Drug and Alcohol Dependence 106 (2010) 186–192

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Predicting DUI recidivism of male drunken driving: A prospective study of the impact of alcohol markers and previous drunken driving

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ARTICLE INFO

Article history:
Received 26 January 2009
Received in revised form 5 June 2009
Accepted 24 August 2009
Available online 12 October 2009

Keywords:
Driving under the influence
Risk factors
Biomarkers
Alcoholism
CDT
GGT

ABSTRACT

The aim of the present study was to determine whether the alcohol biomarkers CDT, GGT, the biomarker γ-CDT index and previous drunken driving contributed significantly to the prediction of DUI recidivism. The subjects consisted of two different samples of drivers, viz. drivers who were found to have a positive breath alcohol concentration during random breath testing surveys ($n = 237$), and drunken drivers who were apprehended during ordinary police work ($n = 193$). The drunken driving events were monitored using a data-base both retrospectively and prospectively.

It was found that the biomarker index, γ-CDT, emerged as a notable predictor of recidivism in the group of random breath tested drivers. Measurement of γ-CDT and its impact on DUI recidivism has not to our knowledge been applied to random breath tested drivers before. The apprehended drunken drivers, on the other hand, did not show a significant relationship between γ-CDT and DUI recidivism. However, in both groups of drivers it was found that a previous conviction for drunken driving strongly predicted DUI recidivism. More attention should be paid by both physicians and the police to the high risk of recidivism among those convicted of drunken driving.

1. Introduction

Reliable predictive factors of the likelihood of recidivism of driving under the influence of alcohol (DUI) are valuable in preventive traffic safety work, and measurable assessment instruments are useful in developing countermeasures for DUI offenders. Awareness of a noteworthy risk factor at an early stage may prevent DUI recidivism.

There are several ways to define DUI recidivism, the most common being a relapse based on statutory legal limits. A broader definition refers to zero tolerance, i.e. driving while under the influence of any amount of alcohol and/or drugs (Nochajski and Stasiewicz, see review 2006). The DUI recidivism rate is the ratio of convicted repeat offenders to first time offenders over a period of time, the length of which has varied significantly across studies.

Numerous studies have shown a rate of DUI recidivism of roughly one-third among drunken drivers (Gjerde et al., 1988a; Gjerde and Mørland, 1990; Yu and Williford, 1995; Pikkarainen et al., 1985, 1995; Pikkarainen and Penttilä, 1992; Skurveit et al., 1998; C'de Baca et al., 2001; Streff et al., see review 2001; Voas and Fisher, 2001; Christophersen et al., 1996, 2002; Nochajski and Stasiewicz, see review 2006), when the follow-up period has been between 2 and 30 years. The drunken drivers in most studies have not been drivers from the traffic flow, but drivers apprehended during ordinary police work.

Random breath testing (RBT) gives without doubt the most reliable information on the rate of drunken driving in the traffic flow. In countries where RBT is a legally accepted method, a police officer is authorized to ask for a breath test even without any suspicion of drinking. A feature of the method is that RBT surveys cover all types of drivers on a non-selective basis within the survey period. They can be designed to measure and follow up the true rate of alcohol use in the traffic flow and to investigate drivers further.

Biomarkers provide objective information about drinking habits. Measurements of both carbohydrate-deficient transferrin (CDT) and gammaglutamyl-transferase (GGT) have been used in several studies of apprehended drunken drivers (Gjerde, 1988; Gjerde et al., 1988b; Ruud and Gjerde, 1992; Iffland et al., 1994; Iffland and Grassnack, 1995; Iffland, 1996; Morgan and Major, 1996; Kristensson and Jeppsson, 1998; Gilg et al., 2000; Bjerre, 1997; Bjerre et al., 2001; Brinkmann et al., 2002; Marques et al., 2007). A mathematical combination of CDT and GGT, named γ-CDT, was first applied by Sillanaukee et al. (2000b) and Sillanaukee and Olsson (2001). The purpose of those studies was to discover by discriminate analysis the variables among the traditional alcohol

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doi:10.1016/j.drugalcdep.2009.08.018

biomarkers, CDT, GGT, ASAT, ALAT and MCV, that best differentiated between high alcohol consumption and controls. The mathematical combination 1.35 ln CDT + 0.8 ln GGT clearly outperformed both CDT and GGT. The other biomarkers added only a small explained variation. Thus, only CDT and GGT were included in the present study, and the use of only two biomarkers is also cost effective. To our knowledge, a mathematical combination (γ-CDT = 1.35 × ln CDT + 0.8 × ln GGT) has not been applied to drunken drivers at all. Neither do there appear to be any studies of these biomarkers and DUI recidivism.

The aim of this study was to determine whether CDT, GGT, the γ-CDT mathematical combination and previous drunken driving contributed significantly to the prediction of DUI recidivism in a sample of drivers who were found to have a positive breath alcohol concentration during RBT surveys, and in another sample of drunken drivers who were apprehended during ordinary police work.

We also evaluated the suitability of biomarkers and the CAGE questionnaire as predictors of drunken driving in terms of blood alcohol levels, and the applicability of blood alcohol levels for predicting values of alcohol biomarkers.

2. Subjects and methods

2.1. Subjects and study design

2.1.1. Random breath tested drivers (RBT drivers). Road-side surveys carried out since 1979 in southern Finland have monitored the traffic flow to determine the rate of drivers with detectable amounts of alcohol in the blood. The legal limit for drunken driving in Finland is 0.50‰, mass/mass (0.053%, mass/volume, 1.055 kg/l used as the specific weight of whole blood). The limit for aggravated drunken driving is 1.20‰ (0.127%, m/v). Police in Finland are allowed to ask drivers for a breath test even with no suspicion of drunken driving. The police have used the same protocol for every survey and they have taken place at comparable places and times. Every year about 30 000 drivers have been breath-tested for alcohol, and the rates of drivers who have drunk alcohol have remained similar over the period (Pikkarainen and Penttilä, 1992, 1995). During recent years the rate of drunken drivers (BAC ≥ 0.053% or 0.50‰) has been about 0.2% and the rate of drivers with a lesser amount of alcohol in the blood (BAC < 0.053% or 0.50‰) about 0.7–1.1% (Penttilä et al., 2000, 2002, 2004).

The roadside survey team consists of a chief inspector, 8–14 police officers, one physician and a few assistants. The surveys take place on three Tuesdays and three Saturdays during both spring and autumn. On Tuesdays the survey sessions occur at 7–11 a.m., 4–6 p.m. and 9 p.m.–1 a.m., and on Saturdays at 8 a.m.–1 p.m. and at 9 p.m.–1 a.m. Every session consists of 4–5 road-blocks, and testing lasts 30–40 min each. These chosen days and times reflect average weekday and weekend traffic. The time of day of the survey is representative of commuter traffic, traffic related to weekend shopping and other customary weekend activities, driving during the evening, and/or late night traffic. Spring and autumn were selected because the traffic conditions during these periods reflect the most common climatic conditions in Finland during the year. The driver of every motor vehicle in turn is breath-tested by using either the Alcometer PST-M1R (Lion laboratories Ltd., Cardiff, U.K.) or the Alcosensor IIIR (Intoximeters Inc., Saint Louis, Missouuri, U.S.) device. If the reading is above 0.053% (0.50‰) the highest-ranking police officer present is authorized by law to temporarily suspend the driver's license on the spot and to instruct an authorized physician to take a blood sample from the driver in question. Drunken drivers are voluntary interviewed for demographic characteristics and the driving event. The volume of traffic and type of vehicle are recorded. If the reading of the device is below 0.053% (0.50‰) and the driver in question gives his informed consent for scientific use of the registered data, blood samples are also taken. Drivers found to have a positive breath alcohol concentration during random breath testing are referred to as RBT drivers.

During 1996 and 1997, 60 560 drivers were breath-tested randomly in the traffic flow and the breath screening device gave a positive reading for alcohol in 346 male drivers. Venous blood samples for forensic alcohol analysis were taken by a physician with the aid of Venoject tubes containing sodium fluoride (100 mg/10 ml) and potassium oxalate (22.5 mg/10 ml). Two tubes were filled in rapid succession. Additionally, a third tube containing EDTA as anticoagulant was taken to receive serum for GGT and CDT determination. Altogether 69% (237) of male drivers gave their informed consent for the scientific use of the blood alcohol, GGT and CDT results. The CAGE questionnaire was completed by 225 of these 237 drivers (95%). The mean age of a representative sample of those who refused to take part in the study (61/109) was 41.6 years.

The mean age of the 237 male drivers was 39.6 years (range 20–70 years). Forty-two percent were married or co-habiting, and 15% divorced. Sixty-four percent had a regular job and 6% were unemployed. The most common used vehicle was a car (82%), and over 50% were driving their own vehicle. Annual driving distance was in the range of 20.000–50.000 km for 54% of the subjects. Female drivers (n = 38) with a positive breath sample reading for alcohol were not included due to their small number.

The DUI recidivism of drunken driving was investigated in subjects (132/237) whose BAC was found to be ≥0.053% (0.50‰).

2.1.2. Apprehended drunken drivers. In the greater Helsinki area during two weeks in spring (May) and autumn (September) of 1996 and 1997, 342 male drivers were apprehended during ordinary police work on suspicion of drunken driving. Blood samples for alcohol determination and serum samples for GGT and CDT determination were taken by a physician at the forensic medical station of the Department of Forensic Medicine, University of Helsinki. Altogether, 56% (193/342) of male drivers gave their informed consent for the scientific use of the blood alcohol, GGT and CDT results. The CAGE questionnaire was completed by 186 of these 193 drivers (96%). Female drunken drivers were not included. The mean age of the 193 drivers was 37.2 years (range 16–77 years).

The reasons for the police intervention leading to drivers being caught were: road block (n = 41, 21.2%), driving behavior (n = 35, 18.1%), denunciation (n = 29, 15.0%), traffic accident (n = 20, 10.4%), exceeding speed limit (n = 9, 4.7%), wrong use of vehicle lights (n = 9, 4.7%), other traffic infringements (n = 8, 4.1%), traffic and crime (n = 5, 2.5%), other reasons (n = 34, 17.6%), information missing (n = 3, 1.5%).

The DUI recidivism of drunken driving was investigated in those subjects (173/193) whose BAC was found to be ≥0.053% (0.50‰).

3. Methods

3.1. The screening device

The devices used by the police for the alcohol field screening test were the Alcometer PST-M1R (Lion laboratories Ltd., Cardiff, U.K.) and the Alcosensor IIIR (Intoximeters Inc., Saint Loius, Missouri, U.S.).

3.2. Chemical analyses

Blood alcohol determinations were made in triplicate at the National Public Health Institute, using a headspace-gas-chromatograph method. A safety allowance in reports of blood alcohol concentrations in drunken driving cases has been used in Finland across the years to guarantee that the reported BAC will not exceed the true BAC. The deduction was calculated from a large material of authentic blood samples (n = 1660) and the probability level was set by the Police Department at the Ministry of the Interior. A deduction of approximately 10% is made from the mean BAC to compensate for random and systematic errors inherent in the method (unpublished data). A similar safety allowance is applied in Sweden (Jones and Schubert, 1989) and in Norway.

The final results were expressed as g ethanol/kg blood, and these figures were used in the present analyses. Serum GGT was determined using established clinical methods, and the cut-off value of 80 U/l was applied. Serum CDT was determined using a commercially available kit according to the manufacturer's instructions (CDTect, Pharmacia & Upjohn Diagnostics, USA), and the cut-off value used was 20 U/l. The cut-off value of 6.5 was used for the mathematical combination γ-CDT = 1.35 × ln CDT + 0.8 × ln GGT (Sillanaukee et al., 2000b; Sillanaukee and Olsson, 2001). The serum samples were stored at −20 °C until analyzed.

3.3. CAGE questionnaire

The CAGE is a simple psychological questionnaire that has been a popular screening tool for nearly 30 years. Each affirmative response scores one point. A cut-off of two or more points has been used to indicate a positive test. The cut-off value for the CAGE questionnaire was ≥2 affirmative answers (Aertgeerts et al., 2004, see review).

3.4. DUI recidivism of drunken driving

A data-base with information on the epidemiological and analytical data relating to each drunken driving event in Finland was constructed in 1990. The data-base covers both RBT drivers and apprehended drunken drivers and makes it possible to discover any additional drunken driving events for these two groups of drunken drivers. Among other information, the data-base contains each person's name and personal identification number, the date and time of the driving event, the type of vehicle used, the reason for being apprehended, the blood alcohol concentration, and the time of sampling.

The groups were followed retrospectively from 1990 to 1996/1997 and prospectively from 1996/1997 to 2006.

3.5. Statistical methods

The relationship between the blood alcohol level and GGT and CDT levels were modelled using linear and logistic regression. Categorical blood alcohol concentration (<0.053% (0.50‰); ≥0.053% (0.50‰)) was used as a response variable in the logistic regression model and CDT score, GGT score and CAGE score were used as