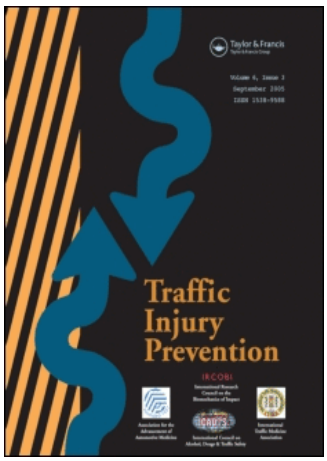

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Do Speeding Tickets Reduce the Likelihood of Receiving Subsequent Speeding Tickets? A Longitudinal Study of Speeding Violators in Maryland

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Objective. *Speeding tickets are the most commonly used tool to deter speeders, yet little is known about how speeding citations affect individual drivers' behavior over time. This study examined the effects of being cited for speeding and types of legal consequences on drivers' subsequent speeding citations, which are an indicator of speeding behavior.*

Methods. *A cohort of 3,739,951 Maryland licensed drivers were identified and followed for one year. Drivers were categorized by whether or not they received a speeding citation in May 2002. Among those cited for speeding in May 2002, drivers were grouped by type of penalty (fines and points; probation before judgment [PBJ, which results in fines but no points]; or no legal consequences). The relative risks (RR) and 95 percent confidence intervals (CI) of receiving a speeding citation during follow-up were compared between drivers ticketed and not ticketed in May 2002, as well as among different penalty groups. Cox proportional hazards regression modeling was used to adjust for potential confounders, including age, gender, alcohol-impaired driving, and residence. Kaplan-Meier survival functions were used to examine timing of violations.*

Results. *Young drivers and male drivers were more likely to receive a speeding citation. Drivers who received a speeding citation in May 2002 had almost twice the risk of receiving a speeding citation during follow-up, compared with those not cited for speeding that month (RR 1.6, 95% CI 1.52–1.68). Overall legal consequences had no significant effect on the risk of receiving a repeat speeding citation relative to ticketed drivers who escaped those consequences (RR 0.98, 95% CI 0.84–1.15); however, stratified analyses showed a significant decrease in repeat citations among females (RR 0.75, 95% CI 0.63–0.90) and drivers who received PBJ (RR 0.81, 95% CI 0.67–0.96). Kaplan-Meier curves showed that the study group of speeders had a significantly shorter time between May 2002 until receipt of a speeding citation than controls. Among penalty groups, significantly shorter times until receipt of another citation were observed among drivers escaping consequences or receiving fines/points compared with drivers receiving fines/PBJ.*

Conclusions. *Drivers who receive speeding citations are at increased risk of receiving subsequent speeding citations, suggesting that speeding citations have limited effects on deterrence in the context of the current traffic enforcement system. When comparing different penalties, PBJ is associated with a reduced rate of recidivism more than stronger penalties; however, it is unclear whether the reduction primarily is attributable to the penalty itself or to characteristics of drivers receiving PBJ. Increasing drivers' perceptions that they are at risk of being caught speeding may improve the effectiveness of speeding law enforcement.*

Keywords Speeding; Traffic Citations; Alcohol-Impaired Driving; Recidivism; Traffic Enforcement; Probation before Judgment

Speeding is one of the most common unsafe driving behaviors. A survey of six rural and five urban interstate highways in the United States conducted by the Insurance Institute for Highway Safety (IIHS) in 2003 showed more than half of the vehicles were going faster than the posted speed limit (IIHS, 2003a). Similar findings were reported in a study in Maryland (Fakhry et al., 2001). Inconsistent law enforcement, uncertain legal consequences, weak penalties, and tolerant social attitudes are reasons that may explain why speeding is so widespread (Shinar et al., 1999).

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Speeding increases the risk of crash occurrence and the severity of crash outcomes. The National Highway Traffic Safety Administration (NHTSA, 2004) reports that speeding was a contributing factor in 31% of all U.S. fatal crashes in 2003. Excessive speed increases the crash risk by reducing a driver's ability to negotiate curves or maneuver around obstacles in the roadway, by extending the distance necessary for a vehicle to stop, by increasing the distance a vehicle travels while the driver reacts to a hazard (IIHS, 2003b). Speeding also reduces the ability of vehicle safety devices such as safety belts and air bags to protect occupants involved in crashes (IIHS, 2003b).

Intensive enforcement campaigns appear to reduce speeding for a limited period of time in the areas where the campaigns are being conducted. Studies in the United Kingdom and Norway demonstrated that fewer people sped during intensive police speed enforcement intervention periods than before the campaigns (Holland et al., 1996; Vaa et al., 1997). However, the effects lasted only up to eight to nine weeks after the intervention was removed.

Speeding citations are the most commonly used tool to identify and deter individual speeders. Yet the effects of a speeding citation on drivers' future behavior are still uncertain. Previous studies have reported that a history of speeding violations is predictive of crash involvement, suggesting that high-risk behavior continues to occur after convictions for speeding violations (Gebers & Peck, 2003; Mesken et al., 2002). Crash occurrence, however, is a complex event that is affected by a multiplicity of behavioral and environmental factors, including speeding, alcohol-impaired driving, driving skills, road characteristics, and weather conditions.

The most direct way to assess the effects of speeding tickets on future speeding behavior is to measure that behavior. A study by Williams and colleagues (2005) observed travel speeds of drivers and then linked the vehicle tags to the driver histories to determine characteristics of speeders. Drivers operating vehicles at least 15 mph above the speed limit were more than twice as likely to have been convicted of speeding during the previous five years. In a study designed to identify drivers at high risk of crash involvement, Gebers and Peck (2000) reported that citations received during a 3-year period (1986–88) were significant predictors of total citations received during the subsequent 3-year period (1989–91).

Another important question is whether the deterrence efficacy of speeding tickets depends on the type and severity of legal penalty. In Maryland, drivers cited for speeding can choose either to appear in traffic court for a trial or pay fines by mail. If an offender pays a fine by mail, the Maryland Motor Vehicle Administration (MVA) will assess points on the driving record, depending on how much the driver was exceeding the speed limit. The number of points assessed typically is one or two; points result in increased insurance premiums for three years following a moving violation on the driving record. Licenses are suspended after drivers accumulate 8 points and revoked at 12 points. If an offender chooses to appear for trial, judges decide guilt and the penalties.

Probation before judgment (PBJ) is a common resolution in many traffic court trials; for speeding violations, a judge giving PBJ waives the points, puts the defendant on probation for a period that usually lasts 6–12 months, and orders the defendant to pay the original fine or a reduced fine. If the driver given PBJ is not caught speeding again during the probation period, then the violation is kept off the driving record, thereby avoiding insurance rate increases. If the driver is detected violating speed limits during probation, then the original points are reinstated together with any additional points from the new violation. With the exception of alcohol-related traffic offenses or violations related to fatal crashes, Maryland law does not specify the minimum period of probation for moving traffic violations or the maximum number of PBJs that a driver may receive (District Court of Maryland, 2006; Maryland General Assembly, 2006). The sole restriction on PBJ is that only one is allowed every five years for violations involving alcohol or fatal crashes.

This study uses a longitudinal cohort design to study the effects of speeding citations on subsequent speeding violations among individual drivers. The objective of this study is to determine the effects of being cited for speeding violations, as well as types of legal consequences from a speeding citation, on subsequent speeding behavior, as indicated by speeding citations during the follow-up period. Our study design permits examination of the relationship between time elapsed since the index citation and repeat violations, in addition to estimation of the effects of a single speeding citation following 12 months during which no other speeding tickets were received.

METHODS

Data Sources

Licensed drivers were identified from the Maryland driver licensure data file. The Maryland citation data file, 2001 to 2003, was used to identify drivers' speeding citation history. The traffic citation (speeding and alcohol traffic offenses) and court disposition data were available through the Maryland Crash Outcome Data Evaluation System (known as CODES), which had obtained the data from court records. Licensure and traffic citation data were linked using driver license numbers.

Study Design

Only Maryland drivers who were licensed by May 1, 2001, were enrolled in the study. We excluded drivers who received speeding citations during May 2001 through April 2002 in order to isolate the effects of receiving a single speeding ticket and minimize the residual effects of previous speeding citations on speeding behavior during our follow-up period.

To assess the effects of receiving a speeding citation, eligible drivers were categorized into two groups:

1. A study group consisting of the licensed Maryland drivers who received a speeding citation in May 2002 and
2. A control group consisting of the licensed Maryland drivers who did not receive speeding citations in May 2002.

The following drivers' characteristics were examined: gender, age as of May 1, 2002, county of residence, and occurrence of alcohol-impaired driving offenses during the follow-up period. Counties in Maryland vary with regard to the level of traffic enforcement. Because county of residence may affect drivers' chances of getting speeding tickets, Maryland's 24 jurisdictions were classified by whether they had low, medium, or high rates of traffic citations per licensed driver residing in the counties. Each individual in the study and comparison groups was followed for one year to ascertain whether a speeding citation was received and, if received, the time between May 2002 and receipt of the speeding citation. The incidence rates of receiving speeding citations during follow-up were calculated for each group.

To determine the effects of receiving legal consequences from speeding citations, drivers who received a speeding citation in May 2002 were classified according to the types of legal consequences they received: either fines combined with points, fines combined with probation before judgment (PBJ), or no legal consequences (Figure 1). Individuals' speeding citation records and time until receipt of a subsequent speeding citation during the follow-up period were observed to determine incidence rates for receiving repeat citations in each penalty group.

Statistical Analysis

The distribution of characteristics among drivers in the speeding citation group and the control group were compared using chi-square tests. Characteristics of interest included age, gender, county of residence, and alcohol-impaired driving citations issued during the follow-up period of June 2002–May 2003. The co-variables were considered potential confounders if they were associated both with receipt of a speeding citation in May 2002 and with receipt of a speeding citation during the follow-up period. Stratified analyses were done to determine the presence of effect modification, namely whether the effects of receiving a speeding ticket in May 2002 varied over different categories within a driver characteristic such as age.

Survival analysis, including Kaplan-Meier survival curves, was used to explore the frequency and timing of speeding citations. The difference between the survival curves of each group was examined by the Wilcoxon test. After calculating the crude risk ratios, adjustment for potential confounders were done by using Cox proportional hazard regression analysis. Statistical significance was defined as a two-sided p-value less than or equal to 0.05, or if the 95% confidence intervals for risk ratios excluded 1.0. To determine the effects of different types of legal consequences on subsequent speeding citations, similar procedures were used. SAS software version 9 was used for all data analyses.

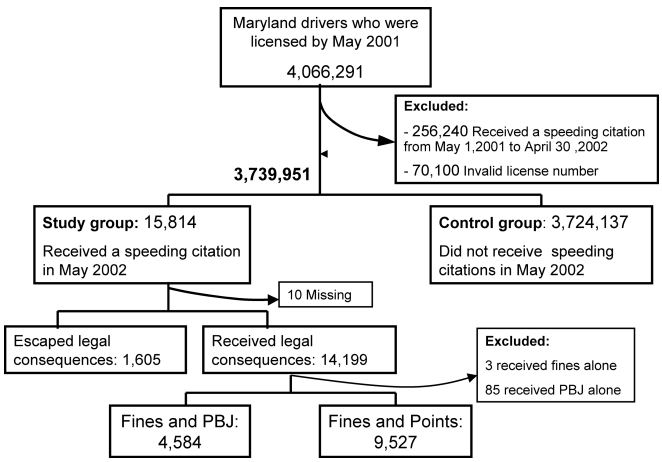

Figure 1 Study population.

RESULTS

Receiving a Speeding Citation

We identified 4,066,291 drivers who were licensed by May 2001 from the Maryland driver licensure database. We also examined the Maryland citation database for the period May 1, 2001 through April 30, 2002, and then excluded 70,100 drivers from the citation database who had an incorrect Maryland driver license number format. We also excluded 256,240 drivers who received a speeding citation during May 2001 through April 2002. Of the remaining 3,739,951 drivers (0.4%, n = 15,814) received a speeding citation in May 2002 (Figure 1). Both drivers receiving a speeding ticket in May 2002 and other remaining drivers were followed for a 12-month period, starting June 1, 2002.

In comparison with those who did not receive a speeding citation in May 2002 (control group), those who received a speeding citation in May 2002 (study group) were significantly more likely to be male, to be younger, and to be cited for driving under the influence or driving while intoxicated (DUI/DWI) during follow-up (p-value < 0.0001) (Table I). In addition, statistically significant associations were present between county of residence and being cited in May 2002, but the absolute differences between the study and comparison drivers were slight.

Drivers in the study group had more than twice the risk of receiving a speeding citation during the follow-up period (June 2002 through May 2003), compared with those in the control group (unadjusted RR 2.66, 95% CI 2.53–2.79) (Table II). During this period, 11% (n = 1,697) of drivers in the study group and 5% (n = 168,795) of drivers in the control group received a speeding citation. After adjusting for potential confounders (gender, age group, county of residence, and DUI/DWI offenses during follow-up), the risk ratio for receiving a speeding citation during follow-up decreased somewhat but was significantly elevated (adjusted RR 1.6, 95% CI 1.52–1.68).

Stratified analyses showed that both male and female drivers who were cited for speeding during May 2002 had significantly elevated risk for receiving speeding citations during follow-up relative to the comparison group (males: RR = 2.10, 95% CI = 1.99–2.22; females: RR = 2.52; 95% CI 2.32–2.73) (Table II). Female drivers had a significantly greater risk of repeat citations than male drivers (Breslow-Day p-value = 0.003). Significantly increased risk of speeding citations during follow-up among drivers cited for speeding in May 2002 was present in all age groups. A trend of increasing risk with increasing age

Table I Distribution of drivers by receipt of a speeding citation in May 2002 and associated factors, Maryland citation and licensure files

		Speeding citation in May 2002		
	Total N (%)	Yes N (%)	No N (%)	p-value*
Total	3,739,951 (100)	15,814	3,724,137	
Gender				
Male	1,792,990 (48)	9,508 (60)	1,783,482 (48)	<0.0001
Female	1,946,795 (52)	6,305 (40)	1,940,490 (52)	
	(100)	(100)	(100)	
Age group				
17–20	142,022 (4)	1,911 (12)	140,111 (4)	<0.0001
21–24	227,103 (6)	2,152 (14)	224,951 (6)	
25–29	294,217 (8)	2,116 (13)	292,101 (8)	
30–59	2,271,977 (61)	8,796 (56)	2,263,181 (61)	
60+	796,417 (21)	835 (5)	795,612 (21)	
	(100)	(100)	(100)	
County**				
Low	3,059,711 (92)	12,771 (90)	3,046,940 (91)	<0.0001
Medium	123,734 (4)	616 (4)	123,118 (4)	
High	159,017 (4)	794 (6)	158,223 (5)	
	(100)	(100)	(100)	
DUI/DWI*** during follow-up				
Yes	14,770 (0.4)	210 (1)	14,560 (0.4)	<0.0001
No	3,725,181 (99.6)	15,604 (99)	3,709,577 (99.6)	
	(100)	(100)	(100)	
DUI/DWI in May 2002				
Yes	4,347 (0.1)	19 (0.1)	4,286 (0.1)	0.88
No	3,735,604 (99.9)	15,795 (99.9)	3,719,809 (99.9)	
	(100)	(100)	(100)	

*Chi-square P-value.
**County groups based on citations per licensed driver residing in the county.
***DUI/DWI: Driving under the influence of alcohol or driving while intoxicated.

for speeding citations during follow-up was observed: drivers ages 21 or older had RR ranging from 1.54 to 2.96, whereas drivers ages 17–20 had a RR = 1.25 (95% CI = 1.14–1.38) (Breslow-Day p-value < 0.0001).

Among the study group of May 2002 speeding violators, drivers with DUI/DWI offenses during follow-up had a strongly elevated risk of receiving a subsequent speeding citation compared with drivers who did not receive a DUI/DWI during follow-up (RR = 4.21; 95% CI = 3.58–4.95). The association was even stronger among the comparison drivers, with an RR of 9.67 (95% CI = 9.48–9.86) (Table III). We compared time until receipt of a speeding citation using Kaplan-Meier survival

Table II Relative risks (RR) and 95% confidence intervals (CI) for speeding citations during follow-up among group receiving speeding citations in May 2002 compared with control group by selected driver characteristics, June 1, 2002, to May 31, 2003, Maryland citation and licensure files

	Received a speeding citation during follow-up period			
	Study group (N = 15,814) N (%)**	Control group* (N = 3,723,520) N (%)**	RR	95% CI
Total	1,697 (11)	168,795 (5)		
Unadjusted			2.66	2.53–2.79
Adjusted***			1.6	1.52–1.68
Gender				
Male	1,158 (12)	103,171 (6)	2.10	1.99–2.22
Female	538 (9)	65,616 (3)	2.52	2.32–2.73
Age group				
17–20	354 (19)	20,711 (15)	1.25	1.14–1.38
21–24	345 (16)	23,401 (10)	1.54	1.39–1.69
25–29	298 (14)	21,483 (7)	1.91	1.72–2.13
30–59	673 (8)	94,379 (4)	1.83	1.70–1.97
60+	27 (3)	8,677 (1)	2.96	2.04–4.30

RR, Relative risk; CI, Confidence interval.
*Reference group.
**Percentages within age and gender subgroups of the study and control groups.
***Adjusted for age, gender, grouped county of residence, DUI/DWI citations during follow-up.

Table III Relative risks (RR) and 95% confidence intervals (CI) for speeding citations during follow-up among group receiving DUI/DWI citations during follow-up compared with group not receiving DUI/DWI citation during follow-up stratified by receiving speeding citation during May 2002 status, June 1, 2002, to May 31, 2003, Maryland citation and licensure files

Received a DUI/DWI citation during follow-up	Speeding citation during follow-up: Yes	No*	Total	RR	95% CI
Received speeding citation during May 2002					
	Number (%)	Number (%)	Number (%)		
Yes	91 (43)	119 (57)	210 (100)	4.21	3.58–4.95
No	1,606 (10)	13,998 (90)	15,604 (99)		
Total	1,697 (11)	14,117 (89)	15,814 (100)		
Comparison group: no speeding citations during May 2002					
Yes	6,170 (42)	8,390 (58)	14,560 (100)	9.67	9.48–9.86
No	162,625 (4)	3,546,952 (96)	3,709,577 (100)		
Total	168,795 (5)	3,555,342 (95)	3,724,137 (100)		

RR, Relative risk; CI, Confidence interval.
*Reference group.

analysis. Drivers in the study group had a significantly shorter time between May 2002 until receipt of a speeding citation than those in the control group (Wilcoxon p-value < 0.0001) (Figure 2).

Receiving Legal Consequences

Of the 15,814 drivers who were cited for speeding violations in May 2002, 90% received some type of legal consequence, whether fines alone, PBJ alone, fines and PBJ, or fines and points (Table IV). However, very few drivers received fines alone ($n = 3$) or PBJ alone ($n = 85$), so they were excluded from the analyses. Overall, 29% ($n = 4{,}584$) of drivers who received a speeding citation in May 2002 received PBJ with fines, 61% ($n = 9{,}527$) received points with fines, and 10% ($n = 1{,}602$) of them escaped legal consequences. There were significant differences in type of penalty by gender, with a higher percentage of female speeding violators receiving fines/PBJ (34%) than male speeding violators (26%). A slightly smaller percentage of female violators escaped legal consequences (9%) than male violators (11%).

Significant age differences in type of penalty received also were present, with a lower percentage (24–26%) of violators ages 21–29 receiving PBJ than either younger drivers (ages 17–20) or drivers age 30 or older (about 30%). A higher percentage of drivers from counties with low traffic citation rates received PBJ (28%) compared with drivers from counties with higher citations per licensed driver (about 23%) (Table IV). Drivers who received a DUI/DWI offense during the follow-up period were somewhat less likely to receive PBJ for speeding (23%) during May 2002 relative to drivers not cited for alcohol-impaired driving (29%). Paradoxically, drivers cited for DUI/DWI offenses during follow-up were more likely to escape legal consequences for speeding than drivers not cited for alcohol offenses (16% versus 10%); we were unable to determine whether this could have occurred because some drivers cited for DUI/DWI and speeding at the same traffic stop may have had their speeding citation dismissed and received a legal consequence solely for the alcohol offense.

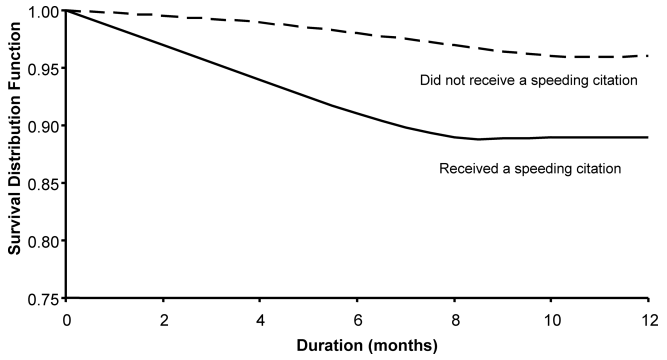

Figure 2 Kaplan-Meier curves for survival function of speeding citations among speeding violators (May 2002) and control group during June 1, 2002, to May 31, 2003.

From June 2002 through May 2003, 11% of drivers who received legal consequences and 11% of those who escaped legal consequences received a subsequent speeding citation (Table V). There was no significant difference in time to receipt of a subsequent speeding citation between drivers who received legal consequences and those who escaped legal consequences (Wilcoxon p-value $= 0.37$). In addition, there was no significant effect of receiving legal consequences on the risk of receiving a subsequent speeding citation after adjusting for potential confounders (gender, age group, and DUI/DWI offenses during follow-up) (adjusted RR 0.98, 95% CI 0.84–1.15) (Table V).

The risk of receiving a subsequent speeding citation was significantly lower among drivers who received fines and PBJ than among those who escaped legal consequences (unadjusted RR 0.75, 95% CI 0.63–0.90) (Table V). The effect remained significant after adjusting for potential confounders (gender, age group, county of residence, and DUI/DWI offenses during follow-up) (adjusted RR 0.81, 95% CI 0.67–0.96). There was no significant difference in the crude RR or adjusted RR for getting a subsequent speeding citation among people who received the most severe penalty, fines and points (crude RR 1.04, 95% CI 0.88–1.21; adjusted 1.07, 95% CI 0.91–1.25).

Stratified analyses suggested that gender could affect the association between receiving legal consequences and receiving a subsequent speeding citation. After receiving legal consequences, females had a lower rate of repeat offenses (Crude

Table IV Speeding penalties: Distribution of drivers by specific penalty and associated factors, May 2002 Maryland citation and licensure files

		Penalties from a citation in May 2002			
	Total N (%)	Fines + PBJ N (%)	Fines + points N (%)	No legal consequences N (%)	P-value*
Total	15,713 (100)	4,584 (29)	9,527 (61)	1,602 (10)	
Gender					
Male	9,455 (100)	2,452 (26)	5,966 (63)	1,037 (11)	<0.0001
Female	6,257 (100)	2,131 (34)	3,561 (57)	565 (9)	
Age group					
17–20	1,900 (100)	614 (32)	1,090 (58)	196 (10)	<0.0001
21–24	2,146 (100)	512 (24)	1,381 (64)	253 (12)	
25–29	2,106 (100)	542 (26)	1,351 (64)	213 (10)	
30–59	8,734 (100)	2,680 (31)	5,184 (60)	870 (10)	
60+	823 (100)	235 (29)	519 (63)	69 (8)	
County**					
Low	12,687 (100)	3,602 (28)	7,807 (62)	1,278 (10)	<0.0001
Medium	616 (100)	137 (22)	422 (69)	57 (9)	
High	787 (100)	180 (23)	544 (69)	63 (8)	
Subsequent DUI/DWI					
Yes	210 (100)	49 (23)	127 (61)	34 (16)	0.007
No	15,503 (100)	4,535 (29)	9,400 (61)	1,568 (10)	

*Chi-square P-value.
**County groups based on citations per licensed driver residing in the county.

RR 0.75, 95% CI 0.58–0.98, adjusted 0.79, 95% CI 0.61–1.03), whereas males did not (Crude RR 1.07, 95% CI 0.88–1.29, adjusted 1.08, 95% CI 0.90–1.31) (Table V). Among both genders, one legal penalty, PBJ, was associated with greater reductions in repeat speeding citations than points. The risk of receiving a subsequent speeding citation was significantly lower among female drivers who received fines and PBJ than among those who escaped legal consequences (crude RR 0.70, 95% CI 0.52–0.94, adjusted 0.73, 95% CI 0.55–0.98) (Table V). Men also appeared to have lower recidivism rates after receiving PBJ but this decrease did not attain statistical significance (crude RR 0.80, 95% CI 0.64–1.00, adjusted 0.83, 95% CI 0.66–1.03). We compared time to receipt of a subsequent speeding citation with regard to the severity of penalties. The Kaplan-Meier curves showed significant differences in survival curves among the three penalty groups, with shorter times until receipt of another citation in the groups escaping consequences or receiving fines and points compared with the group receiving fines/PBJ (Wilcoxon p-value < 0.0001) (Figure 3).

DISCUSSION

Our findings indicate that a single speeding citation has limited effects on changing drivers' likelihood of receiving subsequent speeding citations. To the extent that speeding citations are a valid proxy measure of speeding behavior, this study suggests that speeding citations have inadequate deterrent effects in the context of the current law enforcement system. Drivers who received a speeding citation during May 2002 had almost twice the risk of receiving a speeding citation during the

Table V Relative risks (RR) and 95% confidence intervals (CI) for subsequent speeding citations by receipt of legal consequences, June 1, 2002, to May 31, 2003, Maryland citation and licensure files

	Received a speeding citation during follow-up period			
	Yes, N (%) (N = 1,678)	No, N (%) (N = 14,107)	Unadjusted RR (95% CI)	Adjusted RR* (95% CI)
No legal consequence	181 (11)	1,424 (89)	1 (ref)	1 (ref)
Legal consequence	1,513 (11)	12,683 (89)	0.94 (0.80–1.09)	0.98 (0.84–1.15)
Female			0.75 (0.58–0.98)	0.79 (0.61–1.03)
Male			1.07 (0.88–1.29)	1.08 (0.90–1.31)
Fines and PBJ	351 (8)	4,233 (92)	0.75 (0.63–0.90)	0.81 (0.67–0.96)
Female			0.70 (0.52–0.94)	0.73 (0.55–0.98)
Male			0.80 (0.64–1.00)	0.83 (0.66–1.03)
Fines and points	1,165 (12)	8,362 (88)	1.04 (0.88–1.21)	1.07 (0.91–1.25)
Female			0.79 (0.60–1.04)	0.83 (0.63–1.09)
Male			1.17 (0.97–1.42)	1.18 (0.97–1.43)

RR, Relative risk; CI, Confidence interval.
*Adjusted for age, gender, grouped county of residence, subsequent DUI/DWI citations.

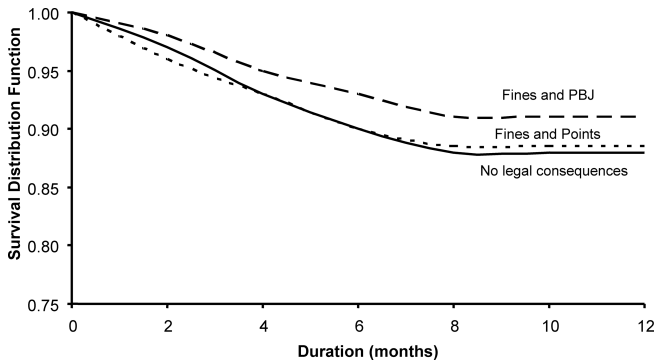

Figure 3 Specific penalties: Kaplan-Meier curves for survival function of speeding citations by presence and type of penalty from June 1, 2002, to May 31, 2003.

follow-up period than drivers who did not receive a speeding citation during that month. Young drivers and male drivers were more likely to receive speeding citations in May 2002, consistent with previous research (Maryland Department of Transportation, 2002; NHTSA, 2003; Williams et al., 2005). The risk of repeat violations was higher among drivers age 21 or older than among younger drivers; this could be due either to more lifestyle changes among younger drivers during the observation period (such as attending college or joining the military) or a greater influence of speeding citations on their likelihood of repeat citations.

The current study observed that drivers cited for alcohol-impaired driving during the follow-up period were more likely to receive speeding tickets during the follow-up period compared with drivers not cited for DUI/DWI. Further exploration of the speeding-alcohol relationship is needed to understand whether this association occurred because drivers are more likely to be ticketed for speeding when detected driving while impaired by alcohol or whether speeding and alcohol offenses occur at separate points in time. Additional analyses of speeding in relation to other risky driving behaviors, including non-use of seatbelts, also would be useful.

Punishments for violating traffic laws are intended to deter illegal driving behaviors. Results showed no differences in repeat citation rates among drivers who escaped legal consequences from speeding and drivers who received any legal consequence. When we compared the less severe and more severe penalties, we observed a significantly decreased risk of repeat citations among drivers who received fines and PBJ relative to drivers who escaped legal consequences. Receiving fines and points had no significant impact on the risk of repeat citations, although this was the most severe penalty. This finding is consistent with a review of the literature on traffic law enforcement by Zaal (1994), which stated that perceived probability of being caught was more important than penalty severity for deterrence. Stronger deterrent effects of PBJ relative to more serious consequences also have been observed among first-time alcohol traffic offenders. A study of Maryland DWI offenders observed that those who received PBJ were less likely to be reconvicted (Taxman et al., 1998).

Some gender differences in response to legal penalties were suggested by our findings. Based on stratified analyses, it appears that receipt of fines and PBJ may reduce repeat speeding violations among both females and males, with greater reductions among females. Unlike males, females receiving fines and points appeared to be less likely to have repeat citations than females escaping legal consequences, although this relationship was not statistically significant. Similarly, Castella and Perez (2004) reported that women responded to punishment from traffic violations more than men did.

Unlike most other studies of the effectiveness of speed enforcement, which used ecological data, we followed a cohort of violators over time. Therefore, we were able to gain a stronger understanding of the deterrent effects of speeding citations and of the characteristics of speeding violators. Our comparison group consisted of virtually all licensed drivers in Maryland, which increased the statistical power to detect differences and the precision of our estimates of relative risk. The effects of receiving PBJ versus points have not been sufficiently studied among individual speeding violators in previous studies.

Speeding citations are an inherently flawed measure of speeding behavior. The majority of driving trips that involve speeding do not result in speeding citations; however, when police issue speeding citations, the ticketed drivers will have been speeding, usually more than 10 mph above the limit. This means that our study group probably consisted of drivers who traveled at speeds higher than those of the general population of drivers when they were cited. In some cases, warnings rather than citations are given by officers. In theory, an officer's decision to ticket a driver rather than warn the driver not to speed again could be based on the driver's prior driving record, which could bias our findings toward higher rates of recidivism; however, our discussions with police indicate that Maryland officers typically do not check the driving record although they have access to it. Rather, the decision to give a citation is influenced by many other factors, including officer membership in a traffic enforcement unit, individual officers' response to drivers' attitudes after being caught, and by how much the speeding limit was exceeded. Officers also are not aware of whether a driver is on probation before judgment. Warnings are difficult to study. Both drivers in the study and comparison groups would be subject to the variability surrounding enforcement decisions by officers.

Owing to speeding citations being used as the measure for continued speeding, this study underestimated the extent of speeding behavior; however, this problem would affect both the study group of speeders cited in May 2002 and the comparison group. A sizeable proportion of controls likely were speeding during May 2002 but were not caught; the net result of this misclassification is underestimation of the differences between the known speeders and drivers who travel at lower speeds, so the estimated associations and outcomes reported by this study were conservative. In our study, people who were caught for speeding probably were a mix of habitual and non-habitual speeders, so that the risks calculated in our study were averages of these two groups. Potentially, receiving a ticket may have had different

effects on habitual versus non-habitual speeders, but there was no method to distinguish them. One possibility that the present study could not examine was whether the drivers ticketed in May 2002 may have engaged in less speeding than if they had not been cited.

A limitation in our analysis is that we did not control for license suspensions, yet these are relatively rare. If any members of the May 2002 citation group had their licenses suspended as a result of their citation, this could have resulted in an underestimate of the risks of repeat violations if the suspended drivers drove less than unticketed drivers. Suspended drivers appear to reduce their driving and drive more carefully in response to suspension (Gebers & DeYoung, 2002); however, suspended drivers also are more likely to be involved in at-fault collisions (Chandraratna et al., 2006), suggesting that the relationship between license suspension and driving exposure is complicated. Travel patterns were not known among the study and control groups, so that our only means of accounting for potential differences in travel through areas with high traffic enforcement activity was controlling for county of residence, which is a relatively crude surrogate for exposure to enforcement.

A more definitive study of the effects of speeding citations would involve longitudinal comparisons of driving behavior among ticketed and unticketed speeders detected using unobtrusive roadside observations, such as automated speed cameras. Such a study would be worthwhile, although it would pose considerable logistical challenges. Our study strongly suggests that drivers cited for speeding have a propensity to speed; thus, future research on effects of speeding enforcement should use a comparison group of speeding drivers who do not receive a citation. A topic that was beyond the scope of this study is potential bias in the issuance of speeding tickets by age, gender, race, or other factors; however, our analyses adjusted for age and gender, thus reducing the effects of potential age or gender bias on the findings.

The success of law enforcement depends on its ability to create a meaningful deterrent threat to road users. Previous research on alcohol-impaired driving and on seatbelt use has shown that when drivers perceive that their likelihood of getting caught for violating traffic laws is high and that punishment is swift and certain, violations of traffic laws decrease (Foss et al., 1997; Williams et al., 2000a, 2000b). To improve compliance with speed limits, the primary focus should be on increasing the perceived risk of detection. In Maryland, where speed enforcement is based almost entirely on police patrols, drivers may perceive correctly a low likelihood of being caught speeding. Increasing enforcement activity by using automated speed enforcement devices or increasing the visibility and unpredictability of traffic police operations may have greater deterrence potential (Holland, 1996; IIHS, 2004; Pilkington, 2005; Straddling, 2003; Vaa, 1997).

Although less important than perceived probability of being detected, drivers' perceptions of the severity of the penalty from speeding may influence deterrent efficacy as well. The legal consequences from speeding citations are relatively low, compared with those associated with DUI/DWI citations. The current results suggest that fines combined with PBJ were the most effective deterrent method. In comparing speeding citations during follow-up among drivers receiving probation and drivers receiving other legal consequences, one hindrance is that the drivers in various penalty groups may differ from one another, despite our adjustment for age, gender, county of residence, and DUI/DWI citations during follow-up. Judges' decisions might be influenced by traffic violations occurring more than 12 months prior to the index citation and other factors such as how fast the driver was traveling. Taxman and Piquero (1998) observed that a slightly higher percentage of first-time alcohol defendants receiving PBJ had a cleaner driving record than those who received more severe punishment. Aside from potential differences in the driver subgroups receiving PBJ versus other legal consequences, PBJ might be more effective than other legal penalties because of the personal contact with a judge, who warns the driver that points will be reinstated if he or she is caught speeding again within 6 months to a year.

Our findings suggest the need for further investigation of who receives different types of punishments and the efficacy of different severities of penalties, as well as whether there are subgroups within the population of speeders for which certain types of punishments may be more or less effective. In addition, a study with a longer follow-up period is needed to learn more about the drivers who repeatedly speed, particularly those who exceed the speed limit by 15 mph or greater and thereby pose a high risk to themselves and others sharing the road with them.

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REFERENCES

Castella J, Perez J. (2004) Sensitivity to Punishment and Sensitivity to Reward and Traffic Violations. *Acid Anal Prev.*, Vol. 36 (6), pp. 947–952.

Chandraratna S, Stamatiadis N, Stromberg A. (2006) Crash Involvement of Drivers with Multiple Crashes. *Accid Anal Prev.*, 38, pp. 532–541.

District Court of Maryland. (2006) Topics: Traffic. Available: http://www.courts.state.md.us/district/selfhelp/traffic.html.

Fakhry SM, Salaita K, Smooth Operator Aggressive Driving Task Force.. (2001) Aggressive Driving: A Preliminary Analysis of a Serious Threat to Motorists in a Large Metropolitan Area. *Journal of Trauma*, Vol. 5, pp. 217–223.

Federal Highway Administration, U.S. Department of Transportation. (2004) Synthesis of Safety Research Related to Speed and Speed Limits. Washington, DC. Available: http://www.tfhrc.gov/safety/speed/speed.htm. Accessed March 5, 2005.

Fildes BN, Rumbold G, Leening A. (1991) Speed Behavior and Driver's Attitude to Speeding. Monash University Accident Research Centre. Victoria, Australia.

Foss RD, Beirness DJ, Tolbert WG, Wells JK, Williams AF. (1997) Effect of an Intensive Sobriety Checkpoint Program on Drinking-Driving In North Carolina. Proceedings of the 14th International Conference on Alcohol, Drugs, and Traffic Safety, Ed. C. Mercier-Guyon, Centre d'Etudes et de Recherches en Médecine du Trafic, Annecy, France, Vol. 2, pp. 943–948.

Gebers MA, Peck RC. (2000) Using Traffic Conviction Correlates to Identify High Accident-Risk Drivers. RSS-00-187. California Department of Motor Vehicles, Sacramento: Available: http://www.dmv.ca.gov/about/profile/rd/r_d_report/Section%203/187-Traffic%20Conviction.pdf. Accessed September 4, 2006.

Gebers MA, Peck RC. (2003) Using Traffic Conviction Correlates to Identify High Accident-Risk Drivers. *Accid Anal. Prev.*, Vol. 35, pp. 903–912.

Holland CA, Conner MT. (1996) Exceeding the Speed Limit: An Evaluation of the Effectiveness of a Police Intervention. *Accid Anal. Prev.*, Vol. 28, pp. 587–597.

Insurance Institute for Highway Safety. (2003a) Special Issue: Speeding. Washington, DC. Available: http: //www.iihs.org/srpdfs/sr3810.pdf. Accessed March 5, 2005.

Insurance Institute for Highway Safety. (2003b) Speed and Speed Limit. Washington, DC. Available: http://www.iihs.org/safety_facts/qanda/speed_limits.htm. Accessed March 5, 2005.

Insurance Institute for Highway Safety. (2004) Statement before Maryland Senate Judicial Proceedings Committee: Automate Speed Enforcement. IIHS, Arlington, VA. Available: http://highwaysafety.org. Accessed March 5, 2005.

Jorgensen F, Pedersen H. (2005) Enforcement of Speed Limits—Actual Policy and Drivers' Knowledge. *Accid Anal. Prev.*, Vol. 37, pp. 53–62.

Kloeden CN, McLean AJ, Moore VM, Ponte G. Travelling Speed and the Risk of Crash Involvement. NHMRC Road Accident Research Unit. SA, Australia. Available: http://casr.adelaide.edu.au/speed/SPEED-V1.PDF. Accessed March 5, 2005.

Maryland General Assembly. (2006) Maryland Code, Criminal Procedure, Probation before Judgment. Annapolis, MD. Available: http://mlis.state.md.us. Accessed April 15, 2005.

Mesken J, Lajunen T, Summala H. (2002) Interpersonal Violations, Speeding Violations and Their Relation to Accident Involvement in Finland. *Ergonomics*, Vol. 45, pp. 469–483.

National Highway Traffic Safety Administration. (2003) Speeding. Traffic Safety Facts. NHTSA, Washington, D.C. Available: http://www-nrd.nhtsa.dot.gov/pdf/nrd 30/NCSA/TSF2003/809771.pdf. Accessed March 5, 2005.

Pilkington P, Kinra S. (2005) Effectiveness of Speed Cameras in Preventing Road Traffic Collisions and Related Casualities: Systemic Review. *BMJ*, Vol. 330, pp. 331–334.

Redelmeier DA, Tibshirani RJ, Evans L. (2003) Traffic-Law Enforcement and Risk of Death from Motor-Vehicle Crashes: Case-Crossover Study. *Lancet*, Vol. 361, pp. 2177–2182.

Roads and Traffic Authority, RTA. (2000) Speed: Speed Problem Definition and Countermeasure Summary. RTA, New South Wales, Australia.

Shinar D, Schechtman E, Compton R. (1999) Trends in Safe Driving Behaviors and in Relation to Trends in Health Maintenance Behaviors in the USA: 1985–1995. *Accid Anal. Prev.*, Vol. 31, pp. 497–503.

Siskind V. (1996) Does License Disqualification Reduce Reoffence Rates? *Accid Anal. Prev.*, Vol. 28, pp. 519–524.

State Highway Administration, Maryland Department of Transportation. (2003) Maryland Traffic Safety Facts 2002. Hanover, MD. Available: http://www.sha.state.md.us/Safety/oots/factbook2002_Nov12.pdf. Accessed March 5, 2005.

Stradling SG, Martin L, Campbell M. (2005) Effects of Speed Cameras on Driver Attitude and Behavior, in Traffic and Transport Psychology, Ed. G. Underwood. Elsevier, New York, pp. 513–520.

Taxman FS, Piquero A. (1998) On Preventing Drunk Driving Recidivism: An Examination of Rehabilitation and Punishment Approaches. *Journal of Criminal Justice*, Vol. 26, pp. 129–143.

Vaa T. (1997) Increased Police Enforcement: Effects on Speed. *Accid. Anal. Prev*, Vol. 29, pp. 373–385.

Williams AF, Ferguson SA, Cammisa MX. (2000a) Self-Reported Drinking and Driving Practices and Attitudes in Four Countries and Perceptions of Enforcement. *Proceedings of the 15th International Conference on Alcohol, Drugs, and Traffic Safety* (CD ROM). Swedish National Road Administration, Borlänge, Sweden.

Williams AF, Kyrychenko SY, Retting RA. (2005) Characteristics of Speeders. Insurance Institute for Highway Safety, Arlington, VA.

Williams AF, Wells JK, McCartt AT and Preusser DF. (2000b) "Buckle Up Now:" An Enforcement Program to Achieve High Belt Use. *J. Safety Res.*, Vol. 31, pp. 195–201.

Zaal D. (1994) Traffic Law Enforcement: A Review of the Literature. Report No.53, Monash University Accident Research Centre, Monash, Australia. Available: http://www.monash.edu/muarc/reports/muarc053.pdf. Accessed March 5, 2005.