Evaluating Crime Trends Of Five Ohio Cities To Enhance Law Enforcement's Understanding Of The Communities They Serve

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Abstract

Law enforcement agencies are tasked with combating crime in their respective jurisdictions. For local departments, these responsibilities rarely extend beyond the borders of the city they serve. However, when federal law enforcement agencies are considered, these responsibilities become more complex, as they often extend beyond just one city. Often, law enforcement officials have to re-evaluate the most effective means of curtailing crime in these different neighborhoods, as a result of their diverse area of responsibility. This evaluation can be accomplished through meaningful comparisons of the areas they serve. However, difficulties arise as law enforcement agencies attempt to draw overarching conclusions for cities that differ in terms of population and other societal influences.

To gain a better understanding of how crime trends vary among communities, a portion of the jurisdiction of the Cleveland Division of the Federal Bureau of Investigation (FBI) was examined. Using the Uniform Crime Reports (UCR), which are annual publications of the FBI that detail the volumes of crime occurring in local, state, and national jurisdictions, the violent crime occurrence in specific cities was examined. The violent crime trends, which include murder/non-negligent manslaughter, rape, robbery, and aggravated assault were established for the five largest cities within the jurisdiction of the Cleveland FBI Field Office and its Youngstown Resident Agency. The cities of interest included Cleveland, Lorain, Warren,

Salem, and Youngstown. Each of these cities were determined to be the largest in their respective counties according to their average population from 1995-2014. These populations are reported as follows: Cleveland (451,239), Lorain (68,413), Salem (12,188), Warren (43,906), and Youngstown (78,915).

Once the violent crime trends for these communities were established over a twenty year period, from 1995 to 2014, two different statistical analyses were conducted to determine the relationship between the violent crime rate and the population in each city. The statistical evaluations that were performed have been documented in literature and were modeled after attempts that were made previously to understand the relationship between crime volume and population.

Further analysis was performed to determine if any relationship existed between number of crimes being committed and unintentional drug deaths. In many communities, but especially in the five of interest, drug use has been classified as a serious problem; its contribution to the crime rates in these communities is one of intrigue. To examine the influence of drug use and crime rate, the crime numbers and overdose statistics for these communities were subjected to the same statistical analyses to determine any relationship that existed between these variables.

These analyses led to the conclusion that most of the instances explored showcased a substantial relationship between violent crime rate and population or violent crime rate and unintentional drug deaths. This led to the determination that meaningful comparisons could not be made between the communities observed due to their varying sizes and the various societal influences impacting them. This research is limited to exploring violent crime in terms of population and drug use; however, future research should be performed to examine other societal influences, such as poverty and education, and their influence on violent crime occurrence.

Federal jurisdictions are unique in that they are responsible for a multitude of cities, all of which provide their own set of challenges. Reasons for these differences include number of violent crimes occurring, populations, and societal influences, such as drug use. Agencies such as the FBI, who are tasked with serving these areas, must work to understand these relationships. By establishing these relationships, agencies can evaluate their current practices in meaningful ways and can determine whether to maintain or modify them in order to provide the most effective means of law enforcement for their wide area of responsibility.

Introduction

It is common knowledge that law enforcement utilizes all resources available in order to maintain peace and security within the communities that they serve. However, at times, law enforcement may overlook or fail to take advantage of resources that are readily available. Often, these are resources that could enhance the practices that are implemented every day. There are many publications created to aide law enforcement in some form or another. Many of these resources contain a variety of different statistics, documenting crime numbers for various jurisdictions. Although often overlooked, these numbers have the potential to greatly impact law enforcement's influence in their communities.

One of the most well-known and most premiere sources of crime data are the Uniform Crime Reports, which are published annually by the Criminal Justice Information Services (CJIS) of the FBI. The report of interest in this case is the publication *Crime in the United States*. This report goes into extensive detail regarding violent and property crimes throughout the United States on the federal, state, and local level. In these reports, national statistics are complied in order to summarize the type of crimes, volumes of crime, and rates of crime affecting the United States as a nation. Going into further detail, the report also breaks down

crime statistics for individual states, counties, cities, colleges and universities, among other areas. However, these numbers are just listed, with no trends being examined within the report itself (2). This means that crime trends and the relationship between these local statistics are not fully established in the report, despite the data being available.

Crime in the United States was chosen as the source of information for this project because it is a publication of the FBI, although there have been reports suggesting other statistical reports are more valid, such as the National Crime Victimization Survey, which is published through the Department of Justice (4). However, since the FBI was the agency that was observed throughout the course of this research, the *Crime in the United States* publication was utilized to maintain consistency of source information.

The data in *Crime in the United States* are very simplistic and yield very little insight for law enforcement unless the reports are examined yearly for the area of interest. Without having these trends readily published in the literature, it becomes very likely that law enforcement agents simply peruse the report, if at all. Then, they disregard it without utilizing the data in a constructive way. The value and potential benefit of these data are not realized, when this information is neglected in this way. By compiling these yearly data sets into organized figures and charts, pertaining to a particular area of interest, these statistics could benefit local, state, and federal law enforcement. Utilizing this data to generate trends can greatly aid in the evaluation of current crime trends within an area. In turn, this evaluation can enlighten local law enforcement to issues their own communities face, and can cause them to consider whether current methods are aiding in the abatement of these crimes or failing to have the desired effect.

Beyond the local critique of specific areas of interest, the FBI warns against using this data to compile rankings of different jurisdictions or comparisons between cities, counties, or

states (1). This advice acknowledges that other societal factors, such as drug use and population, can greatly impact a society. Additionally, this warning is in place because the interconnectedness of these societal factors is not fully understood. This research acknowledges the potential limitations of this data; however, it is believed that these statistics offer more to law enforcement than what was initially thought. Many local jurisdictions are concerned with the data from their own communities; however, there are agencies that are not limited to one area; rather, they serve multiple roles and their influence transcends jurisdictional lines. This is the case for the FBI, a federal agency that may work with multiple communities.

The FBI is structured in such a way that divides the United States into fifty-four divisions, each under the direction of a field office. Under each of these field offices, there are resident agencies (RA) that are assigned specific jurisdictions within these divisional areas. Thus, the RAs are responsible for these areas and field offices are responsible for their own territory, as well as, overseeing all functions of the RAs (3). With this structure in mind, it becomes clear as to why agencies with overreaching influence like the FBI should be interested in the crime rates occurring throughout their own area of responsibility and areas beyond the actual city in which they are located. As a result, this becomes the driving purpose behind this research.

Although the FBI cautions against it, this research aims at evaluating the crime statistics for a select number of cities to see if meaningful comparisons can be made between different jurisdictions (2). This will be accomplished through statistical testing via two different methods. One statistical method will be adopted from the study performed by James Nolan III, who examined the relationships between crime rates in California using UCR data and the other method employed will be the Pearson Correlation, which is a more widely known statistical

analysis method (6, 1). Furthermore, two different societal influences, population and unintentional drug deaths, will be examined for their potential correlation to violent crime rates within these selected cities. Finally, these numbers will be compared to state data in order to determine if the occurrences of crime within these areas are consistent with the average in Ohio, or are proving to be higher or lower than the average.

The Cleveland Division of the FBI was the focus of this research. This field office serves as headquarter city for the northern half of Ohio, and also serves as the responsible party for two counties: Lorain and Cuyahoga. Additionally, under the direction of Cleveland, there are eight different resident agencies. Of these RAs, the Youngstown RA was also examined. This office is responsible for all crime occurring in three counties: Trumbull, Mahoning, and Columbiana (3).

As an attempt to maintain continuity, the statistics prepared and reported in the FBI's UCRs were utilized. With this data, attempts were made to draw conclusions on crime rate and its various influences in these five counties. As stated previously, these reports cover data ranging from violent crime to property crimes. Although the FBI investigates all types of crime within its jurisdiction, specific investigative duties typically fall under the responsibility of different squads, who specialize in specific crime types. After serving with the violent crime squad in Youngstown, it was decided that the scope of this research would be limited to violent crime.

The UCR's *Crime in the United States* publication acknowledges four different offenses as violent crimes. These are the offenses that are considered and examined in detail. These include murder/non-negligent manslaughter, forcible rape/rape, robbery, and aggravated assault. Each of these crimes are defined within the reports, and only those offenses that fulfill the

definitions are counted. According to the FBI, murder/non-negligent manslaughter is "the willful (non-negligent) killing of one of human being by another"(2). In order to be classified in this category, the offense must be deemed a murder by law enforcement standards. This determination is not considered from the opinion of a medical examiner/coroner, or other body of the judiciary like the court or jury. Furthermore, offenses that are not considered in this category include suicides, accidents, or deaths that are the direct result of negligence. Additionally, justifiable homicides and attempts to murder are not considered within these figures (2).

The second offense considered to be a violent crime is rape. Initially, the offense was considered forcible rape, which was defined as "the carnal knowledge of a female forcibly and against her will" (2). However, the obvious misguiding and limited scope of this criteria prompted the UCR to reevaluate their definition and create a revised definition. In 2013, the offense became known as rape and its definition was revised to include those offenses that involve the "penetration, no matter how slight, of the vagina or anus with a body part or object; or oral penetration by a sex organ of another person, without the consent of the victim" (2). In the case of the legacy definition and the revised definition, attempted rape and assaults with the goal to commit rape were also counted in these figures. However, statutory rape, which is without force, and other sex offenses were not included (2).

In the UCR, robbery is considered the third violent offense. Robbery is defined as "the taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence, and/or by putting the victim in fear" (2). This definition is straightforward and no exceptions are laid out in the UCR.

Finally, the last violent offense is aggravated assault. Aggravated assault is known as the "unlawful attack by one person upon another for the purposes of inflicting severe or aggravated bodily injury" (2). The UCR program further classifies aggravated assaults as those assaults that involve the use of a weapon, or other means that are likely to cause extreme bodily harm. In addition to the assaults that fulfill the above definition, attempted assaults that involve the display or threat of use of a weapon, whether that be a gun, knife, or some other item, are also included in this overall count. This is due to the understanding, that had the assailant been successful in carrying out the assault, serious bodily injury would have been likely. Finally, in cases where assault and larceny or theft occur within the same incident, the event is counted as a case of robbery (2).

Data were accessed and compiled for the five largest cities within the five counties under the jurisdiction of Cleveland and Youngstown FBI personnel. These five cities were chosen due to their faithful contribution to the UCR with local data. Additionally, the largest cities were examined to serve as a representation of the counties as a whole, as data for these five counties were sporadically reported to the UCR and could not be considered complete data sets. The cities of interest include Cleveland, Lorain, Salem, Warren, and Youngstown of Cuyahoga, Lorain, Columbiana, Trumbull, and Mahoning counties respectively. Again, as stated above, Cuyahoga and Lorain counties are served by the Cleveland office; therefore, Cleveland personnel are responsible for Cleveland and Lorain. Meanwhile, Youngstown is responsible for Columbiana, Trumbull and Mahoning county; therefore, Youngstown personnel are concerned with Salem, Warren, and Youngstown.

These numbers were evaluated just for basic trends occurring in each city over the course of a twenty year period, from 1995 to 2014. Unfortunately at the time of this report, the 2015

statistics were not published in full. Preliminary 2015 data was available; however, the data were not complete and did not cover all of the cities of interest in as much detail as the full report provides, so these numbers were not utilized (2). Similarly, no statistics were retrieved for 2016, as the year is currently in progress and full access to these numbers will not be available until the Fall of 2017. Once data were analyzed in a way to generate trends, general trends for each territory were compared to state data. However, these comparisons were done cautiously until determinations were made regarding the reliability of these comparisons.

After this precursory analysis was done, an in-depth examination into the relationship between crime rates and population was performed. Also, the relationships between crime rate and unintentional drug overdose records were examined for any significant correlations. Drug overdose statistics were chosen as they were deemed an appropriate indicator of drug use in these areas. Through this analysis and statistical testing, these correlations were established and the likelihood of successfully comparing these data sets was ascertained. Regardless of these results and the ability of these results to be readily compared, these trends and relationships can enlighten and promote conversation among local, state and federal law enforcement agencies to better their tactics and approaches to combating these violent crimes.

There is an important distinction that needs to be drawn between the two different data interpretations that appear within the UCRs. The first representation of crime in these publications is what is known as crime volume. This number represents the total number of crimes that occurred, in any given year, throughout a particular jurisdiction, whether city, county, or state. The second set of data represented in these reports are known as crime rate. Crime rate is a statistic that is presented in terms of crime per capita. By reconfiguring this crime data in

this way, the number of crimes per one hundred thousand people within a given population is expressed.

There have been numerous research attempts performed in order to determine the relationship between crime volume and population. Based on these examinations, it is well documented that these two variables are related with a high degree of correlation. This fact has become well-recognized and rarely disputed (6). However, this is not the case for crime rate data. The amount of research into the relationship between crime rate and population has not been explored to the same degree. As a result, conclusions vary among different publications. According to Reiman in 2001, it was justified that there is a "striking lack of correlation between crime rate and population" (8). This refuted older claims that there were small positive correlations between these two variables. Due to these inconsistent interpretations, it is clear that further exploration into these relationships was required to fully understand them.

One of the most current examinations into this issue is found in Nolan's "Establishing the statistical relationship between population size and UCR crime rate: Its impact and implications." In this study, James Nolan III looks at how these two variables relate, in order to determine if credible comparisons can be made between jurisdictions (6). Since this research aims at making meaningful comparisons between five different cities, the research performed by Nolan and the methods he used were utilized.

In Nolan's work, the foundation for the determination of correlation between crime rate and population is laid. By examining crime rate and population, positive, negative, or zero correlations can be determined. If a positive correlation is observed, then areas with a greater population exhibit higher crime numbers. Meanwhile, if a negative correlation exists, the smaller populations are experiencing a higher number of crimes. In both of these cases, whether

there is a positive or negative correlation, population and crime rate show a relationship where one variable is affected by the other (6). In these instances, where an obvious relationship exists, comparing one jurisdiction to another is cautioned against (2).

Despite the two previously mentioned outcomes, there is a third possibility. The third relationship is known as a zero correlation. This type of correlation between two variables suggests that the two variables in question do not appear to be dependent on each other. This is the ideal outcome for the purposes of cross-jurisdictional comparisons that attempt to evaluate areas that differ significantly in population size.

Eventually after these statistical analyses are performed, the implementation of various law enforcement initiatives could be examined for their influence on the reduction or increase of these violent crimes. It became apparent through the observations of these cities that various initiatives currently employed err on the side of caution and attempt to prevent violent crimes from happening. In other words, these procedures assume a more proactive approach, rather than a reactive one. One way in which law enforcement attempts to prevent these crimes is by limiting lesser crimes that may precede violent crimes.

Today, one of the most prevalent issues being tackled is drug use. It is understood that drug use continues to pose a threat to many comminutes throughout the country and these five cities are not exempt from that fact. Although the relationship between drug use and incidence of violent crime are debatable, as expressed in the work of Merrin, it was meaningful for the areas being observed to see if a connection could be drawn between these two variables (5). According to the Center for Disease Control, Ohio recorded the second-highest number of deaths relating to drug overdose in 2014 (9). Therefore, there is reason to believe the issue of drug use is compounded in these areas and could be attributing to the violent crime rates of these areas.

Based on these facts, it is becoming more common for law enforcement to initiate task forces that aim at targeting specific crimes like drug use before it can escalate any further. In terms of the FBI in these cities, they have well-established task forces that serve these roles. By looking at when these task force teams were established and relating that to the trends of violent crime, correlations and conclusions can be drawn as to the success of these programs and the influence they have had on local crime rates.

Methods

In order to obtain violent crime data for Cleveland, Lorain, Salem, Warren, and Youngstown, the FBI's UCRs' publication *Crime in the United States* was accessed. This document is published annually and summarizes data collected by the FBI from local law enforcement agencies. In this case, the reports used covered a twenty year period from 1995 and 2014. From these reports, the populations of the five cities and the crime volume, or the number of crimes occurring each year, were collected. This process of data collection was performed for each of the five cities of interest and for each violent crime: murder/non-negligent manslaughter, rape, robbery, and aggravated assault. These values were then used to generate overall crime trends for the areas of interest. These trends were presented in the form of bar graphs and line graphs. Additionally, these crime trends were related to population and evaluated through statistical analysis, using two different methods, in an attempt to assess the correlations between population and crime rate.

Additionally, the UCR provides data for each state. Since all five cities fall within the state of Ohio, the data for violent crime occurrence were obtained for the state as well. Using the local and the state data, conclusions were drawn as to the relationship between these five cities

and the rest of the state of Ohio. Evaluations as to where these five cities rank in terms of violent crime in Ohio were made.

As stated previously, the data from the UCR were used because these statistics were endorsed by the FBI. Thus, to remain consistent, the population figures utilized in these statistical analyses were obtained from the same source. In addition, these figures were used to generate crime rate data, which were then explored in detail.

The crime rate and population statistics were examined in the methods suggested by James Nolan III in his research, "Establishing the statistical relationship between population size and UCR crime rate: Its impact and implications." This method of analysis allows one to determine if population and crime occurrence were correlated in such a way as to prevent meaningful comparisons from being made (6).

For the purposes of this research, the five Ohio cities were examined to determine what type of correlation existed between population and crime rate. To accomplish this evaluation, the methods presented by Nolan were utilized. In his research, he attempted to describe crime rate using two different methods. The first method attempted to determine crime rate using **Equation 1**. Through this simple equation, crime volume which was the figure reported in the UCR for the five cities of interest was converted to crime rate. In this equation, crime volume is indicative of the total number of crimes occurring in the area of interest. Population, on the other hand, represents the total population in that same area (6).

Equation 1. $Crime\ Rate\ 1 = \frac{crime\ volume}{population}$

Crime rate was then calculated using a second method. In this second equation, the sum of a particular jurisdiction's crime rates was divided by the total number of jurisdictions. The equation can be seen below in **Equation 2**. This calculation provided the mean of crime rates and was used to compare the crime rate figure obtained from **Equation 1**, which is a representation of the average crime rate (6).

Equation 2. $Crime\ Rate\ 2 = \frac{sum\ of\ jurisdictional\ crime\ rates}{number\ of\ jurisdictions}$

To compare the two different crime rate values for each jurisdiction, the mean of the crime rates, or Crime Rate 2, was subtracted from the average crime rate, or Crime Rate 1, as seen in **Equation 3**. This value allowed for the strength and direction of the relationship between the variables to be determined. If the difference between these two values was positive, than a positive correlation is described. Likewise, a negative difference exhibits a negative correlation. However, if the value of the difference is minimal, or close to zero, no correlation is observed. This suggests that the two values being compared are very close. In other words, if this is the case, the two are said to be not correlated.

Equation 3. $Correlation = Crime\ Rate\ 1 - Crime\ Rate$

In addition to using Nolan's proposed analysis, each data set was subjected to Pearson Correlation testing to determine the strength and direction of correlation between the variables: population and violent crime rate and then crime rate and unintentional drug deaths. With this statistic, a value ranging from +1 to -1 will be produced. The positive and negative signs

indicate a positive or negative correlation respectively. The closer a value is to +1 or -1, the stronger the correlation between the two variables. In other words, there is a stronger relationship between those two items, and each has the possibility of impacting the other. When a value is equal to zero, a zero correlation is represented. This relationship is one in which the two variables do not impact each other (1). This determination was then compared to the method presented by Nolan to determine whether or not the values coincided. With this data, conclusions about the population size and crime rate could be addressed.

To make an assessment regarding the relationship of crime rate and drug use, drug use statistics had to be obtained. Due to drug use not being addressed in the FBI UCRs, the data had to be obtained from another source. Although this prevented complete continuity between all data, it is acknowledged that the FBI and all law enforcement rely on outside agencies for help to accomplish their investigative goals at some point. With this in mind, this research maintained that philosophy and utilized the Ohio State Department of Public Safety for drug use statistics. Due to the lack of current drug use information, the data for drug overdose deaths was used as a surrogate. The reasoning for this is that the number of confirmed drug overdoses directly comments on the drug usage in a specific area. If number of drug overdoses increases, it can be assumed that drug use has increased, whether that is due to an increase in the number of users or an increase of drug potency (7). Thus, the number of unintentional drug overdoses in these areas offers insight into drug use. Therefore, these numbers were examined in relation to violent crime rates in these areas of interest to see if there is a significant correlation between the two variables in question.

Additionally, **Equations 1-3** were used when evaluating unintentional drug deaths. In these cases, the drug death rates and the violent crime rates were compared. Similarly, these

variables were also subjected to the Pearson Correlation equation to obtain values that would serve in the comparison of the statistical methods. This was done in an attempt to see if the statistical methods produced the same results or if discrepancies were observed.

Data

Upon initial observation, it was noted that data presented in the UCRs come in two forms. The first is volume of crime, which is a straightforward representation of the total number of crimes occurring within a particular jurisdiction. The second method of recording is through crime rate, or the number of crimes that occur per one hundred thousand citizens in the location of interest (1). Summaries of the crime volume data collected for the five cities of interest can be seen in **Appendix 1**. Each table includes the raw data covering murder/non-negligent manslaughter, rape, robbery, and aggravated assault spanning the years of 1995 to 2014. **Table 1** shows the data obtained for Cleveland, **Table 2** is Lorain, **Table 3** is Salem, **Table 4** is Warren, and **Table 5** is Youngstown.

In order to just get a precursory understanding of the crime trends in the cities of interest, the crime volume was used to create bar graphs representative of the twenty year period. These figures were generated in order to visually depict the numbers provided, without any data analysis. Although simplistic in nature, these bar graphs can be utilized to get a better understanding of the current climate in terms of violent crimes in these areas. Each bar graph focuses in on the trends for the individual violent crimes in order to show the crime volume trends. The line plots, that follow, then combine the four violent crimes into one graph in order to show how the crime volumes of each offense relates to the others in each city.

Results and Discussion

General Violent Crime Trends Across Five Cities of Interest

Figures 1-5 depict the raw data information obtained for Cleveland as bar graphs. Through these bar graphs, each violent crime can be examined individually and trends can be visualized without any data manipulation. In the case of murder/non-negligent manslaughter, which is depicted in **Figure 1**, the city of Cleveland shows a general decline, since 1995. However, although the general trend is one of decrease, there are obvious periods of slight increase. This is especially evident from 2003-2005 and 2006-2008.

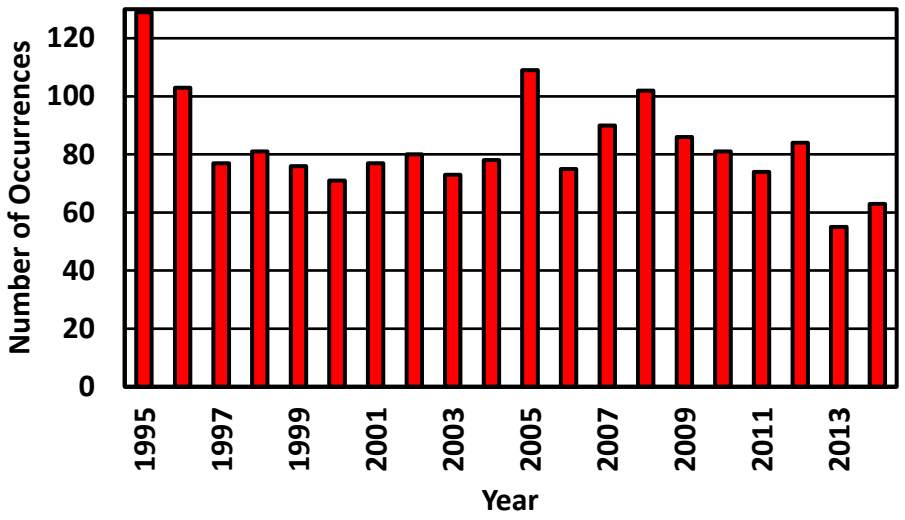

Figure 1. Murder/non-negligent manslaughter values for Cleveland, OH, 1995-2014.

Much like murder, the incidences of rape that occur in Cleveland show periods of decrease and increase. However, as seen in **Figure 2**, there is a relatively stable period, from 1995-2003, where the incidences of rape remain relatively consistent. Although there is a drop in numbers in 1999, this time period expresses very few changes in the overall number of rapes

occurring in this area. After 2003, there is a dramatic decrease in incidences of rape through 2010. From here, the numbers begin to climb again; however as of 2014, these numbers do not rival those observed during the first half of the twenty year period observed.

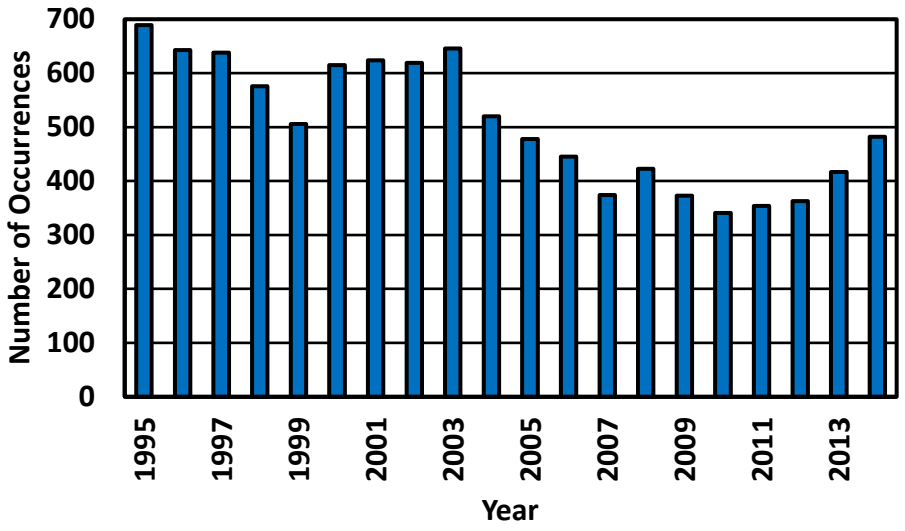

Figure 2. Rape values for Cleveland, OH, 1995-2014.

The third crime that was observed, robbery, is detailed in **Figure 3**. Here, the number of robberies occurring appear in patterns of decrease, followed by an increase, and then a decrease again. This manifests itself as a wave on the bar graph that repeats itself every so many years. Although there are waves of decrease followed by increase, the overall trend of robberies appears to be decreasing, as the apparent waves do not rise as high in the later years observed versus those at the beginning.

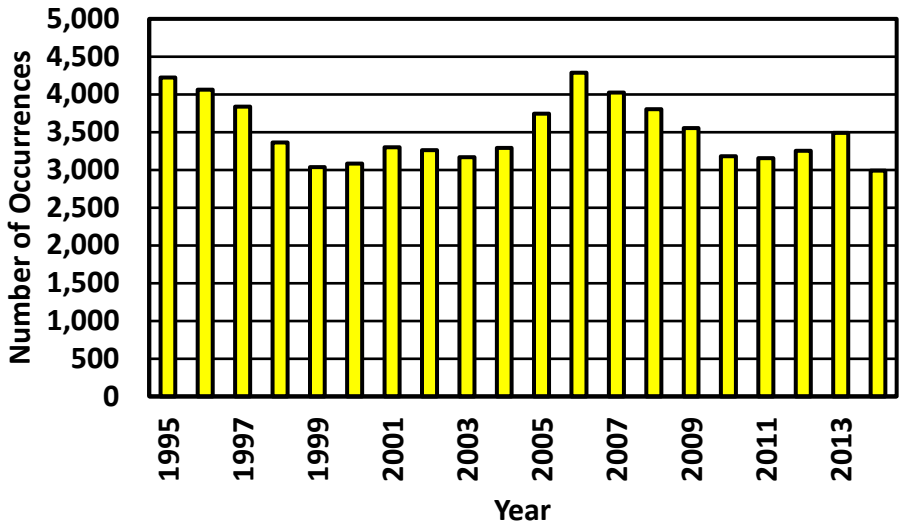

Figure 3. Robbery values for Cleveland, OH, 1995-2014.

Unlike the previous three violent crimes observed, aggravated assault does not exhibit periods of decrease followed by increase. Rather, a steady trend of declination can be observed across the twenty year period of concern. This observable overall trend is much more obvious than those observed for murder, rape, or robbery. The details for robbery are found in **Figure 4**.

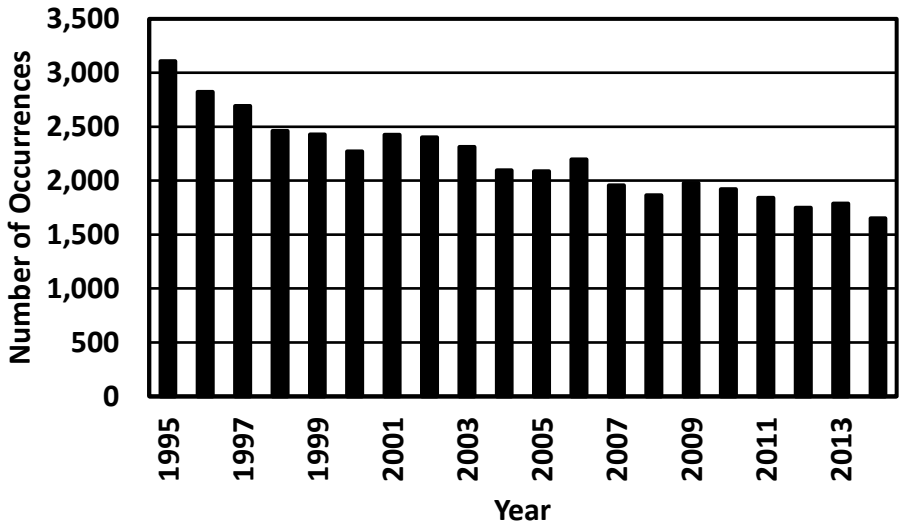

Figure 4. Aggravated assault values for Cleveland, OH, 1995-2014.

By observing the trends of violent crime as bar graphs, it allows for the interpretation of individual crimes and the trends associated with them. However, if careful attention is not paid to these values, the data may be misinterpreted when attempting to compare the four crimes to each other. Therefore, to alleviate this possibility, all four data sets for Cleveland were plotted on a line graph, which can be seen in **Figure 5**.

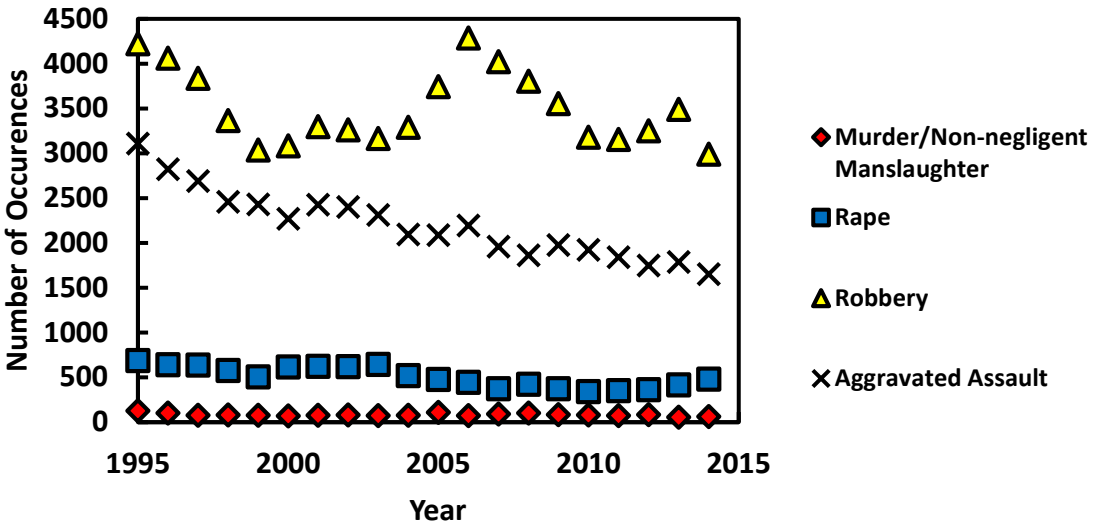

Figure 5. Summary of violent crimes in Cleveland, OH, 1995-2014.

From this figure, the interrelationships between these crimes become more clear. By representing the data in this way, it can be noted that the largest number of incidences of violent crimes occurring in Cleveland from 1995-2014 represents robbery. This is then followed by aggravated assault. Meanwhile, the violent crime with the smallest number of instances was murder/non-negligent manslaughter. Rape occurred more often than homicide; however, it still remains much lower than either aggravated assault or robbery. In addition to these observations, it becomes evident that the general trends of decrease observed in all cases via the bar charts, are more readily observed through this plot.

The information obtained from the city of Lorain was represented in the same way as those numbers obtained for Cleveland. In the case of Lorain, the values related to murder/non-negligent manslaughter are very staggered. In other words, no pattern can be established. The periods of increase and decrease are sporadic. There are instances where clear increases and

decreases occur; however, these occur over one or two year periods. This makes the number of incidences of murder unpredictable in Lorain. This graph can be observed below in **Figure 6**

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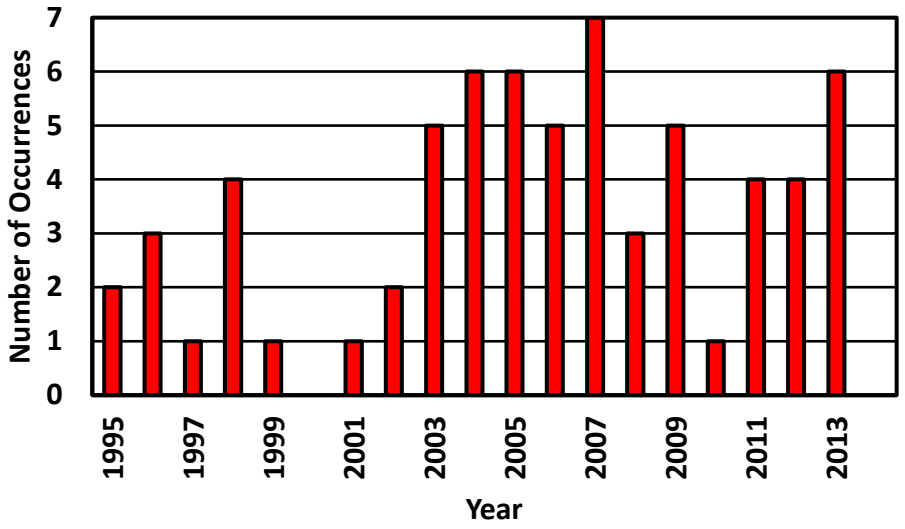

Figure 6. Murder/Non-negligent manslaughter values for Lorain, OH, 1995-2014.

Unlike the data observed above in **Figure 6**, the incidences of rape in Lorain are not as sporadic. In **Figure 7**, one can observe the trends observed for rape. Here, there is a dramatic decrease in rapes occurring from 1995-2003. This is followed by a quick uptick in occurrences, followed by a brief decrease. It is as this point, in 2006, where one sees the smallest number of rapes occurring in this area. From here, numbers become much more elevated and hover around this elevated point for the duration of 2008-2014.

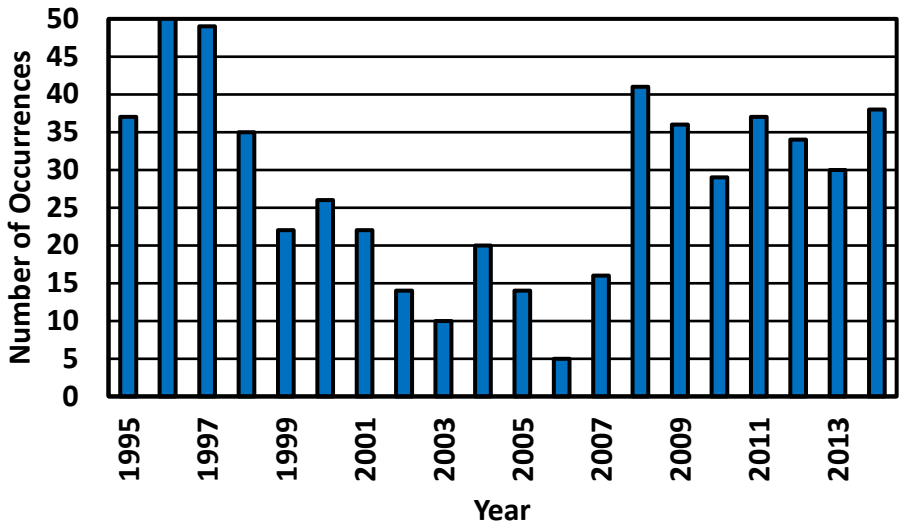

Figure 7. Rape values for Lorain, OH, 1995-2014.

Robbery details for Lorain can be found in **Figure 8** below. By looking at this information in detail, one will notice that the trend begins rather low and increases through 2009. After 2009, there is a period where robberies were occurring at a constant rate, then increased slightly, and dropped off finally in 2014. The number of instances occurring in 2014 appears to be consistent with those low numbers observed in the first half of the data set, from 1995-2004.

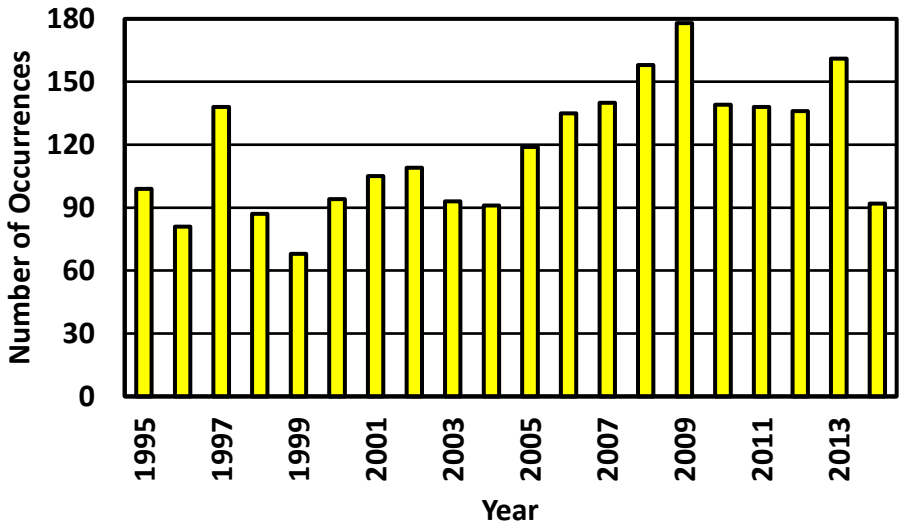

Figure 8. Robbery values for Lorain, OH, 1995-2014.

Finally, aggravated assault numbers can be observed in **Figure 9**. Here, the trend starts out at its lowest point in 1995. There is a sharp increase over the next two years, which culminates in the highest number of aggravated assaults recorded over the twenty year period in 1997. After this apex, there are periods of increase and decrease that occur. These periods start to resemble the wave-like nature that was observed in robberies that occurred in Cleveland. However, the overall trend from 1998-2014 can be described as a decrease despite the few instances of increase.

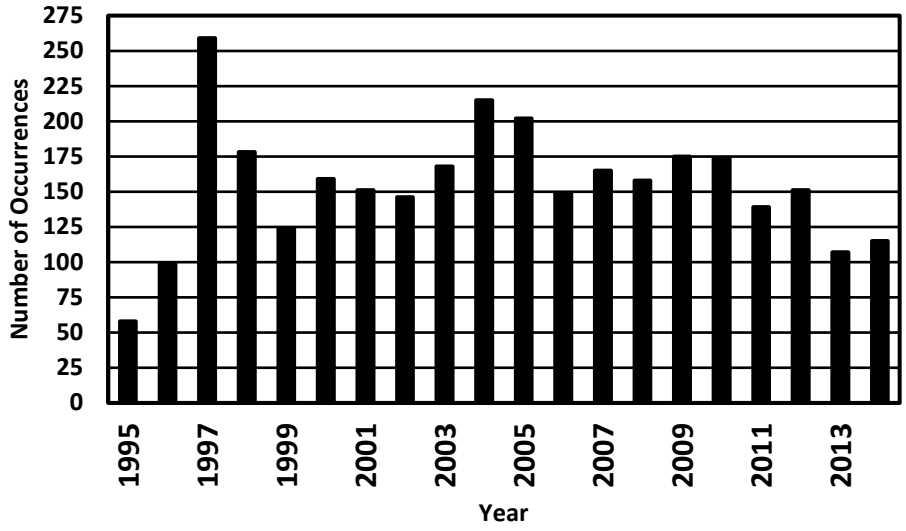

Figure 9. Aggravated assault values for Lorain, OH, 1995-2014.

After analyzing each individual violent crime trend for Lorain, these values were compiled onto a line graph. Once again, this was done to examine the relationship between one of the violent crimes to the others. In the case of Lorain, the violent crimes are not as isolated as they were for Cleveland. In **Figure 10**, it can be noted that the violent crimes cross each other at various points on the plot. This indicates that there are years where Lorain experiences a switch in the leading cause of violent crimes.

Overall, looking at the figure, it is understood that aggravated assault most commonly is the violent crime that occurs in the greatest number. However, there are periods, such as 2008 and 2009, where the numbers of robbery and aggravated assault appear to be equal, or extremely similar. At other times, it is observed that robbery overtakes aggravated assault with the highest occurrence of violent crimes. This is the case in 1995, 1996 and 2013. Thus, from these observations, it can be seen that aggravated assault generally occurs in the largest numbers in Lorain. However, robbery is a close second.

As for rape and murder, these violent crimes remain consistent with the trends observed in Cleveland. Much like Cleveland, murder/non-negligent manslaughter is the lowest occurring violent crime in Lorain, and rape occurs at a slightly higher number all while remaining lower than aggravated assault or robbery. However, the occurrences of rape and murder are much closer to the number of occurrences of robbery and aggravated assault. This was not consistent with the observations made in Cleveland, where murder and rapes were significantly lower in number than the other two violent crimes.

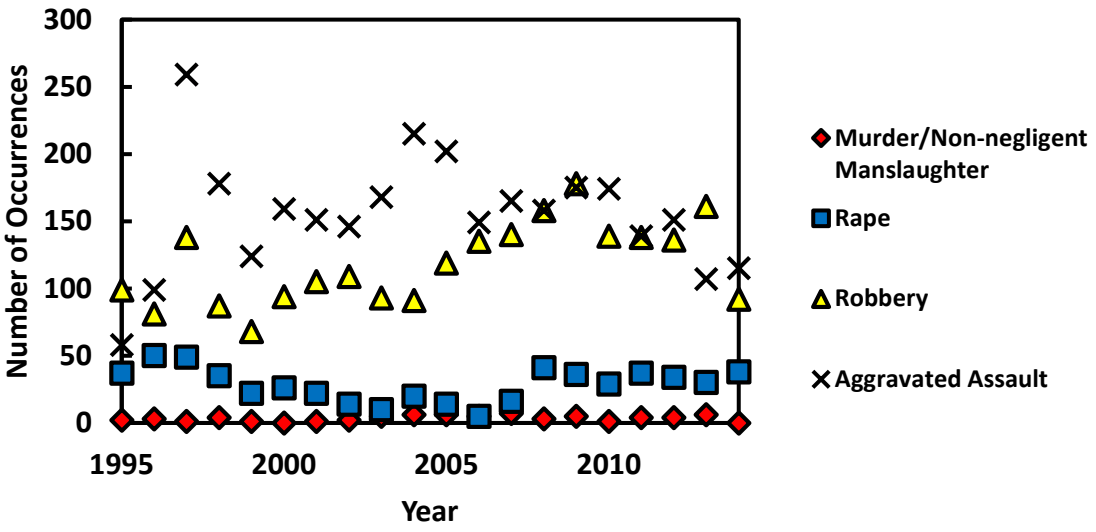

Figure 10. Summary of violent crimes in Lorain, OH, 1995-2014.

The third city that was examined was Salem. Unlike the four other cities researched, Salem is unique in the fact that it is located in a very rural area. As a result, the number of violent crimes that occur in this city are dramatically lower than those discussed in the remaining cities. In terms of murder/non-negligent manslaughter, there has only been one reported incident over the twenty year period. This event occurred in 2013.

Much like murder, the numbers of rape cases in Salem is significantly lower than those in any other city. These values can be seen in **Figure 11**. Of the twenty years examined, only six years saw evidence of a rape occurring. When looking at the total numbers of rape, two years, 2003 and 2010, experienced two rapes; meanwhile, 1998, 2011, 2012, and 2014 involved one rape. As far as the trend is concerned, the incidences have remained relatively consistent in terms of number of rapes occurring per year, but they are occurring more frequently in recent years.

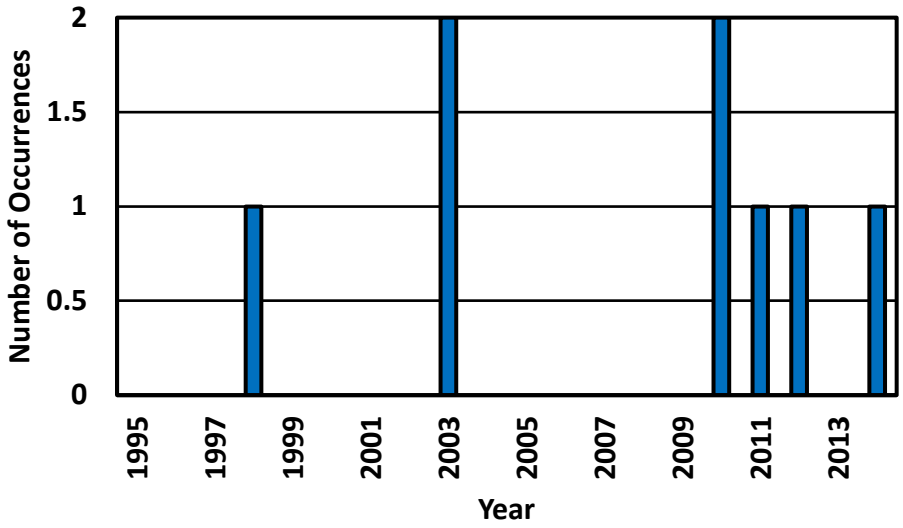

Figure 11. Rape values for Salem, OH, 1995-2014.

Robbery is another low-occurring violent crime in Salem. Nine of the twenty years in this data set had incidences of robbery. These included seven years where the total number of robberies was only one. Meanwhile, one year involved five robberies, while another consisted of four robberies. This information is summarized in **Figure 12**. From these values, it becomes

obvious that robberies in Salem are remaining fairly consistent; however, there are concerning increases occurring sporadically over the questioned period.

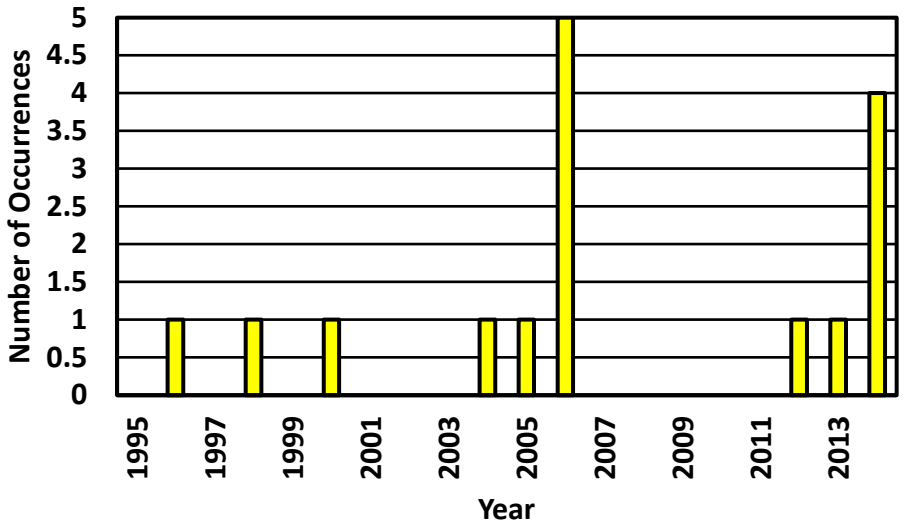

Figure 12. Robbery values for Salem, OH, 1995-2014.

In **Figure 13**, the number of aggravated assaults occurring in Salem can be found. Unlike the three previous violent crimes discussed, aggravated assaults are reported almost every year, with the exception of 2004 and 2008. Additionally, there are elevated values over the course of the first nine years of this study, 1995-2003. In 2004, the reported value drops to zero, and then hovers between one and two occurrences through 2012. Beginning in 2012, the values begin to climb again towards those observed during the early years. This trend of decrease followed by an apparent increase is a trend that had not been observed in Salem prior to aggravated assaults.

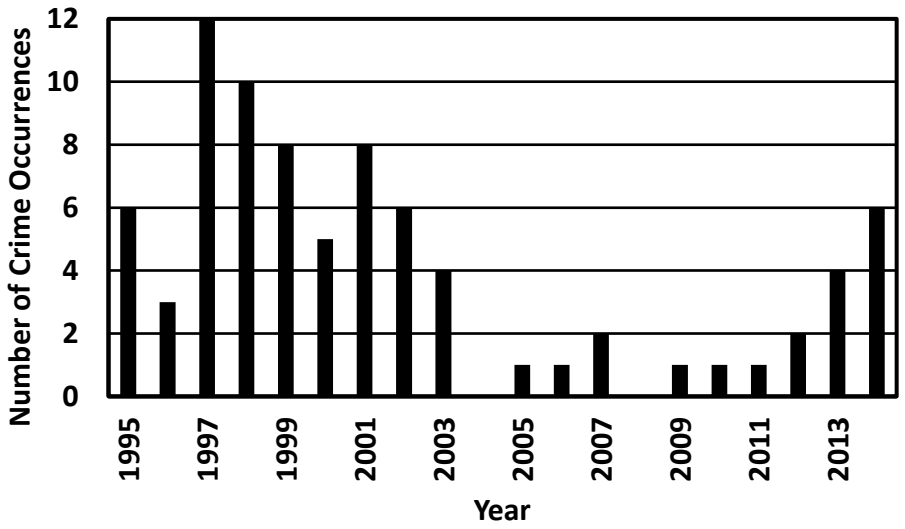

Figure 13. Aggravated assault values for Salem, OH, 1995-2014.

The combined data for the four violent crimes in Salem is represented in **Figure 14**. Again, it is noted that the values of these violent crime occurrences are much lower than any of the cities previously discussed or those that will be described in further detail later. Here, all four crimes are being reported in numbers that are similar. Through 2003, aggravated assaults are occurring in the highest numbers. In 2004, robbery becomes the largest issue. In 2005, robbery and aggravated assault are equivalent. Robbery replaces aggravated assault in 2006 as the number one problem. Then, in 2007, aggravated assault returns as the highest occurring violent crime. The year 2008 shows a drop in all cases of violent crime. From 2009-2014, aggravated assault remains the highest incident of violent crime, with the exception of 2010 where rapes occur in the highest number and in 2011, where rape and aggravated assault are equal. From this information, it can be noted that overall Salem sees the occurrence of violent crime, from highest to lowest, as aggravated assault, robbery, rape and finally murder.

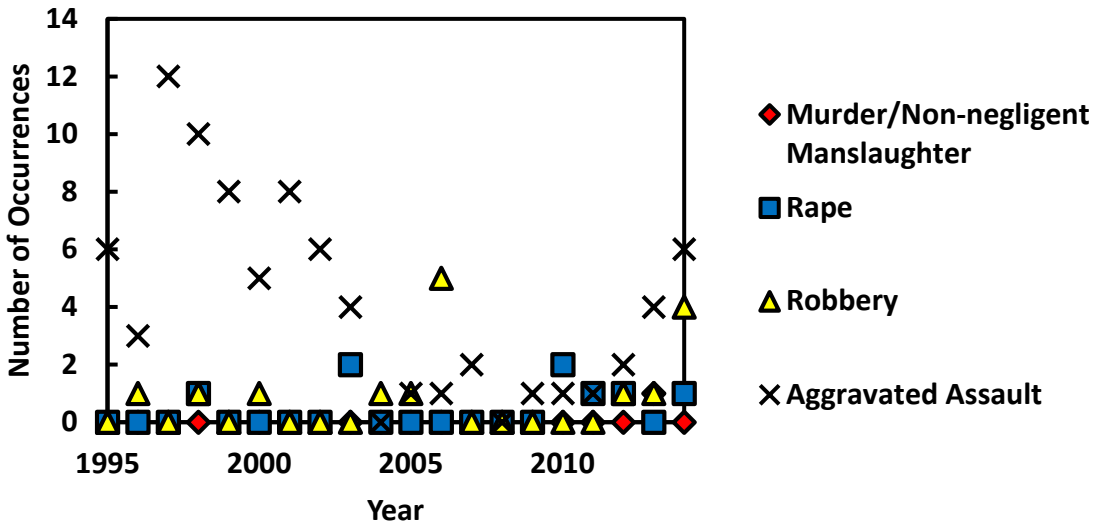

Figure 14. Summary of violent crimes in Salem, OH, 1995-2014.

The next city observed was Warren. This city, unlike the other cities investigated, failed to report to the UCR on a consistent basis from 1995-2014. Of the twenty years, Warren reported statistics for twelve years, 2001-2004, and 2007-2014. This posed a potential problem for generating an accurate representation of the violent crime trends occurring in this city. However, a general idea could be constructed from the data that were provided, especially when considering that data were available consistently from 2007 and onward.

Figure 15 indicates the murder/non-negligent manslaughter numbers for Warren. In the first set of available data from 2001-2004, a steady increase in the number of these crimes is clearly observed. When the data becomes available again in 2007, a more discontinuous period of increase and decrease is observed. During this timeframe, there is no consistent pattern; however, it can be assumed that these increases and decreases will continue, but with an overall decrease being observed.

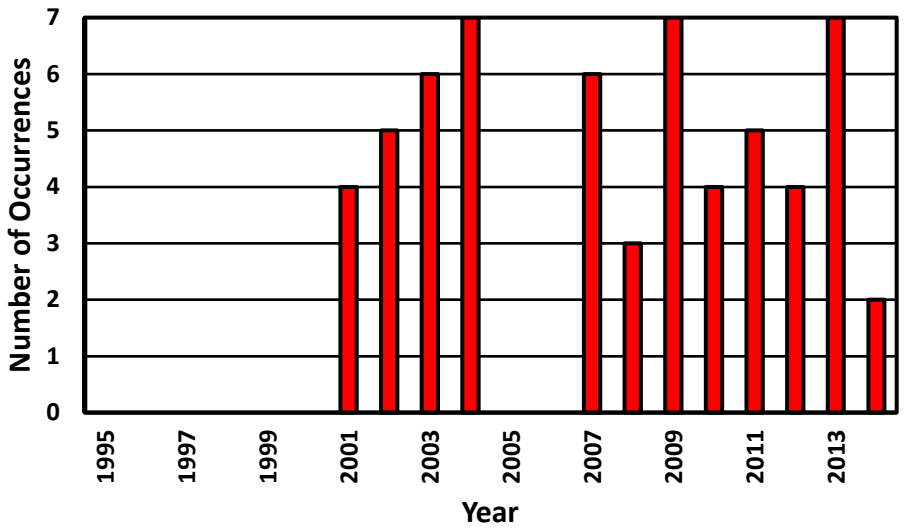

Figure 15. Murder/Non-negligent manslaughter values for Warren, OH, 1995-2014.

Rape statistics for Warren are found in **Figure 16**. With this violent crime, the first set of available numbers show a general uptick in the number of rapes occurring. Following this period, there is a slight decrease in the total number of rapes. Then, beginning in 2009, there is a pattern of stair-step increases that occur over the course of three years. Once the three years are over, the numbers drop and the pattern repeats itself. The actual values observed over this six year period appear to remain consistent.

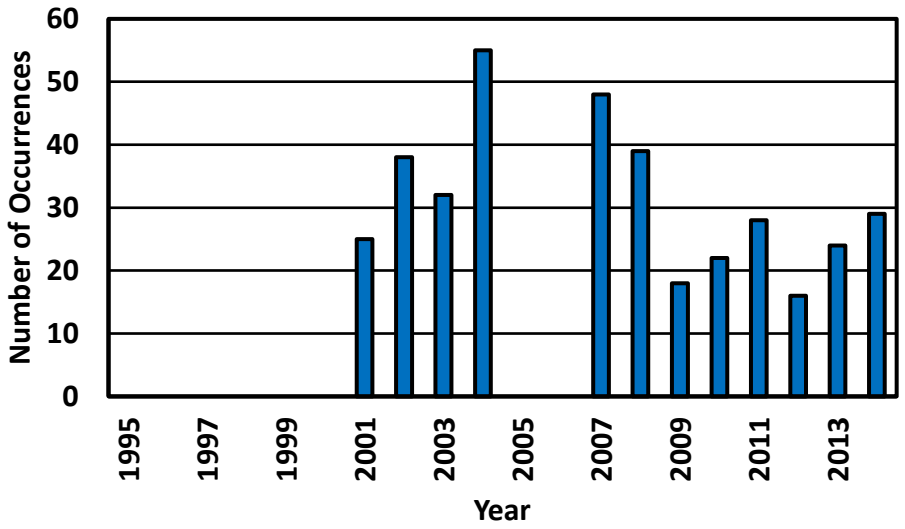

Figure 16. Rape values for Warren, OH, 1995-2014.

Figure 17 summarizes the data for robbery in Warren. Here, the first set of data shows an increase in the number occurring during these years. There is a decrease in 2002; however, the overall trend suggests that this year was slightly out of the norm. Beginning in 2007, there is a decrease in the number of incidences occurring. This decrease continues until 2011, where the lowest value is found, prior to a short two-year increase. In 2014, a drop in occurrences is observed.

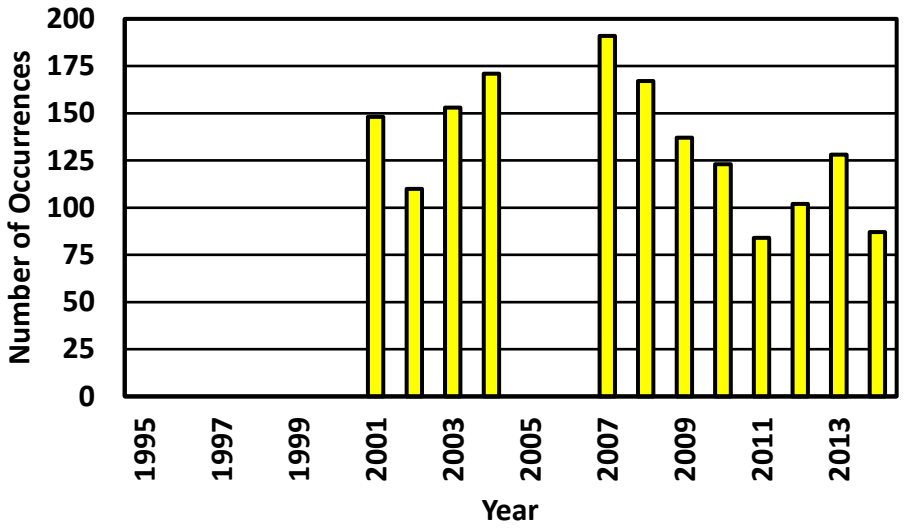

Figure 17. Robbery values for Warren, OH, 1995-2014.

Aggravated assaults are represented in **Figure 18**. Here, the first four years of reported data exhibit a slight increase, followed by a decrease, where the number of aggravated assaults reported remains consistent. When data became available again in 2007, the number reported was the highest during the twenty year period. This high peak is immediately followed by three years of dramatic decrease. A short period of increase then follows, only to immediately begin dropping again in 2013. The value in 2014 is the lowest reported value for the years that were available.

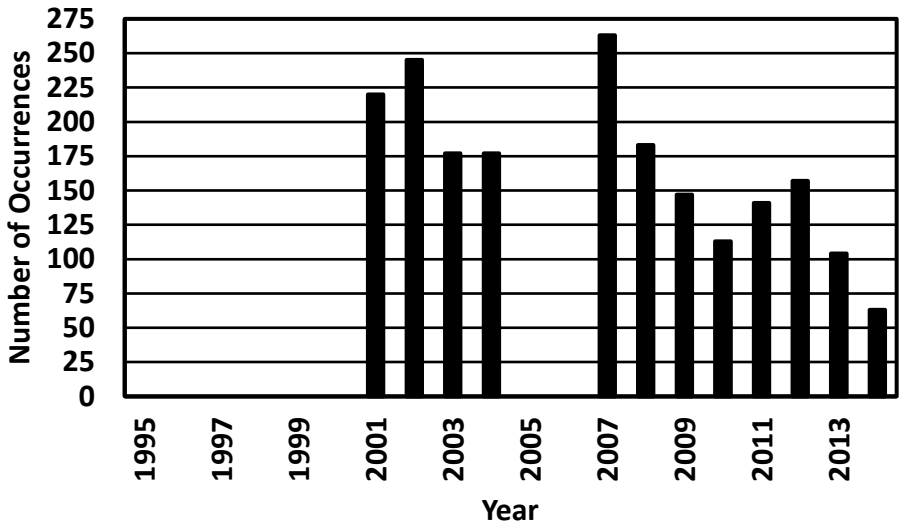

Figure 18. Aggravated assault values for Warren, OH, 1995-2014.

Figure 19 showcases the four violent crimes plotted together. From this figure, aggravated assault is consistently occurring in the highest numbers, with the exception of 2010, 2013 and 2014. During these years of exception, robbery overtakes aggravated assault. When considering the crime occurring in the lowest numbers, Warren remains consistent with the previously mentioned cities, as murder/non-negligent manslaughter occurs in the smallest number. Similarly, rape falls in between murder/non-negligent manslaughter and robbery in the hierarchy of violent crime occurrence in Warren.

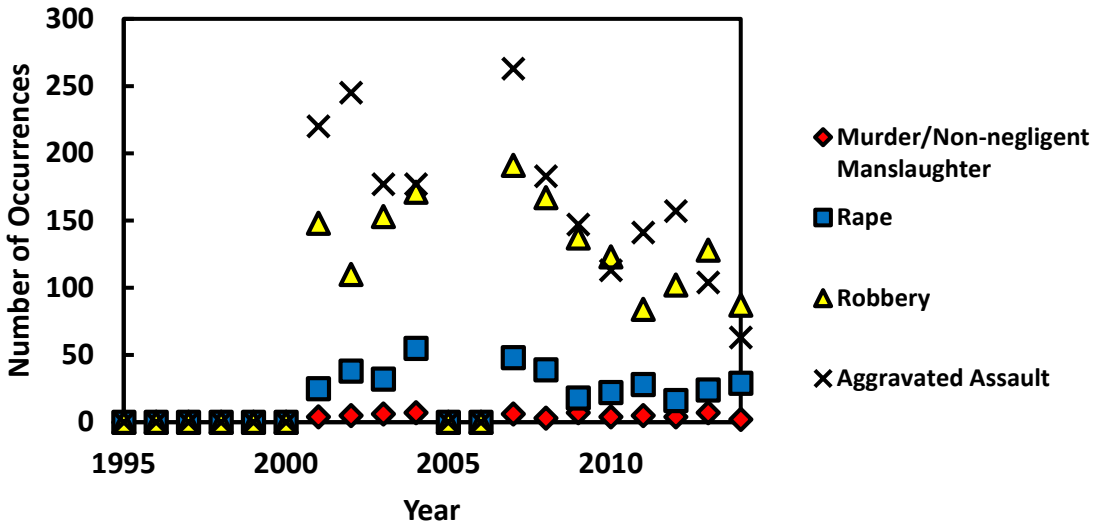

Figure 19. Summary of violent crimes in Warren, OH, 1995-2014.

The final city examined in this study was Youngstown. When considering the murder/non-negligent manslaughter numbers for this city, a general decrease in the values reported was observed. Like noted previously in multiple cities and with multiple crimes, this general decrease does consist of periods of increase when looking at any particular couple of years. However, when considering the entire twenty year period the number present in 1995 is by far the largest value recorded and the number in 2014 is the smallest. This suggests an overall decrease in the occurrence of these crimes. This all can be observed in **Figure 20** below.

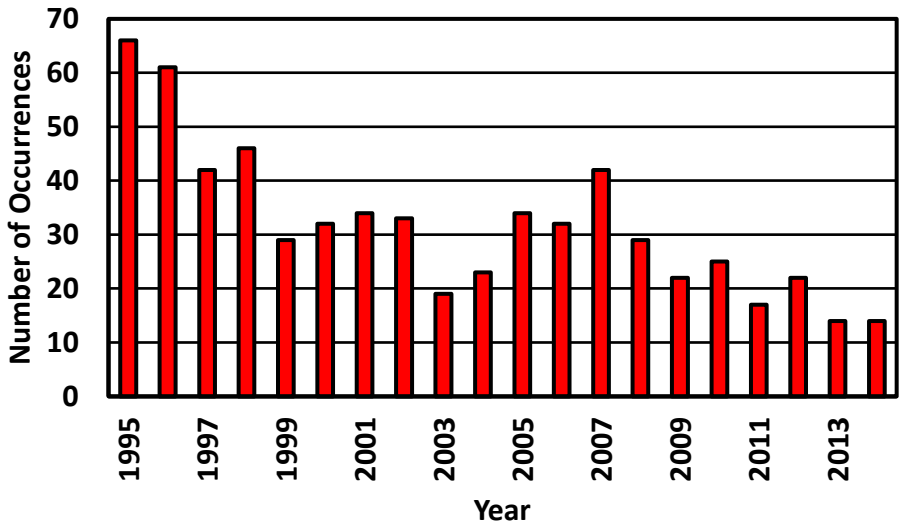

Figure 20. Murder/Non-negligent manslaughter values for Youngstown, OH, 1995-2014.

Rape values for Youngstown can be observed in **Figure 21**. Here, much like the murder rates, an overall decrease in the number of occurrences is shown. In this case, there is a more prominent period of increase that peaks in 2004 and gradually continues to fall. From the year 2008 through 2014, there are more common periods of increase and decrease present; however, the difference in the value in 1995 and that occurring in 2014 maintains the claim that there is an overall pattern of decrease occurring in terms of rape in Youngstown.

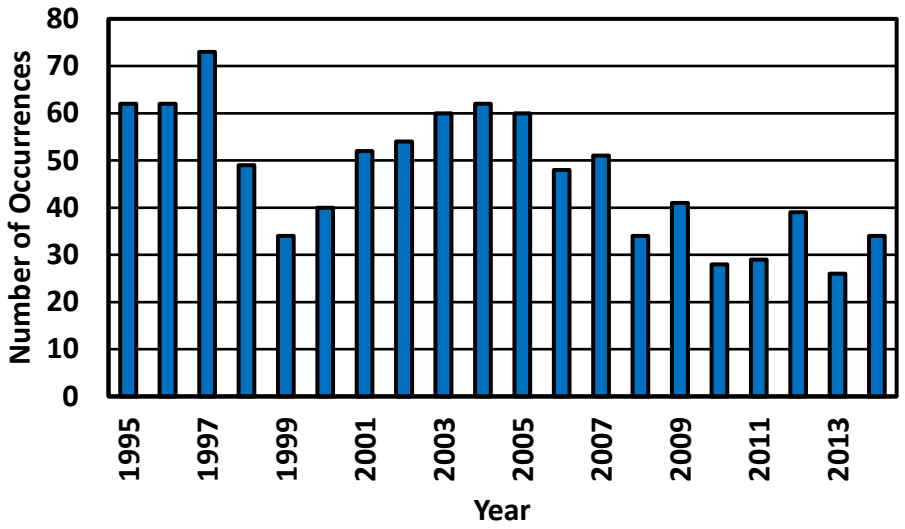

Figure 21. Rape values for Youngstown, OH, 1995-2014.

Robbery numbers and their subsequent trends remain consistent with murder and rape numbers. Much like these two violent crimes, the robbery numbers for Youngstown present an obvious trend of decrease over the twenty year period of interest. Likewise to those mentioned previously, there are years where an increase in occurrences is noted. These instances however do not mask the fact that the drop in the number of robberies in Youngstown has dramatically decreased from 1995-2014. This trend can be found in **Figure 22** below.

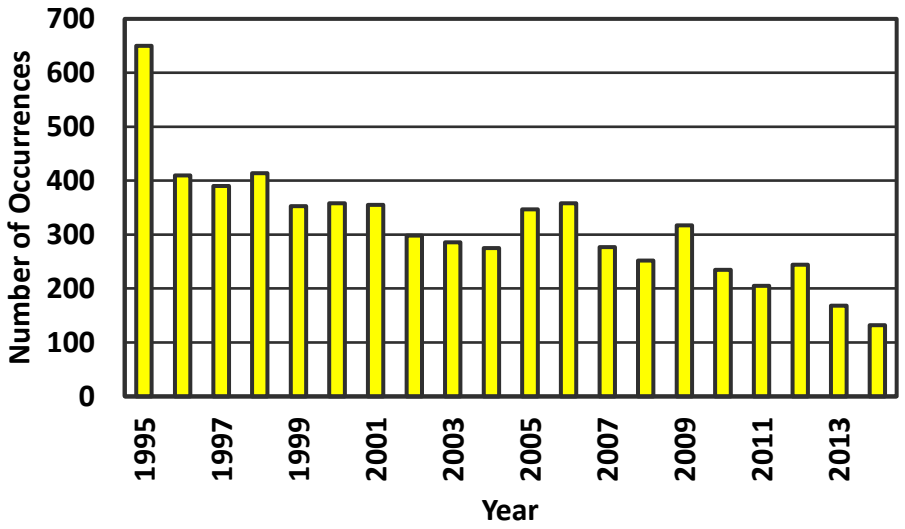

Figure 22. Robbery values for Youngstown, OH, 1995-2014.

Figure 23 expresses the number of aggravated assaults occurring in Youngstown. Again, like all other violent crimes discussed, there is an apparent overall decrease in the number of occurrences happening from 1995-2014. Unlike the previous three crimes, this case exhibits a slight increase during the first three years of this study. Therefore, the highest value recorded is not recorded during the year 1995, but rather it is seen in 1997. From here, there is a relatively drastic decrease followed by a period of increase. This pattern repeats itself until 2009, where a constant rate of decrease begins. Again, like discussed above, the value listed in 2014 appears to be the lowest number recorded.

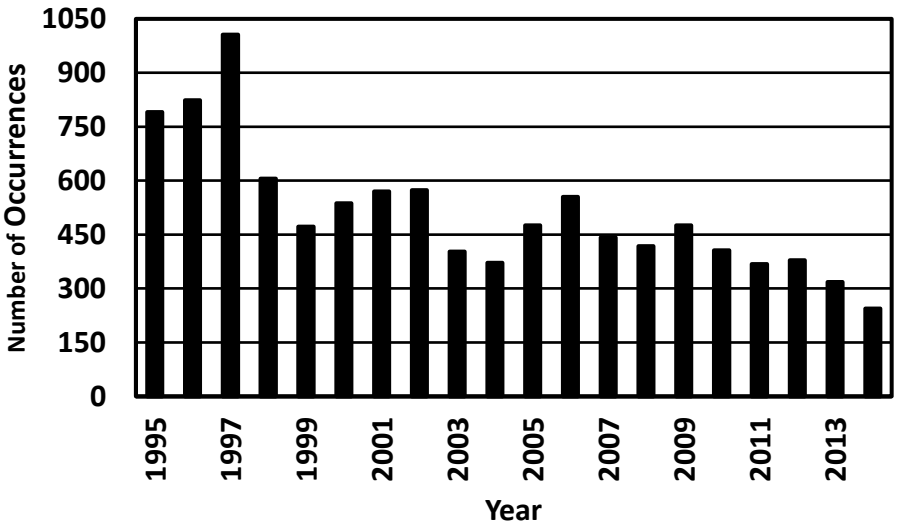

Figure 23. Aggravated assault values for Youngstown, OH, 1995-2014.

Looking at **Figure 24**, the four violent crimes can be evaluated in terms of each other. Here, similar to Cleveland, there is a distinct separation between all four crimes. At no point are there periods where the trend line for one crime crosses the line of another, indicating a switch in the ranking of violent crimes that occur. As a result, it can be stated that for Youngstown, the highest occurring crime is aggravated assault, followed by robbery, rape and finally murder/non-negligent manslaughter is the smallest occurring crime. Additionally, the decreasing numbers for all four crimes are obvious in this figure, much like the bar graphs above.

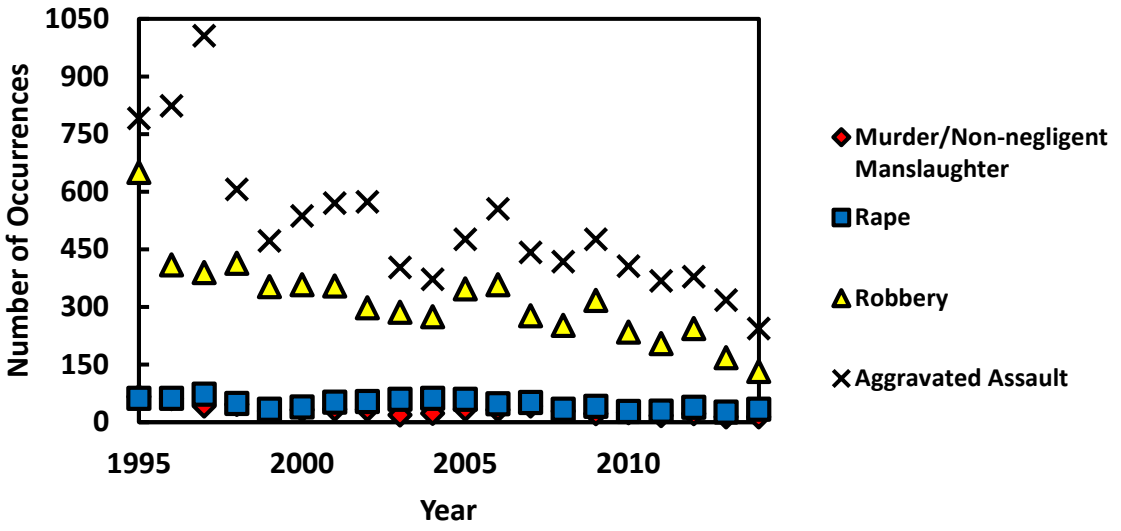

Figure 24 . Summary of violent crimes in Youngstown, OH, 1995-2014.

In order to understand how the violent crime trends in the above cities were comparing to those rates for the state of Ohio, the same initial method of interpretation was performed for the state as a whole. By evaluating the trends in Ohio, the observed trends in Cleveland, Lorain, Salem, Warren, and Youngstown can be assessed as to how events in these jurisdictions compare to those throughout Ohio. First, like above, murder/non-negligent manslaughter was observed. The details can be observed in **Figure 25**. For this crime, there is a decrease in the number initially. However, this is followed by an increase beginning in 1999 and peaking in 2005. From 2005, a very gradual decrease in the number of occurrences can be observed. Overall, although there are distinct periods of increase and decrease through this timeframe, the values for the number of murders occurring through the state of Ohio remains pretty consistent from 1995-2014.

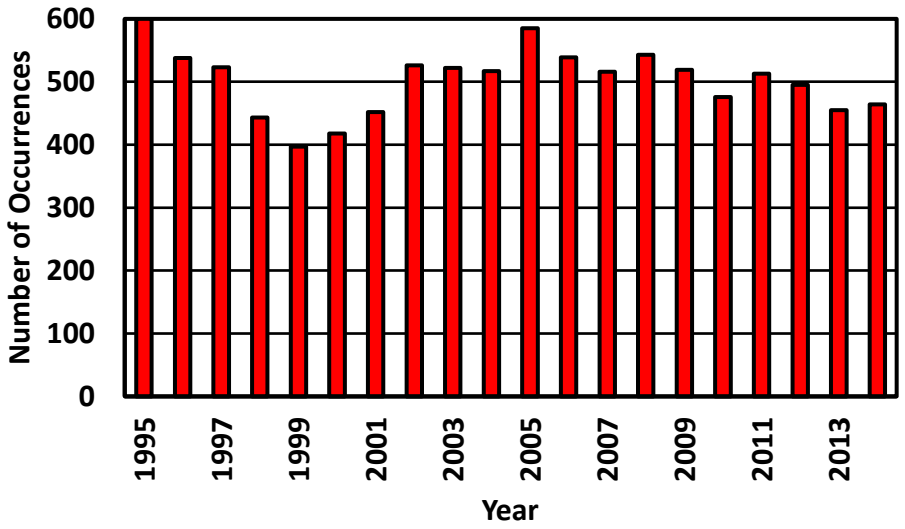

Figure 25. Murder/Non-negligent manslaughter values for Ohio 1995-2014.

Rape statistics for Ohio are shown in **Figure 26.** Much like murder/non-negligent manslaughter, the overall values for rape remain relatively consistent over the twenty years. There are periods of increase and decrease that can be noted; however, up until 2012 these changes are slight. From 2012-2014, there is an obvious increase in the number of rapes occurring. This increase leads to the number of occurrences in 2014 being the largest number recorded during the timeframe in question.

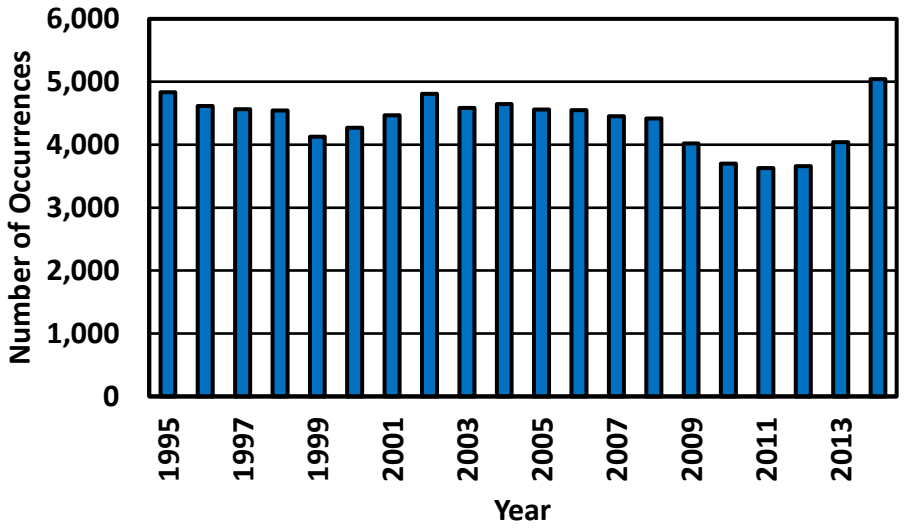

Figure 26. Rape values for Ohio 1995-2014.

Robbery values can be seen in **Figure 27** below. Here, there is an initial drop in the number of robberies from 1995-1999. From 2000-2012 there is a slow increase and decrease pattern that can be observed. The striking change in this data can then be observed in 2013 and 2014. The values recorded during these years are drastically smaller than any of the numbers recorded in the previous years. The reason for this drop is unclear.

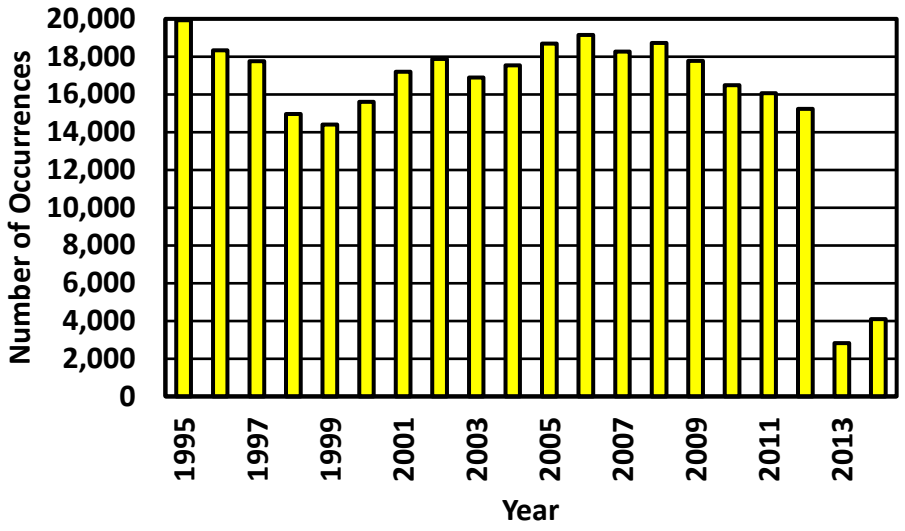

Figure 27. Robbery values for Ohio 1995-2014.

Aggravated assaults, again, were the final crime evaluated for Ohio. The data can be found below in **Figure 28.** Over the course of the first four years of this study, a decline was observed in the number of aggravated assaults. Once the number of incidences decrease the reported values level out and are consistent through 2014. There is a slight decrease that appears to be occurring throughout this period of relative consistency.

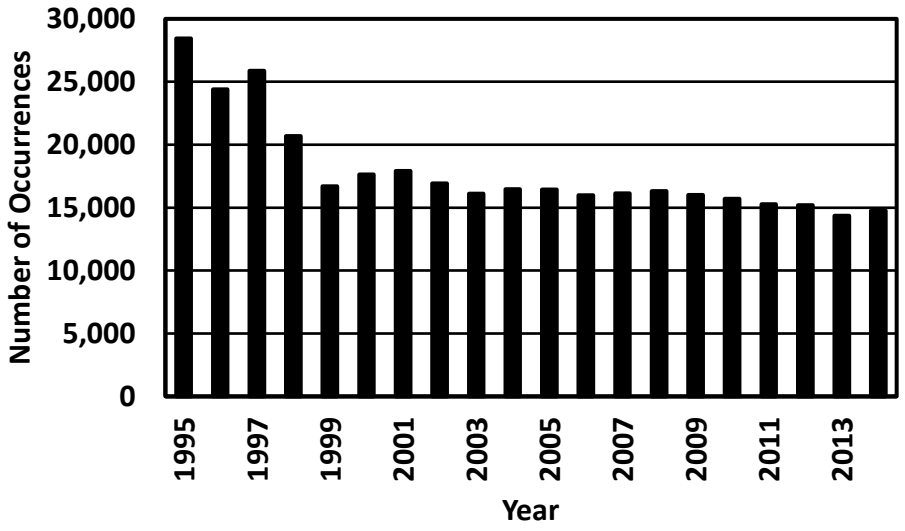

Figure 28. Aggravated Assault values for Ohio 1995-2014.

In order to evaluate all four violent crimes, **Figure 29** was examined. Here, it was immediately noted that murder/non-negligent manslaughter was the violent crime that occurred in the smallest number. Rape was the next highest, but maintained a consistent number of occurrences across the twenty year period. Looking at the two highest occurring crimes, aggravated assault and robbery, it is seen that they replace each other periodically as the most common violent crime occurrence. During the first seven years of data, aggravated assault is the largest occurrence. However, in 2002, robbery surpasses aggravated assault and maintains this position until that dramatic drop that was observed in 2013. When this occurred, robbery actually dropped below not only aggravated assault but also rape in terms of number of incidences. Meanwhile, aggravated assault remained constant.

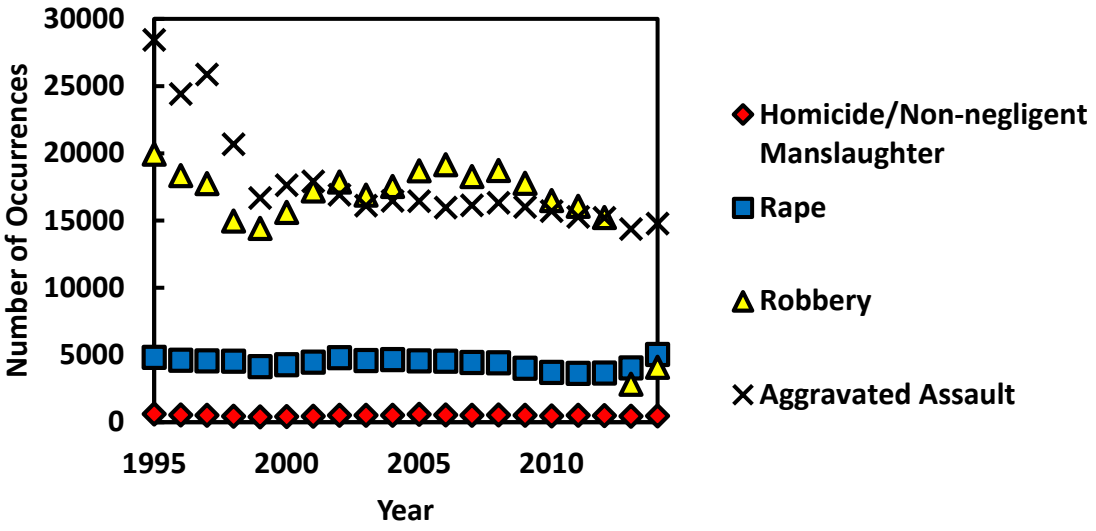

Figure 29. Summary of violent crimes in Ohio 1995-2014.

Next, in order to evaluate whether or not meaningful comparisons could be made between the different cities, the crime volume had to be converted to crime rate. The data for each city, each crime type, and each year were evaluated in this way. This was accomplished using two different methods as discussed above. By converting the data to these crime rates, the influence of population size could be evaluated in terms of violent crime occurrence. Through this comparison, correlation values could later be calculated and relationships could be established between population and violent crime.

Correlations Between Overall Crime Rate and City Population - Nolan Statistics

In order to convert the reported crime volumes into comparable crime rates, the data was subjected to two different equations (**Equations 1 and 2**) in order to generate the crime rate for each city. By calculating the crime rate in these two ways, conclusions as to the direction and strength of the relationship between crime and population could be made. Below are tables

summarizing the calculations performed to determine the two crime rates. **Table 6** shows the results of calculating crime rate for all five cities using **Equation 1**. **Table 7** indicates the results obtained for all cities after calculating crime rate using **Equation 2**.

Table 6. Calculation of Crime Rate 1 using Equation 1.

City	Total Crime Volume	Total Population	Quotient	Crime Rate
Cleveland	125951	9,087,358	0.0136	1386.00
Lorain	6084	1,368,262	0.0044	444.65
Salem	106	243,768	0.0004	43.48
Warren	4025	526,873	0.0076	763.94
Youngstown	18135	1,578,305	0.0115	1149.02

Table 7. Calculation of Crime Rate 2 using Equation 2.

City	Total Crime Rate	Number of Jurisdictions	Crime Rate
Cleveland	27733.89	20	1386.69
Lorain	8897.68	20	444.88
Salem	863.66	20	43.18
Warren	12984.96	12	1082.08
Youngstown	22520.53	20	1126.03

Using these two values for each of the respective cities, the correlations of the population and crime rate were determined. Depending on the difference of Crime Rate 1 and Crime Rate 2, each correlation could be determined as either positive, negative, or zero. **Table 8** below depicts the results of these calculations and the numbers used to determine these correlations.

Table 8. Comparison of crime rates for each city.

City	Crime Rate 1	Crime Rate 2	Correlation
Cleveland	1386.00	1386.69	-0.69
Lorain	444.65	444.88	-0.23
Salem	43.48	43.18	0.30
Warren	763.94	1082.08	-318.14
Youngstown	1149.02	1126.03	22.99

Looking at Cleveland, Lorain, and Warren, it can be seen that the difference between these numbers is a negative number, indicating a negative correlation. This type of correlation suggests a situation where one variable increases while the other decreases. Therefore, in these scenarios population increases and violent crime occurrence decreases, or population decreases and violent crime increases. If one were consult the raw data tables found in **Appendix A** for these cities, one would be able to understand these conclusions by looking at the trends in population and subsequent violent crime occurrences.

For Cleveland, there is an increase in population from 1995-2000. After 2000, the population in the city began to decrease. These changes in population were met with a pretty constant decrease in violent crime occurrence. This appears to contradict the negative correlation claim suggested by the data in **Table 8**, since the population decreases and the violent crime rates are also decreasing. This contradiction is the direct result of that brief five year period of population growth that occurred from 1995-2000. During this period, the population was growing, as violent crime steadily decreased, which corresponds to a negative correlation.

Similarly, Lorain also has a relatively low correlation value of -0.2323. This value suggests a slight negative correlation. However, due to its proximity to zero, which suggests there is no correlation between the two variables in question, this negative correlation is only considered minimal. This is substantiated when the population and violent crimes are examined

in detail for this jurisdiction. In Lorain, the violent crime rates steadily fall. However, the population tends to increase and then decrease over the twenty year period. Therefore, during the beginning of the time period in question, Lorain clearly follows a negative correlation; meanwhile, recent years are following more of a positive correlation.

Warren is the third city that produced a negative correlation. This value is much larger than those values obtained for either Cleveland or Lorain. With this larger value, the negative correlation that is observed is more pronounced than those correlations observed with the other two cities. This correlation corresponds to what is occurring in the city in terms of population and violent crime. Here, the population exhibits a period of decrease from 1995-2014. Violent crime on the other hand has increased and then decreased during this period. The periods of violent crime increase are consistent with the negative correlation that is suggested. However, the periods of decrease in violent crime are conflicting with the large negative correlation value. It is important to remember that Warren was the city where the data set for the twenty years was not complete; only twelve years of information were available. As a result of this lack of data, the actual correlation between population and violent crime is not accurately represented by the value suggested above in **Table 8**.

Converse to the abovementioned three cities, Salem and Youngstown, produced a positive number, which suggests a positive correlation. This correlation implies that the two variables in question move in the same direction, or both increase or both decrease with each other. If one were to look closely at Salem, one would observe that the population in this city decreases and then increases from 1995-2014. The same holds true for violent crime occurrence. Initially, the crime rate decreases, but then shows a period of increase in recent years. As

expected from the positive correlation, the trends of both these variables match throughout the twenty years.

As for Youngstown, the positive correlation that was produced suggests a stronger correlation between population and violent crime rate than the correlation seen with Salem. This was due to the value produced for Youngstown being much greater than zero. This suggested correlation relates to the information available for Youngstown. In this city, the population has decreased generally, with a slight period of increase, which was then followed with continued decrease. Crime rate in this city has decreased steadily from 1995-2014. With the exception of the slight increase in population, the overall trends show both population and crime rate decreasing together, which is reminiscent of a positive correlation.

Conclusions for Correlations Between Overall Crime Rate and City Population

Upon closer inspection of the five cities and their correlations, it becomes obvious that Cleveland, Lorain, and Salem all have differences that are less than ±1. This suggests that in each of these cases Crime Rate 1 and Crime Rate 2 were very close. Therefore, it can be concluded that these three cities exhibit an almost zero correlation, since this value is so small and the two crime rate values are so similar. This ultimately suggests that in these three cities the correlation between population and crime rate is low and the influence the two have on each other may be minimal.

Furthermore, If the current trends of population decrease and violent crime decrease continue in the coming years in Cleveland, one would expect the correlation value to slowly switch to a positive correlation or a zero correlation. Evidence of this potential change is suggested by the low correlation value of -0.6916. This number hovers close to zero; therefore,

a change in the correlation direction would be likely. Much like Cleveland, Lorain has a low correlation value and could reasonably see a shift in the correlation between population and violent crimes in coming years.

Considering Warren and Youngstown, these values indicate clear negative and positive correlations between crime rate and the city's population. In the case of Warren, this was the largest number produced and clearly indicates a negative correlation between the two variables being examined. Meanwhile, Youngstown's difference, although not as great as Warren's, also was clearly indicative of a correlation between crime and population. However, this value can still be considered to be quite low when compared to other research conducted (4). Regardless, these values are clearly indicative that a relationship exists between population and violent crime rate in these jurisdictions. The influence the two have on each other cannot be disregarded.

When comparing the values determined for each of these cities, it becomes obvious that the number for Warren is drastically different. This extreme difference was attributed to the fact that Warren only reported data to the UCR for twelve years out of the twenty available. Since the data were not known for these eight years, all calculations were performed using the twelve jurisdictions instead of the twenty. No assumptions were made in order to estimate the figures that were missing. Due to this lack of data, it can be assumed the number produced in this case would be different if data was available for those eight years. Therefore, the correlation suggested for Warren, is noted but is considered with caution, as it is not a completely accurate representation of crime rate and population in Warren throughout the two decades considered for the other four cities.

With the exception of Warren, the data generated for the four remaining cities indicated that the correlations between crime rate and population was generally consistent. Of the four,

Cleveland, Lorain, and Salem suggested minimal correlation, if any, due to closeness of the two crime rate values in each case. The number produced for Youngstown was more indicative of a substantial correlation between the two variables; however, this is not as extreme as it could have been. Furthermore, it becomes apparent from the data above that there are instances of positive and negative correlations. Again, disregarding the clear outlier that is Warren, there were two positive correlations and two negative correlations noted. Of course, three of these correlations were only slight and could be written off as zero correlations. Thus, there is only one value of this list that suggests a true correlation of any kind.

Correlations Between Individual Violent Crime Rate and City Population - Nolan Statistics

With these initial indications as to the magnitude and the direction of the correlations of population and overall violent crime rate, further analysis was performed in order to determine if the observations noted for overall crime rate were maintained when examining each of the four violent crimes individually. By examining each violent crime individually, determinations could be made as to whether there were true relationships between population and each violent crime and whether the desired comparison could be made between these cities and crimes, without sacrificing the integrity of the data and what it was representing.

Below, in **Tables 9-13**, the breakdown for the four violent crimes in each city can be seen. Here, the same calculations were performed as described above for the information presented in **Table 8**. Each violent crime was looked at individually and the value shown in the respective table was produced. Each value was classified as indicating a positive or negative correlation. The magnitude of each correlation was also classified as weak, average, and strong. The cut-off values for these distinctions were set as follows: weak were considered those values

from 0 - ±1.00, average were considered ±1.01 - ±10.99, and strong were classified as anything greater than ±11.

Table 9 shows the correlations calculated for the violent crime rates in Cleveland. Based on these values, it was noted that murder and rape rates were weakly correlated to population, as they were recorded as -0.72 and 0.91 respectively. Of these two, the murder correlation was negative and the rape correlation was positive. As for robbery, it was a negative correlation that was considered average, as it was listed as -3.88. Aggravated assaults was determined to be an average positive correlation with a value of 2.60.

Table 9. Correlations of specific violent crimes to population in Cleveland.

Crime	Correlation
Murder	-0.72
Rape	0.91
Robbery	-3.88
Aggravated Assault	2.60

The results for Lorain are found in **Table 10**. Here, when looking at the magnitude for the four violent crime categories, it was noted that in all cases, the correlations between violent crime rate and population were determined to be weak. This was due to all of these values being within the 0 - ±1.00 range. In the case of murder and robbery, there was a slight negative correlation produced. This correlation was more observable in robbery than in murder, as the robbery value is higher than that of murder. For aggravated assault, a positive correlation was observed. Meanwhile, for rape, a zero correlation was recorded.

Table 10. Correlations of specific violent crime to population in Lorain.

Crime	Correlation
Murder	-0.02
Rape	0.00
Robbery	-0.42
Aggravated Assault	0.20

Very similar to Lorain, the results for Salem suggest a minimal relationship between all four violent crimes and population. Looking at the results in **Table 11**, one will notice that all values again are suggesting a weak correlation, if any at all. Murder in this case suggests a zero correlation. Rape and robbery are indicative of very slight negative correlations and aggravated assault has a positive correlation that is greater than any of the previous three correlations

Table 11. Correlations of specific violent crime to population in Salem.

Crime	Correlation
Murder	0.00
Rape	-0.02
Robbery	-0.03
Aggravated Assault	0.36

In the case of Warren, all values were suggestive of a negative correlation for all violent crimes. These results can be seen in **Table 12**. Warren is the only city where all negative correlations were observed. In this case, the correlation that exists for murder can be considered weak. Those that exist for rape, robbery and aggravated assault are strong.

Table 12. Correlations of specific violent crime to population in Warren.

Crime	Correlation
Murder	-0.90
Rape	-22.39
Robbery	-102.08
Aggravated Assault	-192.77

Finally, the results for the individual violent crimes for Youngstown can be seen in **Table 13.** Here, all of the values produced suggest a positive correlation between that violent crime rate and population. Youngstown is the only city in which a consistent positive correlation was observed in all four categories. After classifying each violent crime, it was noted that the rape correlation was weak, the murder and robbery correlations were average, and the correlation for aggravated assault was strong.

Table 13. Correlations of specific violent crime to population in Youngstown.

Crime	Correlation
Murder	1.13
Rape	0.72
Robbery	7.88
Aggravated Assault	13.25

Conclusions on Correlations Between Individual Violent Crime Rate and City Population

All of the information presented in **Tables 10-13** and all of the discussion that followed these values are summarized below in **Table 14**. From this information, attempts were made to draw conclusions for each city as a whole. Then individual violent crimes in each city were analyzed in terms of population.

Based on the results for Cleveland, no trends are observed that are applicable to all four violent crimes. The only trend that could be stated was that for Cleveland no violent crimes are

exhibiting a high correlation in terms of population. This is consistent with the values that were produced in **Table 8** for Cleveland.

For Lorain, the information obtained suggests that when considering the four violent crimes in this city and the subsequent population of the city, the relationships that do exist between them are minimal and the resulting influence that the two variables have on each other are not cause for concern when comparing these values to other like values.

The weak correlations observed for Salem suggest that the relationships that exist between violent crime rates and population are minimal and result in little impact. Thus, these values can theoretically be compared with other values that are deemed to be not correlated, such as those in Lorain. This comparison does not produce any unnecessary risk due to this fact.

Warren data implies a strong relationship exists between rape, robbery, and aggravated assault rates and the city's population. Again, the results obtained for Warren are noted, but are done so with caution due to the lack of a complete data set from which these results were obtained. As for Youngstown, all correlations were positive. However, there was no over-arching conclusions that could be made regarding the magnitude of the correlations between the four violent crimes in Youngstown.

Table 14. Summary of the correlations for each city, broken down by crime type.

		Weak	Average	Strong
Cleveland	Homicide	X	-	-
	Rape	X	-	-
	Robbery	-	X	-
	Aggravated Assault	-	X	-
Lorain	Homicide	X	-	-
	Rape	X	-	-
	Robbery	X	-	-
	Aggravated Assault	X	-	-
Salem	Homicide	X	-	-
	Rape	X	-	-
	Robbery	X	-	-
	Aggravated Assault	X	-	-
Warren	Homicide	X	-	-
	Rape	-	-	X
	Robbery	-	-	X
	Aggravated Assault	-	-	X
Youngstown	Homicide	-	X	-
	Rape	X	-	-
	Robbery	-	X	-
	Aggravated Assault	-	-	X

Correlations Between Individual Crime Rate and City Population - Pearson Correlation

In order to avoid putting too much weight on any one statistical evaluation, a second method of evaluation was employed to see if the results obtained with the first method were sound. The previously discussed evaluations were determined using the same statistical approaches used by Nolan in his work. However, these methods are not as widely recognized as other statistical methods. Therefore, a more common statistical method was utilized to compare the correlations of these violent crimes and populations of the five cities.

The second statistical method used was the Pearson Correlation as described above. This method allows one to assess the direction and the strength of a correlation between two variables. Ultimately, it is producing similar results as those statistics performed by Nolan. Unlike Nolan, the value produced through the Pearson Correlation will fall between -1 and +1. The closer one value is to zero, the less correlation exists between the two variables in question. The closer to +1 or -1 a value falls, the stronger the correlation is between the two variables. For the purposes of classifying these values as weak, average or strong correlations, cut off values had to be established. The cut-off values for these distinctions were set as follows: weak were considered those values from 0 - ±0.30, average were considered ±0.31 - ±0.79, and strong were classified as ±0.80 - ±1.00.

In **Table 15**, the Pearson Correlations calculated for Cleveland can be found. Before evaluating the strength of the correlations, it was noted that all correlations were positive in nature. Using the established cut-off values, it was determined that the robbery rate was weak, the murder rate was average, and the rape and aggravated assault rates were strongly correlated to population. These results were not consistent with those described above in **Table 9**.

Table 15. Pearson Correlations of individual violent crimes for Cleveland.

	Crime	Correlation
Cleveland	Murder	0.33
	Rape	0.80
	Robbery	0.21
	Aggravated Assault	0.87

The Pearson Correlations for Lorain can be found in **Table 16**. Here, murder and robbery were negative correlations and rape and aggravated assault were positive correlations. These were consistent with the results obtained in **Table 10**. As for the strength of the

correlations, it was determined that all four crimes were weakly correlated to the population. Again, this was consistent with the results obtained from the first set of statistics performed for Lorain.

Table 16. Pearson Correlations of individual violent crimes for Lorain.

	Crime	Correlation
Lorain	Murder	-0.11
	Rape	0.12
	Robbery	-0.09
	Aggravated Assault	0.21

Table 17 shows the results for Salem after performing the Pearson Correlations. When considering whether the correlations were positive or negative, it was determined that murder, rape and robbery exhibited a negative correlation. Meanwhile, aggravated assault was showing a positive correlation to population. These determinations were not consistent with those seen in **Table 11**. Here, there were only negative correlations observed for rape and robbery. When considering the strength of the correlations, it was determined that murder, rape and robbery were weak correlations and aggravated assault was indicative of an average correlation. Again, this was not consistent with the information obtained from the first set of statistics, where all violent crimes were deemed to have a weak correlation with Salem's population.

Table 17. Pearson Correlations of individual violent crimes for Salem.

	Crime	Correlation
Salem	Murder	-0.05
	Rape	-0.12
	Robbery	-0.09
	Aggravated Assault	0.48

The Pearson calculations performed for Warren produced the results seen in **Table 18.** Here, all of the correlations were positive. This was the exact opposite of what was observed using the first statistic calculations. In the first statistical analysis, all values were indicative of negative correlations. As for the strength of the correlations, it was determined that the murder rate was weak, rape and robbery were average, and aggravated assault was strong. Once again, this was inconsistent with the previous results in terms of rape and robbery, which were also considered to have a strong correlation to the population. The reason for the complete reversal of correlations was not investigated in this research; however, attempts will be made to determine the reason for this discrepancy.

Table 18. Pearson Correlations of individual violent crimes for Warren.

	Crime	Correlation
Warren	Murder	0.27
	Rape	0.53
	Robbery	0.58
	Aggravated Assault	0.76

Finally, the results for the Pearson Correlations for Youngstown can be seen below in **Table 19**. Here, like Warren, all correlations were established as positive correlations. This was consistent with the information obtained from the first statistic, as described in **Table 13**. When classifying the strength of these correlations, it was established that all four violent crimes were exhibiting strong correlations to the population of Youngstown. For murder, rape, and robbery, these were not the strength classifications that were assigned initially.

Table 19. Pearson correlations of individual violent crimes for Youngstown.

	Crime	Correlation
Youngstown	Murder	0.84
	Rape	0.76
	Robbery	0.84
	Aggravated Assault	0.85

Conclusions on Correlations Between Individual Violent Crime Rate and City Population

After examining the results of the Pearson Correlations, it was quickly observed that those results were not consistent across individual violent crime types. These results can be found in **Table 20**. Much like those results previously discussed, when considering one crime across all five cities, the associated strength of the correlations were not consistent. This poses a problem when trying to assess the possibility of comparing these values to other values in other cities. With no consistency, no meaningful comparisons can be made. The only consistencies that were noted in this evaluation were all violent crimes in Lorain were weakly associated with population and the violent crimes in Warren were all strongly associated with the population in that city. From this lack of consistent results, it was determined that no generalizations could be drawn from this data that would accurately represent the violent crime rates and their associated correlation to population across these five cities of interest.

Table 20. Summary of conclusions, broken down by crime type, obtained after using the Pearson Correlation.

		Weak	Medium	Strong
Cleveland	Murder	-	X	-
	Rape	-	-	X
	Robbery	X	-	-
	Aggravated Assault	-	-	X
Lorain	Murder	X	-	-
	Rape	X	-	-
	Robbery	X	-	-
	Aggravated Assault	X	-	-
Salem	Murder	X	-	-
	Rape	X	-	-
	Robbery	X	-	-
	Aggravated Assault	-	X	-
Warren	Murder	-	-	X
	Rape	-	-	X
	Robbery	-	-	X
	Aggravated Assault	-	-	X
Youngstown	Murder	X	-	-
	Rape	-	X	-
	Robbery	-	X	-
	Aggravated Assault	-	-	X

Additionally, it became obvious that the results obtained for the Pearson Correlations did not match those obtained using the statistics made available in Nolan's paper. With the exception of the data for Lorain, the strength and direction of the correlations were different between the two statistical evaluations. The reason for these differences are not fully understood, but research will be performed in an attempt to understand them and to determine which statistical method produces the most accurate results. However, it is apparent that the correlations between violent crime and population are not easily classified. It is important to

consider all aspects of a city when evaluating the violent crime rates occurring in that city. From the information above, it is obvious that there are relationships between crime rate and population. These relationships are not consistent across cities and need to be evaluated in every instance to understand the magnitude of these relationships and the ultimate impact they have on the violent crimes occurring in these areas.

Unintentional Drug Death and Violent Crime Rate

Up to this point, this research has been concerned with the relationship between violent crime rate and population. Based on the information obtained, it became apparent that societal influences such as population ultimately have an effect on violent crime rates. Since population is one aspect of society, it drew into question the effects other societal influences have on violent crime rates. Therefore, various societal influences were considered. Influences such as drug use, poverty, education and family structure all seemed like legitimate starting points. However, the drug use issue quickly was recognized as the largest issue plaguing the cities in question; therefore, it was used in order to access its effect on violent crime rates.

Since drug use data is not available in the UCR, drug use statistics were obtained from the Ohio Department of Public Safety. The statistics used were actually the number of unintentional drug deaths that occurred in the areas of interest. The raw data used can be found below in **Table 21**.

Table 21. Unintentional drug death raw data, 2000-2010.

	Unintentional Drug Deaths, 2000-2010					
	Columbiana	Cuyahoga	Lorain	Mahoning	Trumbull	Ohio
2000	2	89	8	9	13	411
2001	2	111	9	10	12	555
2002	4	106	15	14	18	702
2003	4	87	13	17	23	658
2004	4	114	12	16	38	904
2005	1	115	13	29	29	1020
2006	7	168	18	25	30	1261
2007	7	134	16	25	58	1351
2008	8	144	18	42	41	1475
2009	9	144	25	38	43	1423
2010	8	159	21	38	43	1544
Total	56	1371	168	263	348	11304

Looking at this table, it needs to be noted that the information obtained is notably different than all other information obtained up to this point. Here, one will notice that numbers presented are for the counties in which the five cities of interest are located. This is the case because data was not available for each individual city. Furthermore, the information for unintentional drug deaths only covers the years 2000-2010. If attempts would have been made to compare these values to the raw violent crime data used, issues would have arisen with the incompatibility of the data. Therefore, the UCR was consulted again and the violent crime data that represented the five counties of interest were accessed rather than the data for the five cities of interest. These values can be seen below in **Table 22**.

Here, the data obtained from the UCR for the years in question is summarized. It will become quickly apparent that there are glaring issues with this data set. For one, Cuyahoga county, which is where Cleveland is located, failed to report county-wide data in all years of interest. Therefore, it was impossible to draw conclusions as to the relationship between unintentional drug death rate and violent crime rate in this county. Similarly, there are years of

data missing for Columbiana, Lorain, and Mahoning counties as well. The only county that regularly reported to the UCR was Trumbull county; therefore, this county is the only county in which the following results had significant meaning.

Table 22 . Crime volume in counties of interest, 2000-2010.

	Crime Volume in Counties of Interest				
	Columbiana	Cuyahoga	Lorain	Mahoning	Trumbull
2000	No Data	No Data	34	No Data	35
2001	146	No Data	65	28	28
2002	209	No Data	69	No Data	47
2003	No Data	No Data	55	21	21
2004	15	No Data	62	No Data	23
2005	No Data	No Data	58	No Data	28
2006	47	No Data	No Data	No Data	31
2007	22	No Data	59	13	27
2008	-	No Data	39	10	27
2009	6	No Data	52	2	23
2010	8	No Data	38	4	12

Correlations Between Unintentional Drug Death and Violent Crime Rate - Nolan Statistics

Despite the lack of complete data, the correlations for all four crime rates and unintentional drug death rates were analyzed in the same way as crime rates and populations. To accomplish this, unintentional drug death rate was calculated in the same way as described above. However, in this case, population was not utilized. Rather the crime volumes for these areas were utilized in the calculations. This would allow for the relationships between these two variables to be examined. The calculation of Drug Death Rate 1 is detailed in **Table 23** and Drug Death Rate 2 is found in **Table 24**.

Table 23. Drug Death Rate 1 calculations.

County	Drug Related Deaths	Crime Volume	Drug Rate 1
Columbiana	41	453	0.0906
Cuyahoga	N/A	N/A	N/A
Lorain	531	150	0.2825
Mahoning	78	170	2.1795
Trumbull	302	348	1.1523

Table 24. Drug Death Rate 2 calculations.

County	Total Drug Related Deaths	Number of Jurisdictions	Drug Rate 2
Columbiana	0.0179	7	0.0016
Cuyahoga	N/A	N/A	N/A
Lorain	0.0785	10	0.0785
Mahoning	0.0161	6	0.0027
Trumbull	0.0891	11	0.0081

Table 25 details the comparison of these two different drug death rates. As described above, the difference between these two values indicates the correlation that exists between the two questioned variables in that city. The difference actually indicates both the strength and the direction of the correlation between unintentional drug death rates and violent crime rates. This helps establish whether a meaningful relationship exists between the two.

Table 25. Comparison of two drug death rates.

Comparison of Drug Death Rates			
County	Drug Death Rate 1	Drug Death Rate 2	Correlation
Columbiana	0.0906	0.0016	0.0890
Cuyahoga	N/A	N/A	N/A
Lorain	0.2825	0.0785	0.2040
Mahoning	2.1795	0.0027	2.1768
Trumbull	1.1523	0.0081	1.1442

Using the same procedure as above, the correlations recognized with this method of analysis were classified. First, looking at the values produced, it was described that all values were positive. This indicates the presence of a positive correlation between unintentional drug death rates and violent crime rates. Therefore, as the number of unintentional drug deaths increases, the number of violent crimes occurring increases, or both will decrease together. Further analysis can be done to determine the magnitude or strength of these values. Staying consistent with the cut-off values established for Nolan's method above, it is noted that the correlations suggested here are all weak correlations.

Conclusions for Correlations Between Unintentional Drug Death and Violent Crime Rate

From the data above, this means that a slight relationship between these values exists; however, this relationship does not indicate the influence these two variables have on each other is significant. If these values are accurate, then meaningful comparisons could be made outside of jurisdictional lines. This is especially true in the case of Columbiana where the correlation value hovers close to zero.

Correlations Between Unintentional Drug Death and Violent Crime Rate - Pearson Correlations

Again, an attempt was made to compare the above-mentioned statistical analysis with a more common method. The Pearson Correlations were calculated for the four cities that data was available for. This was accomplished in the same way as described earlier. The results of this calculation can be found below in **Table 26.**

Table 26. Pearson Correlation comparison of drug death rates.

	Pearson Correlation
Columbiana	-0.7048
Cuyahoga	N/A
Lorain	-0.2021
Mahoning	-0.9207
Trumbull	-0.5044

The results in this case suggest that the correlations are all negative. This implies that as the unintentional drug death rate increases, the violent crime rate will decrease and vice versa. This is the exact opposite of what the numbers are describing in **Table 25**. In terms of magnitude or strength of these correlations, Lorain County expresses a weak relationship, Columbiana and Trumbull express an average relationship, and Mahoning indicates a strong relationship between the two variables. The strength of these relationships are not consistent with the unanimous weak correlations implied with the first statistical method.

Conclusions for Correlations Between Unintentional Drug Death and Violent Crime Rate

Much like the correlations between population and crime rate, a reversal was seen in the direction of the correlations when the Pearson Correlation was applied. The results presented in Table 25 and Table 26 are not consistent. Again, the reason for this is unknown at this time, but future studies will work to understand these changes.

Final Conclusions

The goal of this research was straight-forward: attempts were made to understand the relationships between violent crime rates and other societal influences such as population and unintentional drug deaths. By understanding these relationships, law enforcement can better evaluate the violent crimes occurring in their areas of responsibilities. These determinations become difficult when multiple jurisdictions are of concern because multiple communities, each with their own unique set of societal influences, are under one law enforcement agency's control.

If relationships exist between violent crimes and other societal influences then comparisons of one city to another have little weight because these factors will affect each differently. This research attempted to evaluate these relationships using two different statistical methods. Although there were significant differences noted with these methods, both methods suggested that the relationships between crime rate and population and those between crime rate and unintentional drug deaths cannot be ignored. The relationships imply that the variables all affect each other in some form or another. Therefore, it becomes vitally important to recognize these societal influences, among others, when thinking about violent crimes. Answers to the issues of combating crime may be produced by looking at these other societal influences.

This research examined five northeast Ohio cities and the violent crime trends that have occurred in these areas throughout a twenty year period. Conclusions were drawn as to the trends between individual cities and across violent crime types. Attempts were made prior to the breakdown of individual violent crimes to draw conclusions that could summarize overall violent crime rate and population relationships in the cities observed. However, as described above, the results for each of the five cities were not consistent with each other. This ultimately prevented generalizations from being made.

From simplistic bar graphs and line graphs, conclusions as to the observable trends for all four violent crimes were established for each city. From this information, an understanding of the crimes plaguing these areas was established and inherently a ranking of the four could be done to understand which crimes are occurring in the greatest number and which are occurring in the lowest. As a result, it was determined that in the case of Lorain, Salem, Warren, and Youngstown, aggravated assaults were the most common violent crimes occurring and murder/non-negligent manslaughters were the least common. Cleveland was unique in that robbery was the most common violent crime; however, like the other four cities the number of murders/non-negligent manslaughters were the smallest.

These trends were then compared to the state of Ohio to see if the findings for the five cities were consistent with state-wide data. If not, the abnormalities of the trends observed could be investigated further to determine the cause. Based on the data provided for the state, it was determined that, overall, all four violent crimes were relatively consistent in number from 1995-2014. Additionally, it was determined that aggravated assault was the most common violent crime, followed by robbery, rape, and then murder/non-negligent manslaughter was the least common. This was consistent with the results obtained for Lorain, Salem, Warren and

Youngstown. Again, Cleveland varied slightly from these common trends with robbery coming in with the highest number of occurrences. Therefore, it is suggested that the circumstances surrounding Cleveland robberies be examined in an attempt to understand why these numbers are higher than in any other city observed.

The mixture of correlation values that was obtained for the cities and violent crimes was consistent with what was presented in Nolan's research and implies there are no overarching conclusions that can be drawn regarding relationships between populations and crime rate for different cities across the board (4). However, compared to those results seen in Nolan's research, the data in this case showed more similarities to each other and were more consistent in the suggestion that very little correlations exist between crime and population in many of the cities examined. However, in some cases the correlation between the two could not be avoided. Therefore, it becomes clear that generalizations cannot be made as to the relationship between population and violent crime rate. In each case, these two variables must be examined in an attempt to understand the circumstances of the city in question. It would be a mistake to assume all cities exhibit the same correlations.

Although no conclusions could be made for overall violent crime, an effort was made to look at each individual crime to see if there were any connections to the observed correlations across jurisdictional lines. It was the hope to see consistent correlations being observed in cases of murder and so on across all five cities. However, this was not the case. Any one violent crime was never consistent in terms of the type of correlation it produced across all five cities. Therefore, it was concluded that no generalizations could be made regarding a specific violent crime when looking at different cities. In every case, the details of the city must be accounted for prior to making any classifying statements regarding violent crime rates.

The only trends that could be observed from this data was the fact that both Lorain and Salem exhibited weak correlations for all four violent crime types. This is beneficial to note, as these values would ultimately be able to be compared to other values without fear of misinterpretation. However, this fact is of little value in this case, because all of the jurisdictions being compared were not weakly correlated, so comparisons of these areas would not produce reliable details about the different cities in question.

In addition to acknowledging the relationships between violent crime and population, the relationships between unintentional drug deaths and crime rate were also established. Similar to the trends observed with population and violent crime, the unintentional drug deaths and violent crime relationships were not consistent across counties or across crime type. The correlation values obtained using Nolan's statistical method contradicted the results obtained through the Pearson Correlation.

Based on this information, it becomes even more clear that work needs to be done to evaluate which statistical evaluation is most appropriate for these comparisons. The two methods used in this paper produced concerning differences that need to be evaluated. However, in both cases, it became that much more evident that there are relationships that exist between violent crime rates in these cities and counties and other societal influences. These relationships cannot be overlooked, as their impact on violent crime rates vary depending on the jurisdiction being observed. Although these societal influences may not be the direct cause of these violent crimes, they do contribute to their presence in some way or another. Therefore, law enforcement would be remiss to not acknowledge these facts and use these influences to interpret the violent crime rates in these areas and understand how all factors are intimately connected.

The research presented in this paper is far from being complete. Through these simple methods of evaluating these figures, details emerged for these cities and counties that could help law enforcement assess their treatment of the violent crimes in these areas. Everything mentioned above can be expanded upon as new data becomes available for these cities and counties each year. Additionally, other societal influences such as poverty, education, or family structure among others can be evaluated for a comprehensive examination of these cities. Through simple work like this, law enforcement officials can establish the most effective ways to combat these violent crime issues and can determine whether their current allocation of resources is the best for their jurisdiction. However, these evaluations are not possible without complete data. Meaningful relationships and correlations cannot be deduced without sufficient data to draw from. Thus, it is vitally important for law enforcement agencies to continue reporting to the UCR and similar outlets so data is readily available for analyses such as this.

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Appendix A.

Table 1. Raw data summary of crime volume in Cleveland, Ohio from 1995-2014.

Violent Crime in Cleveland, Ohio					
Year	Population	Murder and Non-negligent manslaughter	Forcible Rape	Robbery	Aggravated Assault
1995	495,074	129	689	4,224	3,108
1996	496,049	103	643	4,062	2,823
1997	496,624	77	638	3,837	2,692
1998	495,516	81	576	3,364	2,460
1999	497,903	76	506	3,038	2,429
2000	505,962	71	615	3,084	2,271
2001	479,263	77	624	3,298	2,425
2002	481,274	80	619	3,263	2,402
2003	468,446	73	646	3,167	2,314
2004	462,260	78	520	3,289	2,096
2005	458,885	109	478	3,743	2,086
2006	452,759	75	445	4,288	2,196
2007	439,888	90	374	4,022	1,958
2008	433,452	102	423	3,804	1,864
2009	429,238	86	373	3,555	1,976
2010	426,042	81	341	3,181	1,922
2011	397,106	74	354	3,156	1,842
2012	393,781	84	363	3,252	1,750
2013	389,181	55	417	3,490	1,789
2014	388,655	63	482	2,990	1,651

Table 2. Raw data summary of crime volume in Lorain, Ohio from 1995-2014.

Violent Crime in Lorain, Ohio					
Year	Population	Murder and Non-negligent manslaughter	Forcible Rape	Robbery	Aggravated Assault
1995	71,231	2	37	99	58
1996	71,371	3	50	81	99
1997	71,453	1	49	138	259
1998	70,227	4	35	87	178
1999	69,147	1	22	68	124
2000	67,955	0	26	94	159
2001	68,775	1	22	105	151
2002	69,064	2	14	109	146
2003	67,790	5	10	93	168
2004	68,093	6	20	91	215
2005	67,945	6	14	119	202
2006	67,903	5	5	135	149
2007	70,861	7	16	140	165
2008	70,302	3	41	158	158
2009	70,410	5	36	178	175
2010	70,242	1	29	139	174
2011	64,144	4	37	138	139
2012	64,148	4	34	136	151
2013	63,582	6	30	161	107
2014	63,619	0	38	92	115

Table 3. Raw data summary of crime volume in Salem, Ohio from 1995-2014.

Violent Crime in Salem, Ohio					
Year	Population	Murder and Non-negligent manslaughter	Forcible Rape	Robbery	Aggravated Assault
1995	12,897	0	0	0	6
1996	12,922	0	0	1	3
1997	12,936	0	0	0	12
1998	12,236	0	1	1	10
1999	11,944	0	0	0	8
2000	11,952	0	0	1	5
2001	12,219	0	0	0	8
2002	12,270	0	0	0	6
2003	12,334	0	2	0	4
2004	12,126	0	0	1	0
2005	12,068	0	0	1	1
2006	12,020	0	0	5	1
2007	11,915	0	0	0	2
2008	11,763	0	0	0	0
2009	11,709	0	0	0	1
2010	11,676	0	2	0	1
2011	12,312	0	1	0	1
2012	12,269	0	1	1	2
2013	12,115	1	0	1	4
2014	12,085	0	1	4	6

Table 4. Raw data summary of crime volume in Warren, Ohio from 1995-2014.

Violent Crime in Warren, Ohio					
Year	Population	Murder and Non-negligent manslaughter	Forcible Rape	Robbery	Aggravated Assault
1995	No Data Collected				
1996	No Data Collected				
1997	No Data Collected				
1998	No Data Collected				
1999	No Data Collected				
2000	No Data Collected				
2001	46,916	4	25	148	220
2002	47,113	5	38	110	245
2003	47,285	6	32	153	177
2004	46,703	7	55	171	177
2005	No Data Collected				
2006	No Data Collected				
2007	44,858	6	48	191	263
2008	43,809	3	39	167	183
2009	43,331	7	18	137	147
2010	42,850	4	22	123	113
2011	41,587	5	28	84	141
2012	41,355	4	16	102	157
2013	40,474	7	24	128	104
2014	40,592	2	29	87	63

Table 5. Raw data summary of crime volume in Youngstown, Ohio from 1995-2014.

Violent Crime in Youngstown, Ohio					
Year	Population	Murder and Non-negligent manslaughter	Forcible Rape	Robbery	Aggravated Assault
1995	92,179	66	62	650	791
1996	92,360	61	62	410	824
1997	92,467	42	73	390	1,006
1998	86,890	46	49	414	606
1999	85,006	29	34	353	472
2000	83,466	32	40	358	537
2001	82,173	34	52	355	570
2002	82,518	33	54	298	574
2003	80,128	19	60	286	403
2004	79,432	23	62	275	372
2005	77,747	34	60	347	476
2006	82,938	32	48	358	555
2007	81,521	42	51	277	442
2008	72,887	29	34	252	418
2009	72,008	22	41	317	476
2010	71,380	25	28	235	406
2011	67,031	17	29	205	368
2012	66,567	22	39	244	379
2013	64,938	14	26	168	318
2014	64,669	14	34	132	244