2.

The mean serum GGT levels in heavy drinkers are 125.89±109.96 U/L, higher than the means of moderate drinkers (51.16±29.82) and abstainers (25.12±10.61 U/L), with a strong statistical significance at $p<0.001$ and $F=27.318$ as shown in Table 3 and figure 4.

DISCUSSION

The findings of this study highlight ã-GT (gamma-glutamyl transferase) as an important biomarker for assessing alcohol consumption in men. Serum GGT levels were found to be significantly elevated in participants classified as

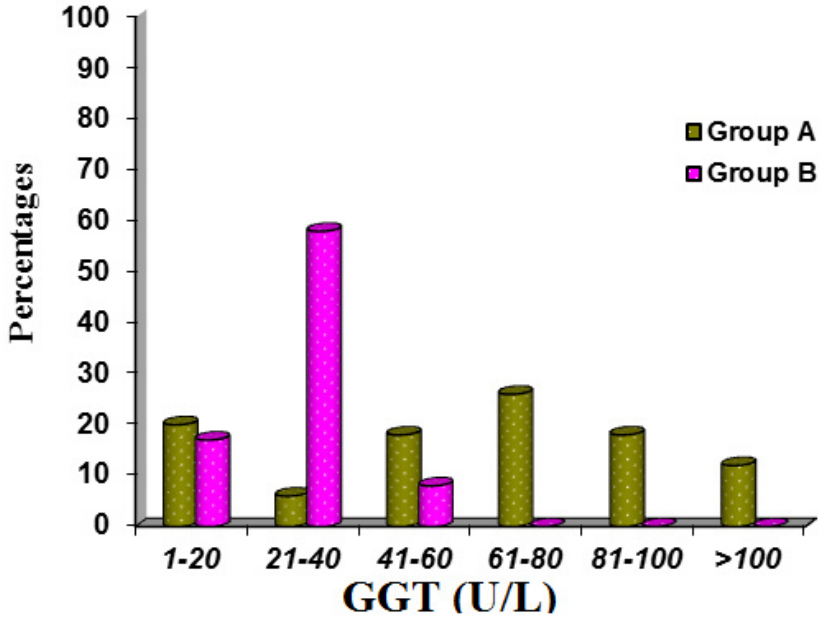

Fig. 3. Levels of GGT (U/L) in A & B groups

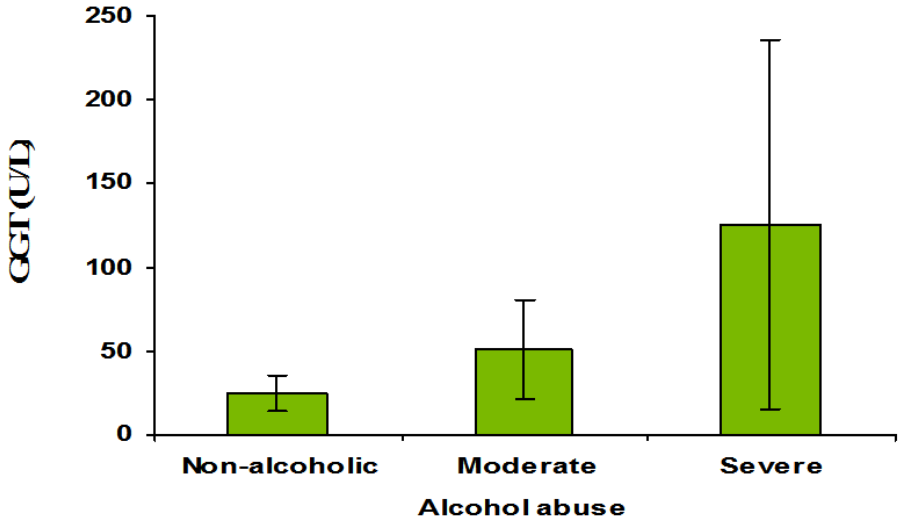

Fig. 4. Alcohol abuse and GGT (U/L)

Table 1. Pearson correlation of age and GGT in two groups

Age vs GGT (U/L)	Group A	Group B
r value	-0.076	0.390
p value	0.600	0.006**

heavy drinkers compared to moderate drinkers and non-drinkers. The findings exhibited that participants engaged in heavy alcohol consumption had serum GGT levels significantly exceeding those of moderate drinkers and abstainers, which aligns with findings from numerous research indicating that elevated GGT levels correlate strongly with alcohol intake[14,15].

Table 2. Alcohol abuse and GGT (U/L)

Alcohol abuse	Number of patients	GGT (U/L) Min-Max	Mean ± SD
Moderate	32	8.0-105	51.16±29.82
Severe	18	14.0-376.0	125.89±109.96
Total	50	8.00-376.0	78.06±77.91
Inference	GGT is increased when the Patients had severe alcohol abuse with t=3.639; P=0.001**		

Table 3. Alcohol abuse and GGT (U/L)

Alcohol abuse	Number of patients	GGT (U/L) Min-Max	Mean ± SD
Non-alcoholic	50	9.0-52.0	25.12±10.61
Moderate	32	8.0-105	51.16±29.82
Severe	18	14.0-376.0	125.89±109.96
Inference	GGT is increased when the Patients had severe alcohol abuse with F=27.318; P<0.001**		

In our study, heavy drinkers exhibited a mean serum GGT concentration of 125.89 U/L, which far surpassed the levels observed in moderate drinkers (51.16 U/L) and non-drinkers (25.12 U/L). Such results align with the observation that chronic alcohol consumption leads to marked changes in liver enzyme activity, particularly GGT, which is produced mainly in the liver and can indicate liver stress or damage[16,17].

Interestingly, we noted a negative correlation between age and GGT levels among those who consume alcohol. This could reflect a unique metabolic adaptation or age-related changes that affect how the body processes alcohol. Recent studies have pointed to variations in metabolic responses to alcohol among older adults, suggesting that age may influence GGT activity and its interpretation as a marker of abuse[18].

Furthermore, ã-GT's relevance goes beyond just indicating alcohol consumption; it also serves as a potential marker for liver health, helping to identify risks associated with alcohol-related diseases such as cirrhosis and liver cancer. These findings indicate that ã-GT could play a crucial role in early identification of individuals at risk for alcohol-related liver diseases, including cirrhosis. Our findings supported by many studies indicated that the elevated plasma GGT enzymatic activity is a significant predictor of the metabolic syndrome and is associated with oxidative stress, and elevated GGT levels are occasionally shown in fatty liver, and individuals with elevated plasma GGT are probably manifesting a sign of a liver disorder [19,20]. a higher serum GGT levels were associated with a higher risk of mortality and several studies have demonstrated that GGT positively correlated with the development of various cancers including breast, lung, endometrium, gastrointestinal tract, and liver[21,22,23].

Given the growing global attention on alcohol consumption's health impacts, there is a pressing need for markers that can reliably detect harmful drinking patterns for early intervention and improved patient outcomes. The serum GGT levels may be useful for risk assessment of all-cause and disease-specific mortality in general population[23]. While ã-GT is a valuable tool in this context, it should not be viewed as isolation. Integrating GGT with additional biomarkers, such as carbohydrate-deficient transferring (CDT) and mean corpuscular volume (MCV), can provide a more robust and accurate assessment of alcohol consumption and its effects on health[24].

Limitations

Our prevalence rates are likely to be lower than those of the general population because these findings were only obtained from subjects who attended the Sneha Mano Vikasa Kendra De-Addiction Center in Tumkur, Karnataka, India, for alcohol detoxification during a limited period of time, from November 2009 to April 2010 (6 months).

Our research does not contain a uniform distribution of ages. One of our limitations was that the age intervals between 40 and 49 years were 62% in alcoholic participants, whereas the age intervals between 50 and 59, 60 and 69, and 70 and 80 years were 12%, 12%, and 14%, respectively.

Future perspective of your study

Future studies should be conducted to evaluate the Gamma glutamyl transferase enzyme as a risk factor for cardiovascular diseases.

CONCLUSION

This study emphasizes ã-GT as a reliable marker for monitoring alcohol use. The significant differences in GGT levels among drinkers compared to non-drinkers underscore its effectiveness in clinical assessments. The relationship between age, alcohol consumption, and GGT levels serves as an important reminder of the need for further investigation into how these factors intertwine.

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Conflict of Interest

The author(s) do not have any conflict of interest.

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

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Informed Consent Statement

This study did not involve human participants, and therefore, informed consent was not required.

Clinical Trial Registration

This research does not involve any clinical trials.

Author Contributions

Mohamed Magzoub: Data Collection, Original Draft , Analysis, Writing; Elrayh Ali: Conceptualization, Methodology, Writing; Ayman Alfeel: Conceptualization, Methodology, Writing; Israa Yousif: Conceptualization, Methodology, Writing; Kiran Gopinath: Writing – Review; Sofiyat Zayyad: Writing – Review; Osman Elsadig: Writing – Review; Mosab Omer: Supervision, and Review & Editing; Kshama K. Hiremath: Supervision, and Review & Editing; Qubaa Ahmed Elzubair: Writing – Review; Marwan Ismail : Supervision and Review & Editing.

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