

## Evaluation of Speed Camera Enforcement in the District of Columbia

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**ABSTRACT**

Washington, D.C., implemented a speed camera enforcement program in 2001. Vehicle speeds were measured before and after the program. Seven sites in Washington were selected randomly from a total of 60 targeted enforcement zones. Speed data were collected 1 year prior to enforcement and approximately 6 months after enforcement began. Results indicated that mean traffic speeds and the proportion of drivers traveling more than 10 mph above the speed limit — fast enough to warrant a speeding ticket — were reduced at each of the Washington study sites. At eight comparison sites in nearby Baltimore, Maryland, where speed camera enforcement was not in place, no decline in traffic speeds was observed. Overall, mean speeds at Washington sites declined by a statistically significant 14 percent compared with Baltimore sites, and the proportion of vehicles exceeding the speed limit by more than 10 mph declined 82 percent. These findings indicate that speed camera enforcement reduced speeding on surface streets throughout Washington. Based on prior research, such speed reductions can be expected to reduce the frequency and severity of motor vehicle crashes.

## INTRODUCTION

Speeding is one of the most prevalent factors contributing to motor vehicle crashes (1). Speed is related to both crash severity and injury risk (2). Therefore, speed management is an important safety function. Traditional police enforcement can be effective in reducing travel speeds but is done only sporadically. Thus, it generally is insufficient to ensure reasonable compliance with speed limits. The number of drivers and vehicle miles traveled have risen faster than the availability of officers whose routine duties include traffic law enforcement (3). Also, other police priorities such as apprehension of violent criminals, emergency response, and, more recently, anti-terrorism efforts can limit resources available for traffic enforcement. Because the perception of the risk of getting a speeding ticket strongly influences motorists' speed choices, low levels of traffic enforcement may encourage speeding violations.

Automated speed cameras, as a supplement to conventional police efforts, can increase both the amount of speed enforcement and driver perception that noncompliers will be detected and apprehended. Speed cameras are used widely throughout Europe, Australia, and, to a more limited extent, North America. Most cameras use a narrow-beam, low-powered Doppler radar speed sensor that triggers the camera to photograph vehicles traveling faster than a preset speed as they pass a specified point. In comparison, conventional radar measures traffic speeds over a much larger area and relies on officer judgment to assign radar measurements to specific vehicles. Speed cameras record the date, time, and vehicle speed along with a photograph. Tickets are mailed to vehicle owners. Speed cameras often are accompanied by police presence but also can be mounted on poles and deployed unattended.

In studies outside the United States, speed camera enforcement has been shown to reduce traffic speeds and motor vehicle crashes. In Victoria, Australia, cameras were introduced in late 1989, and police reported that within 3 months the number of offenders triggering these devices decreased by 50 percent (4). Fatalities decreased 30 percent in 1990 compared with 1989. Following 1 year of camera enforcement in British Columbia, researchers reported a 20 percent reduction in traffic fatalities, a decline of about 7 percent in overall crashes, and a significant reduction in the proportion of speeding vehicles (5). A subsequent evaluation based on the first 2 years of camera enforcement found a 1.8 mph (2.8 km/h) reduction in mean speed and a 14 percent reduction in police-reported crashes at photo radar locations (6).

In the United States, few communities use speed cameras to enforce speed limits, so their effect on drivers' speeding behavior is not well established. Limited evaluations of photo radar published by municipal officials conducting such programs report reductions in mean speeds and speeding violations. For example, the City of San Jose (7), California, which implemented photo radar in 1999, reported a 15 percent reduction in the proportion of drivers exceeding speed limits by 10 mph or more on streets where speed cameras were deployed an average of 1 hour per month. In National City, California, where photo radar was implemented in 1991, Berkuti and Osburn (8) reported a minimum 10 percent reduction in traffic speeds in photo radar enforcement zones. Although these local case studies indicate speed cameras can potentially reduce speeding, they lack experimental design procedures and statistical techniques appropriate for scientific evaluation. The purpose of this study was to evaluate the effects of the Washington, D.C., speed camera program on traffic speeds.

## METHOD

The study was conducted in Washington, D.C., which has an estimated population of 572,000 and a land area of 61 square miles (9). Local legislation took effect in 1997 permitting the use of camera-based enforcement of traffic laws. A photograph is taken of the rear license plate of a vehicle detected speeding. The driver is not photographed. The registered vehicle owner is subject to monetary fines that range from \$30 to \$200, depending on how many miles per hour above the posted speed limit the vehicle was traveling. No driver's license demerit points are assessed for photo-enforced violations.

The Washington Metropolitan Police Department conducts the speed camera program using five camera-equipped unmarked police cars. These units are operated by specially trained, radar-certified police officers. Photo radar uses the same Doppler principle as traditional radar but transmits a very narrow beam across the road, thereby eliminating the risk of tracking two vehicles at once. The radar beam is transmitted at an angle of 20 degrees across the road.

Police initially targeted 60 enforcement zones located among seven patrol districts throughout Washington — a combination of residential streets, major arteries, highways, and school and work zones. Enforcement zones were selected by the police department based on incidence of speeding-related fatalities, their proximity to school zones and other places where children are present, and known sites of chronic speeding. Actual camera enforcement began on August 1, 2001 and was preceded by a 30-day warning period, during which cameras were used to photograph and notify violators, but no tickets were issued. Signs advising motorists of photo enforcement of traffic signal laws were posted on major roadways at numerous locations entering the city. City officials generated publicity and awareness of the new program through the news media. Photo radar vehicles were in service from approximately 6 a.m. to 10 p.m., Monday through Saturday. Speed cameras were deployed at each of the 60 enforcement zones twice per week between August 1 and mid-October 2001. After mid-October, police chose to limit the use of speed cameras to 28 of the 60 designated enforcement zones.

For the present study, one site for speed monitoring was chosen at random from each of seven police patrol districts. These sites were not among the remaining 28 enforcement zones, so no camera enforcement took place at the study sites after mid-October 2001. To control for external factors that might affect traffic speeds (e.g., weather and seasonal variability in travel patterns), a group of eight comparison sites were selected in Baltimore, Maryland, where speed cameras were not in use. The comparison sites were not strictly matched to the camera sites but were a convenience sample based on visual observation of characteristics that made them similar to camera sites (e.g., land use, on-street parking, etc.). Speed limits at the 15 study sites ranged from 25 to 35 mph. Speed data were collected at the seven Washington camera and eight Baltimore control sites approximately one year prior to the warning period (June-August 2000) and then approximately six months after enforcement began (January/February 2002).

Traffic speeds were recorded using the same speed camera equipment used for enforcement in Washington. Two cameras were deployed in a data collection mode, in which the speeds of passing vehicles were electronically recorded but photographs were not taken. Speed cameras were deployed during both the before and after periods using the same vehicles — unmarked passenger vans, which were parked at the roadside parallel to the traffic lanes being monitored. Uniformed police officers or marked police cars were not present during data collection. The same personnel and data collection procedures were employed at the Washington and Baltimore sites.

Table 1 summarizes the speed limits and vehicle sample sizes collected at each of the Washington and Baltimore study sites. Speed data were collected on weekdays, at times when traffic was free-flowing. An attempt was made to collect speed data at the same times of day during the baseline and after periods, but this was only partially successful. Overall, observations for the baseline and after periods were collected between 10:00 a.m. and 10:00 p.m. For six of the seven Washington sites, the times of day for the baseline period roughly matched or substantially overlapped those for the after period; for one site, Florida Avenue, baseline data were collected from approximately 2:30 p.m. to 5:30 p.m., and after data were collected from approximately 6:30 p.m. to 9 p.m. Despite the time difference at this site, hourly traffic volumes were similar during the two periods (approximately 400 baseline and 350 after, based on speed camera measurements). At the Baltimore sites, all observations for the baseline and after periods were collected between 11:30 a.m. and 5:15 p.m. on weekdays but were not precisely matched. At the Washington study sites, sample sizes during the enforcement period generally were smaller than during the baseline period due to fewer hours of data collection.

Summary measures at each site included mean speed and the proportion of vehicles exceeding the speed limit by more than 10 mph. Changes in mean speeds associated with photo radar enforcement were evaluated statistically using linear regression models, including terms accounting for site-to-site variability and expected variability over time. Logistic regression models were used to measure the effect of the program on the proportion of speeding vehicles.

## RESULTS

Figures 1A and 1B summarize mean traffic speeds for the seven Washington camera sites and eight Baltimore comparison sites. Reductions in mean speeds ranging from 1 to 6 mph were found at all Washington sites. At the Baltimore sites, changes in mean traffic speeds ranged from a reduction of 1 mph to an increase of 3 mph. Mean speeds increased or were unchanged at most of the Baltimore sites. Overall, mean speeds at the Washington sites declined by a statistically significant 14 percent compared with the Baltimore sites (Table 2).

Figures 2A and 2B report the proportion of vehicles exceeding the speed limit by more than 10 mph for the seven Washington camera sites and eight Baltimore control sites. Such speeds generally are sufficiently above the speed limits to warrant citations. The proportion of vehicles exceeding speed limits by more than 10 mph declined at all Washington sites. Declines at all sites were large, but the largest proportional decline occurred at the Reno Road location (from 18 percent during baseline to 2 percent after enforcement, or an 89 percent reduction). At the Baltimore control sites, the proportion of vehicles exceeding the speed limit by more than 10 mph increased or was unchanged at 6 of the 8 locations.

Overall, the proportion of vehicles at Washington sites exceeding the speed limit by more than 10 mph declined by a statistically significant 82 percent compared with the Baltimore sites ( $p < 0.001$ ).

## DISCUSSION

This study found a large and significant reduction in speeding vehicles six months after implementation of a speed camera enforcement program in Washington, D.C. Results of this study are consistent with findings from previous research that indicate speed cameras can reduce mean speeds and speeding violations. No such changes were seen at Baltimore sites where no speed camera program was in place. Because camera enforcement did not take place between mid-October 2001 and data collection in January/February 2002 at the seven randomly-selected sites in this study, these data demonstrate that changes in speed and speed violations as a result of camera enforcement are not limited to actively enforced sites.

Although there were some differences in the times of day that baseline and after speed measurements were recorded, these differences were relatively minor, and there is no indication they affected results. Despite time-of-day differences at the Florida Avenue site, hourly traffic volumes were similar during the before and after periods, and the observed reduction in traffic speeds was similar to those observed at other Washington sites. At the Baltimore sites, although observations for the baseline and after periods were not precisely matched, all measurements were collected on weekdays between 11:30 a.m. and 5:15 p.m., leaving little possibility of speed fluctuations attributed to time-of-day differences. Also, speeds at all eight Baltimore sites showed a consistent pattern of little change during the course of the study, regardless of whether baseline measurements were collected slightly earlier or later in the day than the after measurements.

Although crash data are not yet available to tell whether speed reductions have led to decreases in the number or severity of crashes in Washington, reductions in speeding associated with speed camera enforcement can be expected to reduce the frequency and severity of motor vehicle crashes. Joksch reported that the probability of severe injury increases sharply with the impact speed of a vehicle in a collision, reflecting the laws of physics (10). The risk to pedestrians — the most vulnerable of road users — is even greater when urban speed limits are violated (11). The risk of pedestrian death increases by a factor of 2.5 when the driving speed of the striking vehicle increases from 25 to 31 mph (40 to 50 km/h) (12). Speed cameras in Washington primarily target surface streets with speed limits of 25 mph, Washington's statutory speed limit. Because, on a nationwide basis, approximately 26 percent of all crashes take place on streets with speed limits of 30 mph or less (13), urban streets are prime candidates for effective speed enforcement programs.

## ACKNOWLEDGMENTS

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FIGURE 2B Percent of Vehicles Traveling >10 mph above Speed Limit, Baltimore Control Sites

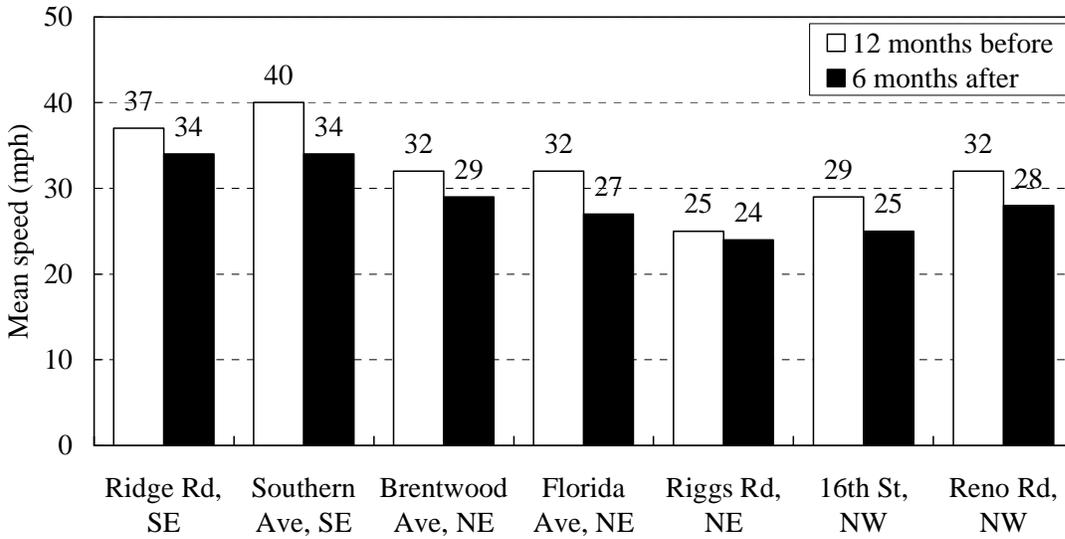
**TABLE 1 Speed Limits and Vehicle Sample Sizes, Washington and Baltimore Study Sites**

	Speed Limit (mph)	Sample Size	
		Baseline	Enforcement
Washington (camera sites)			
Ridge Road, SE	25	559	456
Southern Avenue, SE	30	1,052	442
Brentwood Avenue, NE	25	1,420	1,300
Florida Avenue, NE	25	1,189	868
Riggs Road, NE	25	1,427	1,385
16th Street, NW	25	1,843	1,102
Reno Road, NW	25	580	514
Baltimore (comparison sites)			
33rd Street	30	261	370
Dorithian Road	25	181	178
Falls Road	30	230	260
Hillen Road A	35	225	184
Hillen Road B	35	148	213
Northern Parkway A	35	273	321
Northern Parkway B	35	306	261
Wabash Avenue	25	130	213

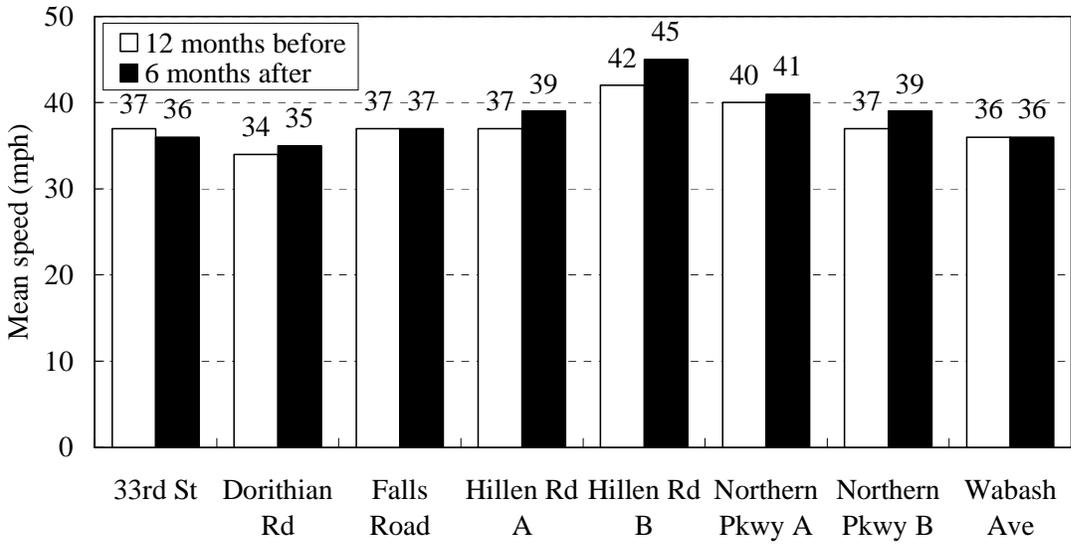
**TABLE 2 Estimated Effects of Speed Camera Enforcement on Mean Speed**

<b>Effect</b>	<b>Degrees of Freedom</b>	<b>Mean Square</b>	<b>F-value</b>	<b>p-value</b>	<b>Estimate</b>	<b>Percent Change*</b>
Site	14	22.94	568.57	0.0001		
Time	1	0.49	12.15	0.0005		
Camera	1	15.75	390.30	0.0001	-0.1473	-14
Error	17,874	0.04				

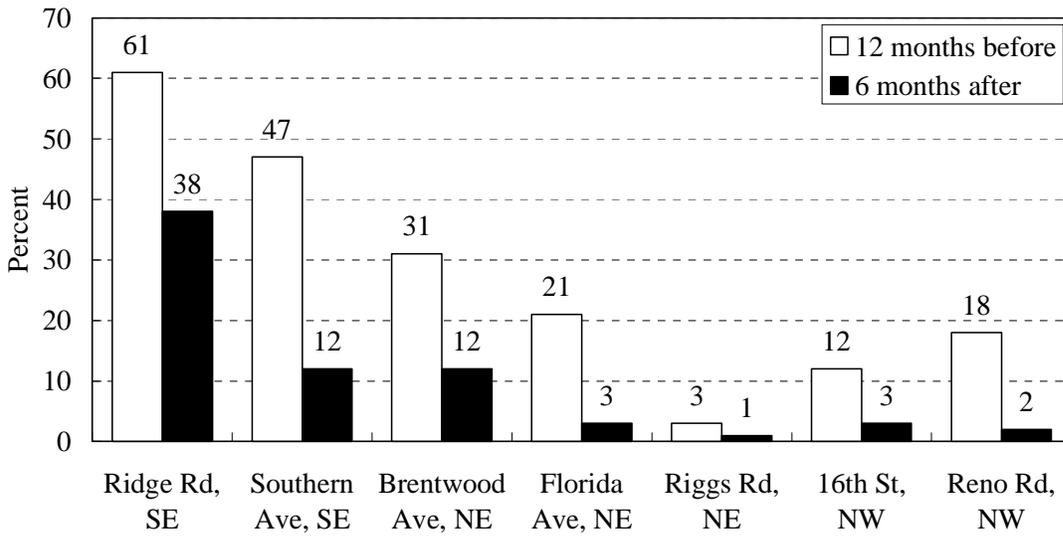
\*As the dependent variable was the natural logarithm of each measured speed, percent change was computed by taking the inverse logarithm of the estimate.



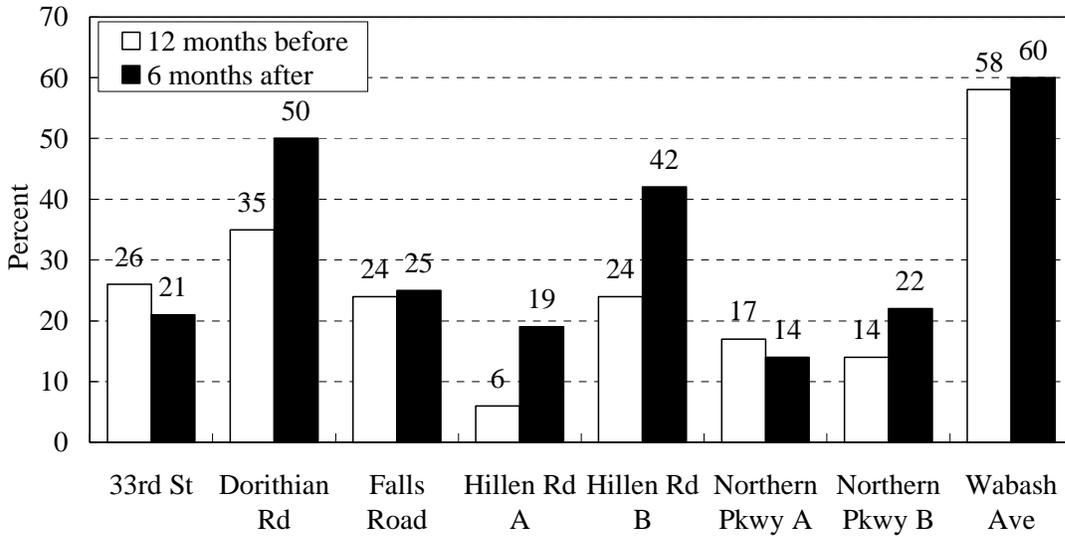
**FIGURE 1A Mean Traffic Speeds, Washington Camera Sites**



**FIGURE 1B Mean Traffic Speeds, Baltimore Control Sites**



**FIGURE 2A Percent of Vehicles Traveling >10 mph above Speed Limit, Washington Camera Sites**



**FIGURE 2B Percent of Vehicles Traveling >10 mph above Speed Limit, Baltimore Control Sites**