Several studies have been conducted in the United States and abroad to examine the utility of gamma-glutamyl transpeptidase (GGT) enzyme activity as a biochemical marker for alcohol consumption, alcohol problems, and abstinence from alcohol.

Much of the information available on GGT levels of drivers and drinking drivers has been conducted by Dunbar and associates (Dunbar, Hagart, Martin, & Devgun (1982); Dunbar, Martin, Devgun, Hagart, & Ogston (1983); Dunbar, Ogston, Ritchie, Devgun, Hagart & Martin (1985). In one study (Dunbar, et al., 1982) blood samples were drawn from 54 drivers before, 1.5 hours after, and 8 hours after a drinking session to determine if one drinking session would substantially raise the GGT level. Forty five of the drivers were able to attain blood alcohol concentrations (BACs) over the legal limit at the time of the second blood drawing. The authors concluded that one drinking session would not cause noticeable increases in GGT levels within 8 hours of the drinking session.

Dunbar, et al. (1983) conducted a study to identify problem drinking drivers arrested for drinking and driving. They compared the BAC and GGT activity with the information filled out by the drivers' general practitioner. None of the respondents tested showed evidence of drug use or diseases known to raise GGT levels. Five hundred and twenty one drivers (499 men and 22 women) ranging in ages from 17 to 70 agreed to participate in the study and had blood drawn at the time of arrest. Second blood samples were drawn five to nine months after from 128 of the drivers. The results showed that 24% of the 521 drivers had elevated GGT activity at the time of arrest (scores greater than 50 u/l). The authors suggested that approximately 1/3 of the drivers may be problem drinkers.

A comparison of the first GGT with the follow-up score revealed a significant relationship. Only 10% of the follow-up subjects had a restoration of "normal" GGT activity. The majority of the drivers had continued abnormal activity or an increase score, indicating that the conviction had not modified drinking behavior.
At Occupational Health Services Multiple DUI Offender Program in Alameda County, California, the GGT test has been used as one means to monitor abstinence from alcohol use, a program requirement. Program participants select one of two programs: Program A, which requires ingestion of Antabuse to maintain abstinence, or Program B, which rather than Antabuse, requires additional 12 Step program participation and periodic GGT blood testing throughout the length of the program.

Program B participants are required to have a minimum of three blood tests during their participation in the program. The first sample is taken within the first month of the program and the other two are drawn at approximately 3 and 6 months into the program. Group leaders can request additional tests for those participants they suspect drinking. Participants with substantial increases in GGT scores determined to be the result of alcohol consumption are referred back to the court system and reviewed for termination from the program.

The study was designed to analyze the data that were collected as part of the drinking driver program. Client files for participants who selected Program B in 1990 and 1991 were examined. GGT scores were examined to address the following issues: (1) Gender and age differences in distribution of GGT scores, and (2) Changes in GGT scores over time in the Program.

METHODS

Subjects: During the years 1990 and 1991, approximately 5,000 blood samples from a total of 2,347 multiple offenders enrolled in Program B were drawn. Eighty seven percent were male, thirteen percent were female. Age breakdowns were as follows: 1% under 21, 28% between 21 and 30, 37% between 31 and 40, 21% between 41 and 50, 9% between 51 and 60, and 4% 61 and older.

Procedure: Enrollees in Program B are required to have blood drawn a minimum of three times during the course of a 12-18 month program. Venous blood samples are obtained at designated times and immediately centrifuged at 2500 RPM for 10 minutes to sepa cells from serum, which is stored at 4 degrees C. GGT activity is determined by a modification of a method of Szasz (1969). Enzyme reactions are carried out at 37 degrees C and pH 8.3+-0.1. The rate of formation of the end product, p-nitroanilide, is measured by a decrease in absorbance at 415nm, using an automatic recording Abbott Bichromatic ABA-100 Instrument, a reaction rate analyzer. L-gamma-glutamyl-p-nitroanilide (4.7 mM) is utilized as the substrate and glycylglycine (60.6 mM) as the acceptor.

Due to the time frame under which the samples were selected, participants had from 1 to 5 scores available for this study.
RESULTS

GGT scores ranged from 2 to 581, with 90% being below 40 u/l (see Figure 1). Using the reference values of 30 u/l for women and 40 u/l for men, (Weill, 1989) 11% of women and 10% of men exhibited elevated GGT scores at the time of the first sample.

A significant relationship between age groups and GGT elevation was found ($x^2=32.4$, $p<.001$), with younger offenders less likely to have elevated GGTs.

For the 432 cases in which at least 3 GGT scores were available, a 3 (GGT score) x 2 (gender) x 6 (age group) MANOVA was conducted to test the hypothesis that GGT scores would decrease with time in the program. Results yielded only a main effect for GGT score, ($F=8.51$, $p<.005$). Figure 2 shows the mean scores for each of the three tests. However, the mean scores decreased from the first to second sample, but in fact increased from the second to third.

Of those males with elevated GGT scores at the first sample, 57% had "normal" GGT activity at the second sample. For females with high GGT at the first sample, 67% fell into the "normal" range at the second sample.

DISCUSSION

At OHS Multiple DUI Offender Program, GGT testing is used as one option to monitor abstinence, a program requirement. The assumption made is that, relative to the baseline GGT score taken in the first month of the program, subsequent scores should decrease. It appears that this is so between the first and second sample but that GGT activity increased slightly by the third sample.

Although this increase was a somewhat unexpected finding, there are possible explanations. A small percentage of program participants may have elevated GGT levels due to underlying diseases (such as liver disease). The most likely explanation, however, is that program participants learn over time that program termination for elevated GGT scores alone is unlikely. Also, there are a number of factors, including liver disease and medications, that affect GGT scores.

The use of GGT testing as a screening measure for alcoholism and problem drinking is common outside of the US. (Dunbar, et al. 1982, 1983, 1985; Rollason, 1972). Its use as a monitor of abstinence is less common and it is unknown how effective it is.

This study was a preliminary review of scores in a larger study designed to evaluate GGT testing. The findings support those of Dunbar and associates and
support the belief that measures of GGT activity alone does not seem to affect program compliance. GGT scores, used by themselves, do not appear to be an effective monitor of abstinence for convicted multiple DUI offenders.

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LITERATURE CITED


Figure 1: Distribution of GGT Scores
Figure 2: Mean GGT Scores