

# Relationships of US Youth Homicide Victims and Their Offenders, 1976-1999

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**Background:** Homicide is the second leading cause of death in children aged 0 to 19 years. Tailoring violence prevention programs to high-risk individuals requires understanding victim-offender relationships.

**Objective:** To elucidate differences in the relationships between homicide victims aged 0 to 19 years and their offenders.

**Design:** Cross-sectional study using the Uniform Crime Reports: Supplemental Homicide Reports, 1976-1999.

**Setting and Participants:** The Supplemental Homicide Reports contain incident-level information about criminal homicides, including location and victim and offender characteristics. National coverage is approximately 92%; 70258 victims were studied.

**Main Outcome Measures:** Differences in the relationships of homicide victims and offenders based on sex, age, population of homicide location, and weapon.

**Results:** Odds ratios and 95% confidence intervals (CIs) are reported. Using strangers as the referent

group, murdered girls were 3.6 (95% CI, 3.4-3.9) times more likely to have been killed by family members and 21.3 (95% CI, 18.5-24.4) times more likely to have been killed by intimate partners than murdered boys. Victims younger than 10 years were 33 (95% CI, 30.4-36.1) times more likely than victims older than 10 years to have been killed by a family member and 2.4 (95% CI, 2.2-2.6) times more likely to have been killed by someone else known to them. Stranger homicides occurred in areas with approximately 145000 more residents ( $P < .01$ ). Handguns were more likely to be used during homicides committed by strangers ( $P < .01$ ). These associations remained after adjusting for potential confounders.

**Conclusions:** Future violence prevention programs may have more effect when targeted to specific sex and age groups. Elucidation of the origins of sex differences, focus on evidence-based child abuse prevention efforts, and enforcement of current gun control laws may help reduce the number of homicides among children.

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**H**OMICIDE IS THE SECOND leading cause of death among children aged 1 to 19 years and the 15th leading cause of death in children younger than 1 year.<sup>1</sup> In 2000, there were 3020 childhood homicides, for a crude homicide rate of 3.84 per 100000.<sup>1</sup> Crude homicide rates vary by age, with bimodal peaks at 0 to 4 years and at 15 to 19 years. One primary goal of Healthy People 2010 is the reduction of childhood assaults and homicides. Specific objectives of Healthy People 2010 include reducing firearm-related deaths and physical assaults by intimate partners.<sup>2</sup>

Understanding the relationship between homicide victims and offenders will

aid in designing violence prevention efforts to achieve the Healthy People 2010 objectives. Numerous studies examining the relationship between homicide victims and offenders have demonstrated that most victims were killed by someone known to them, such as a friend, relative, or intimate partner.<sup>3</sup> These studies also revealed that victims aged 20 to 39 years were most likely to have been killed by an intimate partner<sup>2</sup> and these homicides were most often committed with firearms.<sup>3-5</sup> No previous study has examined victims aged 0 to 19 years nationally. Specifically, prior studies of child victims examined victims aged 15 years and older,<sup>3</sup> 10 years and older,<sup>2,5</sup> and 5 years or younger,<sup>6</sup> infants,<sup>7</sup> or victims in specific US counties.<sup>4</sup>

This study was undertaken to elucidate the relationship between homicide victims aged 0 to 19 years and perpetrators nationally. We sought to identify the circumstances and relationships that place children at increased risk for violent death to support the development of targeted violence prevention interventions. Our primary hypotheses were that relationships of female homicide victims to offenders are different than relationships of male victims to offenders; victim and offender relationships differ depending on victim age; victims in larger cities and towns would more likely be killed by a stranger; and victims killed by strangers are more likely to be killed with handguns than other weapons.

## METHODS

This study analyzed data from the Inter-University Consortium for Political and Social Research, Ann Arbor, Mich. The specific data set used was the Uniform Crime Reports (United States): Supplementary Homicide Reports (SHR), 1976-1999.<sup>8</sup> The Inter-University Consortium for Political and Social Research obtained the data from the Federal Bureau of Investigation.

The SHR contain data on every homicide within the jurisdiction of voluntarily participating police departments. Forms are completed monthly as part of the Uniform Crime Reporting Program.<sup>9</sup> National coverage is approximately 92%,<sup>8</sup> but the missing 8% of data is not uniform over space and time.<sup>10</sup> Additionally, there is no updating of data to reflect subsequent investigations.<sup>10</sup>

The SHR contain incident-level information on criminal homicides<sup>8</sup> including month and year of the offense, county, and metropolitan statistical area (MSA) codes. The MSAs are areas "containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus."<sup>11</sup>(p82228) The MSAs are classified based on their population size: level A, 1 million or more; level B, 250 000 to 999 999; level C, 100 000 to 249 999; and level D, fewer than 100 000. Additional variables collected include the population of the homicide location; geographic regions; age, race, and sex of victims and offenders; victim-offender relationships; weapons; and homicide circumstances (other type of crime, if any, committed during the homicide).

Two data sets accompany the SHR. This study examined the victim data set from January 1, 1976, through December 31, 1999, which contains information on the victim of the homicide and the first perpetrator listed in the SHR. (Even if there were multiple offenders, only the first perpetrator is listed.) If there are multiple victims of a homicide, all victims and their relationships to offenders are listed.

This study included all intentional and nonnegligent homicides. Negligent manslaughters and justifiable homicides (as defined by the Federal Bureau of Investigation) were excluded. The data set was narrowed to include victims younger than 20 years. Next, data were recoded to simplify the relationships between victims and offenders. Relationships characterized as intimate partners are spouse, ex-spouse, common-law spouse, boyfriend, girlfriend, and homosexual relationship.<sup>10</sup> The SHR did not have a category for ex-boyfriend or ex-girlfriend, who are characterized as intimate partners by the Centers for Disease Control and Prevention,<sup>12</sup> leading to an underreporting of intimate partners in the SHR where these relationships have been characterized as acquaintances. Family members are defined as mothers, fathers, stepmothers, stepfathers, in-laws, brothers, sisters, stepbrothers, stepsisters, sons, daughters, stepsons, stepdaughters, and other family. "Other

known" encompasses neighbors, acquaintances, employees, employers, friends, and others known. All odds ratios are calculated using strangers as the referent group.

Analysis was performed using Statistical Package for Social Sciences for Windows, version 11.5.0.<sup>13</sup> Bivariate analysis was accomplished using  $\chi^2$  for nominal variables, *t* tests for normally distributed variables, and the Kruskal-Wallis test for ordinal variables or continuous variables with skewed distributions. Because of the observational nature of the data, multivariate models were used to adjust for potential confounders. Variables found to be significant in bivariate analysis and those believed to be confounders a priori were included in the final multinomial logistic regression models. The variables included year the homicide occurred, season of the homicide, sex of the victim, age of the victim, race of the victim, MSA, and census division. Interaction terms were examined and, if significant, placed in these models. Final results are given as odds ratios with strangers as the referent group.

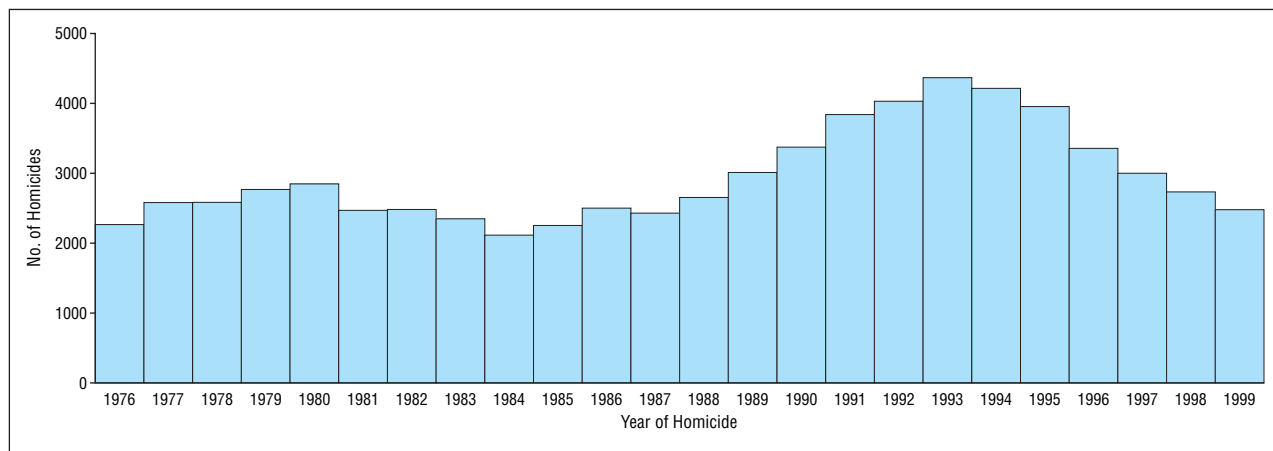
Limitations include some states' incomplete data due to non-adherence to Uniform Crime Reports definitions for crimes or the hierarchy of crimes and other states' nonadherence to the National Incident-Based Reporting Systems methodology.<sup>10</sup> Thirty-seven victims had no sex recorded. Because of this small number, they were eliminated from the analysis. In addition, because negligent manslaughters and justifiable homicides are excluded from the database, the actual numbers and rates of children killed by firearms cannot be inferred.

The variable most often missing was the victim-offender relationship. Reasons for this included: the crime was not witnessed and therefore a relationship could not be determined, or the homicide was not solved and therefore the relationship was unknown. Data were first analyzed excluding all victims missing offender data. Next, we examined the data imputing the missing relationship using the methods described herein. Rates were not calculated for this data set because of the large amount of missing data, a lack of adherence to the Uniform Crime Reports definitions, and unreliability of intercensus population estimations.

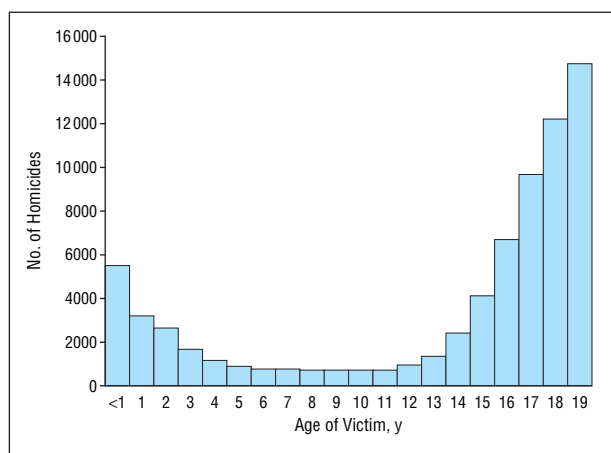
When a relatively large number of observations are missing information on 1 or more of the variables in the model, a complete data analysis in which these observations are discarded can lead to bias. Imputation allows the creation of a complete data set by replacing missing values with values that are imputed from an initial set of assumptions. Multiple imputation procedures account for the sampling variability in the imputation procedure by using Monte Carlo methods to repeatedly create imputed data sets.

In this study, the relationship was missing 29% of the time. Victims missing relationship data were compared with victims who had relationship data. The peak in homicides occurred in 1993 in both groups, and there were no differences in the seasonality of homicides in either group. Victims for whom the relationship was not recorded were 1 year younger, killed in larger cities or towns, more likely to be African American, more frequently killed by handguns, and had a slightly higher male preponderance.

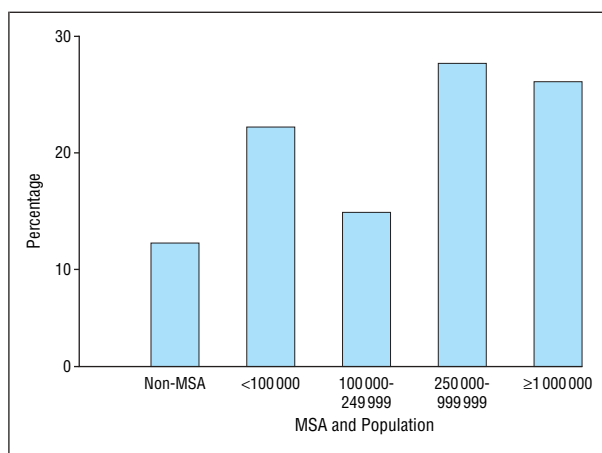
Because of these differences, multiple imputation techniques were used to reanalyze these data. A multinomial model with a Dirichlet prior distribution to estimate the probability of observing each pattern of the study variables was used.<sup>14</sup> We used an estimation-maximization algorithm for the saturated multinomial model to estimate probabilities. Next we used data augmentation with 50 steps at each iteration to generate 10 imputed complete data sets. The logistic regression analyses were refitted using these 10 imputed data sets, and the method of Rubin was used to combine the results to get parameter estimates and their corresponding odds ratios and confidence intervals.<sup>14,15</sup>



**Figure 1.** Number of homicide victims aged 0 to 19 years, by year.



**Figure 2.** Number of homicides by age of the victim, 1976 to 1999.



**Figure 3.** Percentage of homicide victims aged 0 to 19 years, by metropolitan statistical area (MSA) and population group, 1976 to 1999.

To achieve convergence in the estimation procedure, more parsimonious models were chosen. The number of predictor variables in the models was reduced by choosing variables most strongly related to the outcome. Two models were used. The first included the variables MSA, age of the victim, race of the victim, sex of the victim, and year of the offense. To analyze the relationship of handgun use to our outcome, a second model was analyzed including handguns and all of the mentioned variables except age of the victim.

As per the Mount Sinai School of Medicine institutional review board, this study is institutional review board exempt.

## RESULTS

Of the 452965 total homicide victims in this data set, 70295 (15.5%) were 19 years of age or younger.

The number of homicides by year is shown in **Figure 1**. The SHR data demonstrate the same peak in homicides in 1993 and then decline in homicides as seen in the Centers for Disease Control and Prevention's homicide data.<sup>1</sup> Minimal seasonality was observed. Overall, 27.4% of childhood homicide victims were girls and 72.6% were boys. The age distribution of the victims is shown in **Figure 2**. The median age of the victims was 17 years while the mean age of the offenders was 22 years and 8 months. White individuals made up 48% of vic-

tims, African American individuals 49%. The homicide victims were killed in cities and towns with an average of more than 250 000 residents. **Figure 3** displays the population of the homicide location based on the MSAs. The most common circumstance reported in the committing of a homicide was "other argument," indicating the interpersonal nature of these homicides. Childhood homicide victims were killed with guns approximately 60% of the time and with knives 12% of the time. The majority of these victims (57.7%) were killed by someone known to them, 13% were killed by strangers, and 29% of victim-offender relationships were unknown.

The differences in the relationships of victims to offenders by sex was significant at  $P < .01$ , with girls who were killed more likely to have been killed by someone known to them. A multinomial logistic regression model (keeping strangers as the referent group) was used to adjust for the following potential confounders: year of the homicide, MSA, weapon, age of the victim, race of the victim, circumstances of the homicide, and census division where the homicide occurred. In addition, a multiple imputation method (as previously described) was used to account for the missing data. All data are presented with the results of the multinomial model first and the imputed model second (when applicable). After

**Table 1. Relationship of Victim and Offender by Age of the Victim\***

Relationship	<1 Year	1-4 Years	5-9 Years	10-14 Years	15-19 Years
Family member	71.7	54.4	48.9	20.4	5.4
Intimate partner	0	0	0.5	1.7	3.1
Other known	14.1	30.1	23.0	37.4	39.9
Stranger	1.2	3.6	9.4	14.0	16.0
Unknown	13.0	11.9	18.7	26.5	35.6

\*Data are presented as percentage.

**Table 2. Differences in the Relationship of the Homicide Victim and Offender Based on Metropolitan Statistical Area (MSA)\***

Relationship	Non-MSA	<100 000	100 000-249 999	250 000-999 999	≥1 000 000
Family member	32.7	25.9	19.7	16.9	11.8
Intimate partner	3.4	3.1	2.5	2.0	1.4
Other known	40.3	37.2	38.7	33.8	32.8
Stranger	8.8	12.0	13.9	12.6	15.1
Unknown	14.8	21.8	25.2	34.7	38.9

\*Data are presented as percentage. Analysis of variance F statistic  $P<.01$ .

adjusting for the above confounders, murdered girls were more likely than murdered boys to have been killed by a family member (odds ratio [OR], 2.0; 95% confidence interval [CI], 1.8-2.2) (imputed data [ID]; OR, 2.1; 95% CI, 1.9-2.3), and murdered girls continued to be much more likely than murdered boys to have been killed by an intimate partner (OR, 32.7; 95% CI, 28.0-38.2) (ID: OR, 24.1; 95% CI, 20.8-28.9). Additionally, murdered girls remained slightly more likely than murdered boys to have been killed by someone else known to them (OR, 1.1; 95% CI, 1.1-1.2) (ID: OR, 1.1; 95% CI, 1.0-1.2). These findings were similar to those from the bivariate analyses.

The differences in victim-offender relationships were examined by the age groups of the homicide victims. These age groups were as follows: younger than 1 year, 1 to 4 years, 5 to 9 years, 10 to 14 years, and 15 to 19 years. This analysis revealed significant differences between the victim's age and the relationship ( $P<.01$ ) (**Table 1**).

Because of the bimodal peaks of victims' ages (Figure 2), we analyzed the age of the victims as a dichotomous variable, classifying those younger than 10 years as one group and those 10 years and older as another group. Since children younger than 10 years do not have intimate partners, no analysis could be run examining this group. Controlling for potential confounders, murdered children younger than 10 years were 23 times more likely (95% CI, 20.7-25.5) (ID: OR, 28.6; 95% CI, 25.4-30.7) to have been killed by a family member and 2.1 times more likely (95% CI, 1.9-2.3) (ID: OR, 2.3; 95% CI, 2.1-2.5) to have been killed by someone else known to them than murdered children aged 10 years and older. These findings were similar to those from the bivariate analyses.

The next analysis examined changes in the victim-offender relationship based on the population of the

city or town where the victim was killed. Victims killed by family members were more likely than those killed by strangers to have lived in smaller cities and towns, with populations of approximately 193 000 fewer residents ( $P<.01$ ) (mean population, 139 511 vs 333 433) than the cities and towns where those killed by strangers lived. Children killed by intimate partners lived in cities and towns with, on average, 180 000 fewer residents ( $P<.01$ ) than the cities and towns where those killed by strangers lived (153 399 vs 333 433), and those who were killed by someone else known to them lived in cities and towns with 105 000 fewer residents ( $P<.01$ ) than the cities and towns where those killed by strangers lived (228 022 vs 333 433). **Table 2** lists the differences in the relationship of the homicide victim to the offender based on differences in the MSA where the homicide occurred.

The weapon used in committing the homicide was significantly associated with the relationship between the victim and the offender ( $P<.01$ ). After adjusting for potential confounders, victims killed by strangers were more likely to have been killed with a handgun, with similar results in the bivariate model (**Table 3**).

## CONCLUSIONS

Youth homicide remains a significant public health problem. This report is one of the first to examine the relationship between the victims of youth homicide and their offenders. We found marked differences in victim-offender relationships based on the sex of the victim, with murdered girls more likely to have been killed by a family member, an intimate partner, or someone else known to them. After controlling for potential confounders, and using multiple imputation models, the direction and magnitude of the association between sex

**Table 3. Odds Ratios for Homicide Committed With a Handgun and the Relationship of Victim to Offender\***

Relationship	Crude OR (95% CI)	Multinomial Model OR (95% CI)†	Imputed Model OR (95% CI)‡
Stranger vs family member	6.0 (5.7-6.4)§	1.8 (1.6-1.9)§	5.0 (4.6-5.2)§
Stranger vs intimate partner	1.6 (1.5-1.8)§	1.3 (1.2-1.5)§	1.0 (0.9-1.1)
Stranger vs other known	1.6 (1.5-1.7)§	1.4 (1.4-1.5)§	1.6 (1.5-1.6)§

Abbreviations: CI, confidence interval; OR, odds ratio.

\*For simplicity of interpretation (to make all ORs >1), strangers are used for the numerator rather than in the denominator.

†The multinomial model was adjusted for year of homicide, season of homicide, sex of the victim, age of the victim, race of the victim, metropolitan statistical area, and census division.

‡The imputed model was adjusted for year of homicide, sex of the victim, race of the victim, and metropolitan statistical area.

§ $P < .01$ .

and the relationship of the victim to the offender did not change appreciably. Further research is needed to elucidate the reasons for these findings.

The age of the victim was associated with the victim-offender relationship. Murdered children younger than 10 years were much more likely to have been killed by a family member or someone else known to them. This relationship persisted after adjusting for potential confounders. This may be because younger children are more likely to be cared for by family members or others known to them while older children and adolescents tend to have more friends and more varied relationships. One striking finding is that, for those victims aged 15 years and older, strangers were not the most common relationship (16%). These victims were mostly killed by someone known to them (48.4%).

The victim-offender relationship was associated with the population where the homicide occurred. Victims killed by strangers were more likely to have lived in larger cities or towns while those killed by family members and intimate partners were more likely to have lived in smaller cities or towns. Once again, these relationships held when adjusting for potential confounders.

Finally, the weapon used during the commission of the homicide was associated with the victim-offender relationship. Children killed by strangers were more likely to have been killed with a handgun than those killed by family members, intimate partners, or others known to them. The direction and magnitude of these associations remained similar in all models except for handgun use in the murder of strangers vs family members. The direction of the association for this group remained the same, but the magnitude was smaller after adjusting for potential confounders. This change likely was due to the adjustment for age because in the imputed model with age removed the magnitude was similar to that in the unadjusted model. Since a large proportion of children killed by family members were younger than 5 years and these children were the least likely to be killed with a hand-

gun, there was a fairly large change in the OR for this subset of children.

Using a data set such as the Uniform Crime Reports has limitations. Only intentional and nonnegligent homicides are included in this data set. Since negligent manslaughters and justifiable homicides are excluded, no conclusions can be reached regarding the total number of children killed with guns or other weapons, causing an underestimation of the number of children killed with guns and other weapons. Therefore, rates cannot be calculated. In addition, this data set includes numerous unsolved homicides and therefore offender data may be missing. While rates cannot be calculated, the sheer number of homicides included in this data set makes these data extremely compelling.

The National Violent Death Reporting System eventually will be the ideal data set to study victim-offender relationships for homicides. However, since the National Violent Death Reporting System is not yet used nationally, the SHR are the next best alternative.

The fact that 29% of the homicide victims did not have a relationship reported is a known limitation of the data set used. We attempted to eliminate bias by imputing data. All of the associations and magnitudes remained quite similar in both analyses. This mimics results found in other studies of large data sets, such as the cardiovascular health study<sup>16</sup> and other studies,<sup>17-19</sup> and strengthens our findings.

The associations of the victim-offender relationships with the age of the victim, sex of the victim, population where the homicide took place, and usage of a handgun in committing the murder mirror and add to the findings in smaller prior studies,<sup>2-7,20</sup> in which the samples were restricted by age, sex, or location.

Focusing on the victim-offender relationships of homicides can enhance current youth violence prevention strategies. Given that murdered girls are more likely than murdered boys to have been killed by family members, further studies are needed to elucidate the origins of these findings. This may lead to new and unique sex-based primary prevention efforts aimed at families during the newborn period and beyond. Additionally, the knowledge that murdered older girls are more likely to have been killed by intimate partners encourages the initiation of violence prevention counseling early on, which may reduce the number of intimate partner homicides. Finally, the finding that handguns are more likely to be used during homicides of children by strangers supports the vigorous enforcement of gun control laws to reduce childhood homicides. Further studies are needed to develop and demonstrate the efficacy of the violence prevention efforts initiated based on these findings.

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Because of popular demand, we are reinstating our Picture of the Month feature. This will be presented as an unknown in the ARCHIVES, with the reverse side of the page being the denouement. We would like to get common problems presenting uncommonly, rather than total zebras. These cases should be of interest to practicing pediatricians, problems that they are likely to at least occasionally encounter in the office or hospital setting.

Submissions must be high-quality photographs in either 35-mm slide or electronic format. Parent or patient permission to use photographs must accompany the submission. The discussion should be no more than 750 words. Please send materials to: Frederick P. Rivara, MD, MPH, Editor, *Archives of Pediatrics & Adolescent Medicine*, Department of Pediatrics, Child Health Institute, University of Washington, 6200 NE 74th St, Suite 210, Seattle, WA 98115-8160; e-mail: [archpediatrics@jama-archives.org](mailto:archpediatrics@jama-archives.org).