Psychology of Violence
2015, Vol. 5, No. 3, 236–245

2152-0828/15/$12.00 http://dx.doi.org/10.1037/a0038967

Prevalence and Offense Characteristics of Multiple Casualty Homicides: Are Schools at Higher Risk Than Other Locations?

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Objective: In light of public concern about school shootings, this study examined the prevalence and offense characteristics of multiple casualty homicides across locations. ***Method:*** We used the FBI's National Incident Based Reporting System (NIBRS) to examine 18,873 homicide incidents involving 25,180 victims who were either killed or injured from 2005 through 2010. ***Results:*** Multiple casualty homicides were surprisingly common events, with approximately 22% of homicide incidents involving 2 or more victims. Multiple casualty homicides were much more common in residences (47%) versus schools (0.8%), but homicides in residences tended to have 1 victim (78%) rather than multiple victims (22%), whereas homicides in schools were about equally likely to have 1 victim (57%) or multiple victims (43%). Multiple homicides were more likely to involve firearms than weapons such as knives or blunt objects. Finally, there were statistical differences in offense characteristics for homicides with 1, 2, and 3 victims. ***Conclusion:*** These findings suggest that the public perception that schools are a high-risk location for homicides is inaccurate. Although concern about school shootings is understandable, the larger problem of multiple casualty shootings is more common in other locations which do not receive comparable media attention.

Keywords: gun violence, mass homicide, mass shootings, school shootings

School shootings have stimulated widespread debate about the need for increased school security and safety measures (DeAngelis, Brent, & Ianni, 2011; Healy, 2013; *The Sunday Times*, 2013). Within a few months of the shootings at Sandy Hook Elementary School in Connecticut, every state legislature in the United States introduced new school safety measures, and approximately 20 states passed laws to improve school security (Armario, 2013). Although the tragedy of a school shooting understandably raises great public concern that schools are dangerous places, decisions about school safety should be based on an objective assessment of the risk of violence in schools in comparison to other locations. The purpose of this study was to examine the prevalence of multiple casualty homicides in schools in comparison with other locations and to identify risk factors associated with such events. In this study a multiple casualty homicide was broadly defined as any violent crime with at least one homicide and more than one victim, but definitions involving two, three, or four, victims were also investigated.

The location of multiple casualty homicides is of special interest because of the policy debate over whether schools need more protection than other locations. Communities across the country have allocated millions of dollars to school building security measures because of the perceived risk of shootings. Many schools have invested heavily in security personnel and installed security measures such as metal detectors, electronic door locks, bullet-proof glass, intruder alarms, and security video cameras (Armario, 2013; Davidson, 2013; DeAngelis et al., 2011; *The Sunday Times*, 2013). Such measures are expensive investments at a time when public education has limited funding. However, few studies have examined where multiple casualty homicides most frequently occur and in particular, how frequently they occur in schools (Bowers et al., 2010). Petee and Padgett's study (1997) found that multiple casualty homicides most typically occurred at restaurants (16%), retail stores (15%), or government offices/facilities (13%), but they purposely excluded homicides at residences. In contrast, Duwe (2004) found that most multiple casualty homicides occurred at private locations or residences (72%).

The overall number of homicides in schools also must be placed in a larger perspective. The Centers for Disease Control and Prevention (CDC, 2010) reported that 14 to 34 school-age children (ages 5–18) were victims of homicide at school (including travel to and from school) each year from 1992 to 2010 (Robers et al., 2013). In contrast, a far larger number of school-age children were murdered outside of school. For example, CDC identified 19 school-associated homicides during the 2009–2010 school year and 1,377 homicides outside of school (CDC, 2010). School-based homicides represent only one to two percent of homicides of school-age children. However, these data do not indicate how many of the homicides were shootings or how many were multiple casualty homicides, which are the cases that have aroused the greatest concern. More generally, there is substantial interest in the prevalence of multiple casualty shootings and whether they differ

This article was published Online First April 13, 2015.

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in important ways from single-victim shootings or other forms of homicide.

The role of firearms in school homicides is especially controversial. Gun safety advocates have characterized firearms as instrumental to the perpetration of school homicides, while gun ownership advocates have asserted that firearms are the only effective way to stop an attacker (National Rifle Association, 2012). Accordingly, proposals have ranged from restricting firearm purchases to training teachers to carry firearms (Armario, 2013; Healy, 2013). Although an analysis of gun safety strategies is beyond the scope of this study, understanding the relations between firearms and homicides can help clarify their relevance to discussions of school safety.

Finally, there is a general view among homicide researchers that multiple casualty homicides should be distinguished from homicides with only a single victim (Bowers et al., 2010). The tragedy of multiple victims in schools has raised great public concern, and it is important to consider how homicides differ as the number of victims increase. Multiple casualty homicides are most often distinguished from single homicides by the offender-victim relationship, which is typically classified as close relation, acquaintance, or stranger (Bowers et al., 2010; Duwe, 2004). However, previous studies are inconsistent in their findings. Duwe (2004) found that the most common offender-victim relationship in multiple casualty homicides was a close relation (i.e., a family member or intimate partner). This finding differs from some criminological literature (Bowers et al., 2010), which reported that multiple casualty homicide victims tend to be strangers or acquaintances. One possible explanation for this discrepancy is that multiple casualty homicides at public locations typically generate more media attention than such crimes at private locations, which likely involve close relations (Bowers et al., 2010).

The Current Study

Two methodological issues—sample selection and case definition—make it difficult to compare study findings. Some studies (Kelly, 2010; Petee, Padgett, & York, 1997) have relied on media reports as a source of sample cases, which is problematic because news reports are likely to yield a sample biased toward the most extreme cases. Other studies have used the Federal Bureau of Investigation's (FBI) Supplementary Homicide Reports (SHR; Cooper & Smith, 2011; Duwe, 2004), which include a large number of cases, but do not provide information on the number of victims and location where the crime occurred. Several authors have identified the FBI's National Incident Based Reporting System (NIBRS) as especially useful in overcoming both the selection biases embedded in studies derived from media reports and the limited assessment of offense characteristics in SHR studies (Briere, 2014; Huff-Corzine et al., 2014; Maxfield, 1999). The NIBRS was developed to gather more detailed crime information at the incident level than is obtained through the SHR and Uniform Crime Reports (Maxfield, 1999). Like the Uniform Crime Reports, the NIBRS is coded by local and state law enforcement officers using data from official agency reports and investigations, but permits analysis of multiple-victim and multiple-offender incidents.

The definition of a multiple casualty homicide is also problematic. An underlying assumption is that multiple casualty homicides are qualitatively different from single homicides, but this has not been empirically verified (Duwe, 2004; Wright et al., 2008). Previous literature uses terms such as "mass homicide," "mass murder," or "mass shootings," to signify the killing of or attempt to kill many people at a specific location within a brief time span (Bowers, Holmes, & Rhom, 2010; Critical Incident Response Group, 2013; Duwe, 2004; Petee, Padgett, & York, 1997). These studies use various cut-offs of two (Wright et al., 2008), three (Critical Incident Response Group, 2013; Petee, Padgett, & York, 1997), or four (Duwe, 2004; Fox & Levin, 2003; Huff-Corzine et al., 2014) victims. A related problem is that many studies only count homicide victims, and omit cases in which only one or two persons are killed but others are wounded. Bowers et al., (2010) contended that it is not the specific number killed, but the attempt to kill multiple individuals, that is critical. No study has systematically compared homicide incidents in a large enough sample to compare different cut-offs and determine whether there is a distinctive change in offense characteristics, such as location, associated with the number of victims.

To obtain a sufficiently large sample of multiple casualty homicides and overcome some of the limitations of previous research, the present study examined 18,873 homicide cases recorded in NIBRS over a 6-year period. We were primarily interested in comparing schools with other violent crime locations, but included other offense characteristics, including weapon, offender–victim relationship, and the sex and age of offenders, to place findings about locations in an appropriate context. There were three research questions: (a) "How do multiple casualty homicides compare to single homicides in locations, such as schools, and other offense characteristics?" (b) "How do location and other offense characteristics change as the number of victims increases?" and (c) "How do shootings differ from other nonshooting homicides?"

Method

Sample

The sample consisted of incident records from the NIBRS database for the years 2005 to 2010, the six most recent years with data available. The average number of homicide incidents per year from 2005 to 2010 was 3,145 for a total of 18,873. The NIBRS includes the number of victims for each offense, but only indicates whether the victim was killed for the first three cases. Of the 18,873 homicide incidents between 2005 and 2010, there were 14,475 cases (78%) involving a single victim and 4,398 (22%) involving multiple casualties. Among the homicides with more than one victim, the second victim was killed in 1,486 of the incidents (51% of two-victim incidents) and the third was also killed in 296 (40% of three-victim incidents).

Missing Data

The main variables of interest (i.e., location of offense and number of victims), as well as the state of occurrence and incident year (n = 18,873), were complete for all cases. The weapons variable was missing for 1,366 (7.2%) cases, and the offender–victim relationship variable was missing for 8,412 (45%) cases. Offender sex was missing for 3,962 (21%) cases and offender age

for 4,872 (26%) cases. Missing offender data were attributable in part to cases in which the offender had not been identified.

To make use of the cases with missing data, multiple imputation was carried out using SAS PROC MI. Multiple imputation is robust to various types of missing data mechanisms and is regarded as a principled method of handling missing data (Rubin, 1987; Schafer & Graham, 2002). Although no established benchmarks have been set in the literature regarding what is an acceptable percentage of missing data to yield valid estimates (Dong & Peng, 2013), guidelines set by Allison (2012) and Bodner (2008) were followed in generating the imputed datasets. Traditionally, five to 10 multiply imputed datasets have been deemed acceptable (e.g., Roberts, 2007 used 10 multiply imputed NIBRS datasets). As a conservative measure to ensure stable estimates, we used 30 multiply imputed datasets in all inferential statistical analyses. Results from regression models using the datasets were combined using PROC MIANALYZE, which factored in the uncertainty attributable to the missing values.

Measures

The validity of NIBRS data for crime research has been examined by previous researchers who concluded that it is especially useful for research questions that go beyond the scope of the Uniform Crime Reports (UCR) or National Crime Victimization Survey (NCVS; Maxfield, 1999; Roberts, 2007). For example, the NIBRS has been used to examine domestic violence incidents and crimes against children (Finkelhor & Ormrod, 2004; Snyder & McCurley, 2008). Although NIBRS is limited to known offense characteristics, it is most useful for crimes such as homicide that are less likely to go unreported than other violent crimes. The NCVS is derived from interviews with victims and includes crimes not reported to law enforcement, but does not include homicides or identify incidents with multiple victims.

Although NIBRS contains unparalleled information on a large amount of cases, it is a voluntary system that has not been implemented nationwide (Finkelhor & Ormrod, 2004). It includes crimes committed in 37 states, encompassing 29% of the U.S. population and 27% of the nation's reported crime. Two independent studies found that NIBRS incident data were reasonably consistent with Uniform Crime Report homicide data (Addington, 2008; Rantala & Edwards, 2000). A study of mass murders involving four or more victims found that NIBRS data provided estimates of offense characteristics consistent with the larger, but less detailed, data available in the Supplemental Homicide Reports (Huff-Corzine et al., 2014).

Location. Location type refers to where the homicide occurred. The original NIBRS coding had 44 categories, which were reduced before analyses to 12 more general categories (see Table 1). For example, the locations *drug store*, *department store*, and *specialty store* were combined into one *store* category. The *field/woods*, *lake/waterway*, and *park/playground* categories were combined into one *outdoors* category. In the NIBRS dataset, *school/college* was one category. Notably, only 13 of the 49 (27%) school/college homicides involved victims under 18 years of age and there were no victims below 12 years of age.

Weapons. The original weapons variable included 19 categories, 10 of which were variations of firearms (e.g., handgun, rifle, shotgun) and therefore grouped into one category. Consistent with previous studies, the remaining categories were grouped into *close proximity weapons* (e.g., knife, hands, blunt object) or *other weapons*, such as an explosive device or poison (Duwe, 2004; Silverman & Mukherjee, 1987).

Offender–victim relationship. The original offender–victim relationship variable included 25 categories, which were reduced to three more general categories commonly used in previous studies: (a) close relation (family member or intimate partner); (b) acquaintance or otherwise known person (e.g., neighbor or employer); and (c) stranger (Bowers et al., 2010; Duwe, 2004). In multiple-victim cases, the first offender–victim relationship was used.

Offender demographics. NIBRS data provide demographic information for up to three offenders. We used the first offender in our analyses and included the offender's gender (male = 0 and female = 1) and years of age. Age was analyzed as a continuous variable, but four groups are presented for descriptive purposes in Table 1.

Analysis Plan

To address the first research question, we grouped incidents according to the number of victims and compared frequencies of the following: location, weapon, offender–victim relationship, and offender demographics (sex and age).

Because of the skewed distribution for study variables, a truncated Poisson-based regression was used to examine the second research question of whether there was an association between increasing numbers of victims and offense characteristics. Poisson regression approaches have demonstrated greater reliability and accuracy than ordinary least squares regression when analyzing skewed count data (Huang & Cornell, 2012).

To further investigate the second research question, a series of binary logistic regressions were used to systematically investigate how offense characteristics changed with each additional victim, by successively subdividing the sample with multiple victims. The first regression compared single-victim incidents versus all other incidents. The second regression compared incidents with two victims versus those with three or more victims. The third regression compared incidents with three victims versus those with four or more victims, and the fourth and final regression compared incidents with four victims versus those with five or more victims. There were too few incidents with six or more victims ($n = 47$) to merit further comparisons. The homicide offender's sex and age were used as predictors in the regression models.

To address our last research question, logistic regression analyses compared shootings to nonshootings. Weapons was used as the dependent variable, where all firearms = 1 and all other weapons = 0. All of the regression models used in the analyses used a fixed effects approach (Huang, 2014) to account for incidents nested within state and year of incident.

Results

Table 1 presents descriptive information. The most frequent location for homicides was a residence (52%), followed by highway/road/alley (24%), parking lot/garage/terminal (6%), and other location (6%). The remaining 8 categories, including restaurants/bars (3%) and schools (0.3%), comprised 12% of homicide incidents.

Table 1
Descriptive Statistics of Homicide Incidents

Number of victims	1		2		3		4		5		6 +	
	n	Column %	*n*	Column %	*n*	Column %	*n*	Column %	*n*	Column %	*n*	Column %
Incident, *n*	14,745	100	2,912	100	735	100	281	100	110	100	90	100
No. of offenders per homicide incident	14,212	100	2,715	100	1,059	100	471	100	209	100	207	100
Primary incident location												
Residence	7,809	52.9	1,465	50.3	346	47.0	128	45.6	55	50.0	44	48.9
Parking lot/garage/terminal	905	6.1	206	7.1	57	7.8	25	8.9	7	6.4	9	10.0
Highway/road/alley	3,418	23.2	732	25.1	191	26.0	75	26.7	26	23.6	13	14.4
Outside	551	3.7	58	2.0	13	1.8	4	1.4	2	1.8	1	1.1
School	28	0.2	15	0.5	2	0.3	3	1.1	0	0	1	1.1
Store	95	0.6	44	1.5	10	1.4	4	1.4	2	1.8	4	4.4
Gas station/convenience store	224	1.5	75	2.6	25	3.4	5	1.8	3	2.7	1	1.1
Government/office building/place of business	227	1.5	38	1.3	12	1.6	7	2.5	1	0.9	3	3.3
Restaurant/bar	339	2.3	108	3.7	45	6.1	22	7.8	9	8.2	10	11.1
Hotel/motel	170	1.2	33	1.1	6	0.8	2	0.7	0	0	0	0
Religious	19	0.1	4	0.1	0	0	0	0	0	0	1	1.1
Other	960	6.5	134	4.6	28	3.8	6	2.1	5	4.5	3	3.3
Location column total	14,745	100	2,912	100	735	100	281	100	110	100	90	100
Primary weapon of Use												
Knife, blunt object, or personal (e.g., hands)	3,995	29.5	493	17.6	97	13.6	26	9.5	12	11.3	0	0
Firearm	8,688	64.2	2,161	77.2	578	81.0	232	84.7	87	82.1	82	94.3
Other weapon	845	6.2	144	5.1	39	5.4	16	5.8	7	6.6	5	5.7
Weapon column total	13,528	100	2,798	100	714	100	274	100	106	100	87	100
Primary offender–victim relationship												
Close relation	3,357	40.7	483	30.5	94	24.0	29	20.6	18	30.0	8	16.7
Acquaintance/known	3,745	45.5	748	47.3	170	43.5	59	41.8	21	35.0	15	31.3
Stranger	1,136	13.8	352	22.2	127	32.5	53	37.6	21	35.0	25	52.0
Relationship column total	8,238	100	1,583	100	391	100	141	100	60	100	48	100
Offender sex												
Male	10,097	88.5	2,283	93.3	611	95.9	237	97.9	92	95.8	77	95.1
Female	1,311	11.5	164	6.7	26	4.1	5	2.1	4	4.2	4	4.9
Gender column total	11,408	100	2,447	100	637	100	242	100	96	100	81	100
Offender age group												
Under 18 years of age	642	6.0	187	8.3	45	7.5	26	11.4	7	8.0	8	10.8
18–39 years of age	7,298	67.8	1,591	70.8	453	75.9	171	74.7	70	79.5	60	81.1
40–65 years of age	2,588	24.0	440	19.6	94	15.8	32	13.9	11	12.5	6	8.1
66+ years of age	238	2.2	29	1.3	5	0.8	0	0	0	0	0	0
Age column total	10,766	100	2,247	100	597	100	229	100	88	100	74	100

Note. Homicide incidents include at least one homicide. Subsequent victims suffered either injury or fatality.

Regarding weapons used, 68% of homicide incidents involved a firearm, and only 26% of cases involved a close-proximity weapon. The remaining 6% involved other weapons, such as an explosive device. Offender-victim relationships were most commonly acquaintances (46%), followed by close relations (38%) and strangers (16%).

The number of victims ranged from 1 to 54 (M = 1.33). Approximately 78.1% of the homicide incidents had one victim, 15.4% had two victims, 3.9% had 3 victims, 1.5% had four victims, and the remaining 1% had five or more victims. The number of offenders ranged from 1 to 17 per incident (M = 1.44). Approximately 75% of the offenses had one offender, 14% had two offenders, 6% had three offenders, 3% had four offenders, 1% had five or more offenders, and the remaining 1% had six or more offenders.

Finally, 62% of offenses had one offender and one victim, 10% had two offenders and one victim, and 10% had one offender and two victims. Only 3.6% of offenses had three offenders and one victim, and 2.3% of offenses had one offender and three victims.

Offender Characteristics

Offenders in the dataset were predominantly male (n = 13,397, 90%). Offender ages were the following: under 18 years (7%), 18–39 (69%), 40–65 (23%), and 66 or older (2%). Notably, 19 of the 49 (39%) school homicides involved adolescent offenders.

Truncated Poisson Regression Model

To examine the second research question, a truncated Poisson regression model was used to predict increases or decreases in the number of victims based on offense characteristics. The fixed effects regression model included the following variables: location type, weapon, offender–victim relationship, offender sex, age, and number of offenders per incident (see Table 2).

The full model results include an incidence rate ratio (IRR), which is the antilog of the regression coefficient (i.e., exp[b]) that indicates the factor change in counts for a one unit change in the variable. IRRs >1 indicate that an independent variable is associated with an increase in the number of victims, whereas IRRs <1

Table 2
Poisson Regression Results on Multiple Casualty Homicides (n = 18,873)

Predictors	Model		
	b	*SE*	*IRR*
Location[a]			
Gas station/convenience store	0.16*	0.08	1.18
Government/office	0.14	0.09	1.15
Highway/road/alley	−0.12***	0.03	0.88
Hotel/motel	−0.34*	0.14	0.71
Other	−0.39***	0.06	0.67
Outdoors	−0.55***	0.09	0.58
Parking lot/garage/terminal	−0.07	0.05	0.94
Religious establishment	0.33	0.27	1.39
Restaurant/bar	0.47***	0.05	1.60
School	1.24***	0.11	3.47
Store	0.45***	0.09	1.57
Weapon[b]			
Firearm	0.68***	0.04	1.98
Other	0.58***	0.07	1.78
Relationship[c]			
Acquaintance/otherwise known	0.01	0.04	1.01
Stranger	0.24***	0.05	1.28
Female offender	−0.40***	0.06	0.67
Offender age	−0.01***	0.00	0.99
Number of offenders	0.18***	0.01	1.20

Note. Model results using 30 multiply-imputed datasets. IRR = incident rate ratio.
[a] Reference group = residence. [b] Reference group = Knife/personal weapon. [c] Reference group = Close relation.
* $p < .05$. *** $p < .001$.

indicate a decrease in the number of victims. For location, we used residence as the reference category because it was the most common location for a homicide. Notably, victim counts in schools were higher (IRR = 3.47) than victim counts in residences. Of note, there were only 49 (0.3%) incidents at schools in the dataset, but schools had the lowest percentage of single victims among all location categories: 78% of all incidents across all locations had one victim, whereas only 54% of school homicides had one victim. Although homicides occurred infrequently at schools, when they occurred, they were more likely to involve multiple victims than homicides at other locations.

The following locations were also associated with higher victim counts when compared with residences: gas stations/convenience stores (18% higher), restaurants/bars (60% higher), and stores (57% higher). On the other hand, the following locations were associated with lower victim counts, as compared with residences: highways/roads/alleys (12% lower) and hotels/motels (29% lower). Number of victims also tended to be lower outdoors (42% lower) and at other locations (33% lower) than at residences.

We used close-proximity weapon (i.e., knife or blunt object) as the reference category for weapons, because we were interested in how firearm use was associated with higher victim counts. Compared with close-proximity weapons, the use of firearms was associated with a higher number of victims (98% higher) as was the use of other weapons (78% higher). Strangers, compared with close relations (i.e., the reference category), had victim counts that were higher by 28%. The number of victims per incident was lower by 33% for female offenders compared to male offenders. Finally, victim count was higher by 20% as the number of offenders per incident increased, controlling for all other variables included in the model.

Logistic Regression Models

To further examine our second research question, we used five orthogonal, fixed effects logistic regression models. Each was used to predict two dichotomous groups based on the number of victims and included the following variables: location type, weapon, offender-victim relationship, offender sex, age, and number of offenders per incident (see Table 3).

The first regression model comparing single homicides to multiple casualty homicides was significant (Nagelkerke $R^2 = .13$, $p < .001$). Homicides in schools (OR = 2.62) were more likely to have two or more victims, compared with homicides in residences (the reference category), which were more likely to have one victim. Although residences were the most common location for homicides (a total of 9,847 incidents), 22% of incidents involved two or more victims. In contrast, homicides in schools were rare (a total of 49 incidents or .0025% of the 18,873 homicides in the NIBRS), but 43% of these incidents had more than one victim.

Again, comparing the ratios of multiple to single casualty homicides, multiple casualty homicides were less likely among homicide incidents to occur at highway/road/alley locations (OR = 0.88), outside (OR = 0.49), or at other locations (OR = 0.63), and more likely to take place at a gas station/convenience store (OR = 1.43), restaurant/bar (OR = 1.72), or store (OR = 1.99), as compared with homicide incidents at residences.

In multiple casualty homicides, offenders were more likely to use a firearm (OR = 2.13) or other weapon (OR = 1.77) than a knife or other close-proximity weapon. Victims were more likely to be strangers than close relations (OR = 1.35). Multiple casualty homicides were also more likely if the incident involved an offender who was younger (OR = 0.996) or male (OR = 1.56). Multiple casualty homicides were more likely to involve multiple offenders (OR = 1.35).

The second regression analysis contrasted homicides with two victims versus three or more victims (Nagelkerke $R^2 = .06$, $p < .001$). The proportion of incidents with three or more victims was higher at a restaurant/bar than at a residence (OR = 1.84). Offenders were more likely to use a firearm (OR = 1.54) or other weapon (OR = 1.82), rather than a knife or other close-proximity weapon. Cases with three or more victims were less likely to have offenders who were younger (OR = 0.99) and female (OR = 0.62), but more likely to involve multiple offenders (OR = 1.20). Schools were not significantly associated with three or more victims.

The third regression analysis compared homicides with three victims versus four or more victims (Nagelkerke $R^2 = .11$, $p < .001$). Incidents with four or more victims were more likely to involve firearms (OR = 1.67) or other weapons (OR = 2.18), younger offenders (OR = 0.98), and multiple offenders (OR = 1.12). The remaining model that examined five or more victims had no predictor variables that were statistically significant (Nagelkerke $R^2 = .14$, $p > .05$).

Table 3
Logistic Regression Results on the Number of Multiple Casualty Homicides

Predictors	1 vs. 2+ victims			2 vs. 3+ victims			3 vs. 4+ victims			4 vs. 5+ victims		
	OR	95% CI	*SE*	OR	95% CI	*SE*	OR	95% CI	*SE*	OR	95% CI	*SE*
Location[a]												
Gas station/convenience store	1.43**	(1.12–1.83)	0.18	1.07	(0.69–1.64)	0.23	0.45	(0.19–1.04)	0.19	1.25	(0.30–5.11)	0.90
Government/office	0.98	(0.72–1.32)	0.15	1.49	(0.87–2.57)	0.41	1.49	(0.62–3.61)	0.67	0.57	(0.14–2.27)	0.40
Highway/road/alley	0.88**	(0.80–0.97)	0.04	0.92	(0.76–1.10)	0.08	0.77	(0.56–1.05)	0.12	0.64	(0.38–1.09)	0.17
Hotel/motel	0.77	(0.53–1.11)	0.15	0.57	(0.25–1.25)	0.23	0.41	(0.08–2.15)	0.34	N/A	N/A	N/A
Other	0.63***	(0.53–0.75)	0.06	0.73	(0.50–1.06)	0.14	0.61	(0.30–1.22)	0.22	1.69	(0.51–5.52)	1.02
Outdoors	0.49***	(0.38–0.63)	0.06	0.81	(0.47–1.38)	0.22	0.80	(0.30–2.15)	0.40	0.60	(0.11–3.28)	0.52
Parking lot/garage/terminal	0.93	(0.80–1.09)	0.07	0.94	(0.72–1.24)	0.13	0.82	(0.52–1.31)	0.19	0.67	(0.32–1.41)	0.25
Religious establishment	0.97	(0.34–2.74)	0.51	0.47	(0.05–4.74)	0.55	N/A	N/A	N/A	N/A	N/A	N/A
Restaurant/bar	1.72***	(1.42–2.09)	0.17	1.84***	(1.35–2.52)	0.29	1.22	(0.75–1.99)	0.30	0.94	(0.45–1.97)	0.35
School	2.52**	(1.38–4.61)	0.78	0.83	(0.31–2.23)	0.42	4.31	(0.46–40.46)	4.93	0.40	(0.04–4.44)	0.49
Store	1.99***	(1.42–2.79)	0.34	0.93	(0.54–1.62)	0.26	1.46	(0.56–3.81)	0.71	1.18	(0.28–4.92)	0.86
Weapon[b]												
Firearm	2.13***	(1.92–2.36)	0.11	1.54***	(1.24–1.93)	0.18	1.67*	(1.09–2.54)	0.36	1.41	(0.62–3.23)	0.59
Other	1.77***	(1.47–2.12)	0.16	1.82**	(1.26–2.64)	0.34	2.18*	(1.13–4.19)	0.73	1.59	(0.52–4.89)	0.91
Relationship[c]												
Acquaintance/otherwise known	1.05	(0.95–1.17)	0.06	0.93	(0.76–1.15)	0.10	0.82	(0.55–1.23)	0.17	0.84	(0.44–1.62)	0.28
Stranger	1.35***	(1.19–1.54)	0.09	1.23	(0.95–1.58)	0.16	0.95	(0.62–1.47)	0.21	1.04	(0.51–2.12)	0.38
Female offender	0.64***	(0.55–0.75)	0.05	0.62*	(0.44–0.89)	0.11	0.77	(0.38–1.57)	0.28	1.67	(0.50–5.55)	1.02
Offender age[d]	1.00*	(0.99–1.00)	0.00	0.99*	(0.98–1.00)	0.00	0.98*	(0.97–1.00)	0.01	1.00	(0.98–1.03)	0.01
No. of offenders	1.35***	(1.30–1.40)	0.02	1.20***	(1.13–1.26)	0.03	1.12**	(1.03–1.22)	0.05	1.06	(0.94–1.19)	0.06
n		18,873			4,128			1,216			481	
Nagelkerke R^2		.13***			.06***			.11***			.14	

Note. Model results using 30 multiply-imputed datasets. N/A = not available.
[a] Reference group = residence. [b] Reference group = Knife/personal weapon. [c] Reference group = Close relation. [d] Although the odds ratio may indicate 1.00, the upper bound of the confidence interval is 0.9995. ORs that include 1.00 within the 95% confidence interval are not statistically significant.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Shootings Versus Nonshootings

To address our final research question, a logistic regression model compared shootings with nonshootings as the outcome variable and included all previously used independent variables (see Table 4).

The overall model comparing shootings to nonshootings was significant (Nagelkerke $R^2 = .15$, $p < .001$). Shootings were no more likely than nonshootings to occur at schools, compared with residences ($p > .05$). They were more likely than nonshootings to occur at a gas station/convenience store (OR = 2.41), highway/road/alley (OR = 1.81), parking lot/garage/terminal (OR = 1.88), restaurant/bar (OR = 1.41), or store (OR = 2.27), compared with a residence. Shootings were less likely than nonshootings to occur outdoors (OR = 0.73) compared with a residence. They were more likely than nonshootings to involve victims who were acquaintances (OR = 1.11) or strangers (OR = 1.31), as compared with close relations. For offender demographics, shootings were more likely than nonshootings to have male offenders (OR = 1.96) who were older (OR = 1.0004). Finally, shootings were more likely than nonshootings to have higher offender counts (OR = 1.13) and victim counts (OR = 1.47) per incident.

Discussion

There is understandable public concern over tragic events such as a mass shooting at a school because they seem so unjustified and unexpected. Massive news media attention to the shooting at Sandy Hook Elementary school in particular generated nationwide calls for increased school security (Armario, 2013). In response to the same shooting, a position statement on the urgent need to prevent school and community violence was endorsed by nearly 200 professional organizations, including 31 Divisions of the American Psychological Association (Interdisciplinary Group on Preventing School & Community Violence, 2013). However, the need for school security is based on a perception that schools are risky places that need more protection from violent attacks than other locations. Findings from the present study provide a broader perspective on schools as locations vulnerable to homicidal violence.

Based on the NIBRS database containing more than 18,873 homicide incidents, more than half (53%) of homicide incidents occur in residences, including nearly half (47%) of multiple casualty homicides. In contrast, only 0.3% of homicides and 0.8% of multiple casualty homicides in this sample occurred in schools. These results support a previous study using CDC mortality data (Modzeleski et al., 2008) that concluded that school-associated student homicides represent approximately 1% of homicides that occur among school-age youths. From this perspective, schools are one of the safest places in the United States, and should not be regarded as high-risk for homicidal attacks (Borum, Cornell, Modzeleski, & Jimerson, 2010). These findings raise questions about the massive allocation of public funding and human resources to school security (DeAngelis et al., 2011).

From the standpoint of protecting young people from homicidal violence, it would seem to be most effective to increase

Table 4
Logistic Regression Results Comparing Shootings to Non-Shootings (n = 18,873)

Predictors	OR	95% CI	*SE*
Location[a]			
Gas station/convenience store	2.41***	(1.75–3.31)	0.39
Government/office	0.98	(0.75–1.27)	0.13
Highway/road/alley	1.81***	(1.65–1.99)	0.09
Hotel/motel	0.85	(0.63–1.14)	0.13
Other	1.09	(0.94–1.27)	0.08
Outdoors	0.73***	(0.61–0.88)	0.07
Parking lot/garage/terminal	1.88***	(1.61–2.19)	0.15
Religious establishment	1.51	(0.55–4.16)	0.78
Restaurant/bar	1.41**	(1.13–1.75)	0.16
School	0.61	(0.33–1.12)	0.19
Store	2.27***	(1.46–3.53)	0.51
Relationship[b]			
Acquaintance/otherwise known	1.11*	(1.01–1.22)	0.05
Stranger	1.31***	(1.15–1.49)	0.09
Female offender	0.51***	(0.45–0.57)	0.03
Offender age[c]	1.00*	(1.00–1.01)	0.00
Number of offenders	1.13***	(1.08–1.18)	0.02
Number of victims	1.47***	(1.39–1.56)	0.05

Note. Model results using 30 multiply-imputed datasets. Results are statistically significant as a result of the large sample size used in the analyses.
[a] Reference group = residence. [b] Reference group = Close relation. Nagelkerke $R^2 = .15$. [c] Although the odds ratio indicates 1.00, the lower bound of the confidence interval is 1.006. ORs that include 1.00 within the 95% confidence interval are not statistically significant.
* $p < .05$. ** $p < .01$. *** $p < .001$.

security where there is greatest risk. When police officers are pulled from community patrols to stand guard at the entrance of elementary schools, there is legitimate concern that public safety has not been enhanced. Such security decisions imply that "school violence" is a form of violence that requires special attention. To use a striking counterexample, consider the finding that multiple casualty homicides are more frequent in restaurants than schools; "restaurant violence" has not been identified as a public safety concern and there have been no public calls to increase restaurant security or arm waitpersons (Cornell, 2013).

Glassner (2010) conducted a sociological analysis of the culture of fear phenomenon in the United States, identifying many circumstances in which the American public developed an exaggerated fear based on media attention to poignant events that were contrary to statistical trends and scientific evidence. The cases he identified ranged from fears of various infectious diseases such as the Ebola virus to crack babies, superpredator teens, and satanic cult abductions of children. He made an appeal to repudiate media misrepresentations, educate the public, and reallocate public funds to more realistic needs and threats.

One unexpected finding is that a homicide incident in a school was almost evenly likely to have one victim (46%) versus more than one victim (54%), whereas a homicide incident in all other locations typically had one victim (78%). Moreover, approximately 39% of school homicides involved adolescent offenders. These findings may reflect the copycat appeal of a mass shooting in a school. Copycat motivation has been identified in several case studies of school shootings and has been observed in other high profile crimes, and may be especially appealing to adolescents (Dill et al., 2011). The sensational nature of a high profile crime and its capacity to have such forceful impact on the public may make it attractive to some troubled individuals who are already contemplating a violent act (Surette, 2010).

As the number of victims increased, the role of firearms increased substantially, suggesting that firearms are an especially important risk factor for multiple casualty homicides. Firearms were the primary weapons for multiple casualty homicides with two victims (77%), three victims (81%), four victims (85%), five victims (82%), and six or more victims (94%). These findings are consistent with the study by Huff-Corzine and colleagues (2014), who found overall similarity between NIBRS and Supplementary Homicide Report databases, but limited their cases to murders involving four or more fatalities.

The current study also found that fatal shootings at schools were not more likely to occur than homicides with other kinds of weapons. Shootings may be more likely to generate media attention and are more likely to result in multiple fatalities than attacks with other kinds of weapons, but fatal attacks without firearms should not be discounted from school safety considerations. This is noteworthy in light of the comparatively high prevalence of fatal attacks in German schools that involved edged weapons rather than firearms (Bondü, 2010) and a highly publicized knife attack in a Pittsburgh school (Silver, 2014). However, shootings were approximately twice as likely as nonshootings to be associated with a number of public locations, including parking lots, stores, or gas stations/convenience stores. Notably, shootings were associated with more victims, even when compared with a group that included arson and explosive devices. These findings further reinforce the need to develop strategies to reduce firearm-related deaths (American Psychological Association, 2013).

Limitations

This was a correlational study that cannot establish a causal relationship or determine the direction of effects. There is no claim, for example, that firearms cause multiple casualty homicides, although the association between the use of firearms and the number of victims suggests that firearms facilitate an increased number of casualties compared to other weapons.

The NIBRS database is derived from law enforcement records, which have several well-known limitations. Only cases known to law enforcement are included, and data on offenders are available only in cases when the offender has been identified. Despite these limitations, the use of a larger and more comprehensive dataset can lower selection biases that may skew results.

The substantial amount of missing information in the NIBRS may have limited our results, although we employed multiple-imputation to account for the missing data, as have other NIBRS studies (e.g., Roberts, 2007). To strengthen future research, law enforcement agencies should endeavor to code more complete information for homicide incident and offender variables. Furthermore, NIBRS currently includes only about one

third of the U.S. population and nation's reported crime, and cannot be regarded as a representative sample of either states or law enforcement agencies (Addington, 2008). An analysis of nonresponse bias found that NIBRS "may have a greater capacity to illuminate the crime problem than previously believed" but is less suitable for estimating changes in annual crime rates, which were not examined in our study (Addington, 2008, p. 46). Briere (2014) identified the lack of nationwide participation as the major shortcoming of the NIBRS and advocated the need to facilitate data entry and provide law enforcement with greater incentive to adopt the program by making results more accessible.

Research Implications

One of the important unresolved questions in the field concerns the number of victims necessary to define a mass homicide. The present study systematically examined cut-offs of two, three, four, and five or more victims. Based on an analysis of available offense characteristics, there were some significant differences at two, three, and four victims. It seems likely that no specific cutoff for number of victims is sufficient to identify a meaningfully distinct form of homicidal violence and that other distinguishing features must be considered. The most important features for defining a mass homicide, or types of mass homicides, may involve the offense motive, which is not currently captured in NIBRS, SHR, and other crime databases.

A related research problem concerns the limited number of multiple homicide cases available for study. A higher cut-off for number of homicide victims may increase the distinctiveness of a mass shooting, but it reduces the number of cases obtainable for study and has resulted in a research literature populated primarily by case studies and small samples. Our approach was to include injured victims rather than limit the definition to homicide victims (Bowers et al., 2010), and thus we used the term "multiple casualty homicide" rather than "multiple homicide" or "mass homicide." One result of this expanded definition is that there are many more cases available for study. In the present NIBRS database encompassing approximately 29% of the U.S. population, there was an average of 3,145 homicide incidents per year. Of these incidents, an average of 688 (22%) involved two or more victims. By extrapolation, there would be approximately 2,372 multiple homicide casualty incidents nationwide. Even using a more restrictive criterion of three or more victims, there was an average of 203 incidents per year in the NIBRS database, generating an estimated national prevalence of 698 per year. We recommend that researchers use an expanded definition to obtain the largest possible number of cases, and then investigate whether the number of homicides versus injuries makes any meaningful difference in their analyses.

Clinical and Policy Implications

The specter of "school violence" has become a recognized phenomenon that has dramatically shaped school safety policies and in turn affected clinical practice. Although it is widely recognized in the mental health field that individual predictions of violence are often inaccurate and should be placed in a highly qualified and carefully framed context of risk reduction and management (Heilbrun, 1997; Monahan & Skeem, 2014), school authorities who suspect a student might commit a school shooting often make referrals to mental health professionals to determine categorically whether the student is dangerous or can safely return to school (Cornell & Heilbrun, in press). The low base rate for school homicides underscores the futility of predicting a school shooting (Mulvey & Cauffman, 2001). Additional concerns have been raised about the hazards of using psychological profiles which will overidentify nonviolent students who may share nonspecific characteristics with homicidal students, such as anger and feelings of alienation (Mulvey & Cauffman, 2001; O'Toole, 2000). Clinicians must clarify the nature and limitations of their clinical assessments of students and should consider reframing the evaluation from a threat assessment perspective (Borum et al., 2010).

In their report on gun violence, the American Psychological Association (2013) recognized behavioral threat assessment as an effective and cost-efficient prevention strategy. Threat assessment is a form of violence prevention that emphasizes investigation and intervention to reduce the risk of violence following an identified threat of violence. For decades, the FBI and Secret Service have used threat assessment to protect public officials (Fein & Vossekuil, 1998). Threat assessment provides people with opportunities to report threats of violence and helps authorities respond appropriately to such threats (O'Toole, 2000; Vossekuil, Fein, Reddy, Borum, & Modzeleski, 2002). This approach has become a recommended practice for higher education institutions (ASME-Innovative Technologies Institute, 2010), workplaces (ASIS International and Society for Human Resource Management, 2011), and military settings (U.S. Department of Defense, 2010). In studies of school shooters (O'Toole, 2000; Vossekuil et al., 2002), offenders almost always communicated their thoughts or plans of violence to peers, and engaged in extensive preparation for an attack that was observed by others. Given these findings, the FBI and Secret Service recommended that schools adopt threat assessment programs. Threat assessment guidelines have become widely used in K-12 schools, and the Virginia Student Threat Assessment Guidelines (Cornell, Allen, & Fan, 2012) is the first threat assessment program to be recognized as an evidence-based practice by the National Registry of Evidence-Based Programs and Practices (National Registry of Evidence-Based Programs and Practices, 2013). Threat assessment does not presume or predict that individuals are dangerous, but focuses on resolving any identified problem that stimulated threatening behavior. It embodies principles of prevention consistent with a public health approach and can be applied across settings (American Psychological Association, 2013).

More generally, our findings regarding the offender–victim relationship and crime location suggest that most incidents involved a conflict or grievance prior to homicidal violence. Previous literature has found prior conflicts or grievances to be a risk factor for fatal violence in residences, workplaces, and schools (Lankford, 2012; Rugala & Isaacs, 2003). One prevention approach might be greater use of conflict resolution across community contexts for those experiencing relational difficulties. Two meta-analytic studies showed the effectiveness of conflict resolution programs in schools in managing interper-

sonal conflict (Burrell, Zirbel, & Allen, 2003) and reducing antisocial activities like aggression (Garrard & Lipsey, 2007).

The high prevalence of multiple casualty homicides at residences suggests that one focus of violence prevention may be to support family members at risk for homicidal violence. Previous research on intimate partner homicide has found that preexisting domestic violence, estrangement in the relationship, suicidal intentions, and prior threats with a weapon are risk factors for homicide within families (Bailey et al., 1997; Campbell et al., 2003; Sillito & Salari, 2011). Given the frequent intersection of law and mental health in domestic violence cases, programs that involve collaboration between police officers and mental health professionals, such as crisis intervention teams (CITs), have shown promise in de-escalating high-risk situations (American Psychological Association, 2013).

In light of the strong association between firearms and multiple casualties, another important strategy may be to focus on the prevention of firearm-related fatalities. In their article on gun violence in the United States, Webster and Vernick (2013) recommended prohibiting firearm sales to high-risk individuals, such as those with a restraining order for violent behaviors, persons convicted of stalking, and/or seriously mentally ill individuals who have exhibited threatening, suicidal, or other violent behaviors. The diversity of circumstances and locations in which multiple casualty homicides occur makes it unlikely that any single prevention strategy will be sufficient, but our findings suggest promising pathways that merit consideration.

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Received December 4, 2013
Revision received September 29, 2014
Accepted October 2, 2014 ■