Factors associated with civilian and police officer injury during 10 years of officer-involved shooting incidents

Ellen Paddock,[1] Katelyn Kassarjian Jetelina,[2] Stephen A Bishopp,[3] Kelley Pettee Gabriel,[1] Jennifer Marie Reingle Gonzalez [4]

[1]Department of Epidemiology, Human Genetics & Environmental Sciences, University of Texas School of Public Health, Austin, Texas, USA
[2]Department of Epidemiology, Human Genetics & Environmental Sciences, University of Texas School of Public Health, Dallas, Texas, USA
[3]Patrol Division, Dallas Police Department, Dallas, Texas, USA
[4]Meadows Mental Health Policy Institute, Dallas, Texas, USA

Correspondence to
Dr Jennifer Marie Reingle Gonzalez, Meadows Mental Health Policy Institute, Dallas, Texas, USA; jgonzalez@texasstateofmind.org

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ABSTRACT

Background Previous officer-involved shooting (OIS) research has focused primarily on antecedents to fatal shootings, with few studies investigating injury more broadly. Our study examined the factors associated with fatal or non-fatal injury to both civilians and officers during OIS incidents, to better understand how harm might be reduced in the most extreme law enforcement scenarios.

Methods Data included 281 officers involved in 177 unique shooting incidents recorded by Dallas Police Department between 2005 and 2015. Bivariate logistic regression and multivariable generalised estimation equation analyses were used to investigate incident characteristics associated with fatal or non-fatal injury to civilians and officers.

Results Civilian injury occurred in 61% and officer injury in 14% of unique OIS incidents. In adjusted models, multiple shooting officers increased the odds of injury to both civilians (adjusted OR (AOR): 3.22, 95% CI 1.39 to 7.50) and officers (AOR 4.73, 95% CI 1.64 to 13.65). Odds of civilian injury were also significantly higher during the daytime and among non-Hispanic white compared with non-Hispanic black and Hispanic/Latina/o civilians, although a majority of OIS incidents (79%) involved non-Hispanic black or Hispanic/Latino/a civilians. Odds of officer injury were significantly higher for detectives compared with patrol (AOR=9.32, 95% CI 1.85 to 47.03) and during off-duty versus on-duty shootings (AOR=5.23, 95% CI 1.37 to 19.99).

Conclusions Both civilians and officers are at risk for injury during OIS incidents, though to different degrees and with unique risk factors. Additional research is needed to understand whether these results are replicated elsewhere and to further understand the mechanisms of injury.

INTRODUCTION

In the continuum of encounters that law enforcement officers have with residents, officer-involved shootings (OIS) are uncommon. US[1] and international[2] standards hold that firearms should be used only as a last resort under immediate and serious threat of injury or death, given that firearms are the most fatal type of force an officer may use.[3 4] Consequently, OIS incidents tend to be highly volatile situations that place civilians and officers at elevated risk of injury.[5–8]

Whether fatal or non-fatal, OIS incidents exact a physical, psychological, social and economic toll on the individuals and communities involved. Surviving a firearm injury is often the start of a long recovery process involving life-long disabilities.[9] One study of 7573 hospital-treated firearm injury cases found that more than 60% of patients underwent two or more surgical procedures, with hospital stays averaging 6 days and approximately 16% discharged to home care or a long-term care facility.[10] Both civilians and officers involved in OIS incidents are also vulnerable to long-term psychological outcomes, including post-traumatic stress disorder.[11–13]

The costs of firearm injuries are also steep. One study estimated that among patients admitted to the hospital with firearm-related injuries, the average cost per admission ranged from \$19 642 for uninsured patients to \$30 952 for Medicaid.[14] Municipalities often face legal proceedings and settlements to victims and their families,[15] and administrative or sick leave and workers compensation for officers.[16] There are also more diffuse costs to health and safety efforts, as a single high-profile use of force incident can damage the perceived legitimacy of law enforcement agencies and affect the degree to which residents—particularly those in communities experiencing higher levels of crime and policing—feel safe calling the police. For example, one study demonstrated that when controlling for crime and previous call patterns, the occurrence of a high-profile use of force case was associated with a reduction of over 20 000 calls for service, with the effect persisting for over a year.[17]

Existing research on OIS has focused primarily on antecedent factors rather than outcomes. Findings indicate that officers with less experience and lower rank and education are more likely to be involved in use of force incidents or OIS;[18–24] that people who are young, black and male are most at risk of being subjected to force or shootings[23 25 26] and that incidents are generally more common in areas with higher violent crime.[27] These studies have largely focused on fatal shootings, with only a few descriptive studies examining broader injury patterns during OIS incidents.[28–31] To our knowledge, no analytic studies have examined both civilian and officer injury during OIS. To address this gap, this study used 10 years of data to identify factors associated with civilian and law enforcement officer injury during OIS incidents in Dallas, Texas.

METHODS

Study design and sample

This secondary data analysis investigated civilian, officer and situational characteristics associated with (1) civilian or (2) officer injury or fatality during OIS incidents. For this study, an OIS incident refers to any incident in which a Dallas police officer discharged their weapon in the presence of one or more civilians, on-duty or off-duty. Data include all OIS incidents documented by the Dallas Police Department (DPD) in Dallas, Texas between 1 January 2005 and 31 December 2015.[24]

Per departmental policy, an incident report was filed any time an officer discharged their firearm on-duty or off-duty, excluding shots fired on training or firing ranges. Since 2015, Texas law required that these data be made public. To compile the dataset, researchers abstracted and systematically coded incident records to obtain situational and civilian characteristics. Personnel and internal affairs records were used to obtain additional officer characteristics, including prior military experience and internal affairs allegations. Last, neighbourhood characteristics were obtained by linking incident geospatial data with US census records. The final sample included 281 officers involved in 177 unique OIS incidents.

Measures

The primary outcomes were two dichotomous variables: (1) occurrence of any fatal or non-fatal injury to a civilian and (2) occurrence of any fatal or non-fatal injury to an officer. Outcomes were coded from a text field containing both officer and civilian injury information. Four civilian injury outcomes were excluded after review of the incident reports indicated that the officer did not fire their weapon or the injury was not due to shooting involvement. Outcomes include injuries by any cause and do not necessarily mean firearm injuries.

Officer characteristics included age (continuous), race/ethnicity (non-Hispanic white, Hispanic/Latina/o, non-Hispanic black or other), sex (male or female), college education (any college credits or no college credits), military service and deployment history (yes or no), job assignment (patrol, detective or tactical/special operations/warrant serving unit), tenure in DPD (continuous), total number of allegations filed with internal affairs (continuous) and number of allegations sustained (continuous). Four officers were Native American/American Indian and eight were Asian; however, due to small sample size, these categories were combined. All originally continuous variables were skewed and therefore recoded as categorical above or below the median: age (≤38 or>38 years), tenure (≤10 or>10 years), total allegations with internal affairs (0, 1–4 (median) or 5 or more) and sustained allegations (0 or 1 or more).

Civilian characteristics included officer-reported sex (male or female) and race/ethnicity (non-Hispanic white, Hispanic/Latina/o, non-Hispanic black or other) for the primary person to whom police were responding in each incident ('subject'). One person was originally reported as Asian and two as 'other'; due to small sample size, these categories were combined.

Finally, the following situational characteristics were included in analyses: officer on-duty or off-duty status (eg, whether an officer was working on their normal shift), presence of a weapon (no weapon/unarmed, firearm or other weapon), number of shooters (1 or ≥2 shooters), time of day (12:00–05:59 hours, 06:00–11:59 hours, 12:00–17:59 hours and 18:00–23:59 hours), median annual household income for census tracts in which OIS occurred (≤$39 146 or >$39 146) and majority race/ethnicity (census tract majority non-Hispanic white, majority non-Hispanic black, majority Hispanic/Latina/o or no racial/ethnic majority). Notably, 'other weapon' comprised all objects recorded as weapons by the reporting officer, including both conventional weapons (eg, knife, TASER) and other objects (eg, vehicle, screwdriver, toy gun).

Statistical analysis

All analyses were conducted in Stata/IC 15.1 (College Station, Texas, USA). Initial examination of the data revealed the presence of non-independence due to clustering of multiple officers within a single incident and single officers involved in multiple incidents over time. Descriptive characteristics were therefore computed at the incident level (n=177) for situational and civilian characteristics and officer level (n=281) for all shooting officers. Unadjusted logistic regression models were used to examine the bivariate association between each independent variable and outcome.

To account for clustering, a mixed-effects model was initially attempted with random effect terms for clustering of multiple officers within a single incident and for multiple incidents per officer. However, due to the small sample size, there were repeated model convergence issues with this approach. To develop a more parsimonious model, each random effect term was independently tested with respect to each outcome variable. These analyses indicated that incident-level clustering (multiple officers within a single incident) was significantly related to the outcomes, while officer-level clustering (multiple incidents for one officer) was not.

Given this, generalised estimating equation (GEE) models using an exchangeable correlation structure based on incident-level clustering were used to assess factors associated with each outcome while controlling for covariates. After fitting a full GEE model for each outcome with all covariates, backwards selection was used to identify reduced models, removing variables exceeding a prespecified threshold of $p=0.25$. Results of the final GEE models are presented separately for each outcome.

RESULTS

Descriptive results

The 10-year cumulative prevalence of OIS in Dallas was 177 incidents, and descriptive results show that injury to an officer and/or civilian occurred in a majority (65%) of these incidents (table 1). Civilian injury occurred in 61% of incidents, including fatal injury in more than a third (35%). Officer injury occurred in 14% of incidents, with fatality in five incidents (3%).

Among the 281 shooting officers, there were 177 unique incidents involving 1 (123 incidents) to 13 (one incident) shooting officers. Twenty-three officers were involved in two incidents over time (data not shown). Officers who discharged their firearm were more likely to be male (96%), college-educated (82%) and assigned to patrol (84%), with a median age and tenure of 38 and 10 years, respectively. A majority of officers (56%) were non-Hispanic white, while roughly one-fourth were Hispanic/Latina/o and 17% were non-Hispanic black. Nearly 30% of officers had previously served in the military; of these, approximately half were deployed. Over three quarters of officers had at least one allegation filed with internal affairs (median: 4, range: 0–41) and 41% had one or more allegations sustained (median: 0, range: 0–20).

Across the 177 unique incidents, all except four (98%) involved male civilians. Nearly half of civilians were non-Hispanic black and just under one-third Hispanic/Latino/a, while less than 20% were non-Hispanic white. Neighbourhood

Table 1 Descriptive characteristics of officer-involved shooting incidents recorded by Dallas Police Department, 2005–2015*

Sample characteristics	N (%)
Officer characteristics (n=281 shooting officers)	
Sex, %	
Male	270 (96.09)
Female	11 (3.91)
Age in years, %	
≤38 (median age)	149 (53.21)
>38	131 (46.79)
Race or ethnicity %	
Non-Hispanic white	158 (56.23)
Hispanic/Latina or Latino	63 (22.42)
Non-Hispanic black	48 (17.08)
Other race or ethnicity	12 (4.27)
Any college education, %	
Yes	231 (82.21)
No	50 (17.79)
Job assignment, %	
Patrol	236 (83.99)
Detective	14 (4.98)
Special operations/Tactical unit	31 (11.03)
Tenure at DPD in years, %	
≤10 (median tenure)	138 (49.46)
>10	141 (50.54)
Prior military service, %	
Yes	82 (29.18)
No	199 (70.82)
Prior deployment(s), %	
Yes	40 (14.29)
No	240 (85.71)
Total allegations filed with IA	
0 allegations	61 (21.71)
1–4 allegations (at or below median)	93 (33.10)
5 or more allegations (above median)	127 (45.20)
Sustained allegations with IA, %	
0 allegations (median allegations)	166 (59.07)
1 or more allegations sustained (above median)	115 (40.93)
Civilian and situational characteristics (n=177 unique incidents)	
Civilian ('Subject') Sex, %	
Male	169 (97.69)
Female	4 (2.31)
Civilian race or ethnicity, %	
Non-Hispanic white	34 (19.65)
Hispanic/Latina or Latino	52 (30.06)
Non-Hispanic black	84 (48.55)
Other race or ethnicity	3 (1.73)
Off duty, %	
Yes	28 (15.82)
No	149 (84.18)
Time of day, %	
12:00–05:59 hours (Midnight/Early AM)	50 (28.57)
06:00–11:59 hours (Morning)	24 (13.71)
12:00–17:59 hours (Afternoon)	40 (22.86)
18:00–23:59 hours (Evening)	61 (34.86)
Weapon present, %	
No weapon/unarmed	38 (21.59)
Firearm	91 (51.70)
Other weapon	47 (26.70)
Number of shooting officers	
1 (median)	123 (69.49)
2 or more	54 (30.51)
Neighbourhood Race/Ethnicity	
Non-Hispanic white majority	21 (12.57)
Hispanic/Latina or Latino majority	79 (47.31)
Non-Hispanic black majority	45 (26.95)
No majority race/ethnicity	22 (13.17)
Neighbourhood annual household income	
≤ $39 146 (median for included census tracts)	83 (50.00)
> $39 146	83 (50.00)
Injury outcomes	
Any injury, civilian or officer	115 (64.97)
Any civilian injury, fatal or non-fatal (%)	108 (61.02)
Fatal civilian injury (%)	62 (35.03)
Any officer injury, fatal or non-fatal (%)	25 (14.12)
Fatal officer injury (%)	5 (2.82)

*The following numbers of observations were missing per variable: age (1), tenure (2), deployment status (1), civilian sex (4), civilian race/ethnicity (4), time of day (2), weapon (1), neighbourhood majority race/ethnicity (10), neighbourhood median income (10) and civilian injury (4). All variables not listed had complete data for all observations. Complete case analysis was used for all models in this study.
DPD, Dallas Police Department; IA, internal affairs.

demographics followed a similar pattern, with a large majority of incidents occurring in neighbourhoods that are majority non-Hispanic black (27%) or Hispanic/Latina/o (47%). Neighbourhood median annual household income was $39 146 (compared with the overall Dallas median income of $47 285.[32] No civilian weapon was found in 22% of cases, while 52% involved a firearm and 27% involved another weapon. Last, a majority of shootings occurred during the afternoon or evening, and while the officer was on duty.

Bivariate results

Civilian injury

In unadjusted models (table 2), odds of civilian injury were 63% lower during incidents involving non-Hispanic black officers compared with non-Hispanic white officers (OR=0.37, 95% CI 0.18 to 0.73), and the odds of civilian injuries were 56% lower in incidents involving Hispanic/Latino officers (OR=0.44, 95% CI 0.23 to 0.083). When the shooting officer was in a special operations or tactical role, odds of civilian injury were 6.39 times higher compared with patrol (95% CI 1.49 to 27.53), while there was no significant difference between patrol and detectives. Although 79% of incidents involved a non-Hispanic black or Hispanic/Latino civilian, odds of civilian injury were highest in the minority of incidents involving non-Hispanic white civilians, with Hispanic/Latino and non-Hispanic black civilians, respectively, having 86% (OR=0.14, 95% CI 0.04 to 0.47) and 78% (OR=0.22, 95% CI 0.07 to 0.70) lower odds of injury compared with non-Hispanic whites. In terms of situational characteristics, odds of civilian injury were highest during the daytime (06:00–11:59 hours OR=7.65, 95% CI 2.24 to 26.13, 12:00–17:59 hours OR=7.60, 95% CI 2.78 to 20.76) and when there were multiple shooters compared with one (OR=2.81, 95% CI 1.35 to 5.87).

Table 2 Bivariate associations between each incident characteristic and fatal or non-fatal civilian and officer injury, unadjusted ORs with 95% CI

Sample characteristics	Civilian injury unadjusted OR (95% CI)	Officer injury unadjusted OR (95% CI)
Officer characteristics (n=281 shooting officers)		
Sex		
Female	(ref)	(ref)
Male	0.92 (0.24 to 3.56)	2.27 (0.28 to 18.16)
Age in years		
≤38 (median age)	(ref)	(ref)
>38	0.83 (0.49 to 1.40)	2.45** (1.30 to 4.61)
Race or ethnicity		
Non-Hispanic white	(ref)	(ref)
Hispanic/Latina or Latino	0.44* (0.23 to 0.83)	1.68 (0.80 to 3.52)
Non-Hispanic black	0.37** (0.18-.73)	2.42* (1.13 to 5.19)
Other race or ethnicity	0.81 (0.21 to 3.17)	(empty)
Any college education		
No	(ref)	(ref)
Yes	1.20 (0.62 to 2.32)	1.45 (0.61 to 3.43)
Job assignment		
Patrol	(ref)	(ref)
Detective	0.44 (0.15 to 1.30)	12.85*** (4.03 to 40.99)
Special operations/ Tactical unit	6.39* (1.49 to 27.53)	5.16*** (2.29 to 11.62)
Tenure at DPD in years, %		
≤10 (median tenure)	(ref)	(ref)
>10	0.86 (0.51 to 1.46)	2.52** (1.32 to 4.80)
Prior military service		
No	(ref)	(ref)
Yes	1.13 (0.63 to 2.01)	1.41 (0.74 to 2.69)
Prior deployment(s)		
No	(ref)	(ref)
Yes	1.27 (0.59 to 2.73)	0.46 (0.15 to 1.34)
Total allegations filed with internal affairs		
0	(ref)	(ref)
1–4 (at or below median)	0.61 (0.29 to 1.31)	2.39 (0.95 to 6.01)
5 or more (above median)	0.65 (0.32 to 1.35)	1.62 (0.65 to 4.02)
Sustained allegations with internal affairs		
0 (median)	(ref)	(ref)
1 or more (above median)	0.60 (0.36 to 1.02)	1.01 (0.55 to 1.88)
Civilian and situational characteristics (n=177 unique incidents)		
Civilian sex		
Female	(ref)	(ref)
Male	5.25 (0.53 to 51.60)	(empty)
Civilian race or ethnicity		
Non-Hispanic white	(ref)	(ref)
Hispanic/Latina or Latino	0.14** (0.04 to 0.47)	0.76 (0.21 to 2.71)
Non-Hispanic black	0.22* (0.07 to 0.70)	1.16 (0.38 to 3.52)
Other race or ethnicity	(empty)	(empty)
Off duty		
No	(ref)	(ref)
Yes	0.46 (0.20 to 1.03)	1.40 (0.48 to 4.11)
Time of day		
12:00–05:59 hours	(ref)	(ref)
06:00–11:59 hours	7.65** (2.24 to 26.13)	1.23 (0.32 to 4.68)
12:00–17:59 hours	7.60*** (2.78 to 20.76)	1.30 (0.42 to 4.08)
18:00–23:59 hours	2.66* (1.22 to 5.83)	0.80 (0.26 to 2.44)
Weapon present		
No weapon/unarmed	(ref)	(ref)
Firearm	1.45 (0.66 to 3.20)	4.75 (1.05 to 21.52)*
Other weapon	0.74 (0.31 to 1.76)	1.67 (0.29 to 9.68)
Number of shooting officers		
1 (median)	(ref)	(ref)
2 or more	2.81** (1.35 to 5.87)	3.56** (1.50 to 8.49)
Neighbourhood race/ethnicity		
Non-Hispanic white majority	(ref)	(ref)
Hispanic/Latina or Latino	2.10 (0.76 to 5.79)	3.58 (0.44 to 29.25)
Non-Hispanic black majority	2.01 (0.68 to 5.98)	5.00 (0.59 to 42.37)
No majority race/ ethnicity	5.56 (0.95 to 32.46)	3.64 (0.29 to 44.78)
Neighbourhood annual household income		
≤ $39146 (median for included census tracts)	(ref)	(ref)
> $39146	0.93 (0.50 to 1.71)	0.63 (0.26 to 1.48)

*P<0.05, **p<0.01, ***p<0.001.
CI, Confidence Interval; DPD, Dallas Police Department; OR, Odds ratio; ref, Reference.

Officer injury

Unadjusted logistic regression results for officer injury (table 2) show that above-median officer age was associated with 2.45 times higher odds of officer injury during an OIS incident compared with age 38 or younger (95% CI 1.30 to 4.61). Similarly, tenure greater than 10 years was associated with 2.52 times higher odds of officer injury (95% CI 1.32 to 4.80). Officer race was associated with officer injury only when comparing non-Hispanic black and non-Hispanic white officers, with 2.42 times higher odds of officer injury in incidents involving non-Hispanic black officers (95% CI 1.13 to 5.19). Compared with patrol officers, detectives had 12.85 times higher odds of injury (95% CI 4.03 to 40.99) and special operations/tactical officers had 5.16 times higher odds (95% CI 2.29 to 11.62). Multiple shooters were associated with 3.56 times higher odds of officer injury compared with one shooter (95% CI 1.50 to 8.49) and presence of a civilian firearm with 4.75 times higher odds of officer injury compared with no weapon (95% CI: 1.05 to 21.52).

Multivariable model results

Multivariable models are presented in tables 3 and 4. When controlling for incident-level clustering and covariates, Hispanic or Latina/o civilians had 79% times lower adjusted odds of injury compared with non-Hispanic white civilians (adjusted OR (AOR)=0.21, 95% CI 0.06 to 0.73) and non-Hispanic black civilians had 75% lower odds of injury (AOR=0.25, 95% CI 0.08 to 0.81). For time of day, the highest odds of civilian injury were from 06:00 to 11:59 hours (AOR=5.58, 95% CI 1.53 to 20.35), and the lowest odds from midnight to 06:00 hours. Unexpectedly, presence of a non-firearm weapon was inversely associated with civilian injury (AOR=0.35, 95% CI 0.12 to 0.98). Last, incidents with multiple shooters had over three times higher odds of civilian injury compared with one shooter (AOR=3.22, 95% CI 1.39 to 7.50). Officer race/ethnicity and tenure did not retain a significant association with civilian injury in the final model.

For officer injury, job assignment, off duty status and number of shooters remained significant in the final model. Detectives

Table 3 Reduced GEE model predicting fatal or non-fatal civilian injury, adjusted ORs with 95% CI

Civilian injury, GEE adjusted OR		
Sample characteristics (n=2651)	**Adjusted OR (95% CI)**	**P value**
Officer race or ethnicity		
Non-Hispanic white	(ref)	
Hispanic/Latina or Latino	0.64 (0.32 to 1.28)	0.211
Non-Hispanic black	0.54 (0.25 to 1.18)	0.122
Other race or ethnicity	0.71 (0.14 to 3.76)	0.689
Tenure at DPD in years, %		
≤10 (median tenure)	(ref)	
>10	0.67 (0.37 to 1.20)	0.175
Civilian race or ethnicity		
Non-Hispanic white	(ref)	
Hispanic/Latina/o	0.21 (0.06 to 0.73)	0.014
Non-Hispanic black	.25 (.08-.81)	0.021
Other race or ethnicity	(empty)	
Time of day		
12:00–05:59 hours	(ref)	
06:00–11:59 hours	5.58 (1.53 to 20.35)	0.009
12–17:59 hours	5.36 (1.79 to 15.99)	0.003
18:00–23:59 hours	1.92 (0.81 to 4.58)	0.14
Weapon present		
No weapon/unarmed	(ref)	
Firearm	0.77 (0.31 to 1.96)	0.59
Other weapon	0.35 (0.12 to 0.98)	0.046
Number of shooting officers		
1 (median)	(ref)	
2 or more	3.22 (1.39 to 7.50)	0.007
Overall Wald χ^2 (p value)		32.52 (0.0011)

*16 cases were dropped from analysis due to missing data and/or few cases with no difference in outcomes (civilian other race or ethnicity—4 cases; all of these were non-injury cases).
CI, Confidence Interval; DPD, Dallas Police Department; GEE, generalised estimating equation; OR, Odds Ratio; ref, Reference.

Table 4 Reduced GEE model predicting fatal or non-fatal officer injury, adjusted ORs with 95% CI

Officer Injury, GEE adjusted OR		
Sample characteristics (n=2771)*	**Adjusted OR (95% CI)**	**P value**
Job assignment		
Patrolnonsignificant	(ref)	
Detective	9.32 (1.85 to 47.03)	0.007
Special operations/Tactical	2.34 (0.68 to 8.03)	0.175
Tenure at DPD in years, %		
≤10 (median tenure)	(ref)	
>10	1.62 (0.83 to 3.16)	0.16
Off duty		
No	(ref)	
Yes	5.23 (1.37 to 19.99)	0.016
Time of day		
12:00–05:59 hours	(ref)	
06:00–11:59 hours	1.05 (0.27 to 4.06)	0.943
12:00–17:59 hours	0.55 (0.15 to 1.98)	0.358
18:00–11:59 hours	0.44 (0.13 to 1.52)	0.194
Weapon present		
No weapon/unarmed	(ref)	
Firearm	3.08 (0.65 to 14.58)	0.157
Other weapon	1.09 (0.19 to 6.23)	0.923
Number of shooting officers		
1 (median)	(ref)	
2 or more	4.73 (1.64 to 13.65)	0.004
Overall Wald χ^2 (p value)		24.12 (0.0073)

*Four cases were dropped from analysis due to missing data.
CI, Confidence Interval; DPD, Dallas Police Department; GEE, generalised estimating equation; OR, Odds Ratio; ref, Reference.

had 9.32 times higher odds of injury compared with patrol officers (95% CI 1.85 to 47.03), though the difference between tactical and patrol officers was non-significant. Incidents that occurred off duty (AOR: 5.23, 95% CI 1.37 to 19.99) and involved multiple shooters (AOR: 4.73, 95% CI 1.64 to 13.65) also had substantially higher odds of injury when adjusting for covariates. Tenure and presence of a weapon were retained in the final model but remained non-significant.

DISCUSSION

This study found that injuries to civilians, and to a lesser extent officers, were highly prevalent during OIS incidents in Dallas from 2005 to 2015. Five key findings emerged with respect to risk factors for injury. First, the involvement of multiple shooters in an incident was associated with increased odds of injury for both civilians and officers. Second, non-Hispanic black and Hispanic civilians comprised the highest number of civilian injuries, but odds of injury were highest during the minority of incidents involving non-Hispanic white civilians. In the 15 incidents involving multiple injuries to civilians and/or officers, only four involved non-Hispanic white civilians (data not shown to prevent deductive disclosure due to small sample sizes). Third, job assignment was a major risk factor for officer injury, with detectives and tactical officers at particularly high risk. Fourth, unique situational factors influenced officer versus civilian injury, with higher odds of civilian injury during the daytime and higher odds of officer injury while off duty. Last, the presence of a firearm was not significantly associated with either civilian or officer injury after adjusting for covariates, though other weapons were inversely (and unexpectedly) related to civilian injury.

Findings related to civilian race and injury are striking, particularly in light of Dallas's broader demographics. According to the US Census, Dallas is 61% non-Hispanic white, 41.5% Hispanic/ Latina/o and 24.6% non-Hispanic black;[32] in contrast, more than three-quarters of civilians involved in OIS incidents were Hispanic/ Latina/o (30%) or non-Hispanic black (49%). This suggests that non-white residents in Dallas are disproportionately exposed to OIS, but that incidents involving whites have substantially higher odds of injury or death. Little information is available in these data or the broader literature to explain this finding, though controlling for covariates such as weapon and job assignment helps rule out some possibilities. It is possible that there may be qualitative differences between incidents involving white and non-white residents that are not detected in our data. With regard to racial bias, our study does not provide any direct answers. However, results suggest that if bias is a determining factor in OIS injuries, its role is complex—OIS incidents overall disproportionately involved non-Hispanic black and Hispanic/ Latino civilians relative to the Dallas general population, yet odds of injury were highest among whites, regardless of the race of the shooting officer. Explanations for the modest inverse association between civilian injury and non-firearm weapons remain similarly elusive. In contrast, the relationship between injury and time of day is consistent with results of previous studies conducted primarily in the context of 'accuracy',[33–35] with some studies pointing towards lighting as a likely mechanism for this finding.[34 35]

Officer injury results should be interpreted with caution given the small number of cases (25 fatal or non-fatal injuries), yet suggest compelling underlying patterns. Detectives, whose job responsibilities include collecting evidence and more office-based work, may be less routinely involved in critical incidents and therefore more vulnerable when they do so.[36] The finding that off-duty status is associated with higher odds of injury when controlling for number of officers may reflect a variety of situational differences, including lack of backup.

The fact that both civilian and officer injury were associated with multiple shooters points towards a stark, obvious conclusion: when more officers discharge their firearms, more people get hurt. In contrast, results regarding the presence of a civilian weapon (which may or may not have been used) require a more nuanced interpretation. Justification for using deadly force revolves around real or perceived imminent threat of death or serious bodily injury.[1] However, results of this study indicated that neither civilian firearms nor other weapons present on scene were associated with officer injury in final models, while civilian injury was similarly unrelated to firearms and inversely related to presence of an 'other weapon', though this finding should be treated with caution given the broad array of objects included in this category. While a larger sample size would provide increased statistical power to examine this association, this finding nevertheless reinforces the importance of using de-escalation techniques whenever possible to avoid officer and civilian injuries during high-stress situations.

Results of this study should be interpreted cautiously as a single-site study with potentially limited external validity. The small sample size limits our ability to reliably examine a large number of possible risk factors for injury and contributes to imprecise estimates for many of the computed ORs. While OIS incidents were combined across 10 years to increase sample size, this approach may also obscure secular changes in OIS characteristics over time. Some issues related to data collection are also worth noting, such as the reliance on officer-observed civilian race/ethnicity and the lack of more detailed data on civilian, neighbourhood and injury characteristics.

Despite these limitations, this study provides important context regarding the risk of injury during OISs and may have implications for injury prevention. Findings regarding the presence of a civilian weapon and number of shooters reinforce the importance of training law enforcement officers to understand their own physiological and psychological response during stressful and unpredictable situations,[37] to reliably evaluate a situation while under stress and to de-escalate rather than discharge a firearm wherever possible.[38] This is true at all hours, but may be particularly so during the daytime, when light gives officers increased visibility with which to observe the situation, but may also play a role in increasing odds of civilian injury. With respect to officer injury, results suggest that enhanced injury prevention measures may be needed for officers in roles such as detectives or special operations and while off duty. Departments may consider recurring defensive tactics training for detectives who may have interactions with the public to reduce their risk of injury in the future.

Future studies should continue to investigate injury during OIS incidents through replication in other jurisdictions and the inclusion of more nuanced incident and injury data. Findings may be used to identify and evaluate future opportunities for injury prevention during these critical incidents.

What is known on this subject

- Officer-involved shootings (OIS) are uncommon events but exact very high medical, psychological, economic, and public safety costs for the individuals and communities involved.
- Prior studies have focused on fatal shootings, largely ignoring injurious but nonfatal incidents, and a separate examination of civilian versus officer injury.

What this study adds

- This study assessed the prevalence of and risk factors associated with civilian and officer injury during OIS.
- Results suggest that both civilians and officers are at risk of injury during OIS, though the risk is much higher for civilians, and that a majority of these injuries are nonfatal.

Contributors EP conceptualised of the project, managed and analysed data and drafted the manuscript. KKJ assisted with data collection for key covariates and analyses and provided feedback on manuscript drafts. SAB collected data and provided feedback on the manuscript draft from a law enforcement perspective. KPG worked with EP to develop a data analysis strategy and provided iterative feedback on manuscript drafts. JMRG conceptualised the study and acquired funds to complete it. She oversaw all data collection, analysis and manuscript preparation for this project.

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ORCID iD
Jennifer Marie Reingle Gonzalez http://orcid.org/0000-0002-7294-505X

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