Safety Science 62 (2014) 168–174

Contents lists available at ScienceDirect

Safety Science

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

An evaluation of the traffic safety effect of fixed speed cameras

Ellen De Pauw *, Stijn Daniels, Tom Brijs, Elke Hermans, Geert Wets

Transportation Research Institute, Hasselt University, Wetenschapspark 5, BE-3590 Diepenbeek, Belgium

ARTICLE INFO

Article history:
Received 9 January 2013
Received in revised form 29 July 2013
Accepted 30 July 2013
Available online 21 September 2013

Keywords:
Before- and after evaluation
Crash
Enforcement
Fixed speed camera

ABSTRACT

Speeding remains a major challenge in traffic safety. The government often invests a lot of means to manage this problem, for example through the installation of speed cameras. In order to achieve an effective traffic safety policy it is important to examine the traffic safety effects that these investments bring about. This study evaluates the traffic safety effects of 65 fixed speed cameras, installed between 2002 and 2007, on highways in Flanders-Belgium. The adopted approach is a before- and after study with control for the trend. The evolution in the number of crashes at the locations with speed cameras was compared with the evolution in the total number of crashes in Flanders. The analyses showed a non-significant decrease of 8% in the number of injury crashes. In the case of the more severe crashes with serious and fatal injuries, a decrease of 29% was found, significant at the 5% level. A favorable effect is found for all road user categories (car occupants, cyclists, moped riders, motorcyclists and pedestrians), with a higher decrease in the number of injured road users at the treated locations compared to the general trend. It can be concluded that speed cameras have a favorable effect on traffic safety, mainly on severe crashes.

1. Introduction

Driving speed influences both the chance to be involved in a crash and the severity of the injuries when a crash occurs (Elvik et al., 2004; Mountain et al., 2004). Nevertheless, many drivers exceed the speed limits. A study of different countries around the world showed that on average 40–50% of the drivers drive faster than the posted speed limit (OECD, 2006). Nilsson (2004) and Elvik et al. (2004) described the relationship between speed and crashes as a power function, which indicates the crash risk increases more than proportionally with higher speeds. A measure that is often implemented to tackle this problem is the installation of speed cameras. In Flanders, Belgium which covers about 5000 km of highways (roughly the upper category of roads, motorways excluded), more than 250 speed cameras were installed since 2002. All of these cameras are placed along road sections. The speed cameras installed at signalized intersections in Flanders also detect red light running, and are discussed in another paper (De Pauw et al., n.d.). The decision to install a camera is based on the number and severity of the crashes during the last 5 years and the presence of black spots in a distance of one kilometer. The threshold for ticketing drivers is 1 km/h and the fine includes €50 up to a speeding level of 10 km/h. Inside the built-up area, 30 km/h zone, school and residential areas €10 is added for every km/h above the initial level of 10 km/h. At a speeding level from 30 km/h or more drivers are brought to court, they receive a fine between €55 and €2750 and a driving ban for 8 days to 5 years. For other roads the rules are less strict: there is an additional €5 for every km/h above the initial 10 km/h and drivers are brought to court at speeding levels from 40 km/h.

In order to determine whether speed cameras are an appropriate method to tackle the speeding problem, an evaluation of the safety effect is essential. Elvik et al. (2009) carried out a meta-analysis of studies that analyzed the effect of speed cameras on crash numbers and crash severity. Only studies that applied some kind of comparison group were included, as studies that did not applied a comparison group systematically showed larger effects, probably due to a lack of control for confounding factors. Based on several studies, mainly conducted in Europe and Australia, an overall decrease of 16% in the number of injury crashes was found. Furthermore, a favorable effect was found in the number of fatal crashes, for which the overall estimation was a decrease of 39%.

Mountain et al. (2004) studied the effect for separate distance bands in order to analyze to what distance these speed cameras have an effect. Therefore they analyzed the effect of 62 speed cameras in the United Kingdom at roads with a speed limit of 30 miles/h (48 km/h). The highest effect was found at a distance up to 250 m from the camera, on which a significant decrease of 25% in the number of injury crashes was found. Between 250 m and 500 m this decrease dropped to 15% and between 500 and 1000 m this was 12%. However, both of these results were non-significant. Also Hess (2004) analyzed the effects of speed cameras, but he used cumulative distances of 250 m, 500 m, 1000 m and 2000 m. He

* Corresponding author. Tel.: +32 11 26 91 11.
E-mail addresses: ellen.depauw@uhasselt.be (E. De Pauw), stijn.daniels@uhasselt.be (S. Daniels), tom.brijs@uhasselt.be (T. Brijs), elke.hermans@uhasselt.be (E. Hermans), geert.wets@uhasselt.be (G. Wets).

0925-7535/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ssci.2013.07.028

found the highest effects in the immediate vicinity of the camera, for which a decrease of 46% was found up to 250 m after the camera. The effects dropped with the distance from the camera, and at a distance of 500 m, 1000 m and 2000 m decreases of respectively 41%, 32% and 21% in the number of injury crashes were found.

2. Study design

The present study aims to examine the traffic safety effect of fixed speed cameras in Flanders through a before- and after comparison of the injury crash frequencies. Two groups of crash data were included: (1) all injury crashes; (2) severe injury crashes which included crashes with severely injured (every person that needed more than 24 h of hospitalization as a result of a crash) and fatally wounded persons (every person that died within 30 days after the crash). All crashes that occurred at a distance of 500 m upstream and downstream from the camera were selected. In addition, the crashes were selected at different distance bands of 250 m, until 1000 m from the camera. Through these different distance bands it was examined whether or not the effect differed according to the distance from the camera. Furthermore, the characteristics of the locations were taken into account and it was analyzed whether or not effectiveness differed according to the localization inside or outside the urban area, number of lanes, maximum speed limit, and whether or not other speed cameras were located nearby. Next to the crash level, an analysis on the level of casualties was executed, and the effect on each type of road user (car occupants, cyclists, moped riders, motorcyclists and pedestrians) was examined.

The most commonly used study design to evaluate the effectiveness of a traffic safety measure on the number of crashes is a before- and after study (Elvik, 2002; Shinar, 2007). This method compares the occurrence of the crashes before the implementation of a measure with that after the implementation. In a before- and after study it is important to control for other variables that could have had an effect on the number of crashes across the study period. For this reason a comparison group is used, which controls for general trend effects (Hauer, 1997). Furthermore, other traffic safety measures that were implemented at the treated locations throughout the research period were also taken into account. It was however not possible to control for the regression-to-the-mean effect. In order to control for this effect, the mean crash rates and the dispersion of comparable locations are required. The comparison group that is used in the present study only included total crash numbers for Flanders, for which it was not possible to calculate the over dispersion.

3. Data

In order to perform an effect evaluation, the following information was collected:

- A geographical localization of the crashes around the speed cameras.
- Crash information (year, involved road users, severity) for both treated locations and comparison group.
- Date (year) the camera was installed and operational.
- Information about other measures implemented on the treated road section during the research period.
- Characteristics of the road section (inside/outside urban area, number of lanes, speed limit).

At the time of the study, crash data for Belgium was available until 2009 (Federal Public Service Economy, department Statistics), however geo-coded crash data was only available until 2008 (Ministry of Mobility and Public Works, Roads and Traffic Agency). This data is gathered by the police through a crash form and reported digitally. Afterwards this data is controlled by the Federal Public Service Economy and supplemented with data of deaths (injured persons who died within 30 days of the crash) provided by the public prosecutor. Based on the information about the place the crash occurred a geo-coding is executed by the Ministry of Mobility and Public Works.

The Roads and Traffic Agency also delivered information of the year during which the camera was installed and the year the camera was operational (i.e. drivers were ticketed). The before period ranged until the year before the camera was installed, the after period ranged from the year after the camera was operational. Subsequently, the years during which the camera was installed until this was operational were not taken into account in this study. This period ranged from one to six years, and is further referred to as the installation period. In most cases this time of installation and the time the camera came into operation was during the same year. However, some locations had problems with the inductive loops and subsequently with the registration of the speeds. It took four to six years until the cameras at these locations were operational and drivers were ticketed. We decided to restrict the before period until the year the camera was installed, as we can expect drivers' behavior to change when they see the newly installed camera. On the other hand, the after period started from the time the camera was operational, because it is unclear whether drivers knew that offenders were not ticketed and whether this had an influence on their behavior.

Furthermore, responsible authorities were asked to provide information about other measures that were implemented during the research period, for example change of the maximum speed limit, changes in the infrastructure for pedestrians or cyclists and resurfacing of the road. Based on this information it was possible to exclude the traffic safety effects of these measures and to examine the isolated effect of the speed cameras.

At the end of 2012, around 230 fixed speed cameras were installed at the Flemish highways. All of these cameras are photo radar units mounted in boxes. Speed can be detected through two systems: either through two inductive loops embedded in the pavement, which calculates the speed of the vehicle based on the time the vehicle needs to pass the two loops and the distance between the loops. Or either through electromagnetic waves, for which the system can detect the speed of a vehicle based on the echo of these waves (Ministry of Mobility and Public Works, Roads and Traffic Agency). Crash data of at the least one year before and after the installation period of the camera is required in order to enable a before- and after evaluation. Since at the time of the study localized crash data for Flanders was available up until 2008, only cameras installed up to and including 2007 could be evaluated. One-hundred-and-seven locations were excluded, since these were installed after 2007, or installed before 2008, but operational (i.e. offenders were ticketed) after 2007. In addition 15 cameras were excluded because the date of installation or commencement was unknown and 11 locations were excluded, as no information was received about other local measures. This information is required in order to make it possible to assess only the effect of speed cameras and to exclude the effect of other measures that were implemented during the research period. Eventually 97 locations were included in the treated group. For 32 locations the required information was available, but it was not possible to exclude the effect of other traffic safety measures, as these measures were implemented the year during which the camera was installed or during the year directly before or after. For 65 locations the isolated effect of the installation of a speed camera could be examined. The flow chart of this selection is shown in Fig. 1.