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The Effect of Less-Lethal Weapons on Injuries in Police Use-of-Force Events

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Objectives. We investigated the effect of the use of less-lethal weapons, conductive energy devices (CEDs), and oleoresin capsicum (OC) spray on the prevalence and incidence of injuries to police officers and civilians in encounters involving the use of force.

Methods. We analyzed data from 12 police departments that documented injuries to officers and civilians in 24380 cases. We examined monthly injury rates for 2 police departments before and after their adoption of CEDs.

Results. Odds of injury to civilians and officers were significantly lower when police used CED weapons, after control for differences in case attributes and departmental policies restricting use of these weapons. Monthly incidence of injury in 2 police departments declined significantly, by 25% to 62%, after adoption of CED devices.

Conclusions. Injuries sustained during police use-of-force events affect thousands of police officers and civilians in the United States each year. Incidence of these injuries can be reduced dramatically when law enforcement agencies responsibly employ less-lethal weapons in lieu of physical force. (*Am J Public Health.* 2009;99:XXX–XXX. doi:10.2105/AJPH.2009.159616)

Police officers are disproportionately affected by intentional injuries in the workplace.[1] Although incidents of use of force by police officers account for less than 2% of the estimated total of police and civilian contacts (official interaction between any person and an officer), the prevalence of injury to civilians and officers in these situations is high.[2–8] Police departments in the United States are increasingly providing officers with less-lethal weapons to control suspects who physically resist arrest. The limited body of research on risk factors associated with injury during use-of-force incidents suggests that suspects have a greater likelihood of sustaining an injury when officers use canines, impact weapons (e.g., batons), or other physical force than when they use less-lethal weapons like conducted energy devices (CEDs) or chemical irritants like oleoresin capsicum (OC), also known as pepper spray.[9–13]

Less-lethal weapons have been accused of causing unnecessary injuries to and deaths of civilians.[14,15] CEDs and OC spray are routinely used by police officers and have been the focus of these accusations.[16,17] Police officers in more than 7000 law enforcement agencies in the United States now use CEDs, and use of OC spray is nearly universal.[18,19] Medical research indicates that most deaths associated with these weapons are the result of positional asphyxia, pre-existing health conditions, or drug-related factors.[20,21] CEDs appear to be relatively safe when used on healthy individuals in clinically controlled research settings,[22–34] but these weapons are not risk free. For example, CEDs may increase one's chance of secondary head injuries from falls.[35–37] Because of a lack of rigorous epidemiological studies, it remains unclear whether less-lethal weapons produce harmful effects among individuals at risk for police use of force, such as persons intoxicated by illicit drugs and physically struggling with the police. A review of police and medical records of suspects exposed to a CED shock during a 2-year period found that less than 1% received moderate injuries, and only 1 suspect (0.1%) received severe injuries.[38]

Few rigorous studies have examined the effect of policy decisions to adopt less-lethal weapons on the incidence of injuries to suspects and officers. Several studies have suggested that adoption of less-lethal weapons has led to substantial reductions in assaults on officers and injuries to suspects but have either failed to control for the level of resistance by the suspect or other important circumstances[39–41] or have relied on simple comparisons of injury rates before and after the introduction of less-lethal weapons.[42–44] These studies suffer from a number of potential methodological problems, including regression to the mean and a lack of sufficient control variables. Also, because research in this area has been sponsored by law enforcement agencies, lack of independence has been a point of contention.[15,17,45] Use of force by police involves multiple types of force, so it is critical to assess the independent contribution of less-lethal weapons on the prevalence and incidence of injury to the suspects and officers involved.

Injury from police use-of-force incidents continues to be a public health problem affecting tens of thousands of people in the United States each year. We investigated whether use of less-lethal weapons was associated with the likelihood of injuries to suspects and officers during police–civilian use-of-force incidents after statistical control for other important aspects of the events.

Relying on administrative data collected by 12 police departments across the United States (collected from 1998 through 2007), we investigated whether the use of CEDs or OC spray was associated with the odds of injury to officers and suspects in use-of-force cases. Because an association between use of these weapons and injury could result from selection effects, whereby events that require these weapons' application by police are more serious than those that do not, we tested for such an effect by examining whether these associations remained after control for important confounders including physical force used by the police; relative physical resistance from suspects; age, race, and gender of suspects; differences in departmental policies restricting use of force by the police; and average agency differences in the prevalence of use of force. Finally, to assess the effect that an agency's decision to adopt CEDs has on the incidence of injury to suspects and officers, we examined data from 2 cities in which monthly data were available for periods before and after adoption of this less-lethal weapon.

METHODS

A total of 12 police departments provided electronically available records on more than 24380 police use-of-force incidents for which injuries to suspects and officers were recorded. Dates for these data ranged between 1998 for the oldest data and 2007 for the most recent. Departments in Orlando, Florida; Austin, Texas; and Cincinnati, Ohio, provided the largest number of cases, representing 62.4% of the data used in our analysis. The Austin police department provided 6576 cases that occurred between 2002 and 2006; the Orlando police department provided 4358 cases that occurred between 1998 and 2006; and the Cincinnati police department provided 4299 cases that occurred between 2003 and 2007. The other 9 police departments provided between 1 and 3 years' worth of data on use-of-force cases and injuries, each contributing less than 10% of the cases we analyzed. Details are available elsewhere.[46]

Some modifications in data structure were necessary to develop a common set of uniformly measured variables. Some departments did not have incident identifiers from which to identify unique officers or subjects. One consequence of this is that some cases are not independent of each other and may be "nested" within use-of-force incidents, such that some use-of-force events may generate more than 1 case record. The estimated prevalence of this nonindependence in the sample is approximately 10% to 20%. This source of nonindependence affects the calculation of standard errors in the regression analysis. Therefore, these estimates are likely conservative.

Measures

All departments provided an indicator of whether there was an injury in each use-of-force case or a brief narrative describing the nature of the injury. Injury narratives were examined as a validity check on the injury indicators in each agency dataset. For example, a few departments counted skin irritation from pepper spray and CED dart punctures as injuries. We, therefore, recoded these cases as noninjuries unless CED dart punctures occurred in unapproved targets, such as the groin or face.

Eleven of the 12 departments provided varying details on the level of suspect resistance (e.g., passive resistance, active resistance, aggressive resistance, aggravated resistance). To provide a consistent measurement scheme, all resistance indicators were categorized into a dichotomous measure that recorded "resistance"; defensive (muscle tensing, fleeing on foot, grasping a fixed object) or greater (fighting an officer) was categorized as physical resistance. Passive (sitting or lying down) or verbal (refusing to comply with directives) resistance was coded as no physical resistance.

Records varied between departments on the types of physical force that was used (e.g., firm grips, takedowns, punches, elbow strikes, kicks, use of impact weapons like batons and flashlights). We created dichotomous measures of the types of physical force used by the police that included the use of any physical force (any use of hands, fists, feet, or impact weapons like batons and flashlights), the use of a chemical agent (such as OC), or CED. Less than 1% of these cases also included the discharge of a firearm. Removing these cases had no material effect on our results.

Ten out of 12 police departments provided information about suspect demographic characteristics; 8 departments provided data on suspect age, race, and gender, and 3 on only race and gender. Race was measured according to White versus non-White status. As part of a data-sharing agreement with police departments, we did not obtain information on officer demographic characteristics.

We also included a measure of how these police departments regulated the use of CEDs and OC spray among officers. Each agency was asked to respond to 5 hypothetical scenarios involving use of force by police and to indicate whether CEDs or OC spray would be authorized for use in each situation under the department's existing use-of-force policy. The scenarios ranged from passively resistant suspects (goes limp, sits down) to assaultive suspects (swings at officer's head with a closed fist). For the purpose of this study, we collapsed the departments' responses into a dichotomous variable that was coded 1 for a more restrictive OC spray or CED policy (e.g., weapons could be used against suspects exhibiting defensive or greater resistance) or 0 for a less restrictive policy (e.g., weapons could be used against passively or verbally resistant suspects).

Statistical Methods

We carried out 2 sets of analyses on injuries to officers and suspects, a set of cross-sectional estimates for injury outcomes across all 12 departments, and time-series estimates of the effect of CED adoption on the monthly incidence of injuries in 2 departments (Austin, TX, and Orlando, FL) for which we had data on periods before and after these departments adopted these weapons. Models were estimated using Stata version 10.0.[47]

In the first set of analyses, we assessed the cross-sectional relationship between individual-, situation-, and agency-level variables of use-of-force cases on the odds of suspect or officer injury, using multilevel regression models.[48] We specified a multilevel logistic regression model of injury to suspects and officers (separately) according to the following form:

$$(1)\quad \eta_{ij} = \beta_o + \beta x_i + \gamma_j \quad i = 1 \ldots N; j = 1 \ldots 12,$$

where η_{ij} represents the odds of experiencing an injury during a use-of-force event or the log

$$(2)\quad P(Yij = 1) \div (P(Yij = 0),$$

for individual event i in agency j, where xi represents the vector of individual case attributes (race, age, gender, physical force, OC use, etc.), with a group-level (random effect) parameter (γ_j) that allows the effects of individual case features to shift up or down according to each police department (j). To examine whether the department policies were associated with the probability of injury independent of individual case features, we extended equation 1 and included parameters measuring departmental policies—restricting the use of OC or CEDs to defensive resistance or higher—in place of the group-level parameter:

$$(3)\quad \gamma\omega_j = \gamma CED_j + \gamma OC_j.$$

The error structure was specified as an exchangeable covariance matrix, thus allowing a shared variance among departmental policies but a common pairwise covariance with individual case features. The group-level intercept term was substituted to improve the numerical stability in the model optimization.

We also estimated a multilevel regression model of individual case features including dummy variables (fixed-effect terms) for each police agency, thereby removing the average between-agency differences in prevalence of suspect or officer injury. This model controlled for the average between-agency differences, rather than assuming they were randomly distributed, and was capable of unbiased estimates of the covariates, assuming no important omitted variable bias.

In the second set of analyses, we assessed the effect of adopting CEDs on the monthly incidence of injuries to suspects and officers by estimating cross-sectional time-series models for Orlando and Austin, where we had monthly data on use-of-force events for periods before and after adoption of CEDs. We modeled injury incidence according to a Poisson distribution with the incidence of injuries (λ_t) per use-of-force case as a function of the adoption of CEDs. We specify the injury incidence during a given month (t) according to the following form:

$$(4)\quad \log(\lambda_t) = \log(force_t) + \beta(CED_t) + \sum_{k=1}^{4} \beta_k NS_k(t) + \varepsilon_t.$$

In equation 4, incidence of injuries in a given agency is indexed by month t. CED_t denotes a dummy variable indicating the month that CEDs became fully deployed. We included the natural log of the number of use-of-force events on the right-hand side of the regression equation and constrain the parameter to equal 1 so that the count of injuries is equivalent to a rate of injuries per event in a given month (t). To control for monthly trends in the use of force, we included 4 natural cubic spline parameters (NS_k).

The time-series model proposes a simple counterfactual: that the incidence of injuries (per month) in each agency after CEDs become fully adopted is proportional to what the incidence would have been had CEDs not been adopted. Tests for over-dispersion (excessive variation) indicated that no substantial improvement in fit occurred using a negative binomial model version of the Poisson model. We also substituted month and year fixed-effects parameters for the natural cubic spline parameters and found substantively similar results.

RESULTS

Table 1 presents descriptive statistics of the demographic and situational characteristics for the total sample and how the prevalence of injury outcomes varied by these factors. The majority of suspects were male (87.7%), 31% were White, and the average age was 30 years. The age distribution of suspects was curvilinear, consistent with the well-established age distribution of criminal offending.[49] Approximately 39% of all use-of-force cases resulted in an injury to a suspect. Injury to suspects was more prevalent than the sample average if a suspect was White (43%) or male (41%) or physical force was used by the police (48.9%). This injury prevalence was lower than the sample average if the police used OC spray (22.1%) or a CED (25.1%) or the department had a policy restricting officers to defensive use or greater for CEDs (35.2%) or OC spray (38.1%). Approximately 14% of cases resulted in an injury to a police officer. Injury to police officers was more prevalent than the sample average if physical force was used by the police (21.2%) and if a suspect physically resisted (16.7%). This injury prevalence was lower than the sample average for officers when CEDs were used (7.6%), but prevalence of officer injuries did not vary significantly by OC use. The observed difference in the prevalence of injuries to suspects and officers by demographic and situational features of cases reaffirm the need to adjust for these variables in our subsequent analysis of the effect of less-than-lethal weapons.

TABLE 1—Descriptive Statistics of Overall Sample of Use-of-Force Cases (N=24 380) and Prevalence of Suspect and Officer Injury, by Demographic and Situational Variables: United States, 1998–2007

	Sample, % (No.)	Suspect Injury, %	Officer Injury, %
Injuries			
Suspect	39.4 (9529)	100.0	0.0
Officer	13.8 (3209)	0.0	100.0
White	31.0 (7475)	43.0*	13.9
Male	87.7 (21286)	41.0*	14.1
Use of force			
Physical force	56.2 (13668)	48.9*	21.2*
OC use	23.4 (5723)	22.1*	14.0
CED use	22.3 (5437)	25.1*	7.6*
Resistance	76.3 (14331)	39.9*	16.7*
Defensive CED policy	65.5 (15968)	35.2*	12.5*
Defensive OC policy	89.4 (21818)	38.1*	13.7

Note. CED=conductive energy devices; OC=oleoresin capsicum;. The mean sample age was 30 years.
*$P<.001$ Pearson χ^2 test.

Cross-Sectional Models

Table 2 presents the multilevel models for suspect and officer injury outcomes. The first column shows the results for models of suspect and officer injury that included dummy variables for race (White=1), gender (male=1), use of physical force (yes=1), CED use (CED=1), and chemical spray use (OC=1). The average differences between departments were allowed to vary randomly around the group mean. We found that the use of OC or CEDs reduced the odds of suspect injury by 69% (odds ratio [OR]=0.31; 95% confidence interval [CI]=0.28, 0.33) and 65% (OR=0.5; 95% CI=0.32, 0.38), respectively, after control for other case attributes. For officer injury outcomes, the odds of injury increased slightly if an officer used OC spray (OR=1.42; 95% CI=1.29, 1.58) than if he or she did not. There was no relationship between CED use and officer injury.

Column 2 includes the baseline covariates, along with suspect resistance and age variables, for the departments that had complete data on these factors. The results from these models are substantively the same as those in column 1 and indicate that OC or CED use reduces the odds of suspect injury. Suspects who exhibited defensive or greater resistance had 27% greater odds of injury than did suspects who resisted passively (OR=1.27; 95% CI=1.16, 40). Suspect resistance also increased

TABLE 2—Individual and Department-Level Covariates of Suspect and Officer Injury: United States, 1998–2007

	Model 1		Model 2		Model 3		Model 4	
	No, χ^2, or OR (95% CI)	P	No, χ^2, or OR (95% CI)	P	No, χ^2, or OR (95% CI)	P	No, χ^2, or OR (95% CI)	P
			Suspect Injury					
No. of incidents	24004		12508		18168		18168	
No. of agencies	12		9		11		Fixed[a]	
Use of force								
Physical force	1.56 (1.45, 1.68)	<.001	1.97 (1.77, 2.20)	<.001	1.38 (1.26, 1.52)	<.001	1.31 (1.20, 1.44)	<.001
OC	0.31 (0.28, 0.33)	<.001	0.39 (0.35, 0.44)	<.001	0.34 (0.31, 0.38)	<.001	0.33 (0.30, 0.37)	<.001
CED	0.35 (0.32, 0.38)	<.001	0.49 (0.43, 0.56)	<.001	0.41 (0.37, 0.46)	<.001	0.41 (0.37, 0.46)	<.001
Gender[b]	2.11 (1.92, 2.33)	<.001	2.09 (1.85, 2.37)	<.001	2.29 (2.07, 2.56)	<.001	2.26 (2.03, 2.52)	
White (vs others)	1.20 (1.13, 1.28)	<.001	1.17 (1.08, 1.28)	<.001	1.20 (1.12, 1.29)	<.001	1.19 (1.11, 1.28)	<.001
Resistance			1.27 (1.16, 1.40)	<.001	1.25 (1.16, 1.36)	<.001	1.23 (1.14, 1.34)	<.001
Age			1.01 (0.99, 1.03)	.08				
Age^2			0.99	.31				
Defensive CED			(0.99, 1.00)		0.58 (0.39, 1.10)	.08		
Defensive OC					1.35 (0.71, 2.56)	.38		
Likelihood ratio, χ^2	2136	<.001	1195	<.001	1343	<.001	2802	<.001
			Officer Injury					
No. of incidents	22649		11321		17003		17003	
No. of agencies	11		8		10		Fixed[a]	
Use of force								
Physical force	4.49 (3.98, 5.06)	<.001	3.89 (3.34, 4.54)	<.001	3.79 (3.51, 4.36)	<.001	3.77 (3.28, 4.34)	<.001
OC	1.42 (1.29, 1.58)	<.001	1.25 (1.10, 1.43)	<.001	1.23 (1.09, 1.39)	<.001	1.23 (1.10, 1.40)	<.001
CED	1.01 (0.89, 1.14)	.869	0.98 (0.84, 1.15)	.84	1.04 (1.91, 1.21)	.743	1.03 (0.90, 1.20)	.63
Gender[b]	1.11 (0.99, 1.26)	.086	1.17 (1.01, 1.35)	.036	1.16 (1.01, 1.32)	.022	1.15 (1.01, 1.32)	<.001
White (vs others)	0.87 (0.80, 0.95)	.002	0.83 (0.75, 0.92)	<.001	0.83 (0.75, 0.91	<.001	0.81 (0.74, 0.90)	<.001
Resistance			1.72 (1.51, 1.95)	<.001	1.75 (1.55, 1.98)	<.001	1.75 (1.55, 1.98)	<.001
Age			1.02 (0.99, 1.05)	.07				
Age^2			0.99 (0.99, 0.99)	.03				
Defensive CED					1.22 (0.62, 2.42)	.568		
Defensive OC					1.19 (0.79, 1.81)	.40		
Likelihood ratio, χ^2	700.66	<.001	464.92	<.001	532.87	<.001	1631	<.001

Note. CED = conductive energy devices; CI = confidence interval; OC = oleoresin capsicum; OR = odds ratio.
[a]Fixed-effect models included department parameters (data not shown).
[b]1 = male.

the odds of officer injury by 72% (OR=1.72; 95% CI=1.51, 1.95).

Column 3 includes measures of departmental restrictions on OC spray or CED use, thus allowing an examination of whether the effects of individual-level case features on injury outcomes were conditional on departmental differences in these policies. Neither department-level differences in policies restricting the use of OC or CEDs were associated with odds of suspect or officer injuries, nor did they have a material effect on the other associations between individual use-of-force case features and injury outcomes.

Column 4 includes dummy variables (fixed-effects) for each agency to control for average departmental differences in the prevalence of injuries. Including agency parameters did not materially change the substantive conclusions regarding the covariates of suspect or officer injuries. The odds of suspect injury decreased by 67% (OR=0.33; 95% CI=0.30, 0.37) with use of OC and 59% (OR=0.41; 95% CI=0.37, 0.46) with use of a CED. By contrast, the odds of officer injury increased slightly if an officer used OC spray (OR=1.23; 95% CI=1.10, 1.40); there was no relation between CED use and officer injury.

Time-Series Models

The cross-sectional models control for observed differences between departments but do not explain the specific agency-level effect of deployment of less-lethal weapons on incidence of injury. This raises the question of whether agency-level differences are merely proxies for omitted variables. Because we do not know the level of potential omitted variable bias between departments, we focused a subsequent analysis on changes in the monthly injury incidence for Orlando and Austin associated with their adoption of CED technologies. Orlando data were aggregated to a 108-month period (1998–2006), with the major deployment of CEDs starting in the 62nd month (February 2003). Austin data were aggregated over a 60-month period (2002–2006), with the major deployment of CEDs occurring in the 31st month (July 2004), when all officers were issued CEDs and trained in their use. In Austin, CEDs were phased in during the 18 months before the 31st month, so the estimates we present of the impact of CEDs for this city are conservative. Neither department had a change in its use-of-force policy during the observed time periods.

Figure 1 displays the estimated monthly incidence of suspect injury, by city and month, after CEDs were fully deployed. There was an increase in use-of-force cases after CEDs were deployed in Orlando and a decline after full deployment of CEDs in Austin, but in both cities there was a significant drop in the monthly predicted incidence of injuries.

Table 3 presents the results from each model estimating the effect of adopting CEDs on the monthly incidence of suspect and officer injuries. These results are presented in terms of incidence ratios or the expected average monthly incidence in the postadoption period relative to the prior period. The results show a substantial reduction in incidence of injury to suspects and officers in both cities after the introduction of CEDs. For Orlando, the average monthly incidence of suspect injury decreased by 53% after adoption of CEDs (incidence ratio [IR]=0.47; 95% CI=0.37, 0.59). The incidence of officer injury dropped by 62% after introduction of CEDs (IR=0.38; 95% CI=0.23, 0.62). The results for Austin indicate that full-scale deployment of CED devices was associated with a 30% reduction in monthly incidence of suspect injury (IR=0.70; 95% CI=0.55, 0.88). For police officers, the monthly incidence of injury dropped by 25% (IR=0.75; 95% CI=0.55, 1.02) after the full deployment of CEDs. These models adjusted for the monthly total number of use-of-force events and time trends in each city, suggesting these associations are not driven by general or seasonal changes in the application of force by officers.

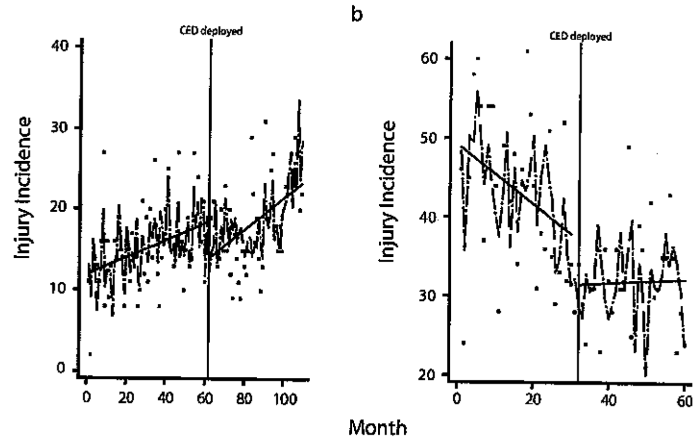

FIGURE 1—Suspect injury incidence and conductive energy device (CED) intervention, by month, in (a) Orlando, Florida, and (b) Austin, Texas: 1998–2006.

To test the sensitivity of these results to the chosen intervention month, we replicated the analysis, substituting the indicator of CED adoption with a measure of the number of CEDs used in each month. For both cities, an additional 10 uses of CEDs in a given month was associated with an estimated 9.8% to 9.9% reduction in the average injury incidence for both suspects and officers.

DISCUSSION

We examined the relationship between less-lethal weapons, situational features, and agency-level policies on injuries to suspects and officers in police use-of-force cases. Using administrative data from 12 local police departments including more than 24000 use-of-force cases, we found that the use of physical force by police increased the odds of injury to suspects and officers. Conversely, the use of less-lethal weapons (OC spray or CEDs) decreased the odds of injury to suspects. In the cross-sectional analysis, officers were unaffected by the use of CEDs, whereas the odds of officer injury increased slightly when OC spray was used. The time-series model of the change in injury incidence to suspects and officers associated with the introduction of CEDs in Austin and Orlando indicated that incidence of injury declined

TABLE 3—Effect of Adoption of Conductive Energy Devices (CEDs) on Monthly Suspect and Officer Injury Rates: Orlando, FL, and Austin, TX; 1998–2006 and 2002–2006

	Suspects		Officers	
	IR (95% CI) or χ^2	P	IR (95% CI) or χ^2	P
		Orlando, FL		
CED use (n=108)	0.47 (0.37, 0.59)	<.001	0.38 (0.23, 0.62)	<.001
Likelihood ratio	1311.97	<.001	2126.72	<.001
		Austin, TX		
CED use (n=60)	0.70 (0.55, 0.88)	.002	0.75 (0.55, 1.02)	.069
Likelihood ratio	2598.28	<.001	3416.31	<.001

Note. CI=confidence interval; IR=incidence ratio. These models controlled for natural cubic spline of the monthly time series.

substantially after this less-lethal technology was deployed. Other studies examining cross-sectional data from use-of-force events in the United States and the United Kingdom have found that CEDs were associated with lower injury risks compared with the use of chemical sprays or physical force.[13,44] Given the findings from this study, as well as those from previously published research, law enforcement agencies should encourage the use of OC spray or CEDs in place of impact weapons and should consider authorizing their use as a replacement for hands-on force tactics against physically resistant suspects.

A few limitations to our findings are worth mentioning. Because the data were derived from administrative records collected by police departments, they are missing many contextual features of these events that have been shown to be correlated with the consequences of force events, such as the nature of the incident that spurred the initial contact between the police and the citizen and whether the suspect was under the influence of alcohol or a controlled substance.[50] Thus, our study provides only conservative adjustments and does not fully account for all important case attributes. We also did not separately analyze cases of rare events such as in-custody suspect deaths. Even though injury rates declined with the introduction of CEDs in the 2 cities, our analysis did not rule out the possibility that in-custody deaths remained unaffected or even increased. We were also unable to fully determine whether a reported injury to a suspect was merely the result of a skin puncture caused by a CED barb or skin irritation caused by exposure to OC. When the type and cause of injury were available, we coded minor barb punctures and skin irritation as noninjuries so as not to confound the injury analysis. Had we been able to identify and remove all such cases, the observed reductions in injury rates might have been greater.

Injuries from police use-of-force incidents continue to be a public health problem affecting tens of thousands of civilians and police officers in the United States each year. Our findings suggest that the incidence of these injuries can be reduced substantially when police officers use CEDs and OC spray responsibly and in lieu of physical force to control physically resistant suspects. ■

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Contributors

J.M. MacDonald originated and performed all analyses and led the writing. R. Kaminski was responsible for organizing the data and collating records for the analytic database. M.R. Smith was the principal investigator on the project and contributed to the writing of the study. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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Human Participant Protection

This study was approved by the University of South Carolina's institutional review board.

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