

## P6400 Group Project

### Group Seminar 2:

Gun ownership as a risk factor for homicide in the home (Kellermann et al., 1993)

Gaotong Liu gl2677

Jun Zhai jz3181

Wen Shen ws2543

### Background and Significance

Homicide, a form of human crime, a fatal outcome of violent and abusive behaviors, has been increasingly drawing public attention as a general concern in the United States since the last century. From 1979 to 1988, an average of 22,000 homicides occurred in the United States each year (Figure 1), meanwhile it was one of the top five leading causes of death among all races and sexes aged 15 to 34 years old (Hammett, Powell, O'Carroll, & Clanton, 1992), and increased continuously from 1984 to 1992, suggesting the importance of studying underlying risk factors of homicides (Figure 2).

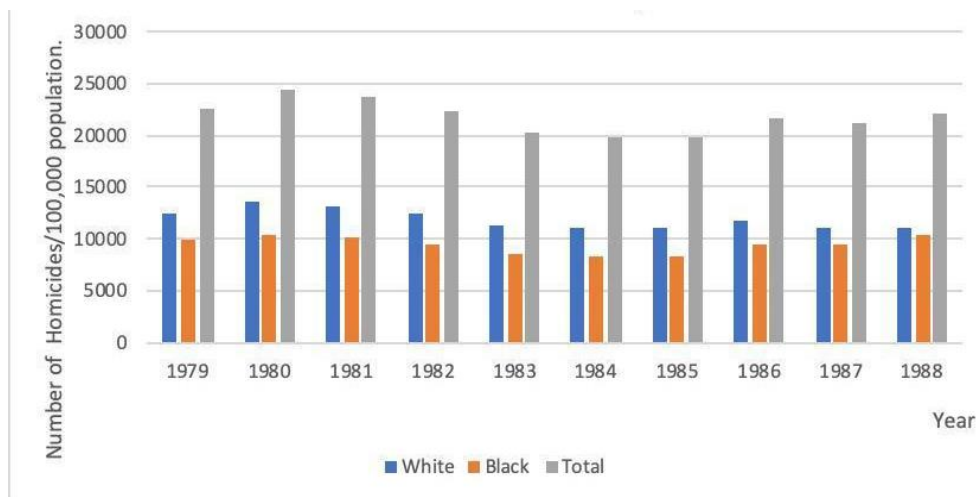
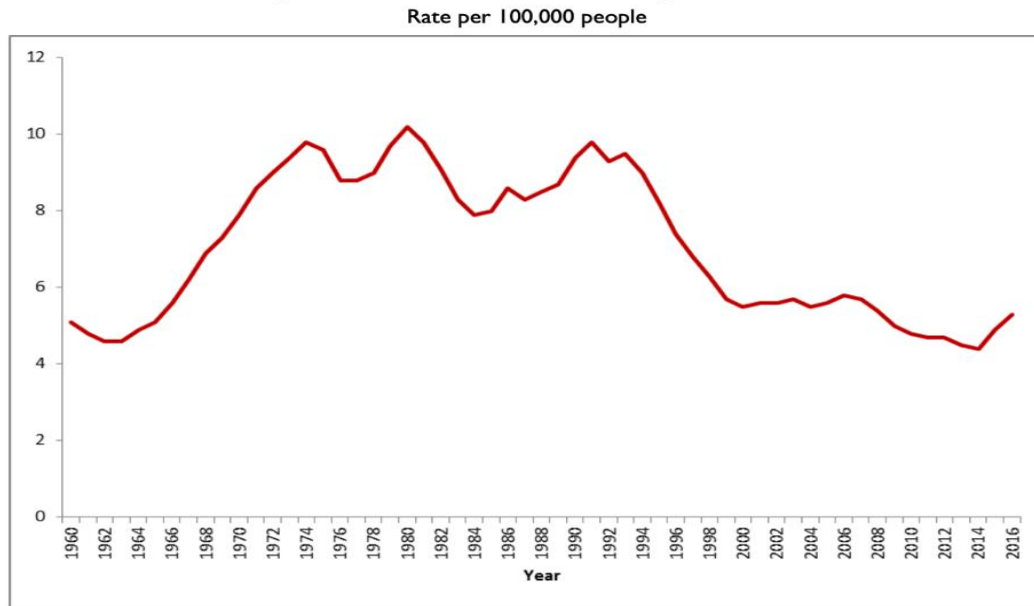


Figure 1. Number of homicides in the United States, 1979-1988 (Hammett et al., 1992)



**Source:** *Sourcebook of Criminal Justice Statistics, Table 3.106.2012*; Federal Bureau of Investigation, *Crime in the United States 2016, Table 1.*

Figure 2. National Homicide Rate, 1960-2016 (James, 2018)

Although there are various types and causes of homicide, the most common weapon used in the homicide is firearms. In 1988, 61% of homicides involved firearms and 75% of them were handguns (Hammett et al., 1992). Most people load guns in their homes for self-protection, but keeping firearms also poses risks, which contain unintentional gunshot injuries or death, homicide due to family quarrels, and suicide in the home. A study of firearm-related deaths at home showed that only approximately 2.5% of these deaths involved necessary self-defense, while other deaths were suicides, homicides and accidental deaths (Kellermann & Reay, 1986). Therefore, it is possible that having a firearm in the home actually increases the risk of homicide in the home.

Holding the same point of view, the study our group discussed addressed that keeping firearms in the home may act as a risk factor for home homicide instead of personal protection. In the study, multiple exposures such as gun ownership, illicit drug use, domestic violence, alcohol use and their association with the outcome, homicides at home, were assessed. Researchers found the use of illicit drugs and a history of domestic violence were essential risk factors for homicide in the home. And there was a strong and independent association between gun ownership in the home and an increase in the risk of homicide. The great majority of the victims were killed by a relative

or someone known to them, but the study found no significant increase in the risk of being murdered by a stranger or intruder.

The predicted direction of association in the study is causal. Gun ownership could be part of sufficient, but not necessary cause of homicide in the home because gun ownership was found to be independently associated with homicide. Other risk factors, like physical fights in the home, contributed to homicide as well when the effects of gun ownership were controlled. Likewise, the use of illicit drugs and prior domestic violence could also be considered as part of the sufficient causes of homicide in the home. The study strongly discouraged people from keeping guns in their homes and called for early identification and effective intervention against different forms of family violence to prevent potential homicides.

Following this study, more and more researchers placed strong evidence and pointed out the association between gun ownership and homicide rates. Matthew Miller et al using survey data and found that in the United States, the state with higher levels of household gun ownership had higher homicide rates (including gun homicides and others) (Miller, Hemenway, & Azrael, 2007). Moreover, David Hemenway et al found that among the 26 developed countries, there are usually more homicides in the regions which have less gun control; and this conclusion stayed applicable when not accounting United States (Hemenway & Miller, 2000). In the mainstream of academic field, the relationship between homicide and gun ownership is basically concluded. The government and citizens are becoming aware of the urgency of gun control as well. However, the big debate about gun control in the country still goes on, and stricter regulation of civilian firearms remains absent.

Although the gun ownership among the fifty states nationwide has declined by approximately 10%, from 1981's 60.6% to 2010's 51.7%, the gun violence never gets eliminated and remains a great issue of United States in the 21st century (Siegel, Ross, & King III, 2013). According to the data collected by the National Crime Victimization Survey, about 68% of murders in 2011 are committed with firearms ("Bureau of Justice Statistics," 2013). From the FBI yearly crime reports

(“FBI — Crime in the U.S.,” 2016), we can tell that gun-related homicide is dramatically climbing in these years (Figure 2). In 2010, there were only 8775 gun-related homicides, and that number slightly decreased to 8124 in 2014, but then peaked to 11004 in 2016 and 14542 in 2017, which means the gun violence issue is getting pressing and calls for immediate policy interventions.

## Study Population and Prevalence

The researchers selected three states (Tennessee, Washington and Ohio) where their institutions were located, in order to accelerate the data collection process and protect data integrity. The study was then conducted on residents from three counties in the base states: Shelby County (Tennessee), King County (Washington) and Cuyahoga County (Ohio). These three counties were chosen mainly because they were located in different geographic regions of the US and were the most populous counties in their respective states. In addition, the three selected counties had a different distribution of black and white as well as living standards of households. As of the 1990 Census, the population of Shelby County was 826,330, of which white and black were equally distributed (Bureau, 1992). The population of Cuyahoga County was 1,412,140 and 25% of the population was African American (Bureau, 1992). Households who lived below the poverty level were 15% in Shelby County and 11% in Cuyahoga County (Bureau, 1992). In contrast, the population of King County was 1,507,319, of which white was predominant and covered 85% of the total population (Bureau, 1992); and most of the households in King County led a relatively high standard of living. However, the source population lacked Hispanic and Asian citizens, and rural region households, which could generate a failure of generalizing the results.

Regions	All Persons	White	Black	Other
Shelby County, Tennessee	826,330	455,063 (55%)	360,083 (44%)	11,184 (1%)
King County, Washington	1,507,319	1,278,532 (85%)	76,289 (5%)	152,498 (10%)
Cuyahoga County, Ohio	1,412,140	1,025,756 (73%)	350,185 (25%)	36,199 (2%)

Table 1. Race Distribution for Three Selected Counties: 1990 Census (Bureau, 1992)

The study population was sampled from a source population. All homicides including residents of the three selected counties that occurred between August, 1987 and August, 1992 were reviewed (1860 homicides in total) to identify any death-ruled homicides in the home or assault-related injuries followed by death within 3 months. According to the study, homicides happened in a person's private housing or in adjacent structures or surrounding yards were all regarded as home-occurred homicides. It was reasonable to expand the definition of home due to the “moveable” characteristic of homicides in the act of killing and defending. For murder-suicides, researchers included the homicide victim that was older than the respective suicide victim, and for multiple suicides, they would include the oldest victim. We believe including only one victim in each murder-suicide and multiple suicides might prevent data replication, but the reason why only the oldest victim was included was not clearly explained in the study. On the other hand, researchers excluded homicides involving children below 12 years of age due to the request of medical examiners. Homicides that were not reported to project staff and late changes to a death certificate were also excluded. These exclusion criteria were rational in order to avoid data missing and data ambiguity. In the end, 420 homicides occurred in the home were selected for the study.

From the univariate analysis in the study, 73.3% of household members and 62.8% of case subjects drank alcohol in the selected case group, in addition, 55.9% of household member and 41.9% case subject drank in the control group. Therefore, alcohol was more commonly consumed in the selected case group both by members of households of case subjects and case subjects themselves. Based on the data collected from Behavioral Risk Factor Surveillance System (BRFSS) from 1985 to 1999, 54.9% of persons were current alcohol users in 1985 and 44.4% in 1991 in the United States (Serdula, Brewer, Gillespie, Denny, & Mokdad, 2004). The prevalence of drinking reported in the control group of the study is roughly consistent with the data reported in BRFSS, which validates the result of the study, and the prevalence in the case group is 1.4 times higher than the BRFSS data. For the time being, 50.7% of respondents drinking alcohol according to the 2016 National Survey on Drug Use and Health (NSDUH) results (SAMHSA, 2016), and alcohol consumption is still substantially present in the homicide in the United States (Naimi et al., 2016).

From the study, 31.8% of case subjects had experienced that household members hit or hurt in a fight in the home in the selected case group, however, only 5.7% of those in the control group. In addition, severe physical fights in the home occurred in 17.3% of cases in the selected case group, whereas only 2.1% of that in the control group. Fights during drinking in the home were reported in 25.3% of cases in the case group, but only 3.4% of that in the control group. 52.7% of household members and 36.0% of case subjects were reported to be arrested in the selected case group comparing to 23.4% of household members and 15.7% of control subjects in the control group. In the Final Conditional Logistic-Regression Model, the Adjusted Odds Ratio for variable Any household member arrested is 2.5(1.6-4.1), which means that there are 2.5 times more household arrested before in the selected case group than that in control group. Therefore, the domestic violence was more frequently reported in the selected case group than in the control group regardless of fighting in the home or formal arrest. Domestic violence is still a concern in all types of crime at present, and it accounted for 23% of serious violent crimes including rape or sexual assault, robbery, and aggravated assault according to the study from 2003 to 2012(Truman & Morgan, 2014).

According to the study, 32 out of 420 homicides (7.6%) in the cases were related to drug dealing. 20.3% of the subjects in the case and 4.2% of the controls used illicit drugs; 31.3% of the case subjects had household members using illicit drugs, and for controls, this number is only 6.0%. In the Final Conditional Logistic-Regression Model, the Adjusted Odds Ratio for variable Any household member used illicit drugs is 5.7(2.6-12.6). So, it is concluded that the use of illicit drugs in the home is an important risk factor for homicides in the home. The illicit drug prevalence in the controls (4.2%) is pretty much the same as national prevalence in 1993 (4.37%) (“National Household Survey on Drug Abuse (NHSDA-1993) | SAMHDA,” 1993), while the drug prevalence in case subjects (20.3%) is four times higher than the national prevalence. Also, from Figure 3, we can acquire that the prevalence of drug use disorder and drug possession nationwide both increase during the last decades.

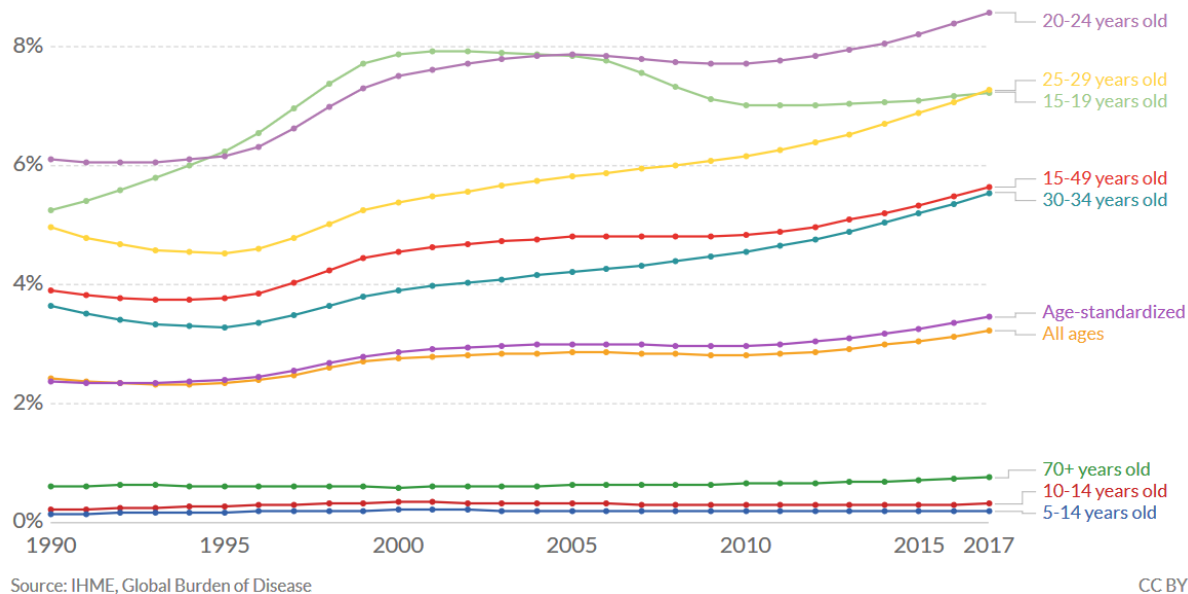


Figure 3. Prevalence of drug use disorders by age, United States (Whiteford et al., 2016)

Gun is well associated with home homicides in the study population. In the total 420 homicides, 209(49.8%) victims died under gunshot, 21 victims tried to use guns as self-defense. Among the paired cases and control subjects, 45.4% owned one or more guns (including handgun, shotgun and rifle); this percentage was 35.8% for the controls, which didn't show much difference in total number, but less handgun owning households. However, 29.6% in the case subjects kept guns unlocked, 26.7% kept guns loaded; and only 17.8% and 12.5% in the controls kept guns unlocked or loaded. The Adjusted Odds Ratio for guns kept in the home is 2.7(1.6-4.4) in the Final Conditional Logistic-Regression Model. The data indicated that gun ownership and homicide had a strong association, and could independently lead to a higher risk of homicides in the home. The gun owning rate of cases (45.4%) in this study kept the same with the 1993 national household gun ownership rate (43%) (Figure 4), and controls obviously had lower household gun ownership (35.8%). From Figure 4, we can tell that there is a great decline in household gun ownership in the last forty years, which actually follows the trend of the National Homicide Rate.

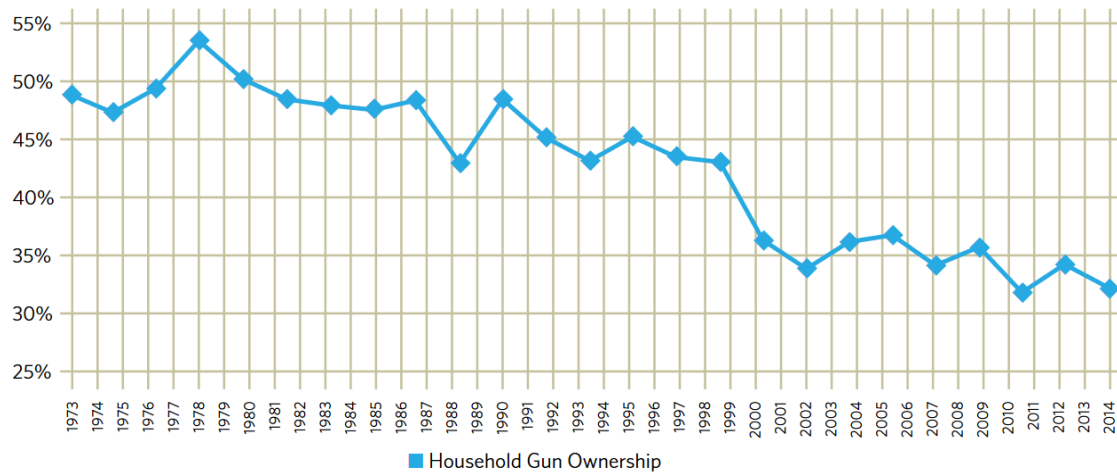


Figure 4. Household Gun ownership in the United States (Smith & Son, 2015)

## Study Design

The study was a typical example of a case-control study. It started with the identification of case subjects, the homicide victims in private homes in three counties (Shelby County, Tennessee; King County, Washington; Cuyahoga County, Ohio) between August, 1987 and August, 1992. Then control subjects, which were matched to case subjects by sex, race, age range, and neighborhood of residence from the same source population, were selected for further comparison.

For data collection, the medical examiner's staff and the police were responsible for conducting investigations and delivering reports to ensure that the incidence details were recorded and the study criteria were fulfilled. It was worth noting that persons close to these case subjects that might provide later interview were recruited to serve as case proxies in the study. It is appropriate to use proxies for case subjects when no further information could be obtained from victims in retrospective studies. During controls recruitment, the interviewers conducted neighborhood census starting at a random point along predetermined routes within the case subjects' residence and chose the first household with a member who was qualified for the matching criteria most as the corresponding control subject to minimize selection bias. Interviews were given to both case proxies and control subjects afterwards with \$10 incentive per subject to guarantee compliance.



When delivering interviews, sensitive questions were arranged later in time and were preceded by permissive statements to increase compliance of interviewees and improve both efficiency and accuracy of the data collection process.

Due to the nature of case control study, temporality cannot be satisfied. The main exposures, firearms in the home and prior domestic violence, were obtained from reports on the scene and interview data. Researchers also acquired other variables like illicit drugs and alcohol from the reports as additional exposures. Then a series of statistical analyses was conducted to compare cases and controls. Univariate analysis was used to calculate crude odds ratio to check if a series of behavioral and environmental factors were associated with the outcome. Multivariate analysis was afterwards conducted to identify variables that independently associated with an increased risk of homicide in the home. The researchers further applied stratification analysis based on the final regression model to identify effect measure modification.

## **Results**

There were 1860 homicides occurred in the three counties during the study period and 444 of them took place in the home of the victim. After filtering by certain excluding criteria mentioned previously, 420 case subjects were used for the study. 388 matched pairs of case and control subjects in total were identified for univariate analysis and 316 of them with completed data were used to conduct multivariate analysis in the final conditional logistic-regression model. There were 28 factors (behavioral and environmental) involved in the univariate analysis and 6 variables remained in the final conditional logistic-regression model.

The researchers found the crude odds ratio of the gun or guns kept in the home was 1.6 (1.2-2.2) in the univariate analysis and the adjusted odds ratio was 2.7 (1.6-4.4) in the final model, indicating the odds of keeping guns in the home among cases were 2.7 times the odds among controls. Therefore, there was a strong association between gun ownership and homicides in the home.

For the association of domestic violence and homicide in the home, the crude odds ratio of “any household member hit or hurt in a fight in the home” was 7.9 (5.0-12.7) in univariate analysis and was adjusted to 4.4 (2.2-8.8) in the final conditional logistic regression model. The results

significantly showed the odds of household members fight in the home in the case group was 4.4 times the odds of that in the control group, indicating a significant relationship between domestic violence and homicide in the home.

The crude odds ratio of “any household member had trouble at work because of drinking” was 10.7 (4.1-27.5) and for case themselves and controls was 20.0 (4.9-82.4) in univariate analysis, illustrating alcohol was highly associated with homicides in the home. Besides, “any household hospitalized because of drinking” was 9.8 (4.2-22.5) and for the case themselves and controls were 14.0 (4.7-41.6) in univariate analysis, also suggesting heavy drinking was highly associated with homicide in the home.

The crude odds ratio of household members using illicit drugs was 9.0 (5.4-15.0) and the adjusted odds ratio was 5.7 (2.6-12.6), both results were significant, revealing the cases had 5.7 times the odds of household members using illicit drugs as controls in the three counties during the study period. The crude odds ratio of the subject themselves using illicit drugs was 6.8 (3.8-12.0), demonstrating the cases had 6.8 times the odds of subjects using illicit drugs compared to controls.

In general, these outcomes illustrated the strong association between the main exposure (gun ownership, prior domestic violence, alcohol usage, illicit drugs usage) and the outcome (homicides in the home) in this study, proving the researchers’ hypothesis was true. The researchers conducted further stratification analysis based on the final model to identify effect measure modification, which will be discussed later in this report.

Variable	Crude Odds Ratio (95% CI) Univariate Analysis	Adjusted Odds Ratio (95% CI) Multivariate Analysis
Any household member drank alcoholic beverages	2.4 (1.7-3.3)	/
Case subject or control drank alcoholic beverages	2.6 (1.9-3.5)	/
Drinking caused problems in the household	7.0 (4.2-11.8)	/
Any household member had trouble at work because of drinking	10.7 (4.1-27.5)	/
Case subject or control had trouble at work because of drinking	20.0 (4.9-82.4)	/
Any household member hospitalized because of drinking	9.8 (4.2-22.5)	/
Case subject or control hospitalized because of drinking	14.0 (4.7-41.6)	/
Any household member used illicit drugs	9.0 (5.4-15.0)	5.7 (2.6-12.6)
Case subject or control used illicit drugs	6.8 (3.8-12.0)	/
Any physical fights in the home during drinking	8.9 (5.2-15.3)	/
Any household member hit or hurt in a fight in the home	7.9 (5.0-12.7)	4.4 (2.2-8.8)
Any family member required medical attention because of a fight in the home	10.2 (5.2-20.0)	/
Any adult household member involved in a physical fight outside the home	2.1 (1.4-3.0)	/
Any household member arrested	4.2 (3.0-6.0)	2.5 (1.6-4.1)

Case subject or control arrested	3.5 (2.4-5.3)	/
Home rented	5.9 (3.8-9.2)	4.4 (2.3-8.2)
Public housing	1.5 (0.7-3.3)	/
Case subject or control lived alone	3.4 (2.2-5.1)	3.7 (2.1-6.6)
Deadbolt locks	0.8 (0.5-1.0)	/
Window bars	0.8 (0.5-1.3)	/
Metal security door	0.9 (0.6-1.3)	/
Burglar alarm	0.6 (0.4-1.0)	/
Controlled security access to residence	2.3 (1.2-4.4)	/
Dog or dogs in home	1.1 (0.8-1.6)	/
Gun or guns in home	1.6 (1.2-2.2)	2.7 (1.6-4.4)
Handgun	1.9 (1.4-2.7)	/
Shotgun	0.7 (0.5-1.1)	/
Rifle	0.8 (0.5-1.3)	/
Any gun kept unlocked	2.1 (1.4-3.0)	/
Any gun kept loaded	2.7 (1.8-4.0)	/
Guns kept primarily for self-defense	1.7 (1.2-2.4)	/

Table 2. Variables Included in the Univariate Analysis and Final Conditional Logistic-Regression Model (Kellermann et al., 1993)

## **Discussion**

### **Confounders**

The covariates were sex, race, age, home rented, living alone, suspect and victim relationship, victim resisted assailant, forced entry and methods of homicide. Sex, race, age, home rented and living alone were potential confounders of gun ownership, domestic violence, illicit drugs and alcohol usage because they were associated with these four exposures and homicide in the home and were not in the causal pathway between the exposure of interest and homicide in the home. For example, female, black young women might be more likely to be the victims in the homicide in the home, and they might be more likely to buy guns, illicit drugs, alcohol beverages and to involve in the prior domestic violence.

First, the researchers compared proxies' answers in the case group with control subjects who have been matched according to sex, race, age and neighborhood. The matching in the study design phase decreased the noncomparability due to confounders such as sex, race and age. Then, the researchers constructed the final conditional logistic regression model based on the selected variables which had been examined significant after adjusting for the effects of other variables. Therefore, from the results, home rented and living alone are confounders in the study, and the researchers used the regression to adjust the odds ratio. The odds of "guns kept in the home" in the case group was 2.7 times higher than that in the control group after adjusting the effects of home rented, living alone, prior domestic violence and usage of illicit drugs. The crude odds ratio of home homicide in relation to gun ownership was 1.6 in the univariate analysis. Those potential confounders decreased the biased odds ratio in general, and the association of gun ownership and home homicide is potential causal, so the confounders pushed the odds ratio towards the null.

### **Selection bias**

Since the study was an example of case-control studies, the possibility of case selection bias was eliminated, and the potential selection bias mainly came from the selection of control groups. To ensure comparability between exposed and unexposed and make controls represent the exposure distribution in the source population that gave rise to cases, controls must be selected from the same cohort and should be independent of exposure of interest. In the study, controls and cases were selected from the same population and the control was selected to match each case subject

on sex, race, age range and neighborhood of residence. There may be a potential risk of selection bias if controls were not selected totally independently of gun ownership, which was the exposure of interest in the study. To minimize the selection bias, researchers used a procedure defined in Yu, et al (1983)'s study for randomly selecting of matching households in the neighborhood (Yu et al., 1983) The interviewers started neighborhood census at a random point along predetermined routes within the case subjects' residence and would choose the first residence subject who satisfied the matching criteria as the control subject.

Although there was no evidence of obvious selection bias after the steps taken by researchers to minimize it in the study, there was still space for selection bias to act as a result of the non-total participation of subjects. According to the study, there were 444 out of 1860 homicides in the home of the victim at the beginning. After excluding some cases and selecting matched control subjects, there were 388 (87.4%) matched pairs left for study. In addition, due to data incompleteness, only 316 (71.2%) matched pairs were used to build the final conditional logistic regression model. Since the missing data and detailed exclusion reasons for cases were not demonstrated clearly in the paper, potential selection bias may bias the results in either direction.

#### Information bias

Since the outcome in this study is home homicide so there could hardly be any information bias for recording the outcome. As for exposures, the researchers obtained information from the crime scene reports and proxies' interviews for cases, and interviews of control subjects for controls.

To avoid misclassification, items from the Short Michigan Alcoholism Screening Test, the Hollingshead-Wilson two-factor index of social position and a 1978 poll of gun ownership by Decision Making Information were included in the interview so that a united criterion of exposure could be set. In addition, interviews were designed to be brief, highly structured, and permissive for sensitive questions, in order to minimize the information bias caused by the design of interviews. Moreover, to lessen the potential recall bias during the interview, researchers delayed their contact with cases proxies to avoid their inaccurate information due to grief.

However, nondifferential misclassification could still happen in both case and control. Usually, people tend to cover up or understate the illegal or negative behavior about themselves or their families, so it was very likely that information bias existed in the interview. Some of the subjects with exposures (drugs, violence, gun-ownership, etc) might describe themselves as without exposures or having a less severe condition. Considering the interview was the only information source for control group, meanwhile the major inference for case group were crime reports obtained from police which could hardly be twisted, thus we can infer that control group was more likely to be biased than case group, and the OR might be pushed away from the null compared to the truth.

### Effect Measure Modification

In the study, the researchers found no interaction terms altering the adjusted odds ratio drastically and the six significant variables (“home rented, case subject or control lived alone, any household member ever hit or hurt in a fight in the home, any household member ever arrested, any household member used illicit drugs, and one or more guns kept in the home”) were independently related to an increased risk of homicide in the home (Kellermann et al., 1993). As a result, the six variables in the study were all in different pies. From a causal inference perspective, these variables were independent, correlated causes of homicides in the home.

After stratifying by 7 subgroups (“sex, race, age, suspect related to or intimate with victim, evidence of forced entry, victim resisted assailant, methods of homicide firearm”) respectively to study homicide in the home in relation to gun ownership, the researchers found strata-specific odds ratio were appreciably different in “suspect related to or intimate with victim” and methods of homicide firearm subgroups, indicating the potential existence of effect measure modification. Gun ownership was strongly associated with homicides when the suspect related to or intimate with victim (adjusted odds ratio, 7.8) and homicides by firearms (adjusted odds ratio, 4.8). In other words, exposure to suspect related to or intimate with victim and firearms modified the association between gun ownership and homicide in the home on the relative scale. Sex, age, suspect related to or intimate with victim, methods of homicide firearm subgroups may respectively act jointly with gun ownership, along the same causal pathway to the outcome, homicide in the home.

Subgroup	Adjusted Odds Ratio (95% CI)
Sex	
Female	3.6 (1.6-8.1)
Male	2.3 (1.1-4.6)
Race	
White	2.7 (1.0-6.9)
Black	2.9 (1.5-5.7)
Age (yr)	
15-40	3.4 (1.4-8.0)
≥41	2.3 (1.2-4.6)
Suspect related to or intimate with victim	
Yes	7.8 (2.6-23.3)
No	1.8 (1.0-3.4)
Evidence of forced entry	
Yes	2.5 (0.7-8.4)
No	2.8 (1.5-5.2)
Victim resisted assailant	
Yes	3.0 (1.3-6.2)
No	3.1 (1.2-8.1)
Method of homicide	
Firearm	4.8 (2.2-10.3)
Other	1.2 (0.5-2.7)

Table 3. Homicide in the Home in Relation to Gun Ownership, According to Subgroup  
(Kellermann et al., 1993)

Likewise, the researchers also stratified by the same subgroups respectively to study homicide in the home in relation to prior domestic violence. The results showed the strata-specific odds ratio were appreciably different in race, suspect related to or intimate with victim, evidence of forced entry, victim resisted assailant and methods of homicide firearm subgroups. Consequently, there was potential effect measure modification. Prior domestic violence was significantly related to homicides when suspect related to or intimate with victim (adjusted odds ratio, 20.4) so it modified the association between domestic violence and homicide in the home on the relative scale. In general, race, suspect related to or intimate with victim, evidence of forced entry and the victim resisted assailant all acted jointly with previously been hit or hurt in the home, along the same causal pathway to homicide in the home.



Subgroup	Adjusted Odds Ratio (95% CI)
Sex	
Female	4.4 (1.6-11.9)
Male	4.4 (1.5-12.6)
Race	
White	6.9 (1.7-27.6)
Black	2.9 (1.2-7.3)
Age (yr)	
15-40	5.2 (1.7-16.0)
≥41	4.5 (1.7-12.0)
Suspect related to or intimate with victim	
Yes	20.4 (3.9-104.6)
No	1.9 (0.8-4.7)
Evidence of forced entry	
Yes	7.2 (2.1-25.3)
No	4.0 (1.0-17.0)
Victim resisted assailant	
Yes	1.4 (0.4-4.4)
No	8.1 (2.8-23.1)
Method of homicide	
Firearm	3.1 (1.0-9.0)
Other	5.4 (1.9-15.6)

Table 4. Homicide in the Home in Relation to Prior Domestic Violence, According to Subgroup  
(Kellermann et al., 1993)

### Strengths and Limitations

Overall, this study was appropriately designed and structured with logic and full detail, presenting a clear and trustworthy association between gun ownership, illicit drug use, domestic violence and home homicide rates. More importantly, it explored a new public health area and began to draw public attention on guns issue. It is one of the first researches that prove the association between gun ownership and homicides, it gave a pioneered angle of view and advocated more studies of guns and violence relationship in the future. It based on case-control study other than retrospective cohort or time-series design, which is more suitable for studying rare outcomes with multiple potential exposures. The researchers also included all homicide cases and randomly selected to minimize selection bias and well-designed interview procedure to lessen information bias.

However, several limitations exist. First, the researchers only studied three urban counties without a considerable proportion of Hispanic citizens, therefore the study could not be generalized to any rural population or Hispanic population. Besides, there were only 444 homicides happened in the home of the victim out of 1860 homicide in those three counties for a two to the five-year study period. However, an average of 22,000 homicides occurred in the United States each year at that time. The sample only represents a small proportion of homicides, so there seems to be a hasty generalization from this small case-control study to the general population in the United States. The result of this study could not make further generalization into nationwide or worldwide. Second, the information bias in the control group could be severe since there were no any sufficient methods to prevent or filter control subject providing inaccurate information. Third, just as the author mentioned, this study lacked consideration of Psychological confounding. There could be many situations that subjects themselves are more violent or antisocial, and keeping guns at home and commit homicides are both outcomes. So far, the study only proved association between gun ownership and home homicides, but no evidence to illustrate the causal pathway. Fourth, the matching in this study only considered sex, race, gender and age, but not the subjects' social status, income level, education level and occupation, etc. For example, if the cases subjects included gang members, they were more likely to possess guns, also accompanied with higher risk of engaging in homicides, which could cause bias in the final results. Finally, the situation may have changed now compared to that in 1993, it is not a perfect resource to reference to address the problems in 2019. The homicide rate reached its peak around 1992, while the homicide rate nowadays is far lower than that around 1992, so the risk factors might have changed. There might not be a strong association between gun ownership and homicide in the home now. Besides, the result is not meaningful for other countries where gun possession is not legal.

If replicating this study, the improvement could be selecting sample from a broader source of population, with subjects from various states, in different colours, and even considering other countries where the household gun is illegal and seek whether the result could be generalized. Furthermore, to best diminish information bias, for control group, we can collect information from multiple sources in addition to control subjects' self-report and synthesize into a more neutral version. Also, in order to study the causal pathway and potential psychological confounding, we

should assess subjects' mental status and violence tendency and figure out if it plays a role as confounders or one of the risk factors. We should also consider more factors when doing matching, thus increase the comparability between pairs and lessen the potential bias.

## **Conclusion**

In conclusion, the researchers discovered that guns kept in the home strongly and independently increases the risk of homicide in the home committed by an intimate acquaintance, but there is no evidence showing the causal link between gun ownership and homicide in the home. According to Hill's guidelines, the strength of the association in this study is 2.7 which is not big enough to show causality. The case-control study lacks temporality and there is no biological gradient showing in the study, in other words, there was no evidence showing more guns kept in the home leading to the higher homicide rate in the home. However, there were other case-control studies showing strong association between gun ownership and suicide in the home at that time and many other literatures shows the association between gun ownership and homicide after 1993. Therefore, there might be some evidence showing the causality of gun ownership and homicide in the home.

The study may influence the public view of the gun ownership for self-protection, and it strongly discouraged people from keeping guns in the home. Besides, it reminded the officers to thoroughly investigate and protect the victims of domestic violence from being victims in the homicide in the home. The follow-up question is related to the current situations. The gun ownership and homicide rate has changed since 1993, so it is still questionable whether the association of gun ownership and homicide in the home also changes or not.

## **Contributions**

Group members accomplish each assignment equally. As for the synthesis of the final report, slides and in-class oral presentation, Jun Zhai (jz3181) takes responsible for Background and Significance, Study population and Prevalence; Wen Shen (ws2543) takes responsible for Study Design and Results; Gaotong Liu (gl2677) takes responsible for Discussion and Conclusion.

## Reference

- Bureau of Justice Statistics. (2013). *Choice Reviews Online*, 51(01), 51-0532-51-0532.  
<https://doi.org/10.5860/choice.51-0532>
- Bureau, U. C. (1992). *1990 Census of Population: General Population Characteristics*.
- FBI — Crime in the U.S. (2016). Retrieved September 25, 2019, from Federal Bureau of Investigation website: <https://ucr.fbi.gov/crime-in-the-u.s>
- Hammett, M., Powell, K. E., O'Carroll, P. W., & Clanton, S. T. (1992). Homicide surveillance—United States, 1979–1988. *Morbidity and Mortality Weekly Report: CDC Surveillance Summaries*, 1–33.
- Hemenway, D., & Miller, M. (2000). Firearm availability and homicide rates across 26 high-income countries. *Journal of Trauma and Acute Care Surgery*, 49(6), 985–988.
- James, N. (2018). Recent Violent Crime Trends in the United States. *R45236*.
- Kellermann, A. L., & Reay, D. T. (1986). Protection or Peril? *New England Journal of Medicine*, 314(24), 1557–1560. <https://doi.org/10.1056/NEJM198606123142406>
- Kellermann, A. L., Rivara, F. P., Rushforth, N. B., Banton, J. G., Reay, D. T., Francisco, J. T., ...  
Somes, G. (1993). Gun ownership as a risk factor for homicide in the home. *New England Journal of Medicine*, 329(15), 1084–1091.
- Miller, M., Hemenway, D., & Azrael, D. (2007). State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003. *Social Science & Medicine*, 64(3), 656–664.
- Naimi, T. S., Xuan, Z., Cooper, S. E., Coleman, S. M., Hadland, S. E., Swahn, M. H., & Heeren, T. C. (2016). Alcohol Involvement in Homicide Victimization in the United States. *Alcoholism: Clinical and Experimental Research*, 40(12), 2614–2621.  
<https://doi.org/10.1111/acer.13230>
- National Household Survey on Drug Abuse (NHSDA-1993) | SAMHDA. (1993). Retrieved October 9, 2019, from <https://www.datafiles.samhsa.gov/study/national-household-survey-drug-abuse-nhsda-1993-nid13577>

- (SAMHSA), S. A. and M. H. S. A. (2016). *National Survey on Drug Use and Health (NSDUH)*. Retrieved from <https://www.samhsa.gov/data/nsduh/reports-detailed-tables-2016-NSDUH>
- Serdula, M. K., Brewer, R. D., Gillespie, C., Denny, C. H., & Mokdad, A. (2004). Trends in alcohol use and binge drinking, 1985-1999: Results of a multi-state survey. *American Journal of Preventive Medicine*, 26(4), 294–298.  
<https://doi.org/10.1016/j.amepre.2003.12.017>
- Smith, T. W., & Son, J. (2015). Trends in gun ownership in the United States, 1972–2014. *Chicago, IL: NORC*, 1–9.
- Siegel, M., Ross, C. S., & King III, C. (2013). The relationship between gun ownership and firearm homicide rates in the United States, 1981–2010. *American Journal of Public Health*, 103(11), 2098–2105.
- Truman, J. L., & Morgan, R. E. (2014). *Nonfatal Domestic Violence, 2003-2012*.
- Whiteford, H., Ferrari, A., & Degenhardt, L. (2016). Global burden of disease studies: Implications for mental and substance use disorders. *Health Affairs*, 35(6), 1114–1120.  
<https://doi.org/10.1377/hlthaff.2016.0082>
- Yu, C. M., Mack, T., Hanisch, R., Peters, R. L., Henderson, B. E., & Pike, M. C. (1983). Hepatitis, alcohol consumption, cigarette smoking, and hepatocellular carcinoma in Los Angeles. *Cancer Research*, 43(12 Part 1), 6077-6079.