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CORRELATION OF BLOOD ALCOHOL LEVELS WITH GAMMA GLUTAMYL TRANSFERASE IN FIBERGLASS FACTORY WORKERS

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ABSTRACT
Alcohol is an organic compound in liquid form, colorless, with a specific odor, flammable, volatile, and miscible with water in all proportions. Fiberglass factories are among the industries that use ethanol in the production process and for testing product compatibility. Ethanol exposure can occur through inhalation, dermal contact, and ingestion. Chronic alcohol exposure may lead to liver dysfunction and an increase in Gamma Glutamyl Transferase (GGT) levels in the blood. This research aimed to determine the correlation between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers. The research method used was analytical observational with a cross-sectional approach, employing a purposive sampling technique. The study sample consisted of 30 fiberglass factory workers exposed to alcohol and meeting the inclusion criteria. Data collection was conducted by measuring blood alcohol levels and Gamma Glutamyl Transferase levels using the enzymatic photometric method. Data analysis was performed using statistical tests to determine the correlation between blood alcohol levels and Gamma Glutamyl Transferase levels. Plasma or blood serum from the workers was used as samples. The alcohol levels were found to be 100% within normal ranges, and Gamma Glutamyl Transferase levels were normal in 93% of cases. Statistical tests using SPSS and Spearman correlation analysis yielded a significance value of 0.600 ($p > 0.05$), indicating no significant relationship between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers.

Keywords: alcohol; ethanol; exposure; fiberglass; GGT

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INTRODUCTION

Exposure to chemicals in the workplace is a major concern in many industrial environments, including the fiberglass manufacturing industry. One of the potential risks for workers in this field is increased blood alcohol (ethanol) levels, which may have adverse effects on their health and safety (Yaqub et al., 2020).Ethanol exposure occurs through inhalation (vapor inhalation), ingestion (such as alcoholic beverages), or dermal contact (Setyaningsih, 2018). Inhalation of relatively large amounts of ethanol vapor may cause respiratory tract irritation, dizziness, nausea, and, at high concentrations, even poisoning (Apriyanto & Mitrayana, 2020). Consumption of ethanol in alcohol form may lead to systemic effects, including impaired motor coordination, decreased consciousness, and mood changes in the short term, while long-term chronic consumption can result in liver damage such as cirrhosis, brain function impairment, and various other health problems (Santi & Wimpy, 2023).

The first source of ethanol exposure in fiberglass factories is from resins or solvents. During fiberglass production, resins used may contain organic solvents such as ethanol. When the resin evaporates, ethanol vapor is released into the air and inhaled by workers. The second source is from cleaning agents and solvents, as ethanol is commonly used for equipment cleaning in the fiberglass industry. Direct skin contact or inhalation may occur during these processes. The third source is evaporation, which happens when the resin dries or fiberglass is

heated, increasing the risk of inhalation by workers. Another source is the compatibility testing of fiberglass products (Ekawandani, 2020). Referring to Putri's research (2023), it was explained that Gamma Glutamyl Transferase has high sensitivity as a biomarker for predicting liver damage due to alcohol. This study confirms that Gamma Glutamyl Transferase levels increase with increasing blood alcohol levels, especially in individuals with chronic alcohol exposure. Gamma Glutamyl Transferase has high sensitivity as a biomarker for predicting liver damage due to alcohol. This study confirms that Gamma Glutamyl Transferase levels increase with higher blood alcohol levels, particularly in individuals with chronic alcohol exposure.Fiberglass factory workers are exposed to hazardous chemicals such as ethanol, resin, and various volatile compounds. This study explores how long-term exposure to these substances affects alcohol metabolism, potentially altering Gamma Glutamyl Transferase levels in the body (Amirah Salsabila & Sandi Husada Health Sciences, 2019). Chronic alcohol exposure causes hepatocellular damage through ethanol metabolism in hepatocytes and malnutrition (Purbayanti et al., 2019). When a person is chronically exposed to alcohol, liver cells release Gamma Glutamyl Transferase into the bloodstream as a response to liver tissue damage or as part of alcohol metabolism, leading to increased levels in the blood (Solar et al., 2021). Workplace factors in fiberglass factories may exacerbate alcohol exposure among workers. This research aimed to determine the correlation between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers, which may differ from the general population.

METHOD

The research was conducted from November 2024 to January 2025. This study was observational-analytic with a cross-sectional design. Alcohol and Gamma Glutamyl Transferase measurements were conducted at the Westerindo Tangerang laboratory. The study population consisted of 30 male fiberglass factory workers in Tangerang, meeting the criteria of having worked for at least two years, not having a habit of alcohol consumption, and signing informed consent.The tools used for sample collection included centrifuges, micropipettes, filter tips, flashback needles, holders, tourniquets, ethylene diamine tetra acid vacuum tubes/clot activators, betadine, sterile cotton, micropores, and gloves. The study process involved obtaining research permission (ethical clearance), interviewing workers, distributing informed consent and application sheets, and administering questionnaires about workers' habits. The questionnaire was distributed via a form and tested for validity using Bivariate Person (Correlation Product Moment), items with a total score of 0.525-0.896 so it can be said that all items are valid with a significance of 0.01. The reliability test use Cronbach's Alpha with a result of 0.896 so that the questionnaire was declared reliable.Venous blood samples (5 cc) were collected in labeled EDTA vacuum tubes/clot activators, stored in an icebox with ice gel, and sent to the Westerindo Tangerang laboratory for alcohol and Gamma Glutamyl Transferase analysis using a Cobas Integra 400 Plus instrument.

RESULT

The research results are presented in Table 1, which describes the subjects' characteristics, including age, work duration, and personal protective equipment usage. These characteristics were obtained from questionnaire responses. Alcohol content and Gamma Glutamyl Transferase levels were measured using a Cobas Integra 400 Plus instrument.

Table 1.

Results of Alcohol and GGT of Fiberglass Factory Workers

Sample Code	Age (Years)	Duration working (Years)	Alcohol Level (mg/dL)	Result (normal level <50 mg/dL)	GGT level (U/L)	Result (normal level 8-61 U/L)
P1	49	16	10	Normal	32	Normal
P2	53	16	10	Normal	50	Normal
P3	22	2	14	Normal	15	Normal
P4	37	12	10	Normal	20	Normal
P5	46	16	20	Normal	63	Abnormal
P6	33	14	20	Normal	30	Normal
P7	42	16	19	Normal	35	Normal
P8	44	15	10	Normal	31	Normal
P9	42	16	15	Normal	39	Normal
P10	42	16	10	Normal	40	Normal
P11	37	12	10	Normal	36	Normal
P12	28	4	10	Normal	25	Normal
P13	38	12	10	Normal	55	Normal
P14	37	10	16	Normal	38	Normal
P15	39	15	10	Normal	45	Normal
P16	31	6	14	Normal	18	Normal
P17	44	16	14	Normal	42	Normal
P18	30	7	10	Normal	40	Normal
P19	40	10	10	Normal	32	Normal
P20	31	6	15	Normal	28	Normal
P21	31	5	18	Normal	45	Normal
P22	28	4	10	Normal	20	Normal
P23	41	15	10	Normal	31	Normal
P24	47	16	16	Normal	62	Abnormal
P25	33	10	14	Normal	25	Normal
P26	38	14	10	Normal	20	Normal
P27	38	12	10	Normal	37	Normal
P28	37	10	10	Normal	40	Normal
P29	40	10	10	Normal	42	Normal
P30	54	16	12	Normal	40	Normal

Based on table 1, it can be seen from the 30 research sample population, the age range of workers is between 22 and 54 years, the majority of workers are between 30 and 45 years old and all of them are male. This can be explained, to become a fiberglass factory worker you need to be physically strong enough, and on the other hand, isolation and exposure to chemicals are contraindicated in the work environment, especially for pregnant and breastfeeding women. Table 1 shows that the population's length of work ranges from 2 to 16 years with the average working between 10 and 16 years. Alcohol levels varied from 10 mg/dl to 20 mg/dl in most samples with a small portion having higher alcohol levels, for example p5 and p24. Most workers have Gamma Glutamyl Transferase levels in the normal range of around 15 U/L to 45 U/L. There were 2 workers, namely P5 and P24, who had higher Gamma Glutamyl Transferase levels, which were outside the normal range (8-61 U/L), which indicated the possibility of impaired liver function.

Table 2.
Frequency Distribution of Alcohol and GGT Levels Based on Age Groups

Age (Years)	Sample (N=30)	Alcohol Level Average (mg/dL)	GGT Level Average (U/L)
21-30	4	11,00	25,00
31-40	15	12,47	33,73
41-55	11	13,27	42,27

Table 2 shows that 31-40 year age group has the largest sample size with 15 people, compared to 21-30 year age group which only has 4 people, and 41-55 year age group with 11 people. Based on 21-30 year age group showed an average alcohol level of 11 mg/dL, which is the lowest level compared to other age groups. Next data shows that 31-40 year age group had an average alcohol level of 12,47 mg/dL, slightly higher than 21-30 year age group. Also 41-55 year age group has the highest average alcohol content, namely 13,27 mg/dL, more higher than the 31-40 year age group.Table 2 shows that 21-30 year age group has an average Gamma Glutamyl Transferase level of 25 U/L, which is lower than other age groups. Data result of 31-40 year age group had an average Gamma Glutamyl Transferase level of 33,73 U/L, higher than the 21-30 year age group. Next data shows of 41-55 year age group had an average Gamma Glutamyl Transferase level of 42,27 U/L, which was the highest level better than another groups.

Table 3.
Frequency Distribution of Alcohol Levels and GGT Based on Years of Working

Years of Working (Years)	Sample (N=30)	Alcohol Level Average (mg/dL)	GGT Level Average (U/L)
2-5	4	13,00	26,25
6-10	7	12,71	33,00
11-16	19	12,68	39,32

Table 3 shows that the group with 11-16 years of service has the largest sample size with 19 people, followed by the 6-10 years group with 7 people, and the 2-5 years group which only has 4 people. Alcohol levels for all work period groups had almost the same figures, namely 13 mg/dL, 12,71 mg/dL, and 12,68 mg/dL. There was an increase in the average level of Gamma Glutamyl Transferase as the working period increased, the 2-5 year group averaged Gamma Glutamyl Transferase 26,25 U/L. The 6-10 year old group averaged Gamma Glutamyl Transferase 33 U/L and the 11-16 year old group averaged Gamma Glutamyl Transferase 39,32 U/L

Table 4.
Normality Test

	Shapiro wilk		
Test	Statistic	df	Sig
Alcohol	.754	30	.000
GGT	.964	30	.392

The results of the Shapiro Wilk normality test obtained a significance value for the alcohol content of fiberglass factory workers < 0.05 ($p < 0.05$) so it can be said that the data is not normally distributed. Gamma Glutaml Transferase levels of fiberglass factory workers, a significance value of > 0.05 ($p > 0.05$) was obtained so that the data could be said to be normally distributed. For one of the variables, the data was found to be distributed abnormally, so it was continued with a correlation test using Spearman's rank.The results of the Spearman rank correlation test in table 6 show a significance value of 0.600. It indicated $p > 0.05$, the correlation between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers who are exposed to alcohol is not statistically significant. The correlation coefficient value was 0.100, indicating a positive relationship between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers but had a very weak correlation level.The results of t-test show a calculated t value of 1.171, while the t table

value with α = 5% and degrees of freedom = n-2 = 28, then the t table value is 2.048. It calculated t value is (1.171) < t table value (2.048) so there is no correlation between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers.

DISCUSSION

The technological advantages of the Cobas Integra 400 Plus tool include having a modular system, this tool can be adapted to laboratory needs, providing flexibility in use for various types of tests. This tool also has reagent efficiency, with an integrated reagent system and economical use of reagents that can increase operational efficiency (Dahman et al., 2021).The Gamma Glutamyl Transferase examination uses an enzymatic method in kinetic photometry with the examination principle: Gamma Glutamyl Transferase catalyzes the transfer of glutamic acid to acceptors such as glycylglycine. This process releases 5-amino-2-nitrobenzoate which can be measured at a wavelength of 405 nm. The absorbance obtained is proportional to the levels of Gamma Glutamyl Transferase (Pratiwi, 2020).Most workers had low blood alcohol levels (10-20 mg/dL), indicating minimal alcohol exposure at the time of measurement. Similarly, most workers had Gamma Glutamyl Transferase levels within the normal range (15-45 U/L), suggesting no significant liver dysfunction. However, two workers (P5 and P24) exhibited elevated Gamma Glutamyl Transferase levels despite normal blood alcohol levels, implying that long-term exposure and individual metabolic factors influence Gamma Glutamyl Transferase levels more significantly.

The relatively stable blood alcohol levels across age groups suggest the body's ability to regulate small amounts of alcohol efficiently. However, Gamma Glutamyl Transferase levels increased with age, likely due to cumulative exposure effects or pre-existing conditions such as diabetes or hypertension. Similarly, a longer work duration correlated with higher Gamma Glutamyl Transferase levels, indicating potential cumulative effects of workplace exposure. Although most of the workers had low blood alcohol levels and Gamma Glutamyl Transferase within normal limits, two workers (P5 and P24) showed high Gamma Glutamyl Transferase levels even though their blood alcohol levels were not classified as high. This indicates that long-term alcohol exposure and other individual factors (such as liver condition and metabolism) play a greater role in influencing Gamma Glutamyl Transferase levels. This could happen because the respondent's health condition, for example, suffers from type 2 DM, hyperthyroidism or liver cirrhosis due to metabolic syndrome.The relatively stable blood alcohol levels at around 11-12 mg/dL in all age groups reflect that the body generally has a regulatory mechanism to deal with relatively small amounts of alcohol. This may be due to the liver's metabolic system processing alcohol in an efficient manner at low levels, although there may be individual differences in tolerance to alcohol. However, for Gamma Glutamyl Transferase there is an increase in levels with increasing age. Gamma Glutamyl Transferase is an enzyme mainly found in the liver, pancreas and kidneys, which plays a role in the breakdown and transport of amino acids and peptides. High levels of Gamma Glutamyl Transferase can indicate liver damage or problems in the biliary system, but can also be increased due to excessive alcohol exposure or other medical conditions such as diabetes, hypertension, and heart disease.

Alcohol metabolism is a complex process involving the conversion of ethanol to acetaldehyde, which is then converted to acetic acid and ultimately used to produce energy. Several factors influence how alcohol is metabolized, including genetics, gender, drinking habits, and liver health. Although the body has mechanisms to deal with alcohol consumption, excessive consumption can cause liver damage and other metabolic disorders, which can be detected through measuring levels of enzymes such as Gamma Glutamyl Transferase. Alcohol levels in all long-term work groups had almost the same figures, namely 13 mg/dL; 12,71

mg/dL; 12,68 mg/dL. This shows that the average alcohol consumption between individuals with various lengths of work is not too different. Other factors influenced alcohol levels (individual alcohol consumption patterns or work habits), but in this group no significant differences were found based on length of service.The higher levels of Gamma Glutamyl Transferase in the group with longer work experience may indicate a cumulative effect of the work environment that can affect liver function. Elevated Gamma Glutamyl Transferase may be related to oxidative stress, alcohol consumption, or other occupational environmental influences related to liver metabolism. Longer periods of work may be associated with longer exposure to factors that can affect liver function, such as lifestyle habits or work that involves substances harmful to the liver (for example, use of alcohol, drugs, or exposure to other toxins).

The use of personal protective equipment in the work environment, especially for fiberglass factory workers, is very important to protect their health and safety. In this context, research shows that 100% of workers in fiberglass factories use personal protective equipment properly. This is closely related to their health condition, including blood alcohol levels which are within normal limits.According to research by Geus et al (2015) there is a correlation between alcohol intake and Gamma Glutamyl Transferase in men (r = 0.17) and women (r = 0.09). Genetic factors influencing alcohol intake are also correlated with genetic factors influencing Gamma Glutamyl Transferase, while environmental influences are only weakly correlated (explaining 4-7% of the variance in Gamma Glutamyl Transferase compared to 1-2% of genetic factors). In this healthy population, the relationship between alcohol and Gamma Glutamyl Transferase is largely influenced by genetic factors (Geus et al., 2015). Meanwhile, in research by Solar and Mewo (2021), it was found that the Gamma Glutamyl Transferase levels in alcoholic beverage consumers in the Tosuraya Selatan sub-district mostly (80%) had normal Gamma Glutamyl Transferase levels. Likewise, in Putri's research (2023), it was found that the Gamma-Glutamyl Transferase levels of the majority of Tambakrejo village fishermen who drank palm wine and wine were normal (83,33%). These results are in line with the findings in this study, namely 93% of Gamma Glutamyl Transferase levels in fiberglass factory workers were normal.

According to research by Wimpy and Santi (2023), it was found that blood ethanol levels of workers at ethanol manufacturing plants did not have a significant influence on Gamma Glutamyl Transferase levels, with a significance value of 0.257 ($p > 0.05$). The coefficient of determination of 0.058 indicates that only 5,8% of the variation in Gamma Glutamyl Transferase levels can be explained by blood ethanol levels. These results are in line with the findings of the current study, which also showed that alcohol levels had no significant effect on Gamma Glutamyl Transferase levels in fiberglass factory workers.

CONCLUSION

Based on the study findings, no significant correlation was observed between blood alcohol levels and Gamma Glutamyl Transferase in fiberglass factory workers exposed to alcohol

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