The effect of traffic tickets on road traffic crashes

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ABSTRACT

Road traffic crashes are globally a leading cause of death. The current study tests the effect of traffic tickets issued to drivers on subsequent crashes, using a unique dataset that overcomes some shortcomings of previous studies. The study takes advantage of a national longitudinal dataset at the individual level that merges Israeli census data with data on traffic tickets issued by the police and official data on involvement in road traffic crashes over seven years. The results show that the estimated probability of involvement in a subsequent fatal or severe crash was more than eleven times higher for drivers with six traffic tickets per year compared to those with one ticket per year, while controlling for various confounders. However, the majority of fatal and severe crashes involved the larger population of drivers who received up to one ticket on average per year. The current findings indicate that reducing traffic violations may contribute significantly to crash and injury reduction. In addition, mass random enforcement programs may be more effective in reducing fatal and severe crashes than targeting high-risk recidivist drivers.

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1. Introduction

Road traffic crashes exact a huge economic, social, and human toll. They are the eighth leading cause of death for all ages globally, with an average of more than 3000 mortalities per day (Lozano et al., 2012; World Health Organization, 2013). Hence, elucidating the underlying mechanisms behind traffic crashes in order to better prevent them is an important public health effort. Driving itself is by nature a dangerous activity, one that demands skill, attention, quick decision making, and on-the-go communication between drivers (Rothengatter, 1997; Wilmot and Khanal, 1999; Factor et al., 2011). Driver behavior is therefore an important aspect of road safety – and indeed, studies suggest that the vast majority of traffic crashes are caused by human factors (Shinar, 2007). Other studies conducted over the years have shown that various behaviors usually regarded as violations of traffic regulations – including driving under the influence of alcohol, speeding, failing to obey a red light or stop signal, and nonuse of restraint devices – are associated with an increased risk of road traffic crashes and of being injured when one occurs (Gebers and Peck, 2003; Elvik and Christensen, 2007; Goldenbeld et al., 2011; Factor et al., 2012).

These associations have often been studied via driver samples – using self-reports, observations, and comparison groups – and evaluation studies (Macdonald et al., 2004; de Winter and Dodou, 2010; Stanojević et al., 2013). However, most previous studies are marked by limitations that weaken their findings. These include the possibility of self-report bias; a limited number of observations; small sample sizes; limited geographical areas; limited time; or controlling for a limited number of confounders, if any (Parker et al., 1995; Blows et al., 2005; Ivers et al., 2009).

The current study aims to overcome these limitations by analyzing the relationship between the number of traffic tickets received by drivers and their subsequent road traffic crashes, using a unique large, longitudinal, individual-level dataset. The dataset merges Israeli census data with data on tickets issued by the police and official data on road traffic crashes over a period of seven years, and so enables robust testing for a correlation between tickets issued and crashes while controlling for various demographic and socioeconomic variables, as well as distance traveled. The findings of the current analysis may enhance our understanding of how risky driving affects road traffic crashes – knowledge crucial for the development of effective interventions and policies to reduce road injuries.

2. Traffic violations and crashes

Drivers seem to violate traffic regulations for different reasons. Even good drivers may succumb to poor planning, decision making, or concentration when they are hungry, tired, in a hurry, or ill-tempered. Other cases may involve sensation-seeking or risk-taking, deliberate social nonconformism, or even acts of social resistance (Jonah, 1997; Rothengatter, 1997; Shinar, 2007; Factor et al., 2013b).

Many studies suggest that traffic law violations, whatever their origin, are – at least at the aggregate level – among the key factors contributing to an increased risk of crashes (Parker et al., 1995;

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ETSC, 1999; Sullman et al., 2002; Gebers and Peck, 2003; Ayuso et al., 2010; Stanojević et al., 2013). For instance, Rajalin (1994) compared drivers who were involved in fatal crashes with a control group randomly selected from the Finnish drivers registry, and found a higher risk of involvement in crashes among drivers with previous traffic violations. In the Netherlands, Lourens et al. (1999) found that drivers who had received traffic tickets were significantly more involved in road traffic crashes than those without tickets at all distance traveled levels. Another Netherlands study found that vehicles whose drivers had committed more than one violation per year were involved in more road crashes than vehicles with only one violation per year (Goldenbeld et al., 2011). Blows et al. (2005) in a sample of drivers from the northern part of New Zealand, found an association between self-reported traffic violations and road crashes, with those reporting a higher frequency of traffic violations 2–4 times more likely to have been injured while driving. Ivers et al. (2009) in a non-representative Web-based cohort study of young drivers in Australia, calculated that self-reported risky driving behaviors were associated with a 50% increased risk of police-reported crashes, controlling for various factors. Finally, a study in British Columbia based on official data but without controlling for confounders suggests that there is a consistent increase in crashes with an increasing number of convictions (and crashes) (Chen et al., 1995).

Beyond the general association between traffic violations and road traffic crashes, researchers have identified a number of specific driving offenses that have significant associations with the prevalence and severity of crashes. These include speeding (Cooper, 1997; Ayuso et al., 2010; Elvik et al., 2012), driving under the influence of alcohol and drugs (Ferrante et al., 2001; Macdonald et al., 2004; Bjerre and Thorsson, 2008; Vingilis and Wilk, 2008), nonuse of seat belts and safety restraint systems (Robertson, 1996; ETSC, 1999; Sivak et al., 2007), and failing to stop at a red light or to yield the right of way (Retting et al., 2003; Pai, 2011).

Further evidence for an association between traffic violations and road traffic crashes comes from studies on the effect of enforcement on crashes and driver behavior. Indeed, the positive association between violations and crashes is one of the key assumptions guiding enforcement efforts (Shinar, 2007). Yannis et al. (2007) using aggregate spatial data from Greece, found that intensified enforcement was the main cause of improved road safety. Similarly, a study in Israel suggests a significant reduction is severe road traffic crashes and casualties on highly enforced roads compared to control roads (Hakkert et al., 2001). Stanojević et al. (2013) show that a lack of enforcement results in greater rates of speeding, failure to use seat belts, driving under the influence of alcohol, engagement in both aggressive and ordinary violations, and involvement in risky situations.

A closer look at the studies reviewed above reveals that most fall into one of two types: driver samples and evaluation studies. The first type, driver samples, can be further divided into three categories: (a) driver self-reports (Reason et al., 1990; Sullman et al., 2002; Blows et al., 2005; de Winter and Dodou, 2010), (b) observations (Stanojević et al., 2013), and (c) comparisons of traffic violators and/or drivers involved in road traffic crashes with a matched control group of "regular" drivers (Rajalin, 1994; Ferrante et al., 2001; Macdonald et al., 2004). The second type, evaluation studies, examines changes in traffic violations and road traffic crashes following an intervention, such as an enforcement or device initiative (Hakkert et al., 2001; Yannis et al., 2007). However, both types of studies are vulnerable to several limitations that may weaken their findings. These limitations include, among others, reliance on self-reports, small sample sizes, a focus on a relative small geographic area, a limited time of study, controlling for a limited number of confounders, or any combination of these. Possibly as a result of such limitations, some research suggests that the correlation between traffic violations and crashes is complex and relatively low (Gebers and Peck, 2003).

The following section describes how the unique dataset of the current study was used to better elucidate the link between the number of tickets received by drivers and subsequent road traffic crashes.

3. Methods

3.1. Dataset

The current study uses a unique individual-level dataset that merges Israeli census data with road traffic crash data and data on traffic tickets issued to drivers. For each driver who was asked to respond to the extended 1995 census questionnaire, which was administrated to a representative sample of 20% of the Israeli population, the census data were merged with individual-level information on traffic tickets issued and involvement in road traffic crashes from the years 2002 to 2008 (the different data sources were matched using each driver's national identification number). This process created, in essence, a set of panel data that made it possible to trace a fifth of the Israeli driver population over a period of 13 years, to identify those drivers who received traffic tickets and/or were involved in road traffic crashes from 2002 to 2008, and to estimate the effect of traffic tickets on crashes while controlling for various demographic and socioeconomic variables. The dataset was obtained especially for the current research from the Israel Central Bureau of Statistics, following approval of an ethics committee which determined that it did not violate drivers' right to privacy or confidentiality.

The quality of the matching process was tested in three stages. The results showed that more than 92% of the crash and traffic ticket records were linked to the census data (the missing records were due either to errors in one or the other data source or to the fact that some of the drivers were new immigrants who did not take part in the census). No meaningful differences were found between the linked and unlinked drivers. Finally, an additional quality check found that among the linked cases, 97.6% fully matched by gender and year of birth, and a further 2.3% matched by gender or birth year only (in the current analyses, only those cases with a perfect match were used). Thus, these tests suggest that the merging procedure was of relatively high quality.

The dataset includes 409,051 drivers who received 830,763 traffic tickets (not including parking tickets) and were involved in 22,562 crashes that resulted in casualties, among them 2401 fatal or severe crashes.

3.2. Variables

In the following analyses only fatal and severe crash data were used, because crashes that lead to light injuries appear to be under-reported (Elvik and Vaa, 2004; Evans, 2004). The road traffic crash variable was dichotomized to represent whether the driver was (1) or was not (0) involved in a fatal or severe crash during the study period. The variable was dichotomized since only 0.005% of the sample had more than one fatal or severe crash during the research period.

The traffic tickets variable comprised tickets for all types of violations, including moving violations, equipment violations, etc., with the exception of parking tickets and tickets related to involvement in a fatal or severe crash. In order to standardize the number of traffic tickets drivers received before their first fatal or severe crash (if any), for each driver the mean number of tickets per year was calculated until the end of the study or until the first fatal or severe crash, if there was one. The number of tickets per year per