Exploring the Spatiotemporal Evolution and Influencing Factors of Shooting Incidents in the United States

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Abstract: Drawing on data from the Gun Violence Archive, this study employs mathematical statistics, spatial analysis, and regression analysis to investigate the essential characteristics, spatiotemporal distribution, and influencing factors of shooting incidents in the United States from 2014 to 2023. The key findings are as follows:1) Demographically, the victims of shootings are predominantly male and older youths. Notably, indirect victimization is more prevalent among older youths, non-white youths (especially African American youths), those from higher-income households, and urban residents. 2) Temporally, there has been a rising trend in U.S. shootings over the decade from 2014 to 2023, with a pronounced increase during the pandemic period of 2019-2023. On a monthly basis, the incidence of shootings peaks from May to July. 3) Spatially, shooting incidents are largely concentrated in coastal regions, decreasing in frequency towards inland areas. Hotspots for shootings include states such as Texas, California, Louisiana, and Florida, followed by Indiana and New York.4) Various factors significantly influence the occurrence of shooting incidents, including family environment, ethnocultural context, residential conditions, business economy, and economic indicators.

Keywords: Shooting incidents, spatio-temporal evolution, influencing factors, USA.

1. INTRODUCTION

A shooting incident is an event that occurs in a public place or private space where a bullet fired from a firearm causes injury or death. These incidents usually involve the illegal use of a firearm or the legal possession of a firearm with unauthorized use. Shootings can happen anywhere, including schools, shopping centers, offices, public transportation, etc. It is one of the most pressing public issues in the United States, with the Centers for Disease Control and Prevention (CDC) reporting more than 40,000 deaths each year. With the number of mass shootings in the U.S. nearly tripling in the last decade (Reiss *et al*., 1993; Fagan *et al*., 2007; Patel *et al*., 2012), it is essential to understand where and why shooting incident occurs. The consequence of a Shooting incident can be divided into death, injury, or gun threat. Community-level spatial and demographic factors play a significant role in shaping the social fabric of neighborhoods. Income inequality, for instance, can lead to economic disparities that affect the quality of life for residents (Loeffler, 2018). Racial segregation often perpetuates social divisions and limits opportunities for diverse populations. Concentrated disadvantages, such as high unemployment and poverty rates, can exacerbate these issues (Papachristos *et al*., 2016). Additionally, family composition, including factors like single-parent households and the presence of elderly or young populations, further influences the dynamics within a community (Desmond & Valdez, 2013; Rios, 2011). Geography also plays a part, with factors like proximity to amenities, transportation networks, and environmental hazards all contributing to a community's overall well-being (Simons *et al*., 2016). Focusing on the spatial and temporal distribution of shootings in the United States, this paper is an attempt to summarize previous research on this crime type in the geography of crime studies, making recommendations for worldwide research on crimes of this nature, and improving the analysis of its influencing factors through the theory of human-place. Shooting crimes in the United States, especially school shootings, have been a serious social problem in American society. A better understanding of the spatial patterns and spread of shooting incidents may help formulate more effective policies for preventing shooting incidents.

Over the past two decades, a variety of interventions have been initiated in the United States to address the shooting problem, including gun control policy, legislative initiatives, target populations education, and community-oriented programs. A number of measures are effective in reducing shooting incidents. For example, Law enforcement interventions utilizing focused deterrence strategies significantly successfully reduce the generation of related shooting incidents. Another example is the implementation of Focused deterrence, which suggests taking guns away

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from high-risk individuals in areas where violence is concentrated. Gun availability and shooting incidents are closely related (Kleck, 1997). Reducing the availability of guns not only mitigates the fatal consequences of intentional violence but also avoids unintentional violence triggered by the presence of guns. Redirecting police activity to hot spots is effective in reducing violence. Based on this empirical evidence, experiments with proactive patrols focusing on gun seizures in hot spots were conducted in Kansas City, Indianapolis, Pittsburgh, and Houston. Evaluations have shown that these targeted deterrence interventions achieve optimal deterrent effects (Lumetal, 2011).

Numerous studies have identified several factors associated with higher rates of shooting incidents in the United States. Researchers have employed a variety of methods to investigate the relationship between these community-level factors and social outcomes. Studies have analyzed data from surveys, administrative records, and interviews to examine how high poverty, high-income inequality, and low educational attainment contribute to social disparities (Griffin, 2010). Additionally, research has focused on the role of gun availability and ownership, as well as the impact of lax gun laws, on crime rates and violence (Geier, 2017; Kalesan, 2016; Kennedy, 1998; Kwon and Cabrera, 2019; Lee, 2017; Siegel *et al*., 2013). Findings from these studies suggest that communities with higher levels of poverty and income inequality, as well as those with greater gun availability and weaker gun laws, tend to experience higher rates of violence and crime. Furthermore, research has also explored the impact of racial segregation and concentrated disadvantage, police-community relations, and legal cynicism on community well-being, finding that these factors can exacerbate social disparities and undermine trust in law enforcement (Kirk and Papachristos, 2011; Sampson and Bartusch, 1998). However, these studies have either focused on trends at the state level or neighborhood comparisons in one to three cities (Braga, 2018; Butts, 2015) and have not systematically compared communities on a national scale. Among the many researchers, one study compared different types of shooting incidents. It found parallel trends between mass shootings, homicides, and suicides (Kwon and Cabrera, 2019). Notably, many types of shooting incidents can be predicted from the same variables; thus, communities that experience one form of shooting incident may experience other forms of shooting incidents, but to date, no studies have provided direct evidence for this observation. Thus, individual state regions must establish a rational evaluation system.

Also, Jeffrey A. Butts was inspired by public health approaches to specific violence reduction strategies in his research on shooting incidents, Cure Violence (formerly Chicago Cease Fire) seeks to create individual-level and community-level change in neighborhoods where it is the norm for young people to carry guns and, for some, to use guns to resolve various forms of conflict.1 The Cure Violence (CV) model seeks to stop the spread of violence, like public health interventions aimed at curbing epidemics or reducing the impact of harmful behaviors such as smoking and drinking. The Cure Violence (CV) model attempts to stop the spread of violence in a similar way to public health interventions designed to curb epidemics or reduce the impact of harmful behaviors such as smoking and binge drinking (Jeffrey, 2015). The CV model identifies individuals who are most likely to spread shooting incidents and intervenes to change their behaviors and attitudes. It attempts to demonstrate to these individuals and the broader community that there are more acceptable and less harmful ways to resolve personal conflicts and disputes.

At the micro level, research perspectives have become more diverse, such as examining shootings with geography and racial characteristics (Zare Hossein, 2022), where SVI, or Social Vulnerability, has been introduced as an independent variable for evaluating shootings. However, many studies restrict the analysis to a limited number of cities or local police agencies (Arnio, 2020; Johnson, 2019; Holmes, 2019; Siegel, 2020; Siegel, 2019). Other studies limit data by incident type (i.e., non-accidental fatal police shootings) or victim description (i.e., not knowing if armed) (Mesic, 2018; Menifield, 2018). This study takes the U.S. states as the scope, using the GVA platform's statistics on U.S. shootings from 2014-2023 as the data source to analyze the evolution of spatial and temporal patterns of U.S. shootings and their influencing factors. The final goal of this study is to reveal the basic rules of the incidents, temporal and spatial patterns, and their influencing factors, and then to provide references for the prevention and control of crime.

2. DATA AND METHODS

2.1. Data Sources

The source of data on shootings is the Shooting Incidents Archive website (SHOOTING INCIDENTS ARCHIVE, or GVA) It provides statistics on the number of deaths and injuries from shooting incidents in the

United States from 2014 to the present, including the number of deaths, injuries, and mass shootings due to shooting incidents. Within this, it is divided into homicides, murders, defensive use, and unintentional incidents. The victim population is divided into children (0-11 years old), youth (12-17 years old), persons involved, and subject suspects.

The selection of influencing factors for shooting incidents comes from Moore and Tonry's (1998) provision of a useful framework for the occurrence of shooting incidents, which are influenced by factors such as social welfare, social order, and economic environment.

2.2. Methods

Textual analysis: The method of textual analysis is not limited to verbal or written texts but also includes different forms of information structures like images.

Textual analytics reveals systematic, objective quantitative, and qualitative analysis of the content of a text, thus revealing its variations and characteristics. It usually involves the generalization of the actual material of meaning and value.

In the study, text analysis was used to obtain relevant data on the portraits of victims and criminals, and the sample proportions of different types of victims and criminals were obtained according to demographic analysis.

Moran's I index: The global spatial autocorrelation Moran's I index was introduced to explore whether the spatial distribution of shootings in the United States is spatially autocorrelated (Moran, 1958).

Regression analysis: On the basis of statistical analysis, IBM SPSS statistics 27 regression analysis was used to explore the main influencing factors of the shooting incidents in the United States. According to the theory of human-land relationships, representative indicators are selected to improve the relationship between independent variables and dependent variables in the study of crime geography.

3. PROFILES OF THE PEOPLE INVOLVED IN THE SHOOTING INCIDENTS

3.1. Profile of the Perpetrators

Table **1** shows sample characteristics and demographic variations in shooting incidents and victimization variables. At the gender level, males have higher rates of shooting incident offenses than females, accounting for more than 80% of fatal attacks with a gun and more than 90% of shooting incidents involving a fatality, implying that males have a higher level of involvement in violent incidents such as shooting incidents.

3.2. Profile of the Victims

Table **2** shows sample characteristics and demographic variations in shooting incidents and victimization variables. Male victims and older youth (16-20) had significantly higher rates of direct shooting incident victimization compared to female victims and younger children. Female youth did not differ from male youth in terms of witnessing shooting incidents; however, nonwhite youth witnessed a greater proportion of shooting incidents compared with white youth, as did black youth relative to nonblack youth. Those with lower household incomes witnessed shooting incidents more frequently compared to those with higher household incomes. Urban youth witnessed shooting incidents at a higher rate compared to non-urban youth. Hearing gunshots in a public place was the most common form of shooting incident

Table 1: Percentage of Sample with Different Types of Offenders by Demographic Factors, 2014-2023[1]

Hallmark	Deadly attacks with guns	Law enforcement incidents involving gun deaths	Total population
Male	156,692 (84.37%)	5523 (96.05%)	2,354,594,299 (49.14%)
Females	29,025 (15.63%)	227 (3.95%)	2,436,605,757 (50.86%)
Hispanic or Latino	33,532 (18.15%)	1156 (20.16%)	722,513,667 (15.08%)
Black or African American	99,879 (54.07%)	1485 (25.89%)	607,597,034 (12.68%)
White man or woman	46,535 (25.19%)	2857 (49.82%)	3,187,900,289 (66.54%)
Asian or Pacific Islander	3250 (1.76%)	129 (2.25%)	233,386,448 (4.87%)
American Indian or Alaska Native	1536 (0.83%)	108 (1.88%)	39,802,618 (0.83%)

[1]Bancalari, P., Sommer, M. & Rajan, S. Youth Exposure to Endemic Community Gun Violence: A Systematic Review. *Adolescent Res Rev* **7**, 383–417 (2022). https://doi.org/10.1007/s40894-022-00178-5

Table 2: Percentage of Different Types of Victim Samples by Demographic Factors, 2014-2023

Variant	Master Sample		Direct victims of shooting incidents		Witnessing shooting incidents		Shots heard in public	
	n	%	n	%	n	%	n	%
Gender								
Males	314	50.7	22	7.0	52	16.6	116	36.9
Females	305	49.3	10	3.3	44	14.4	121	39.7
Race								
White	329	52.2	14	4.3	33	10.0	94	28.6
Black	285	45.2	17	6.0	61	21.4	147	51.6
Hispanic	97	15.4	8	8.3	17	17.5	45	46.4
Gross household income (USD)								
≤ $20k	104	16.5	8	7.7	21	20.2	42	40.4
$20k-$50k	161	25.6	11	6.8	30	18.6	71	44.1
$50k-$75k	89	14.1	4	4.5	10	11.2	36	40.5
$75k$100k	56	8.9	1	1.8	3	5.4	10	17.9
≥ $100k	63	10.0	1	1.6	5	7.9	18	28.6
uncharted	157	24.9	7	4.5	29	18.5	65	41.4
urban population	344	54.6	19	5.5	72	20.9	166	48.3
Non-urban population	286	45.4	13	4.5	26	9.1	76	26.6

victimization, showing similar demographic patterns by gender, age, income, and race. Indirect victimization, such as domestic burglary or witnessing an assault, was higher among older youth, non-white youth (especially black youth), youth living in households with higher incomes, and youth living in cities.

4. SPATIO-TEMPORAL PATTERNS OF SHOOTING INCIDENTS

4.1. Time Variation Dynamics

The theory of criminal time argues that there is an interrelationship between the season, month, time and day and crime, and that certain criminal behavior arises at a certain time, and that there are differences in the number, type, and characteristics of crimes at different times (Sun Fenghua *et al*., 2003). Using a one-sample chi-square to test the sample, it was found that the number of shooting incidents varied significantly with year and month ($p<0.001$), indicating that there is statistical significance in the characteristics of yearly and monthly changes in the number of shootings in the U.S. The fact that the number of missing persons per day was mostly <10 and the results were not significant suggests that there is a greater degree of stochasticity in the daily variation in the number of shootings in the United States. Therefore, only the time-varying characteristics of the number of shooting incidents over years and months were explored.

4.1.1. Annual Trends

The temporal evolution of shootings in the U.S. has trended upward from 2014 to 2023, with a significant increase during the 2019-2023 period. It coincides with the outbreak of the New Crown Epidemic. During this time, the social unrest caused by the epidemic, the economic downturn, and the release of large numbers of inmates from state prisons during the epidemic prompted the purchase of firearms, and according to the U.S. Firearms Report, the production of handguns alone skyrocketed from 3 million to 5.5 million per year during the three years of the neo-cresticerciasis epidemic, with 19,344 unregistered firearms being recovered by U.S. police in 2021 alone. The change in gun ownership rates also confirms the frequency of shootings.

Based on the correlation analysis between the timing of shootings and the epidemic (Paddy Sentongo, 2021), it can be concluded that the increase in shootings across the U.S. during the epidemic may be

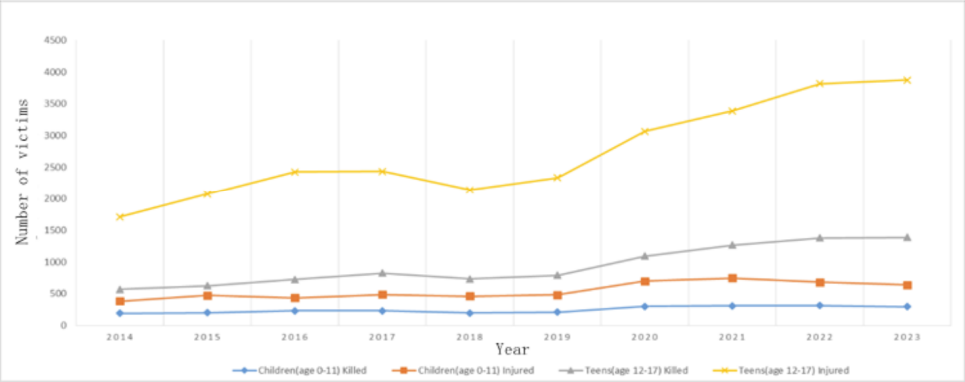

Figure 1: Annual changes in shooting incidents in the United States.

attributed to (1) an increase in COVID-19-induced psychological distress, and (2) an increase in gun sales. Moreover, Riots and Chaos in 2020 are one of the main reasons for the increase. Recent reports indicate a substantial increase in the burden of COVID-19-related depressive symptoms in the United States (Sutherland, 2020), which may have led to an increase in gun-related suicides. It is hypothesized that the development of psychological distress and depressive symptoms during the epidemic may have resulted from the need to maintain a social distance from family and friends, thereby limiting social interactions.

The spatial and temporal distribution of shootings during the epidemic aptly reflects the fact that the spatial and temporal distribution of shootings is consistent with the theory of social dislocation, where the probability of shootings rises dramatically as a result of social dislocation due to the volatile and chaotic social environment during the epidemic, where members of the society are at a loss for norms or act in their ways.

4.1.2. Monthly Trends

From the monthly shooting distribution, incidents can be seen, the high incidence of shooting incidents in the period gathered in May, June, and July. This period and the U.S. primary and secondary school summer vacation coincides with the crime victims in this time is also dominated by teenagers. At the same time, this period also has the peak of out-of-home workers looking for work and returning to the workplace; the concentration of college graduates looking for work in the process of population migration will also increase the probability of shooting incidents. On the contrary, the probability of shooting incidents in winter will be reduced accordingly due to the influence of the holiday atmosphere, reducing the motivation for shooting incidents; the cold weather will also limit the action to avoid shooting incidents.

4.2. Spatial pattern of shooting incidents

4.2.1. State-Level Distribution Pattern

The spatial distribution of shooting incidents in the United States (Figure **3**) exhibits a concentration along coastal areas, with a decreasing gradient towards inland regions. Key hotspots include Texas, California, Louisiana, and Florida, followed by Indiana and New York. This pattern can be attributed to the geographic location of these states, which often serve as entry and transit points for international migrants due to their

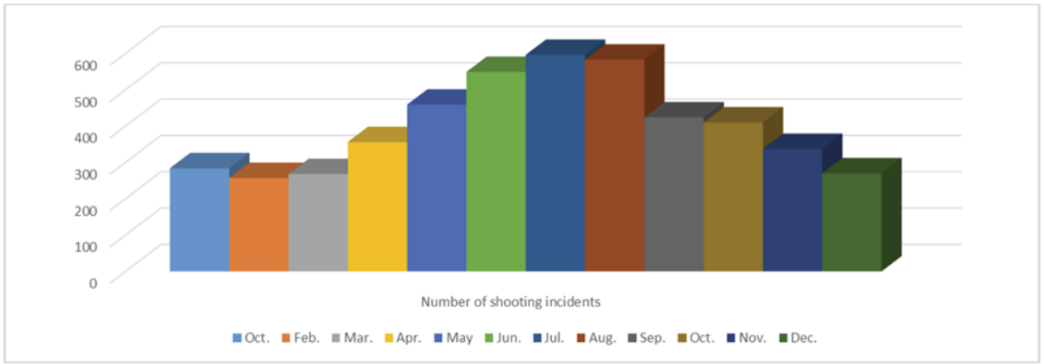

Figure 2: Monthly Change of Shooting Incidents in the United States.

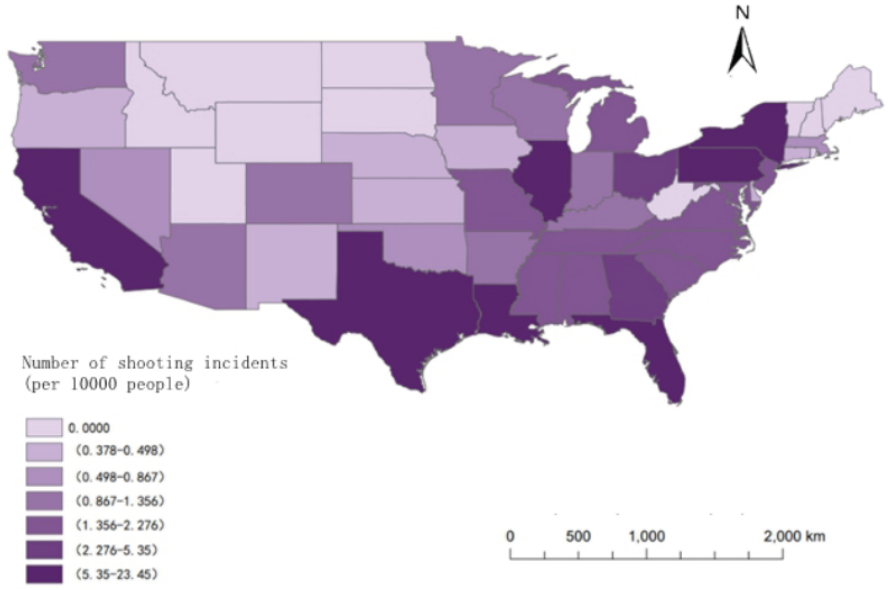

Figure 3: State distribution pattern of shooting incidents in the United States.

proximity to coastlines, lakeshores, or borders with developing countries. High population mobility and diverse ethnic compositions in these areas have impacted pre-existing social orders and placed additional pressures on public safety, thereby contributing to higher incidences of shootings.

The economic, security, and legal landscapes of these regions also play a significant role. More developed areas tend to have higher rates of gun ownership, further influencing the occurrence of shooting incidents. The strong correlation between development levels and gun ownership highlights the need for tailored policies that address both economic prosperity and public safety concerns.

4.2.2. County-Level Distribution Pattern

Figure **4** shows the spatial distribution of shooting incident rates. At the county scale, shooting incidents in the United States are characterized by a spatial distribution concentrated in patches at the edges and scattered internally. Because the U.S. states have a great deal of autonomy, with their own relatively independent legislature and judicial system, criminals can take advantage of the different country's and states' legal systems to escape punishment, which will cause serious harm to the stability of society. Hence, the border of the states, near the sea, and neighboring countries border is the high incidence of shooting incidents in the region. The high incidence of counties more sporadically distributed in the eastern states of

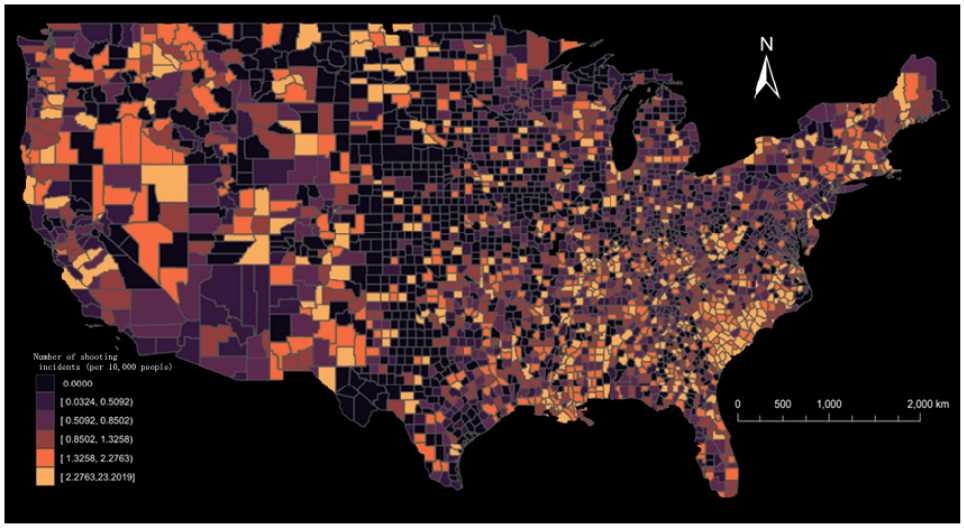

Figure 4: County distribution pattern of shooting incidents in the United States.

the United States, the central United States, and Alaska region of the probability of occurrence of multi-county shooting less. These remote areas have a predominantly Indigenous population, a small foreign population, and close neighborhoods within the community, where strong social control can effectively prevent and stop shootings from occurring on time.

4.3. Micro-Site Location Hotspots

A total of 4,694 shooting incidents were recorded from 2014-2023 on the Gun Archive of America GVA website. More than 65 percent were robberies, followed by 32 percent aggravated assaults and 3 percent criminal homicides. Nearly half of these shootings occurred indoors; one-third occurred in commercial settings, including hotels, business environments, and restaurants; and about 23 percent occurred in open environments, such as streets, parks, and fields (Figure **4**).

This distribution means that for shooting incidents, commercial centers have a higher probability of shooting incidents. The types of incidents during this period are mostly property crimes, and shooting incidents that occur in open environments are also worthy of study, as they have a higher degree of randomness and unpredictability.

School openings and vacations can change social activities within a community and can affect shooting incidents. Schools can alter the activities of potential offenders, victims, and available guardians. A study of school-level shooting incidents (MacDonald, 2015), assessed the impact of opening 59 charter schools and 24 public schools on crime in the surrounding neighborhoods. The authors used a double-difference strategy to compare overall and violent crime rates before and after the schools opened. They found that opening public schools led to a statistically significant 18 percent decrease in predicted crime within a one-tenth-mile radius relative to areas where schools were always present. No significant change in violent crime was found. This implies that school opening periods lead to a weaker rate of shooting incidents relative to vacation periods.

Implementing greening programs in cities can contribute to environmental sustainability and socio-economic development. Many studies have confirmed the link between green spaces and public health and that more green environments and facilities can reduce the probability of violent crime. The study on the link between greening and violent crime (Kuo & Sullivan, 2018) experimented with 145 women who were randomly assigned to 1 of 18 architecturally identical public housing blocks. Outdoor public spaces with varying amounts of vegetation present surrounded each neighborhood. The study found that women living in green housing neighborhoods had less mental fatigue and were less violent.

Streets are often high-risk areas for shooting incidents, with violent crime occurring on more accessible and accessible streets. Therefore, street crime control and streetscape adjustments can play a key role in curbing gun crime. In 1990, the Los Angeles Police Department implemented Operation Cul-de-sac, a program that installed permanent barriers on 14 streets in Los Angeles between 1990 and 1991.1. The program was designed to reduce the number of drive-by shootings between rival gangs. The program was

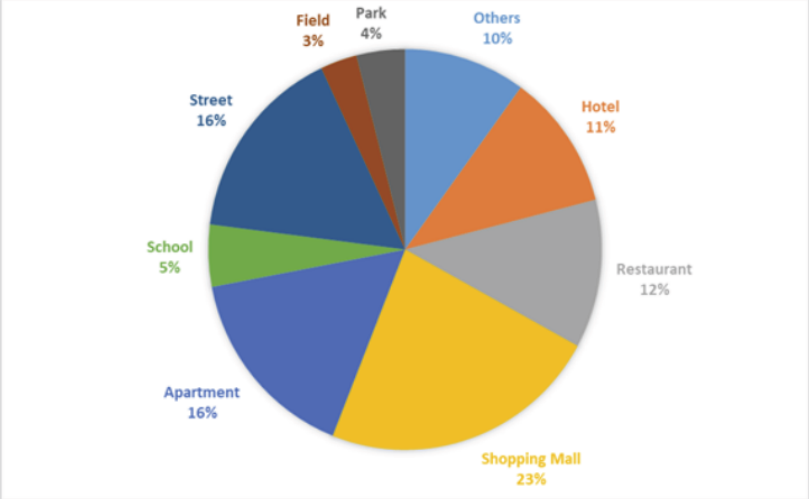

Figure 5: Proportion distribution of micro-site shooting incidents.

designed to reduce drive-by shootings between rival gangs. A study of street crime (Lasley, 2001) assessed the program's impact on various crime measures and found that overall levels of violent crime (assaults and murders) in the intervention area decreased by 20% in 1990 and 14% in 1991 compared to 1989. When traffic barriers were removed, violent crime rates returned to pre-intervention levels. Therefore, for street-level shooting incident prevention and control, additional traffic barriers may be appropriate to suppress the probability of shooting incidents.

5. FACTORS INFLUENCING SHOOTING INCIDENTS

5.1. Impact Factors Selection

Moore and Tonry (1998) provide a useful framework for the production of shootings, which are influenced by social welfare, social order, and economic circumstances. Building on the work of Wilson (1987, 1996), Moore and Tonry describe how the de-industrialization of the economy in the late seventies and early eighties radically altered the conditions of structural factors in inner-city minority communities. Many urban neighborhoods' social and economic fabric collapsed under various social and economic pressures as jobs, businesses, and the middle class fled the city centers. The ensuing cascade of negative conditions in inner-city neighborhoods included the breakdown of families, increased mass incarceration, and increased social and economic isolation. Gangs continued to thrive as youth responded to geographic and structural isolation by turning to these groups for affiliation, security, and new economic opportunities in some cities (Hagedorn, 1988).

In conjunction with the previous discussion of the main influencing factors, based on the characteristics of the shooting incident and the contextual factors, the social norms were selected from the perspective of social order, the four dimensions of education level, family environment, ethnocultural environment, and residential environment from the perspective of socio-cultural environment, the macro-economic environment and the business environment were selected from the perspective of the economic environment, and the quantitative characteristics were selected from the dimension of the basic demographic environment to further explore the degree of influence of each factor (Table **3**).

5.2. Results of Regression Analysis

Upon examining the results of the regression analysis, several key insights emerge regarding the factors that significantly influence the occurrence of shooting incidents. The analysis highlights the importance of family environment, ethnocultural environment, residential environment, business economy, and population density in shaping the likelihood of such events.

Starting with the family environment, it is evident that there is a negative correlation between the number of families in a state or county and the occurrence of shooting incidents. In other words, areas with a higher concentration of families tend to experience a lower

Table 3: Factors Influencing the Generation of Shootings in the U.S.

Factor	Probe	Norm	Pearson correlation	Significance (two-tailed)
Social order	Social norm	Occupation rate	.115	.420
		Crime rate	.516*	.002
Sociocultural environment	Educational level	Bachelor's degree or above	.019	.897
	Family environment	Number of household sizes	.851**	.000
	Ethnocultural environment	Of African descent	.697**	.000
	Living environment	Number of housing units	.853**	.000
Economic environment	Macroeconomic environment	GDP	.116	.418
	Business Economy	Size of economy	.461**	.001
Basic demographic environment	Quantitatively	Population density	.734**	.000
		Sex ratio	.12	.19
		Fertility rate	.43**	.000

probability of shooting incidents. This finding suggests that family-oriented communities may foster a more stable and secure social environment, which in turn reduces the likelihood of violent acts. The presence of numerous families and housing units also indirectly reflects the local security situation, as these areas are likely to have a higher number of police officers and a robust supervisory capacity. These factors collectively exert an inhibitory effect on the occurrence of shooting incidents.

The ethnocultural environment also plays a crucial role in the generation of shootings. Notably, there is a strong correlation between the number of people of African descent and the occurrence of shooting incidents. This finding aligns with the profiles of the perpetrators involved in such incidents, many of whom also belong to this ethnic group. This suggests that cultural and social factors specific to this ethnic group may contribute to a higher incidence of violent behavior.

The residential environment, specifically the number of housing units, similarly exhibits a negative correlation with the occurrence of shooting incidents. This is likely because well-established residential areas with a high density of housing units often have better-developed infrastructure, including security measures, which can help prevent violent events.

On the economic front, the business economy has a positive effect on the generation of shootings. This is particularly evident in economically developed areas, where robbery shootings are more prevalent. This finding highlights the need for robust economic development strategies that also prioritize community safety and security.

Finally, population density, while not explicitly mentioned in the regression analysis results, can be inferred to play a role in shaping the likelihood of shooting incidents. High-density areas may present unique challenges in terms of crime prevention and control, requiring tailored approaches to ensure the safety and security of residents.

In conclusion, the regression analysis reveals that a complex interplay of factors, including family environment, ethnocultural environment, residential environment, business economy, and population density, significantly influences the occurrence of shooting incidents. Understanding these factors is crucial for developing effective strategies to prevent and reduce violent events in communities.

6. CONCLUSION AND DISCUSSION

6.1. Conclusion

In summary, this study has offered an in-depth examination of the spatiotemporal dynamics and influencing factors associated with shooting incidents in the United States from 2014 to 2023. By leveraging a combination of mathematical statistics, spatial analysis, and regression models, we have uncovered significant trends and patterns that provide critical insights into the nature of gun violence.:

(1) Direct victimization from shooting incidents was significantly higher among male victims and older youth compared to female victims and younger children. Indirect victimization, such as domestic burglary or witnessed assault, was higher among older youth, non-white youth (especially black youth), youth living in households with higher incomes, and youth living in cities.

(2) The temporal evolution of shootings in the United States has been trending upward from 2014 through 2023, with a significant increase during 2019-2023. Due to the impact of the epidemic, the social unrest caused by the epidemic, the economic downturn, and the release of large numbers of inmates from state prisons during the epidemic prompted the purchase of firearms. The increase in shootings across the U.S. during the epidemic can be attributed to (1) increased psychological stress due to COVID-19 and (2) increased gun sales. At the monthly level of analysis, the high period for shootings clustered in May, June, and July, which coincided with the summer vacation break for U.S. elementary and secondary schools, and crime victims during this period were also predominantly teenagers.

(3) The spatial distribution of shooting incidents in the United States is mainly concentrated in coastal areas, showing a decreasing trend towards inland areas, with shooting incidents mainly concentrated in Texas, California, Louisiana, and Florida, followed by Indiana and New York. These areas are often the core areas where immigrant groups gather, and the strong mobility of the population and the diversity of ethnic cultures have had an impact on the original social order, bringing pressure on social security and leading to the occurrence of shooting incidents.

(4) Family environment, ethnocultural environment, residential environment, business economy, and population density significantly affect the generation of shooting incidents. The family environment and residential environment harm the occurrence of shootings, and the security situation and high regulatory capacity can inhibit the probability of shootings; the number of people of African descent and the business economy and population density have a positive effect on the occurrence of shootings.

6.2. Improvement Measures

According to the above conclusions and discussions, the following are some viewpoints and improvement measures regarding the governance of shooting incidents in the United States:

(1) Strengthen education and publicity: Carry out targeted education and publicity activities for male and adolescent groups, improve their legal and safety awareness, and reduce the occurrence of shooting incidents.

(2) Improve laws and regulations: strengthen firearms management, formulate stricter regulations on the purchase, possession, and use of firearms, and reduce the illegal circulation of firearms from the source.

(3) Strengthening social security: During high-risk periods such as summer, strengthen patrols and monitoring efforts to promptly identify and address potential safety hazards.

(4) Optimize population management: Strengthen population management and social integration work in areas where immigrant groups gather, reducing conflicts and contradictions caused by cultural differences and social exclusion.

(5) Improving the socio-economic environment: increasing residents' income levels, improving social welfare, reducing social inequality and wealth gap, thereby reducing shooting incidents caused by economic problems.

(6) Strengthening international cooperation: Drawing on the successful experiences of other countries in gun management and social security, enhancing international cooperation and exchange, and jointly addressing transnational crime issues such as shooting incidents.

(7) Improve data monitoring and early warning system: Establish a nationwide shooting incident data monitoring and early warning system, collect and analyze relevant data promptly, and provide a scientific basis for formulating effective governance measures.

6.3. Limitations

This paper examines the spatial and temporal distribution pattern of shooting incident crime on a national basis, which is a complement to and integration of previous studies that limit data research to only the type of incident (i.e., non-accidental fatal police shootings) or victim description (i.e., do not know if they are armed or not), and contributes to the macro-study of shooting incident crime and similar geographies of crime; it also employs a quantitative approach to explore the explanatory power of multiple factors such as the social environment, the economic environment The paper also adopts a quantitative approach to explore the explanatory power of multiple factors such as social environment, economic environment, demographic environment, and ethnocultural environment on the spatial distribution of shooting incidents, which makes up for the shortcomings of the qualitative analysis. At the same time, this paper proposes that the "social disorder theory" can be used to explain the generation of shooting incidents, which is an expansion of the study on the geography of shooting incidents and similar crimes.

However, this paper still has the following deficiencies: 1) Due to data limitations and time constraints, the regression analysis of the factors of the shooting incident is limited to the factors selected, while the micro-scenario and the relationship between the victim and the perpetrator of the elements of the sparse research, the future follow-up research should be supplemented with such indicators to improve the impact of the mechanism. 2) The United States of America as the United States of America exists in its specificity, the independent legislation of each state for the strength of gun control. The differences in future research can discuss the role played by state policies on the generation of shooting incidents in order to improve the gun control system. Differences, future research can discuss the role played by state policies on the generation of shooting incidents to improve the gun control system.

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