



## The arrest of drivers under the influence as a predictor of subsequent social disadvantage and death



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### ABSTRACT

**Background:** The association between DUI (driving under the influence) and disadvantaged social background has been shown in cross-sectional studies, but less is known about the processes behind this phenomenon. We aimed to examine the effect of DUI arrest on subsequent social disadvantage in Finland during 1993–2006 to provide more understanding about the dynamics of DUI and marginalization and to study DUI arrest as a potential point of intervention.

**Methods:** In this longitudinal, register-based study the Register of DUI suspects ( $n = 68\,894$ ) was linked with the Employment Register. An age- and gender-matched reference population ( $n = 67\,740$ ) was drawn from the general Finnish population. A multi-state model was used to estimate the transition intensities between three different states (advantaged social status/disadvantaged social status/death) among three different DUI groups (alcohol only, prescription drugs, illicit drugs).

**Results:** Compared to references, the movement of DUI suspects between different social states was more dynamic in that they were more likely to either move to a disadvantaged social state or to an improved status (except DUI suspects using prescription drugs). A DUI's relative risk of death compared to references was high, especially if currently in advantaged social status. The effect of DUI did not diminish over time.

**Conclusions:** Driving under the influence is associated with an increased long-term risk for social disadvantage. DUI arrest could serve as an opportunity for intervention in the marginalization process.

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### 1. Introduction

Driving under the influence of alcohol or drugs (DUI) is commonly considered a problem of traffic safety, since alcohol and other drugs have an impairing effect on driver performance (Ogden and Moskowitz, 2004), thus increasing the risk of traffic accidents (Movig et al., 2004). DUI can also be seen as an indicator of personal substance use problems, associated with, e.g. mental health disorders (Karjalainen et al., 2013; Lapham et al., 2006) and increased mortality (Impinen et al., 2010; Karjalainen et al., 2010; Skurtveit et al., 2002).

In addition, drunken/drugged driving is linked with disadvantaged social position, the indicators of which are, for instance, low educational level, unemployment, divorce, or alcohol/drug abuse (Shaaban, 2011). The association between DUI and disadvan-

taged social background has been shown in cross-sectional studies (Impinen et al., 2011; Karjalainen et al., 2011; Vaez and Laflamme, 2005; Walsh and Mann, 1999), but less is known about causal relationships, since the longitudinal studies that exist are few (Karlsson and Romelsjö, 1997; Sauvola et al., 2001).

Previous research has shown that poorer social status may already precede DUI (Karlsson and Romelsjö, 1997; Sauvola et al., 2001), but what happens to DUI suspects' social status after the arrest? Is a DUI arrest a step in a process leading to a worsening social disadvantage? And how does the process proceed? These are questions that remain to be answered. This kind of knowledge would be important from the perspective of prevention. If DUI arrest is a good predictor of a worsening social disadvantage, it might be utilized as an intervention point.

In order to find out how these different indicators of social disadvantage are intertwined with DUI, longitudinal studies are needed. A long tradition of maintaining registers (Gissler and Haukka, 2004), some of which gather data on indicators of DUI and others about social disadvantage, provide a good opportunity to conduct follow-up research in Finland.

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The purpose of our study was to provide increased understanding about the dynamics of DUI and social disadvantage. This longitudinal study was based on extensive register-based material constructed by linking the registers of DUI suspects with other registers in Finland. The aim was, firstly, to examine what happens to a person's social status (defined by main activity and family relations) after the first DUI arrest, and secondly, to study what kind of effect different intoxicants used (alcohol/prescription drugs/illicit drugs) has on this process. Thirdly, we aimed to examine whether the effect of DUI arrest on social status changes over time.

## 2. Methods

According to Finnish legislation on drunken driving (Ministry of Justice Finland, 2003) the punishable thresholds of blood alcohol concentration (BAC) are 0.5‰ (g/kg) for drunken driving and 1.2‰ for aggravated drunken driving. A zero tolerance law for illicit drugs and driving was introduced in Finland in 2003 (Ministry of Justice Finland, 2003). Impaired driving, traffic accidents, information from a bystander and random stop checks are the main means of detecting DUI suspects, and the Finnish police are authorized by law to submit drivers for a preliminary breath alcohol screening test or oral fluid on-site drug test. Then, at the request of the police, precision breath testing or blood/urine samples may be taken (Lillsunde and Gunnar, 2005). During 1977–2008, all alcohol/drug analyses of DUI suspects were carried out centrally at the National Institute for Health and Welfare (THL) of Finland, and registered in a database.

### 2.1. Data

The study population was drawn from the register of DUI suspects, which includes all persons apprehended and suspected of DUI by the police. For the purposes of a larger study project concerning DUI, a 50% random sample of DUI offenders was drawn from the register of DUI suspects. An age- and gender-matched control subject (reference population) for each DUI suspect was drawn from the general Finnish population not suspected of DUI, as identified from the Population Information System. In this study, the data consisted of DUI suspects arrested for the first time during 1993–2005 ( $n = 68\,894$ ) and their reference population ( $n = 67\,740$ ). Due to some incomplete identification numbers of DUI suspects, the reference population was slightly smaller than the group of DUI suspects.

The information concerning social status (defined by main activity and family relations) was obtained from the Employment Register, maintained by Statistics Finland (Statistics Finland, 2010). The Employment Register is an annual individual-level register of economic activity and the employment status of permanent residents in Finland. The register was linked individually to the study population by using the personal identification number.

### 2.2. Measurement

DUI suspects were divided into three categories by substances found from their blood/urine samples during their first arrest. The groups consisted of drivers suspected of DUI of (1) alcohol only (DUIA,  $n = 66\,143$ , no other substance findings); (2) prescription drugs impairing driving skills (DUIP,  $n = 1264$ , at least a finding for prescription drugs, also may have been a finding for alcohol ( $n = 573$ ), no other substance findings); and (3) illicit drugs (DUID,  $n = 1487$ , may have had findings for alcohol and/or prescription drugs, too). Mean BAC was 1.4‰ among DUIA suspects and 1.1‰ among DUIP suspects with a concurrent alcohol finding. Most (90%) of the DUIP suspects had a finding for benzodiazepines, 10% for prescription opioids and 35% for other prescription drugs. 63% of DUID suspects had a finding for at least amphetamines and 60% for at least cannabinoids. In addition to illicit drugs, 64% of DUID suspects had a finding for benzodiazepines and 22% for alcohol. DUIP suspects with ( $n = 573$ ) and without ( $n = 691$ ) alcohol were first analyzed as two different groups, but in the final analyses all DUIP suspects were included in the same category since there were no substantial differences in the results between these two subgroups.

The study subjects' social status, a variable describing one's risk of social disadvantage, was based on a person's main activity, marital status and family type, the latter two of which were merged into one variable named family relations. Main activity had nine categories, and it was scored as per an annual basis as follows:

- <sup>1</sup>long-term unemployed (12 months/year), <sup>2</sup>unemployment pensioner, or <sup>3</sup>disability pensioner = 2 points
- <sup>4</sup>short-term unemployed (less than 12 months/year) = 1 point
- <sup>5</sup>employed, <sup>6</sup>student, <sup>7</sup>conscrip, <sup>8</sup>retirement pensioner, or <sup>9</sup>“other”/unknown = 0 points

Family relations had four categories, and was scored:

- <sup>1</sup>divorced and living alone, or <sup>2</sup>divorced single parent = 2 points
- <sup>3</sup>other than divorced, living alone = 1 point

- <sup>4</sup>whatever the marital status (single, married, widowed, divorced), living with someone = 0 points

For the purposes of this study, a combined variable describing one's social status was developed by adding up the scores of these two variables (main activity and family relations), and so the annual maximum score was 4 points and minimum 0 points: the higher the score, the poorer the social status. Based on these scores, the study subjects' social status was identified by three different states: no/low risk for social disadvantage (state 1, 0–2 points), moderate/high risk for social disadvantage (state 2, 3–4 points), and death (state 3).

Transitions between these different states among DUI suspects and reference population were the main interest. A transition was defined as a shift from one state to another, and the transitions among DUI suspects and reference population were followed-up annually from the year of DUI suspects' first arrest until death or until the end of 2006.

Persons with missing social status were excluded from the analyses. Thus, the number of study subjects was: DUI suspects  $n = 68\,084$  (DUIA  $n = 65\,405$ , DUIP  $n = 1218$ , DUID  $n = 1461$ ) and the reference population  $n = 67\,739$ .

Gender and age at the first DUI arrest were taken into account as covariates.

### 2.3. Statistical analysis

A multi-state model, which describes how an individual moves between a series of states in continuous time (Jackson, 2011), was fitted to the data. A Markov multi-state model using three states detailed above was constructed. A four-state model (state 1 = no risk, state 2 = moderate risk, state 3 = high risk, state 4 = death) was also tested, but did not converge, suggesting it would be an over-complicated model, and thus the three-state model was preferred. As shown in Fig. 1, the model included four possible transitions from one state to another: individuals could move in both directions between states 1 and 2, and also die while in either state. State 3 was an absorbing state, meaning that in theoretical terms, transitions from that state are not possible. Transition intensity from a state  $i$  to state  $j$  was expressed as  $\lambda_{ij}$ , representing the risk of moving from one state to another.

In the statistical analysis, the observed number of annual transitions during the entire follow-up was first calculated, and the transition probabilities over three years between different states among all DUI suspects and references were estimated. Transition probabilities were computed with the covariates set to their average values over the sample and they are presented as percentages.

Second, the effects of DUIA, DUIP and DUID on a person's transition intensities from one state to another were estimated, and are presented as hazard ratios (HR) with 95% confidence intervals (CI). The predicting factor for transition was a four-class DUI variable (1 = reference, 2 = DUIA, 3 = DUIP, 4 = DUID), and the model was adjusted for age (continuous) and gender (1 = male, 2 = female). HRs for transitions were calculated by using the social status variable, but also separately for main activity and family relations. The interactions between DUI and gender were analyzed.

Third, in order to take into account the effect of time, i.e. to examine whether there is a short-term and/or long-term effect of DUI on transitions between different states, the data were split in two. One part covered the first three years of follow-up (DUI suspects  $n = 68\,084$ , references  $n = 67\,739$ ), so that it included all the study subjects and they were followed-up for up to three years. In the other part of the data, the first three years were excluded, and the study subjects who were followed-up at least for four years or over (DUI suspects  $n = 49\,840$ , references  $n = 48\,184$ ) were followed-up from the fourth year onwards.

Technical details of the multi-state method have been reported by Jackson (2011). The model was fitted using R 2.15.1 software with the msm package for R.

### 2.4. Research ethics

To ensure privacy, a 50% sample of the DUI suspects' database was drawn, and some information was coarsened. The study protocol was approved by the Institutional Review Board of THL. All data linkage was performed in Statistics Finland, with data made available to researchers in anonymized form. Since the data were anonymous, coarsened register data, and individuals were not contacted, informed consent was not required.

## 3. Results

Demographics of all DUI suspects and the reference population are presented in Table 1. Most of the study subjects were men, DUIP suspects being slightly older and DUID suspects younger than DUIA suspects. At baseline, the proportion of the more deprived state 2 was highest among DUIP suspects.

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