Accident Analysis and Prevention 83 (2015) 154–161

Contents lists available at ScienceDirect

Accident Analysis and Prevention

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

The effect of stricter licensing on road traffic injury events involving 15 to 17-year-old moped drivers in Sweden: A time series intervention study

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ARTICLE INFO

Article history:
Received 7 October 2014
Received in revised form 22 June 2015
Accepted 22 July 2015
Available online 11 August 2015

Keywords:
Road traffic injuries
Intervention
Policy
Injury control
Licensing

ABSTRACT

Introduction: This study aimed to evaluate and quantify the effect of the introduction of the AM driving license on non-fatal moped-related injuries in Sweden. With the introduction of the new license category in October 2009, prospective moped drivers are now required to pass a mandatory theory test following a practical and theoretical course. In addition, obtaining a license to operate a moped is now considerably more costly.

Methods: Time series intervention analysis on monthly aggregated injury data (1st Jan 2007–31st Dec 2013) was performed using generalized additive models for location, shape and scale (GAMLSS) to quantify the effect size on injury events involving teenage (15–17 years) moped drivers, while controlling for trend and seasonality. Exposure was adjusted for by using the number of registered mopeds in traffic as a proxy.

Results: The introduction of AM license was associated with a 41% reduction in the rate of injury events involving 15-year-old moped drivers (IRR 0.59 [95% CI: 0.48–0.72]), and a 39% and 36% decrease in those involving 16-year-old (IRR 0.61 [95% CI: 0.48–0.79]) and 17-year-old drivers (IRR 0.64 [95% CI: 0.46–0.90]), respectively. The effect in the 15-year-old stratum was decreased roughly by half after adjusting for exposure, but remained significant, and the corresponding estimates in the other age groups did not change noticeably.

Conclusions: This study provides quasi-experimental evidence of an effect on non-fatal moped-related injuries as a result of stricter licensing rules. Only part of the effect could be explained by a reduction in the number of mopeds in traffic, indicating that other mechanisms must be studied to fully understand the cause of the reduction in injuries.

1. Introduction

Injury is recognized as a major global health problem, and it is the leading cause of mortality among teenagers and young adults (Peden et al., 2012), accounting for 65% of all deaths in the age group 15–19 years in Sweden over the last decade (The National Board of Health and Welfare, 2014a). Sweden has a long-standing tradition of safety policy, especially regarding the reduction of deaths and severe injuries due to road traffic crashes. This is perhaps best illustrated by the Swedish Parliament's adoption of Vision Zero, a long-term political goal to reduce fatal and severe traffic-related injuries in Sweden to zero (Belin et al., 2012). In recent years, the number of car occupants killed or hospitalized due to road traffic injuries has decreased considerably in relation to other modes of transportation (The National Board of Health and Welfare, 2014a, 2014b), and vulnerable road users (such as cyclists and moped riders) are now increasingly being recognized as a high-risk group worthy of increased focus in injury research and control (Peden et al., 2004).

In Sweden, mopeds have an age restriction of 15 and are a popular means of transportation for teenagers, as other options for motorized transportation are few. At age 15, moped crashes are the leading cause of road traffic injuries in Sweden (Strandroth, 2007), and moped riders accounted for 44% of all road traffic mortality at this age in the last 10 years, almost twice that of car occupants (Swedish Transport Agency, 2011). The proportion of car occupants fatally injured in traffic is higher than mopeds among 16-year-olds,

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http://dx.doi.org/10.1016/j.aap.2015.07.022
0001-4575/

but in relation to other age groups, mopeds riders still account for a considerable proportion of road traffic deaths among teenagers, averaging at 21% for the age group 15–17 years (Swedish Transport Agency, 2011). According to a Norwegian study, moped riders are nine times as likely as car occupants to be injured or killed per distance travelled (Bjømskau, 2009). The incidence of fatal and non-fatal injuries as a result of moped crashes remains relatively high until early adulthood (Strandroth, 2007).

During the last decade, some important changes have occurred which may have affected the moped-related injury trends in Sweden. Prior to 1998, the mopeds used on Swedish roads were designed to reach a maximum speed of 30 km/h (19 mph), but in compliance with European Union (EU) standards, a new class of mopeds was introduced. The new Class 1 mopeds, or EU-mopeds, were designed to reach a maximum speed of 45 km/h (28 mph), and since their introduction, the incidence rate of moped injuries has increased dramatically (Strandroth, 2007), likely due to increased vehicle speeds, popularity, or a mixture of both. Helmet wearing has been mandatory since 1978, but a driving license has historically not been required in order to operate a moped in Sweden. However, as a result of an EU directive (2006/126/EC) on driving licenses which requires all member states to introduce the AM license category for mopeds, stricter licensing rules were introduced nationally in October 2009. As a result of the new licensing rules, an AM license is now required to drive a Class 1 moped in Sweden. However, this did not include previous holders of a conditional driving license for mopeds, administered before October 2009. Instead, they were issued an AM license automatically (Swedish Transport Agency, 2009). Moreover, holders of any other type of driving license can legally operate a moped. In Sweden, the age of driver licensing is 18 years for passenger cars, and 16 years for light motorcycles.

Before October 2009, drivers of Class 1 mopeds were required to complete an 8-hour theoretical course, which usually involved some practical elements and skills training away from traffic, and to pass a theory test issued by an authorized examiner in order to obtain a conditional driving license. While the procedure to obtain a license still involves a mandatory theory test, there are some vital practical differences. The education now includes a minimum of 4 h of practical training, including traffic-based driving practice, extending the length of the mandatory education to a total of 12 h. Due to this, acquiring an AM license now involves additional fees that were not present prior to October 2009. Obtaining a conditional license used to cost approximately 2000 SEK (240 USD in February 2015) prior to the intervention. According to the Swedish Transport Agency, acquiring an AM license now costs approximately 5000 SEK (600 USD in February 2015), which means that the intervention may have served as an economic deterrent to moped ownership and, by extension, use by more than doubling the price of the driving education. Another important aspect of the new licensing rules is that the AM driving license can be recalled in the event of a severe traffic violation (such as drunk driving), which was not the case prior to October 2009.

As of yet, no studies have, to our knowledge, evaluated the effect of the change with regard to moped-related injuries. Since mopeds are a relatively dangerous mode of transportation, with injuries occurring predominantly among teenagers, we thus aimed to identify whether the introduction of the AM license category for Class 1 mopeds resulted in a reduction in road traffic injury events involving teenage Class 1 moped drivers.

2. Materials and methods

In an attempt to estimate the impact of the change, we exploited a characteristic of the intervention that meant that all those born after 31st August 1994, i.e. those who were younger than 15 years at the time of intervention, could not obtain an AM license or operate a Class 1 moped by any other means than taking the educational course associated with the intervention (other than driving illegally). Recall that the intervention was devised so that previous holders of conditional moped licenses, which were used prior to the intervention, could submit a request to have their license changed to an AM license, and that holders of other types of driving licenses can operate a Class 1 moped legally without an AM license. The birth cohort that was hypothesized to be most affected by the stricter licensing rules was thus followed through time. This was done by studying the instant effect of the intervention on 15-year-olds in October 2009, when the changes were enacted, and delayed effects among 16-year-olds in October 2010 and 17-year-olds in October 2011, as the new licensing rules would then fully encompass drivers of these ages as well.

The chosen study design was an interrupted time series (ITS) design, which is classified as a quasi-experimental design where the effect of an intervention is studied by using observational data collected regularly at evenly spaced points in time. With this method, the impact of an intervention can be tested and quantified as an abrupt change in intercept and/or trend of the regression line of a studied outcome coinciding with the implementation of the studied intervention in a continuous time series, while controlling for time trend and regression-to-the-mean bias. It is thus associated with a higher degree of internal validity than simple pre-post designs, and due to the nature of the continuously collected time series data, does not require the use of a control group (Glass, 1997).

Glass (1997) notes that the greater the temporal distance between the intervention and the hypothesized effect, the weaker the argument that any observed changes can be attributed to an intervention becomes unless there is reason to believe that the effect would be delayed or gradually change or time. Gradual effects must thus often be argued for more comprehensively, and if there is no reason to believe a gradual effect might exist, changes in slope between two periods might just be due to other extraneous factors. Since we could not find any good theoretical arguments to expect a gradual effect as a result of the studied intervention, we were only concerned with estimating an abrupt and permanent (or static) effect for the periods where the intervention is active, and delayed (abrupt) effects as noted in the second hypothesis above.

2.1. Data collection

Data on road traffic injury events involving Class 1 moped drivers in the age group 15–17 years reported by the police was extracted from the Swedish Traffic Accident Data Acquisition register for the study period 1st January 2007 to 31st December 2013. The register contains all road traffic injuries and deaths reported by every police district in Sweden (Swedish Transport Agency, 2011). The data that the register contains is anonymized, and the police reports only contain information on the age and sex of the persons involved, along with detailed information on the crash event, such as time, location, vehicle type(s), crash type and a visual assessment of the severity of the injuries sustained. The police are required by law to report all road traffic injury events to which they become aware of to the register, which is done using a standardized form. The assessment of injury severity is made at the scene of the crash. A severely injured person is defined as having sustained a fracture, crush injury, laceration, severe cut, concussion or internal injuries. An injury that the officer suspects will result in hospital admission is also classified as severe. Other injuries are classified as slight (Swedish Transport Agency, 2013). In order to identify our cases, we used information on vehicle type and driver age, time of the event (year and month), and the severity of the injuries sustained by the persons involved.