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Long-term chronic diseases and crash responsibility: A record linkage study

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ABSTRACT

Objective: To assess the population impact of chronic conditions on the risk of road traffic crashes.
Methods: Data from three French national databases were extracted and matched: the national health care insurance database, police reports and the national police database of injurious crashes. Exposure to chronic conditions were compared between responsible and nonresponsible drivers. Analysis was performed using the Lasso (least absolute shrinkage and selection operator) method.
Results: 69,630 drivers involved in an injurious crash in France between 2005 and 2008, were included. 6210 (8.9%) were suffering from at least one long-term disease. When adjusted for prescription of medicines, blood alcohol, demographic driver characteristics and crash characteristics, increased risk of being responsible for a crash was found in drivers registered in the French healthcare database with the following long-term diseases: epilepsy (odds ratio [OR] = 2.53 [1.53–4.20]), type 1 diabetes (OR = 1.47) [1.12–1.92], alcoholic liver disease (OR = 3.37 [1.40–8.13]), asthma (OR = 1.72 [1.13–2.60]) and specific personality disorders (OR = 1.35 [1.05–1.74]). No association was found for cardiovascular diseases or Alzheimer's disease.
Conclusion: The results update the list of medical conditions that may impair driving skills. However, results should be considered cautiously with regards to potential regulatory driving judgments that could have a negative impact on patients' social life.

1. Introduction

Driving has become a basic activity of daily living. Available data suggest that the impact of health is an important issue regarding driving abilities and road safety (Charlton et al., 2010; Dobbs, 2005; Marino et al., 2013). At first glance this question seems to boil down to the list of diseases and medications consistent or incompatible with driving. The problem though is much more complex because many factors come into play: mobility, loss of autonomy, perceptions of disabilities and behavioral adaptations to them, to mention only the most salient. Identification of drivers unfit to drive is a thorny issue (Fitten, 2003; O'Neill, 2012; Redelmeier et al., 2012), and pinpointing relevant medical factors in assessing fitness to drive is subject to the changing pattern of drivers' adaptations to their incapacities and to trends in the sociodemographic characteristics of the driving population.

Epidemiological studies have identified several chronic diseases as a potential risk for road traffic crashes, including epilepsy

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(Hansotia and Broste, 1991; Lings, 2001; Taylor et al., 1996), dementia (Crancer and Quiring, 1969; Dubinsky et al., 2000), diabetes mellitus (Koepsell et al., 1994; McGwin et al., 1999, 2000), cardiovascular disorders (Koepsell et al., 1994; McGwin et al., 2000; Hours et al., 2008; Lyman et al., 2001; Sagberg, 2006; Sims et al., 2000) and psychiatric diseases (Crancer and Quiring, 1969; Barkley et al., 2002; Cox et al., 2000; Tsuang et al., 1985). The main limitation in several of these studies is reliance on data collected using self-administered questionnaires or phone interviews (Taylor et al., 1996; McGwin et al., 1999, 2000; Hours et al., 2008; Lyman et al., 2001; Sagberg, 2006; Sims et al., 2000). The fear of having their driving license suspended may lead drivers deliberately to hide their health problems. Self-reported data may also lead to misclassification or less precise classification of diseases when compared with disease codes available in medical files. Moreover, some medical conditions are rare so the studies lacked power to detect associations (Koepsell et al., 1994; Sims et al., 2000).

In France, chronic diseases are registered in the healthcare insurance database. We took advantage of a nationwide record linkage study to investigate the risk of being responsible for a road traffic crash associated with the presence of a long-term disease.

2. Methods

2.1. Design overview

Data were extracted from three French nationwide databases, as described previously (Orriols et al., 2010). A case-control analysis comparing responsible *versus* nonresponsible drivers was conducted. This study was approved by the French Data Protection Authority.

2.2. Settings and participants

2.2.1. Police reports (PRs)

French police forces are required to fill out a PR for each injurious crash occurring in the country (about 70,000 reports each year). PRs are scanned and stored as image files. For some of the drivers involved in these injurious road traffic crashes, the national health care ID number (NID) is recorded in the police report. These NIDs were extracted from PR image files for later matching against dispensing records in the national health care insurance (HCI) database. All 210,818 PRs available over the study period (from July 2005 to May 2008) were compiled.

2.2.2. National police database of injurious crashes (IC database)

This database contains descriptive variables on crash characteristics, vehicles and people involved in the crash. Police forces also conduct investigations regarding injury severity from hospital records and categorize the people involved into four groups: unhurt, slightly injured, seriously injured (hospitalized more than 24 h) or killed (died in the 30 days following the crash). All drivers involved in an injurious road traffic crash are supposed to be submitted to a breath alcohol test. If this test is positive (≥0.5 g/L), if the driver refuses to take the test or if the severity of the crash makes the test impossible, then the blood alcohol concentration is measured. If the breath test is negative, then the driver is registered as not being under the influence of alcohol.

2.2.3. HCI database

The HCI database covers the entire French population (64,000,000 in 2008) and includes patient's NID, data on long-term diseases and data on reimbursed prescription medicines.

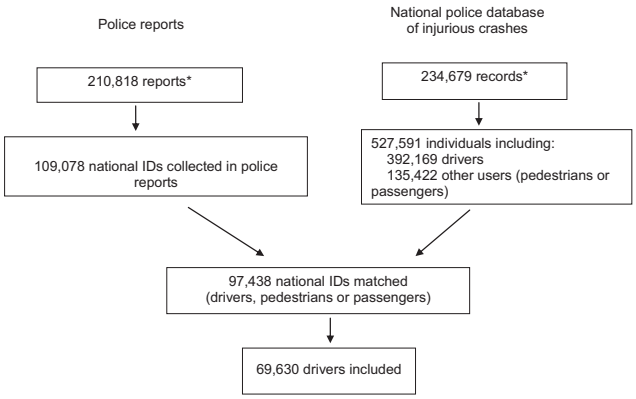

Fig. 1. Flowchart of the inclusion procedure. * The discrepancy between the number of police reports (PRs) and the number of records in the national police database of injurious crashes (IC database) is explained by the fact that a few reports were being used for ongoing legal investigations and so were unavailable.

2.2.4. Data extraction

The NIDs of drivers, aged 18 or more, involved in injurious crashes were extracted from the PR files. PRs were matched with data from the IC database to provide details of the crash context (Fig. 1). NIDs extracted from PRs were matched to the HCI database to collect data on the drivers' diseases and exposure to medication. Subjects whose PR did not contain their NID were not included. Confidentiality was ensured by using the personal information anonymization function of the national health care insurance system (Trouessin and Allaert, 1997).

2.2.5. Cases and controls

Cases were defined as drivers who were deemed responsible for the crash, while controls were drivers who were not responsible. Responsibility levels in the crash were determined by a standardized method adapted from Robertson and Drummer (Robertson and Drummer, 1994). This method, previously used in France (Galera et al., 2012; Laumon et al., 2005), takes into consideration six factors likely to reduce driver responsibility for the crash: road environment, vehicle-related factors, traffic conditions, type of accident, traffic rule obedience and difficulty of the driving task. In each area, a score is assigned from one (favorable to driving) to four (not favorable to driving). The six scores are subsequently summated into a summary crash responsibility score. Cases (responsible drivers) are defined as those with a score of less than 15.

2.3. Outcomes and follow-up

2.3.1. Long-term diseases

In France, patients are fully reimbursed for health care expenses related to recognized long-term diseases (Table 1). Only long-term diseases that imply a chronic treatment are registered in the database. The general practitioner has to fill out a form detailing the treatment protocol. This form will be considered by the health care insurance authorities which consent or not to register the patient as having one of the recognized long-term diseases for which treatment is fully reimbursed (Tables 2 and 3).

In the analysis, diseases were classified according to the International Classification of Diseases 10th edition (ICD-10) code which is available in the HCI database (299 ICD-10 codes).

The start and end dates of the disease were used to determine whether or not the patient was suffering from the disease on the day of the crash. If several chronic diseases are present, then they are all registered in the database. If the diagnosis occurred after the date of the crash, then the subject was classified as not suffering from a long-term disease.