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Risk factors for injury accidents among moped and motorcycle riders

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ABSTRACT

Objective: To study and quantify the effect of factors related to the riders of powered two-wheelers on the risk of injury accident involvement.
Methodology: Based on national data held by the police from 1996 to 2005, we conducted a case–control study with responsibility for the accident as the event of interest. We estimated the odds ratios for accident responsibility. Making the hypothesis that the non-responsible riders in the study are representative of all the riders on the road, we thus identified risk factors for being responsible for injury accidents. The studied factors are age, gender, helmet wearing, alcohol consumption, validity of the subject's driving licence and for how long it has been held, the trip purpose and the presence of a passenger on the vehicle. Moped and motorcycle riders are analyzed separately, adjusting for the main characteristics of the accident.
Results: For both moped and motorcycle riders, being male, not wearing a helmet, exceeding the legal limit for alcohol and travelling for leisure purposes increased the risk of accident involvement. The youngest and oldest users had a greater risk of accident involvement. The largest risk factor was alcohol, and we identified a dose–effect relationship between alcohol consumption and accident risk, with an estimated odds ratio of over 10 for motorcycle and moped riders with a BAC of 2 g/l or over. Among motorcycle users, riders without a licence had twice the risk of being involved in an accident than those holding a valid licence. However, the number of years the rider had held a licence reduced the risk of accident involvement. One difference between moped and motorcycle riders involved the presence of a passenger on the vehicle: while carrying a passenger increased the risk of being responsible for the accident among moped riders, it protected against this risk among motorcycle riders.
Conclusion: This analysis of responsibility has identified the major factors contributing to excess risk of injury accidents, some of which could be targeted by prevention programmes.

1. Introduction

In France, as in other industrialized countries, although the users of powered two-wheelers (PTW) represent less than 2% of the vehicles on the road, they account for a very high proportion of the individuals who are injured and killed on the roads (NHTSA, 2006; ONISR, 2007; SafetyNet, 2008). In 2006, in Europe, this group represented 22% of the total number of road traffic accident fatalities (SafetyNet, 2008). Thus, considering the vehicles that were on the road in 2005, the fatality risk for PTW riders was greater by a factor of 7 for motorcycle riders and a factor of 3 for moped riders, compared to car riders (ONISR, 2007). A specific feature of PTW riders, in addition to their vulnerability, is the high risk of accident involvement, which is several times higher than for motorists (Horswill and Helman, 2003; Langley et al., 2000). This risk may be influenced by several individual and environmental factors that apply to PTW users (Lardelli-Claret et al., 2005).

In epidemiology, the type of study design which is the most used in order to investigate the above factors and estimate accident risks is the case–control study, in which the cases consist of accident-involved PTW riders and the controls consist of a group of non accident-involved PTW riders, selected at random from all the PTWs on the roads, for example at the same times and locations the accidents occurred (Evans, 2004). In the case of a rare event, the estimated odds ratios for each factor provide good estimations of the relative risks of accident involvement. As studies of this type are difficult to perform, researchers have developed techniques that make it possible to estimate accident risks from data that refer exclusively to accident-involved subjects. Such data, which are frequently available, contain information on the accident factors which may allow us to evaluate the primary safety issues (Chandraratna and Stamatiadis, 2009). These methods use a group of accident-involved riders as an exposure metric, making the hypothesis that the controls are representative of both riders

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on the road and accident-involved riders by simple virtue of their presence on the road.

The aim of this study is to quantify the effect of different factors that are related to PTW riders on accident risk by using a case–control study with accident responsibility as the event.

2. Material and methods

This analysis is based on the exploitation of national data from the French police from 1996 to 2005, i.e. injury accident reports or Bulletins d'Analyse des Accidents corporels de la Circulation (BAAC) (ONISR, 2007). The BAACs are the computerized version of the accident reports which the police have the obligation to draw up for all personal injury road traffic accidents occurring in France. Each accident report provides a precise description of the circumstances of the accident and the characteristics of the vehicles and of the users involved.

We have conducted a case–control study and investigated the risk factors for being responsible for an accident among PTW riders. We have made the hypothesis that our controls, non-responsible riders, are a representative sample of all riders on the road. Thus, the prevalences of the different risk factors in this control group provide a picture of the exposure of the population on the road to these factors. With this hypothesis, our analysis amounts to comparing the riders on the road to the riders who are responsible for an accident. The studied event is rare and the estimated odds ratios for each factor provide good estimations of the relative risks of accident involvement. The methodology used here has been presented in the contract report for the SAM survey Psychotropic drugs and fatal accidents (Stupéfiants et Accidents Mortels (Laumon et al., 2009)).

2.1. Determining responsibility

We determined accident responsibility for each rider by using the method developed by Robertson and Drummer (1994) which has been adapted to suit the data available in the BAAC. This systematic determination method calculates a responsibility score based on information that is used by the police in their procedures.

To begin with, each crash-involved rider is considered to be responsible. Several classes of factors that can attenuate this responsibility are considered: the state of the road, that of the vehicle, traffic conditions, the type of accident, compliance with the Highway Code and the complexity of the driving task. Two factors are of prime importance when determining responsibility: whether a rider has committed one or more Highway Code violations, and whether, in the case of accidents involving two or more vehicles, the police considered the rider to be responsible. Factors that relate to the rider such as age, gender and alcohol consumption are not considered when calculating responsibility.

This procedure for determining responsibility assigns a final score to each rider who is then classified as responsible, partly responsible or not responsible. We have decided to group partly responsible riders together with fully responsible riders. We consider that riders having some responsibility in the accident occurrence are the cases, while riders without any responsibility can be considered as good controls, i.e. riders who were involved in the accident as a result of bad luck, and as such representative of riders on the road.

2.2. Validation of ascribed responsibility

A group of experts in accident studies evaluated the responsibility of the riders in 3024 fatal accidents involving two or more vehicles based on the accident reports (Laumon et al., 2005, 2009). The agreement between this expert ascribed responsibility and the responsibility determined by the Robertson and Drummer algorithm was evaluated and found to be adequate (Kappa test = 0.67 95% CI (0.65–0.70)).

2.3. Analysis strategy

For this study, we selected all the PTW riders present in the BAAC files who were involved in an injury accident between 1996 and 2005, irrespective of accident severity. We calculated the responsibility of the riders for the accidents, the riders who were classified as responsible or partly responsible forming the cases and the non-responsible riders the control group.

We compared the distribution of the different characteristics of the PTW riders according to their accident responsibility. The factors that were taken into account were age, gender, helmet wearing, alcohol consumption, whether the individual held a driving licence and if so for how long he/she had done so, the trip purpose and whether the vehicle was carrying a passenger. We estimated the non-adjusted and adjusted relative risks of being responsible for the accident. We used logistic regression models to do this. We estimated the raw and adjusted odds ratios for each factor of interest and calculated the corresponding 95% confidence intervals. The adjustment factors related to the accident and its circumstances: the day (weekday or weekend), time of day (22–7 h or 7–22 h), month and year of the accident, location of the accident (Non-built-up area, Built-up area), the type of road (PTW on its own, PTW with pedestrian, PTW with other vehicle and no pedestrian) and the type of accident (Motorway, Trunk road, County road, Street, Other).

The factors were included in the multivariate analysis irrespective of whether or not they achieved significance.

We conducted separate analyses for moped and motorcycle riders, thereby anticipating potential differences between the two modes: the age at which it is possible to ride a vehicle, the type of training required to drive it, different use of the vehicle. As several PTW riders may be involved in the same accident, the number of PTW riders studied exceeded the number of accidents.

We used different age classes for moped and motorcycle riders in order to give more importance to 14–15 year-old moped riders. The large number of riders and the long period covered by our study allows us to consider age in a precise manner using 13 age classes and enables us to study the relationship between age and accident responsibility in a precise manner. The variables validity of motorcycle driving licence and length of time the licence has been held are only valid for motorcyclists as no licence exists for mopeds.

3. Results

The analysis covered 362,547 PTW riders involved in 352,177 accidents during the study period. For both moped and motorcycle riders, three-quarters of the accidents took place on a weekday and 9 out of 10 during the daytime (Table 1). The main differences between moped and motorcycle riders related to the accident location in terms of the type of road and whether it occurred inside or outside a built-up area. One in four motorcycle accidents took place outside a built-up area, and moped accidents tended to occur more in built-up areas. The proportions of accidents occurring on trunk roads and motorways were very different for moped and motorcycle riders.

The proportion of females was higher among moped riders than among motorcycle riders (Table 2). The sex ratio was 5.5 among moped riders and 17.7 among motorcycle riders. With regard to helmet wearing, the proportion of unhelmeted riders was higher among the moped riders than the motorcycle riders: in the cases where this factor was known, 95.3% of moped riders were helmeted compared with 98.8% of motorcyclists.