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## **The mechanism of using the geographic information system in detecting unsafe spaces in the municipal areas of big cities (Investigation of unsafe places in the city of Dallas, Texas, USA)**

<sup>1</sup> Mohammad Mehdi Norouzian, <sup>2</sup> Nima Gheitarani, <sup>3</sup> Najmeh Heidarian, <sup>4</sup> Mahboobe Safaei-Mehr, <sup>5</sup> Mohammad Amin Gheitarani

<sup>1</sup> Ministry of Road and Urban Planning, Urban Development & Revitalization Organization of Iran, General Director of Supervision on Urban Regeneration Plans, Iran

<sup>2</sup> School of Sustainability, Arizona State University, Tempe, Arizona, United States

<sup>3</sup> PhD Student & Graduate Assistant, Department of Geography and Environmental Studies, Texas State University, San Marcos, Texas, United States

<sup>4</sup> Department of Geography and The Environment, University of Texas, Austin, Texas, United States

<sup>5</sup> Graduate in MA, Department of Management, Faculty of Humanities, Payame Noor University, Hamedan Branch, Iran

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Corresponding Author: **Nima Gheitarani**

### **Abstract**

For a long time, identifying the environmental and spatial factors of crime and trying to eliminate these factors or reduce their effects has been known as the most important way to increase safety and prevent the occurrence of anomalies. Because social anomalies, no matter how they happen to humans, have a place and place and time characteristics. Which distinguishes these behaviors from each other. Surveys show that some urban spaces have a higher crime rate due to their physical, social, and economic characteristics; a city is a collection of special mutual narratives that originate from the role and context of its internal institutions. Therefore, without providing a subjective definition, we accept the existence of the city based on objective characteristics, that is, the quality of the

structure of the society and its economic and administrative role, not just the population quantity. Also, some thinkers have provided a comprehensible definition of urban space "Urban space is an organized, decorated, and orderly structure for human activities". Part of human actions and activities take place in place and space, and according to Anthony Giddens, "space is a physical set for social interactions". And on the contrary, some spaces prevent and prevent crimes from being committed inside them. On the other hand, research has proven that criminals often make rational choices when committing crimes and look for the simplest, least dangerous, and most suitable opportunities and conditions in place and time to commit crimes.

**Keywords:** Unsafe Spaces, Dallas, Texas, Urban Areas, GIS

### **1. Introduction**

The school of crime geography is the result of the thoughts of the Belgian Kotel and the French Gerry (Thuruthy, 2023)<sup>[39]</sup>. In his famous book Social Physics, Cotele studied crime statistics in France between 1825 and 1836 (Zakerhaghighi *et al.*, 2015)<sup>[43]</sup>. With the help of numbers, he showed the correlation between the geographic environment and crime. According to him, the crimes committed in a society and its periodic fluctuations are like a mathematical function depending on the changes in the economic and social conditions of time and place. Katleh's research attracted the attention of many thinkers from different countries of the world, including Italy, France, and Germany, and this caused the emergence of new scientific movements, including the creation of a new discipline in the field of criminal statistics called collectivism (Aghazadeh *et al.*, 2019)<sup>[2]</sup>.

The influence and importance of the studies and investigations of Katleh in the field of crime geography were so great that some sources have introduced him as the father of crime statistics and among the founders of the school of crime geography (Zaker Haghighi *et al.*, 2014)<sup>[42]</sup>. It is said that his research has caused crime to be recognized as a social phenomenon subject

to the two variables of time and place (Tomaszewski, 2020)<sup>[40]</sup>. In the 19th century, Gray thought that he was able to establish a relationship between natural conditions and the type of crime by presenting the "thermal law of crime". He believed that in the warm and southern regions and during the hot season, crimes against people occur more, and in the northern regions and during the cold season, crimes against property are more prevalent (Sadigh Sarabi, M., *et al.*, 2023).

In addition to the theory of the thermal law of crime, he believed that pressure, temperature, gentleness of winds, and rain are effective in crime. Enrico Ferri is one of the other people who studied crime and environmental conditions with the inspiration of Kotle's studies and attitude (Lercel & Hupy, 2023)<sup>[23]</sup>. He believed that crime is the result of complex and decisive factors of human nature and geographical environment, whether natural or human (Ghadarjani *et al.*, 2013a)<sup>[9]</sup>. Sociologists of the Chicago school studied the relationship between the physical structure of the city and the moral system and studied the relationship between crime rates such as suicide, divorce, prostitution, etc., and the natural environment in the city (Aydin *et al.*, 2020)<sup>[5]</sup>.

Their goal was to understand the influence of social and ecological factors on social disorganization and deviant behavior. The Chicago investigation planned the overnight accommodation of those youths and teenagers who were referred to the special court for these people from different areas of the city (Moura de Souza *et al.*, 2022)<sup>[27]</sup>. These studies showed that the distribution of criminals in and around the city is consistent with a systematic pattern (Khanian *et al.*, 2019)<sup>[22]</sup>. Delinquency rates among low-class people in the old neighborhoods of the city were at the highest possible level and decreased in more prosperous areas. Also, the pattern of reduction in crime rates, in parallel with the increase in the distance from the residents living in the old neighborhoods of the city, was observed in racial or ethnic groups (Dizaji *et al.*, 2023)<sup>[7]</sup>.

## 2. Theoretical

Crime is a social structure that indicates the failure of the common values of society by an individual or group (Ding *et al.*, 2021)<sup>[6]</sup>. The increase in the crime rate and its diversity in urban societies is not only in conflict with the principles of social order. Rather, it brings with it the wastage of economic resources, the disillusionment of citizens, and the general deterioration in the quality of life, and by reducing social security, it threatens the foundations of social life (Gheitarani *et al.*, 2013). Also, a crime is an action that causes a violation of the law, especially the criminal law.

Criminal factors. Urban delinquency and crimes have been investigated and researched in most scientific fields from the past until now. In explaining the causes and factors of crime and insecurity, various ideas and theories have emerged as follows: Location and mass. Since long ago, identifying the environmental and spatial factors of crime and trying to eliminate these factors and reducing their effects has been known as the most important way to increase safety and prevent the occurrence of anomalies (Ghadarjani *et al.*, 2013b)<sup>[10]</sup>.

Because social anomalies, no matter how they occur to humans, have a place and time container that differentiates these behaviors from each other (Gheitarani *et al.*, 2020)<sup>[12]</sup>.

Therefore, the difference in the spatial structure and behavioral characteristics of people, along with the time factor, causes the formation of different spatial and temporal patterns of crimes in a unit of place (Sadigh Sarabi *et al.*, 2024)<sup>[34]</sup>. Studies show that some urban spaces have a higher crime rate due to their physical, social, and economic characteristics; on the contrary, some spaces are barriers to committing crimes inside (Norouzian & Sarabi, 2023)<sup>[25]</sup>.

On the other hand, research has proven that criminals often make rational choices when committing crimes and look for the simplest, least dangerous, and most suitable opportunities and conditions in place and time to commit crimes. What is certain is that all human behaviors occur at a specific time and place. Among these behaviors are social deviations that are formed in a unique spatial and temporal context (Norouzian, M. M., 2024)<sup>[32]</sup>. An important point is that the geographical distribution of crimes is influenced by the variables of the place and time of the crime, the perpetrator, and the victim of the crime (Gheitarany *et al.*, 2013)<sup>[15]</sup>. Research shows that in some places of the city due to the special physical structure and social, economic, and cultural characteristics of the residents and users of these places, the possibility and opportunity of crime are greater (Karimimansoob *et al.*, 2024b)<sup>[20]</sup>.

Also, some thinkers have provided an understandable definition of urban space, "Urban space is an organized, decorated, and physically orderly structure for human activities" (Samami *et al.*, 2024)<sup>[36]</sup>. Part of human actions and activities take place in place and space, and according to Anthony Giddens, "space is a physical set for social interactions" (Ghadarjani & Gheitarani, 2013a)<sup>[9]</sup>. The space is divided into three categories based on the degree of "inhibition of social interactions":

- A. Public space: It is a space that can be "accessed" by all members of the society, but the individual does not have complete freedom in performing his actions, and the norms and laws of the society are taken into account.
- B. Semi-public or semi-private space: It is a space that is free for public use but has specific users due to limitations in its purpose and use.
- C. Private space: It is a space that is occupied by individuals (Kahvand *et al.*, 2015)<sup>[18]</sup>.

Investigating the relationship between the city and urbanization and delinquency in the middle of the 19th century was highly noticed (Gheitarani *et al.*, 2024a). Also, space in general and urban space, in particular, is a complete group consisting of three elements or three environments: the human element which is defined as population in its social and collective form (social environment); the element of activity that reflects the livelihood role and economic behavior of humans in the context of the environment (economic environment); and the natural environment, which is made up of various components and is the platform of actions and reactions and the field of action of human activities (Norouzian & Gheitarani, 2023)<sup>[26]</sup>. People in urban spaces are facing all kinds of threats such as crime, terrorism, air and water pollution, earthquakes and floods, and interference with the movement of vehicles and pedestrians (Sadigh Sarabi *et al.*, 2023a). Although developed countries have been able to control many natural threats, the control of human threats is increasing in these

countries (He & Li, 2022) [17]. Therefore, Zukin says in the book *Farhang Shahrha*: "Urban spaces are not safe enough for people to participate in the creation of public culture." Studies show that as the size and population of living environments increase, the underlying factors for the creation of black and crime-prone urban bodies increase (Norouziyan & Gheitarani, 2024) [33]. According to Worth, "Urbanization leads to results such as an increase in the size of the population, which itself causes social and psychological consequences in the life of the city" (Naghbi Iravani *et al.*, 2024b) [30]. Hall also believes that "the population explosion in the world's cities leads to the creation of destructive behavioral cycles that are even more deadly than a hydrogen bomb." In addition to that, with the increase in population, there is diversity in culture, and as a result, cohesion and social agreement become less and less. In such a situation, the dominance of government institutions and organizations and the police force (Khanian *et al.*, 2013) [21].

### 3. Methodology

The research type of this research is applied and its method is descriptive-analytical. In this way, in the context of investigating the distribution of the type and amount of crimes in the 2nd district of Dallas city, using the descriptive method, and in explaining the spatial-spatial factors influencing the formation of these crimes in the studied area, using the analytical-ecological method (the relationship between crime and the environment), has been used. Information gathering tool (Sadigh Sarabi *et al.*, 2023b). To collect information for this research, three basic steps are taken into consideration:

1- In the first stage, through library studies, geographic, demographic, social, and economic characteristics. The anatomy of District 2 of Dallas City was examined in different courses and works done in universities and institutions (Ghourchi, M. *et al.*, 2018) [16]. In this context, the scientific and informational sites the statistical yearbooks of the American Statistical Center, and comprehensive and detailed plans that were previously carried out for the 2nd district of the city of Dallas are used. In the second stage, by using field studies including going to the place, observing, and taking pictures to know the type and amount of crimes in area 2 of Dallas city, information is completed and the maps are updated through observation and photography. In the third stage, after collecting the information, data, and maps required for the research, creating a database digitizing the maps, and entering tabular data into the GIS database, then the required maps were extracted (Farrokhhrad & Gheitarani, 2024) [8].

**Statistical population.** The statistical population of this research includes the set of crimes related to narcotics, including abuse, preparation and production, buying and selling, possession, and transportation of narcotics (Safaei-Mehr, 2024) [35]. Texas is one of the 50 states of the United States, with the city of Austin as its center, the second most populous state in the country (after California), the second largest state in the United States (after Alaska), and the second largest state economy after California. This state is located in the south of America and has an international border with Mexico (Aghazadeh *et al.*, 2018) [4]. Also, in terms of state boundaries, it shares borders with the state of New Mexico on the west, Oklahoma on the north, Arkansas

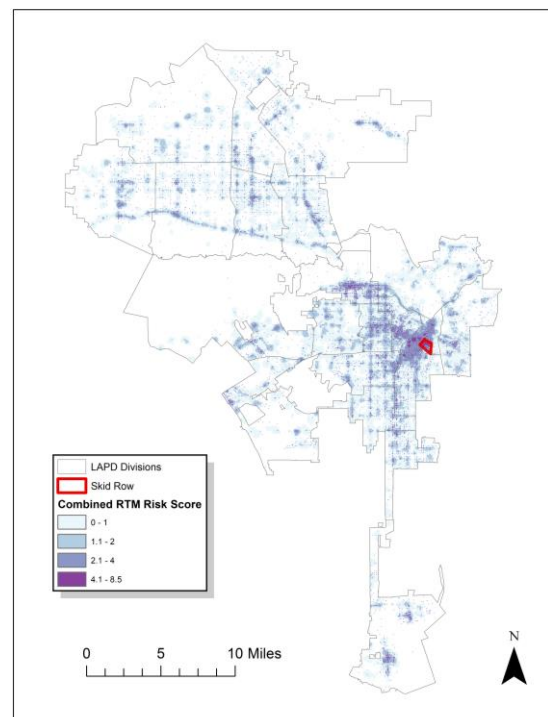
on the northeast, and Louisiana on the east. The area of Texas is 696,200 square kilometers and its growing population is 30.5 million people based on July 2023 statistics.



Source: www.wikipedia.org

**Fig 1:** The geographical location of the state of Texas in the United States

**Data analysis method.** Statistical methods and Office/Excel software were used in the data analysis of this research. For statistical and graphic analysis, geographic information system (GIS) software and Crime analysis software in Arcview environment and Case in ArcGIS environment have been used. Spatial autocorrelation test. Spatial self-correlation test methods examine the relationship between point distributions of crimes with each other (Karimimansoob *et al.*, 2024a) [19].



Source: Wheeler & Reuter, 2020

**Fig 2:** Other hot spot methods, like hierarchical clustering or kernel density maps, however, this is not as big an issue.

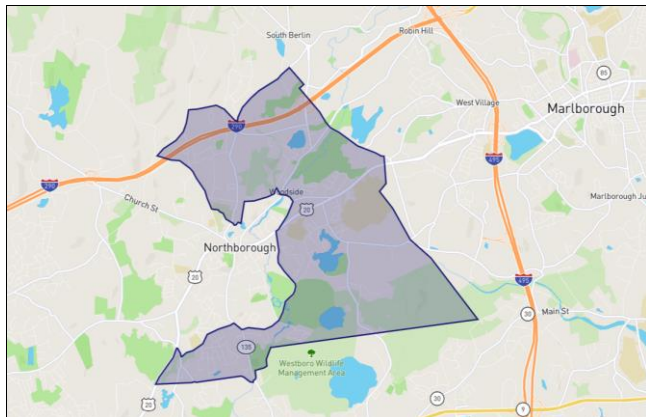
One of the most important methods of spatial autocorrelation analysis is Amara Moran's method and Geary's C method.

### Graphical methods of showing mass centers. *Point map.*

The most common approach to show the geographic patterns of delinquency is to use point maps. Drawing a dot map has become more popular because it is a digitalized and simple form of the traditional and familiar method of placing dots on paper maps on the wall. In digital applications, if these geographic points are properly combined with other relevant information. Like the signs that show the type, date, and time of the crime, then a group of points that have special conditions can be selected simply and quickly (Uding *et al.*, 2024) [41]. Then these choices can be displayed using appropriate symbols representing specific crime groups. However, it is difficult to interpret spatial patterns of crimes and crime hotspots in crime point data, especially when the number of data is very large (Aghazadeh *et al.*, 2017) [3].

### 4. Findings

The median real estate price in Chapinville/Woodside is \$706,054, making it more costly than 55.5% of neighborhoods in Massachusetts and 81.0% of neighborhoods nationwide. Currently, the average rental price in Chapinville/Woodside stands at \$2,811, based on an exclusive analysis from NeighborhoodScout. Rent prices here are lower than those in 61.7% of Massachusetts neighborhoods. Chapinville/Woodside is classified as a rural neighborhood due to its population density and is located in Northborough, Massachusetts. Real estate in Chapinville/Woodside mostly consists of medium-sized (three or four bedrooms) and large (four, five, or more bedrooms) single-family homes and townhomes. A majority of the housing is owner-occupied. Many homes in the Chapinville/Woodside neighborhood were constructed between 1970 and 1999, while some were built between 1940 and 1969.



Source: www.neighborhoodscout.com

Fig 3: West Northborough Neighborhood in Dallas

Vacancy rates in Chapinville/Woodside are at 3.1%, lower than what is found in 79.4% of American neighborhoods. The demand for real estate in Chapinville/Woodside is above average in the U.S., suggesting potential for price increases or new residential construction in this area.

**Notable characteristics of this neighborhood.** Various factors contribute to the perception of a neighborhood, with the overall appearance and unique character often taking precedence. For instance, one might observe if buildings share a common architectural style or if storefronts feature

signs in multiple languages. The Chapinville/Woodside neighborhood in Northborough has significant aspects concerning its visual appeal and lifestyle that deserve attention (Naghbi Irvani *et al.*, 2024c) [31].

**Demographics.** Based on an exclusive analysis by NeighborhoodScout, Chapinville/Woodside ranks among the top neighborhoods for families in Massachusetts. This area is more family-oriented than 98.8% of neighborhoods across the state. The combination of excellent public schools, low crime rates, and predominantly owner-occupied single-family homes gives this neighborhood a nostalgic, family-friendly vibe. Many families choose to reside here, facilitating social connections and the development of a strong community. Furthermore, the high proportion of college-educated parents positively influences the academic performance of local schools. Overall, Chapinville/Woodside provides all essential amenities for families to thrive. Besides its suitability for families with school-aged children, this neighborhood also appeals to urban professionals and highly educated executives.

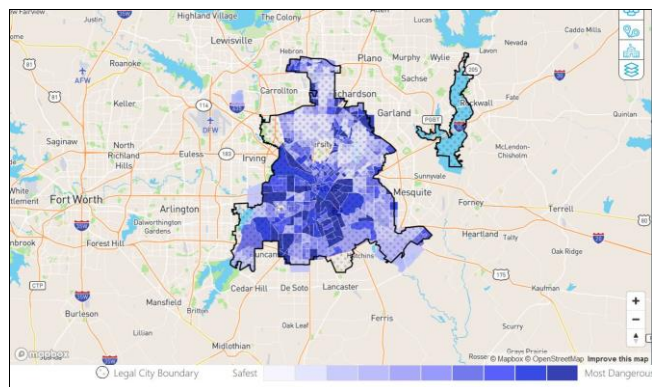
**The Neighbors.** There are two complementary measures for understanding the income of a neighborhood's residents: the average and the extreme. While a neighborhood may be relatively wealthy overall, it is equally important to understand the rate of people - particularly children - who are living at or below the federal poverty line, which is extremely low income. Some neighborhoods with a lower average income may have a lower childhood poverty rate than others with a higher average income, and this helps us understand the conditions and character of a neighborhood.

**Languages.** The most common language spoken in the Chapinville / Woodside neighborhood is English, spoken by 84.6% of households. Some people also speak Langs. of India (2.8%).

**Ethnicity / Ancestry.** Culture is the shared learned behavior of people. Undeniably, different ethnicities and ancestries have different cultural traditions, and as a result, neighborhoods with concentrations of residents of one or another ethnicities or ancestries will express those cultures. It is what makes the North End in Boston so fun to visit for the Italian restaurants, bakeries, culture, and charm, and similarly, why people enjoy visiting Chinatown in San Francisco (Safaei Mehr, M., 2023).

Along with the fundamental change in the economic system of the city and the creation of various urban activities, the attraction of the population and the increase in migration to Dallas began, and the need to provide housing, the formation, and development of new neighborhoods and residential areas in different areas of the city was avoided. He made it unacceptable. Following the onslaught of population and the flood of immigration, the population of Dallas increased dramatically. The rapid and uncontrolled increase of the population in this period and the following periods caused it. At first, the gardens and open urban spaces were invaded and turned into infrastructures and in the next stages and with the continuation of the city's excessive growth, the surrounding lands that had military and industrial users would become part of the city's lands and surrounded by residential uses.

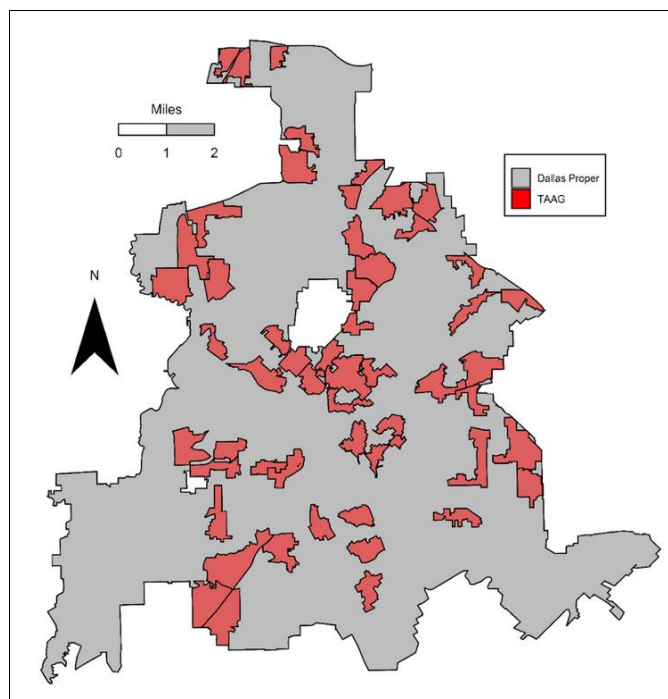
**Natural structure.** Based on the air quality control company's maps, the majority of the 2nd district of Dallas municipality has good and clean air. Among the effective factors in this matter, we can consider the altitude, topography, open and green surfaces (rivers, valleys, and northern slopes), and the microclimate conditions resulting from these factors in the region (local winds and rainfall). The most important sources of air pollution, in this case, can be considered the vast surfaces of highways and activities related to the construction sector (in 9 years, 72 to 81 regions have borne a heavy burden in this field by issuing permits for more than 12 million square meters of buildings.).



Source: www.neighborhoodscout.com

Fig 4: GIS layers of criminology in central Dallas

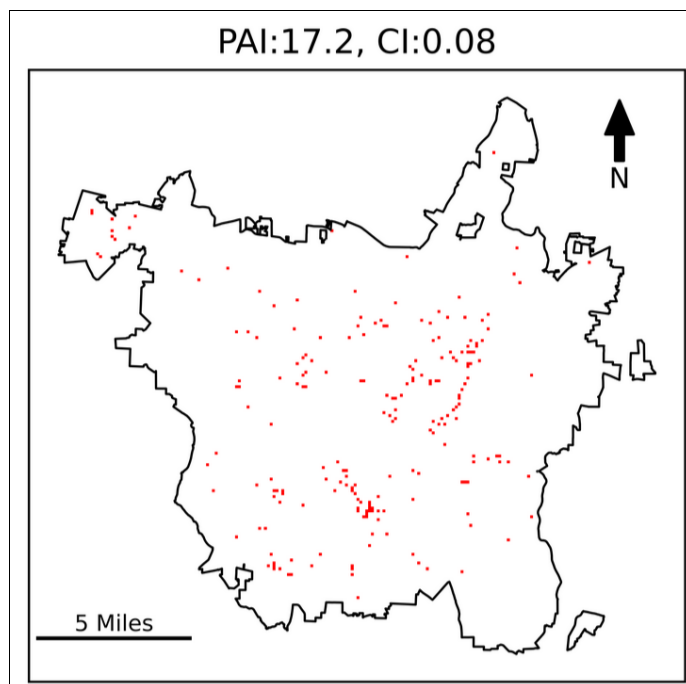
Region 2 due to the passage of the main fault north of Dallas and the secondary faults of Niavaran, Davodieh, and Bagh Faiz; is among the vulnerable areas of Dallas city against earthquakes (Naghbi Irvani *et al.*, 2024a) [29]. In addition to that, other issues such as faults, landslides, etc. are among the factors. Which makes the upper (northern) part of the region full of danger.



Source: www.andrewpwheeler.com

Fig 5: The largest household in the city of Dallas, like the studied area, is in the group of 4 people and includes 277,112 people

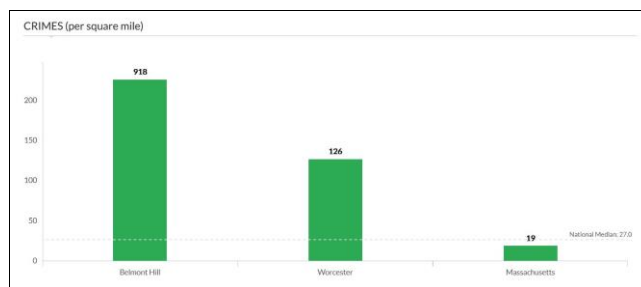
If we do the typical approach of just taking the highest crime grid cells based on the historical data, here are the results both for the PAI and the CI (clumpy index).



Source: www.andrewpwheeler.com

Fig 6: Potentially criminal existence points extracted by GIS layers, 2024

For those not familiar, PAI is % Crime Capture/% Area, so if the denominator is 1%, and the PAI (for the test data) is 17, that means the hot spots capture 17% of the total thefts from vehicles. The CI ranges from -1 (spread apart) to 1 (entirely clustered). Here it is just over 0, suggesting these are randomly distributed in terms of clustering.



Source: www.census.gov

Fig 7: The frequency of crimes per square mile in three different regions in Dallas in 2024

### 5. Discussion

The increase in the commission of all kinds of crimes and perversions is one of the complex issues and problems of the world's metropolises, which has caused insecurity, fear, disturbance, and worry of being victimized in these cities. This issue, on the one hand, increases the financial costs and the expenditure of large budgets, and on the other hand, it calls into question the efficiency of the country's judicial and law enforcement managers and officials in reducing or eliminating the number of crimes despite extensive efforts and activities. It has been secured. One of the current problems of the judicial system of the country and perhaps many countries of the world is that in most cases, it deals

with the self-crime in an abstract and isolated way and separates this undesirable phenomenon from delinquency and the local, social, economic and cultural conditions governing it.

Therefore, considering the effects of geographical conditions in committing crimes and achieving urban security and spatial justice, it is necessary. Effective factors in the formation of crime hotspots. Undoubtedly, the geographical distribution of crime in cities is not uniform and balanced. In addition to this, research shows that the occurrence of crime in cities has a tendency to concentrate in some specific areas, now the basic question is why some urban areas are places of concentration and concentration of crime, violence, and insecurity, and basically how is it possible. Can the place and the local conditions be the cause of this concentration? In response to this question, thinkers have expressed different opinions. Proponents of the daily activity theory believe that the convergence and combination of the following three elements lead to the formation of crime centers:

a) The presence of criminal targets in these places encourages criminals to commit crimes in these areas. These targets can be people or objects that usually become victims of criminals.

b) Existence of criminals who have enough motivation, ability, and skill to commit criminal acts.

c) The lack of proper care and control to deal with criminal actions by the people and some thinkers on the opposite point have considered the main factor in the formation of crime hotspots to be the concentration and excessive number of criminal targets (persons or objects) which they are frequently victims of crime.

It seems that one of the important reasons for the frequency of crime in this area is that the criminals, in evaluating these places, realize that society and official and informal social organizations do not have the ability and possibility to properly control this area. Therefore, in these places, there is a more suitable possibility to commit a crime with minimal risk and threat. It is noted that all the above theories and views are presented based on the role of the environment and the spatial and social conditions of the environment in creating crime hotspots. They are somewhat similar to each other, but what the proponents of the theory of crime hotspots emphasize is that these places are created as a result of the establishment and combination of potential criminal targets (potential victims of crime) and criminals. And it causes maximum opportunity and possibility of crime in these areas.

## 6. Conclusion

Based on the documents, experiences, and opinions of global thinkers in this field, we can refer to the principles that are used as foundations in environmental design. The application of these principles and its allegorical concept has a fundamental contribution in the design of a crime-preventing environment, which these principles are:

**Access control:** By using this principle, it is possible to reduce the amount of access to areas in the city where crime is possible for possible criminals. To provide proper access and reduce the access of criminals to crime-prone areas or areas that have the natural potential of crime. It is possible to take advantage of the supervision of citizens and pedestrians or residents of the passages and access routes.

This is possible by clearly defining the entrance and exit of residential buildings in urban sites and the type and style of lighting and natural monitoring of how to access the site. Crime prevention strategies through environmental design. To reduce and prevent urban crimes through environmental design, we can refer to special strategies that have been addressed by the National Crime Prevention Center.

These strategies can be expressed as follows:

Designing urban spaces in such a way that public surveillance can be used in city spaces to prevent undesirable social activities.

- Definition of controlled spaces in the urban structure.
- Increasing natural surveillance in urban passages and spaces.
- Specific definitions of public, semi-public, and private spaces.
- Creating or enabling safe behaviors in unsafe areas of the city.
- Prevent unsafe places in safe urban areas.

The World Bank (WB) has enumerated tasks for local governments to prevent crimes through environmental design. Based on this, these things are possible only through the supervision of the responsible city bodies with the cooperation of all residents. The strategic point is to try to achieve these goals by empowering local citizens or through local capacity building (such as NGOs; CBO) through participatory urban planning. Undoubtedly, any improvement in the urban structure is possible only by looking at urban neighborhoods as capable sectors of realizing the goals of increasing the quality of life.

Some roles of the municipality in this regard can be mentioned:

- Supervision, control, guidance, and coordination.
- Partnership building and taking advantage of neighborhood capabilities.
- Preparation of maps and accurate identification of urban areas, especially crime-prone areas.
- Financial support and determining strategic strategies.

In addition, in line with the role of local governments/municipalities in preventing crimes through environmental design, the World Bank uses a special procedure to improve urban areas, which can be expressed as follows:

**Diagnosis:** identifying and determining crime-prone areas and expressing challenges and dangerous characteristics.

**Action Plan:** Development of local plans (medium/long term) with strategic goals.

**Management and implementation (Man & Imp):** management and time planning and determining and providing the budget and project implementation process.

**Evaluation (Evaluation):** Evaluation based on goals during implementation and methods of measuring the project's desirability.

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