Homicide Epidemic in Cali, Colombia: A Surveillance System Data Analysis, 1993–2018

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Objectives. To examine homicide rates in Cali, Colombia, during the 1993–2018 period, using information derived from an interagency surveillance system.

Methods. We used homicide data from Cali's Epidemiological Surveillance System to examine homicide trends by victim's age and sex, time, and type of method used. We estimated trend changes and the annual percentage changes using joinpoint regression analyses.

Results. Homicide rates per 100 000 inhabitants dropped from 102 in 1993 to 47.8 in 2018. We observed reductions in homicide rates across age and sex groups. Most homicide victims were men aged 20 to 39 years from poor, marginalized areas. Firearms were used in 84.9% of all cases. The average annual percentage change for the entire period was −3.6 (95% confidence interval = −6.7, −0.4).

Conclusions. Fluctuations in homicide rates in Cali show a clear epidemic pattern, occurring concurrently with the "crack epidemic" in different countries. Reliable and timely information provided by an Epidemiological Surveillance System allowed opportune formulation of public policies to reduce the impact of violence in Cali. (*Am J Public Health*. Published online ahead of print June 10, 2021:e1–e8. https://doi.org/10.2105/AJPH.2021.306254)

Cali, the third largest Colombian city by number of inhabitants, has experienced significant fluctuations in homicide rates in the past 3 decades. According to analysis of death certificates issued by the Colombian Institute of Legal Medicine and Forensic Sciences (IMLCF; Spanish acronym) carried out by the Municipal Secretariat of Health of Cali, the homicide rate per 100 000 people quadrupled from 23 in 1983 to 93 in 1992; during this period, homicides became the first cause of general mortality, surpassing ischemic cardiovascular diseases and contagious diseases.[1]

In 1993, Cali adopted the public health method for violence prevention.[1,2] The public health method required reliable and opportune information about violent events, which were provided by an Epidemiological Surveillance System (ESS), an interinstitutional committee (*Comité Interinstitucional de Muertes por Causa Externa*) created to resolve the notorious discrepancies among the homicide databases from the police, the attorney general's office, and the IMLCF.[3] Since 1993, representatives of these 3 institutions meet once a week to discuss all violent deaths occurring in Cali in the previous week. This process validates and consolidates the data from these sources while it collects information about victims, and when, how, and where events occurred. The ESS approach collects similar information to that collected by the US National Violent Death Reporting System on violent deaths.[4] The ESS model, with the name of Observatories of Crime/Violence, has spread to other countries in the Americas.[5]

Using information from the ESS, Concha-Eastman et al.,[6] analyzed sociodemographic characteristics and homicide trends in Cali from 1993 to 1998 and found a reduction in homicide rates per 100 000 inhabitants from 124 in 1994 to 86.1 in 1997; the authors found that low-income men aged 20 to 34 years were the most affected and that homicides were more frequently occurring on weekend nights and were associated with alcohol consumption

and use of firearms.[6] Also using data from the ESS, Fandiño-Losada et al. found that Cali experienced a substantial reduction in homicide rates from 2012 to 2015, mainly attributable to reductions in organized crime–related homicides.[7] However, despite this evidence, little is known about the trend in homicide rates in Cali over time and the potential factors influencing these rates.

With this study, we aimed to descriptively specify the homicide rate in Cali, overall and by subgroups, to examine trend changes over time, and to describe policies and contextual factors that could be linked to changes in homicide rates, using data from the Cali ESS from 1993 to 2018.

METHODS

We included all homicides that occurred in Cali between January 1, 1993, and December 31, 2018, within the urban and rural perimeter of Cali, regardless of whether the victims were residents of the city. For those who died after being injured, we recorded the date of initial injury. We did not include homicides in which the initial injury occurred outside of Cali.

Initially, homicides were recorded by the working group of the Development, Security, and Peace Program,[1] which was part of the mayor's office. Since 1993, homicides are recorded weekly by the Cali ESS with information provided by the institutions that are primary sources of data: the attorney general's office, the national police, and the IMLCF. Weekly meetings are also joined by a member of the Municipal Secretariat of Public Health and a member of the Cisalva Institute (Violence Prevention Research Institute from Universidad del Valle). Figure A (available as a supplement to the online version of this article at http://www.ajph.org) describes the institutions and the

type of data shared during the ESS weekly meetings. We obtained data from Colombia for 1993 to 2018 from the national official publication from the National Department of Statistics,[8] which regularly collects information from death certificates from all municipalities classified in accordance with the *International Classification of Diseases, 10th Revision*.[9]

We standardized rates by using the direct method and the average world population between 2000 and 2025 as reference.[10] We calculated adjusted rates with the Tiwari et al. 2006 method.[11] We used the Joinpoint Regression Program (version 4.8.0.1; Statistical Research and Applications Branch, National Cancer Institute, Rockville, MD) to describe trends over time. The software estimates a series of permutations with differing inflection points and determines the model with the best fit based on permutations tests or the lowest Bayesian information criterion score.[12] We calculated the annual percentage change (APC) for trends between joinpoints, and we calculated the average APC for the overall trend for the entire study period. We conducted a spatial analysis by using ArcGis (release 10; Environmental Systems Research Institute, Redlands, CA) to describe the neighborhoods with highest number of homicides in specific years.

RESULTS

Between 1993 and 2018, there were 45 819 homicides in Cali, with an average of 1762 per year and 4.8 per day. There was an overall decreasing trend of homicide rates over the study period (53.2% reduction). However, there were 2 periods in which homicide rates increased: from 1998 to 2003 (APC = 3.35) and from 2006 to 2012 (APC = 3.63; Figure 1). The APC in homicide rates for the periods between

trend-change points is presented in Table 1. The average APC for the entire period was −3.6 (95% confidence interval [CI] = −6.7, −0.4).

Colombia's homicide rate showed similar fluctuations to those in Cali, with a decreasing trend for most of the period (69.1% reduction) and a period when the trend changed from 1997 to 2002 (with a 28.6% increase in homicides). Throughout the study period, the rates in Cali were higher than those in Colombia (Figure B, available as a supplement to the online version of this article at http://www.ajph.org).

Homicides by Age and Sex Groups

We observed significant reductions in homicide rates of 47%, 57%, and 68% for the groups aged 20 to 29, 30 to 39, and 40 to 49 years, respectively; in the group aged 10 to 19 years, rates were more stable, staying above 85 per 100 000 inhabitants for most of the years (Figure 2). The group aged 20 to 29 years had the highest homicide rate throughout the study period; on average, this group had 2.5, 2.1, and 1.5 times the rate of the groups aged 30 to 39, 10 to 19, and 40 to 49 years, respectively. After 2013, all age groups experienced reductions in their homicide rates. In the groups aged 50 to 59 and 60 to 69 years, we also observed reductions of 71% (from 69.4 to 19.6 per 100 000) and 45% (from 25.4 to 14.0 per 100 000; not shown in Figure 2).

Regarding the sex of the victim, 93.5% (42 848) of the deceased were men. The male-to-female ratio was 14.5 to 1 (Table A, available as a supplement to the online version of this article at https://www.ajph.org, shows the number of homicides per year by sex). Reductions were of similar magnitude in males (58%) and females (53%). Figure 3 shows the trends for males and females.
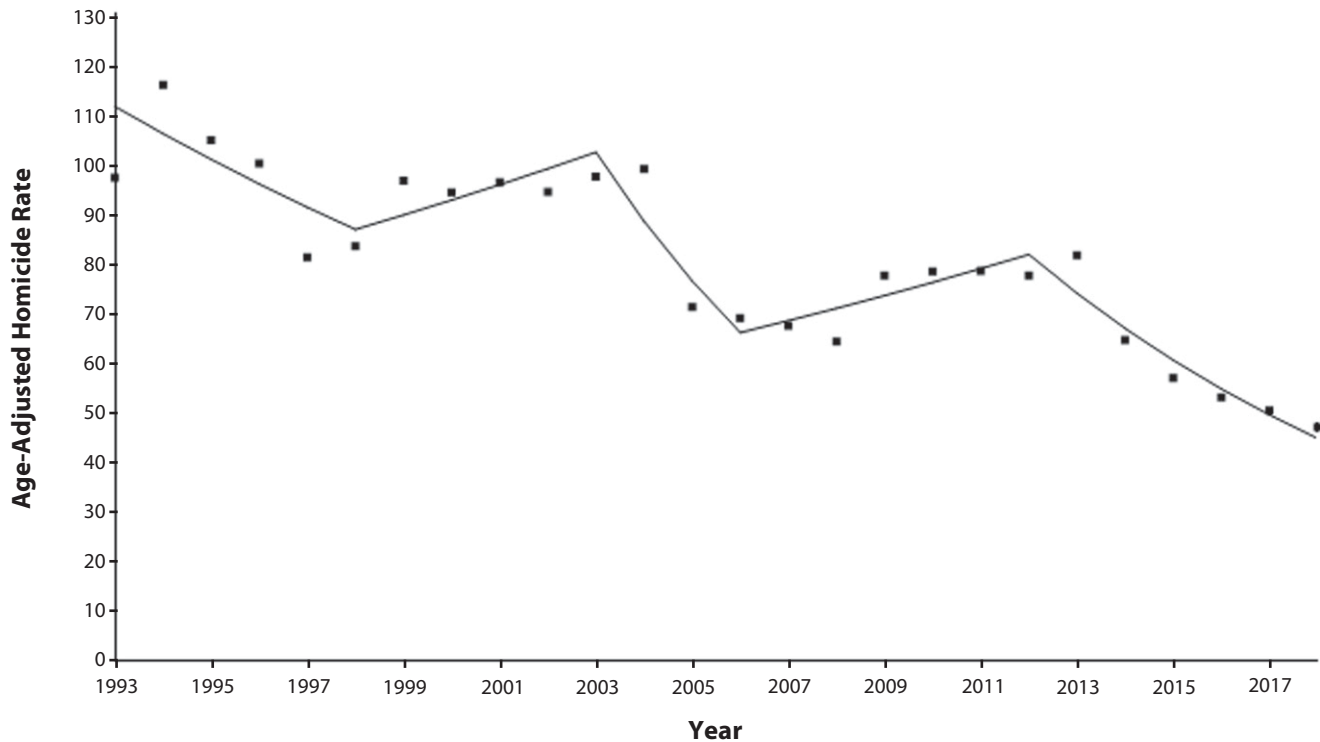
FIGURE 1— Age-Adjusted Homicide Rates: Cali, Colombia, 1993–2018

Note. 1993–1998 annual percentage change (APC) = −4.9 (*P* < .05); 1998–2003 APC = 3.35; 2003–2006 APC = −13.6; 2006–2012 APC = 3.63; 2012–2018 APC = −9.58 (*P* < .05). Lines represent modeled trends via joinpoint regression.

Homicides According to Month, Day, and Time

The daily average of homicides for the entire period was 4.8. A decreasing trend was observed in the daily average of homicides, from 5.0 in 1993 to 3.2 in 2018. December and February had the highest and lowest numbers of homicides per day on average (5.7 and 4.5 homicides per day, respectively).

Sunday and Saturday (7.6 and 5.5 homicides, respectively) had, on average, the highest number of homicides, and Tuesday and Wednesday had the lowest number of homicides (3.9 and 4.0 homicides, respectively). There were 259 Mondays that were holidays during the study period; the average number of homicides on Mondays that were holidays was higher than on nonholiday Mondays (4.9 homicides and 4.1

homicides, respectively). For both males and females, the highest proportion of homicides occurred on Sundays; the odds of dying on a Tuesday (odds ratio [OR] = 1.52; 95% CI = 1.33, 1.73) or Thursday (OR = 1.46; 95% CI = 1.28, 1.67), compared with Sunday, were higher among females than among males.

A total of 41% of homicides occurred between 18:00 and 23:59, and 23% occurred between 00:01 and 06:00. For most days of the week, the hour with the highest number of homicides was between 20:00 and 20:59 (9.8%). The lowest number of homicides was observed between 07:00 and 07:59 (2.1%). This tendency was observed throughout the study period.

Multiple Homicides

A multiple homicide was defined as 3 or more people killed in a single event. In

Cali, multiple homicides are often the product of retaliations between organized crime gangs (as evidenced from the information provided by data primary sources in ESS meetings). According to information (available only as of 2007) the distribution of multiple homicides was as follows: 2 events with 8 homicides, 1 with

TABLE 1— Trends in Homicides in Cali, Colombia: 1993–2018

Period	Change Year	APC (95% CI)
1993–1998	1998	−4.9* (−9.1, −0.5)
1998–2003	2003	3.35 (−2.9, 10.0)
2003–2006	2006	−13.6 (−32.9, 11.2)
2006–2012	2012	3.63 (−1.0, 8.5)
2012–2018		−9.58* (−12.8, −6.2)

Note. APC = annual percentage change; CI = confidence interval.

*P < .05.
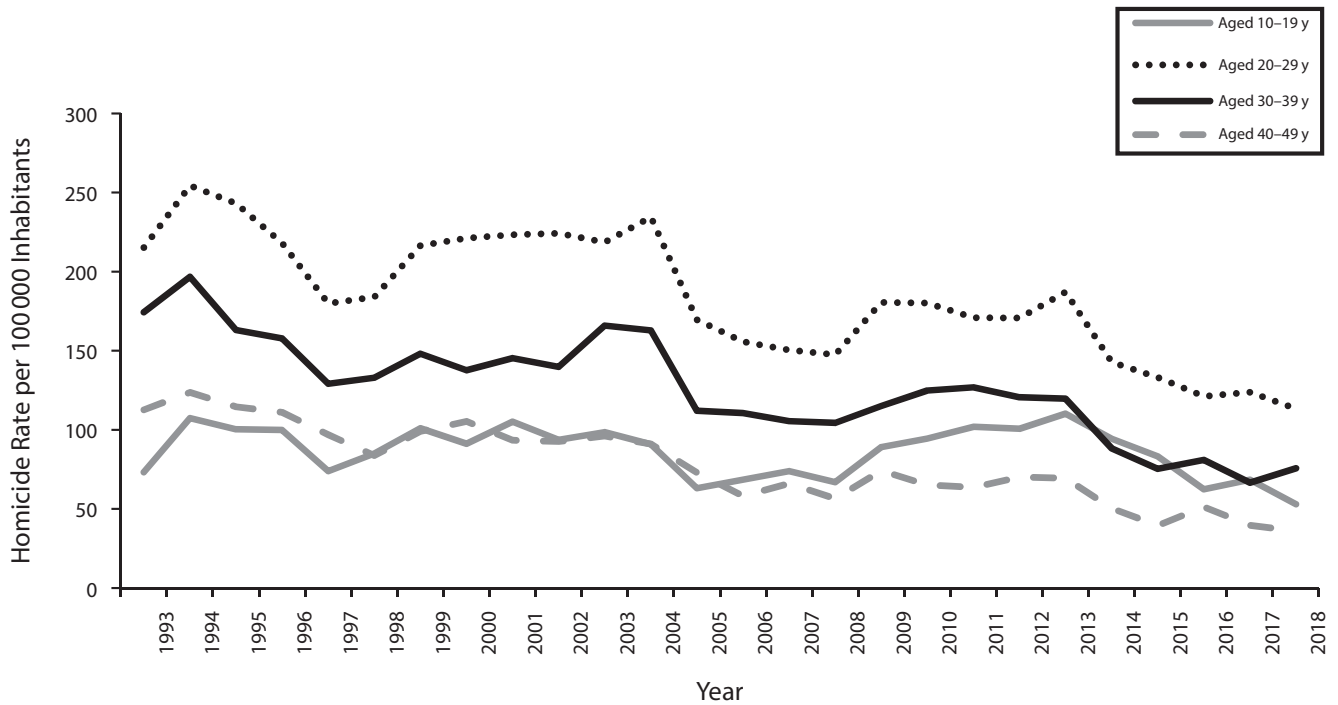
FIGURE 2— Homicide Rate per 100 000 People in Cali, Colombia, by Age Groups: 1993–2018

Source. Cali Epidemiological Surveillance System (1993–2018).

7 homicides, 1 with 5 homicides, 60 with 4 homicides, and 168 with 3 homicides. The year with the highest frequency of multiple homicides was 2012 (11 events with 3 homicides and 3 events with 4 homicides, for a total of 45 homicides). From 2015 to 2018 there were 2, 5, 1, and 3 multiple homicides per year. December was the month and Sunday the day with the highest number of multiple homicides.

Homicides by Weapon Used

Of all homicides, 84.9% were perpetrated with a firearm, and 12.3% with knives or similar bladed instruments. Figure C (available as a supplement to the online version of this article at http://www.ajph.org) shows that both firearm homicide (left margin) and knife homicide rates (right margin) decreased approximately by half during the study period. Starting in 2013, the knife homicide rate increased slightly while the firearm homicide rate continuously decreased until 2018. The odds that a homicide was committed with a knife (i.e., knife vs firearm) were higher in females than males (OR = 1.41; 95% CI = 1.27, 1.56).

The proportion of homicides committed with knives was higher on Sundays (17.2%) and lower on Wednesdays (12%); it was also higher in the early morning (00:00–05:59; 19.1%), and lower at night (18:00–23:59; 10%).

Homicide Rates by Commune

Figure D (available as a supplement to the online version of this article at http://www.ajph.org) shows the distribution of homicides in Cali in 2004, 2011, and 2018. Homicides tended to accumulate in areas of marginalization and more recent development in the east and southeast of Cali. For example, 35.5% of all homicides were concentrated in the Aguablanca District (communes 13, 14, 15, and 21) and adjacent commune 16, 8.7% in downtown communes 3 and 9, 10.2% in communes 18 and 20 (in the western part of the city), and 5.8% in commune 6 (located in the north), all areas at economic disadvantage.

DISCUSSION

Cali specifically and Colombia generally experienced a drastic increase, considered an epidemic, in homicide rates from the early 1980s until the early 1990s, associated with the increase in drug trafficking and cocaine production,[13] the presence of drug cartels and guerrilla groups,[14] and the emergence of paramilitary groups.[15–18]
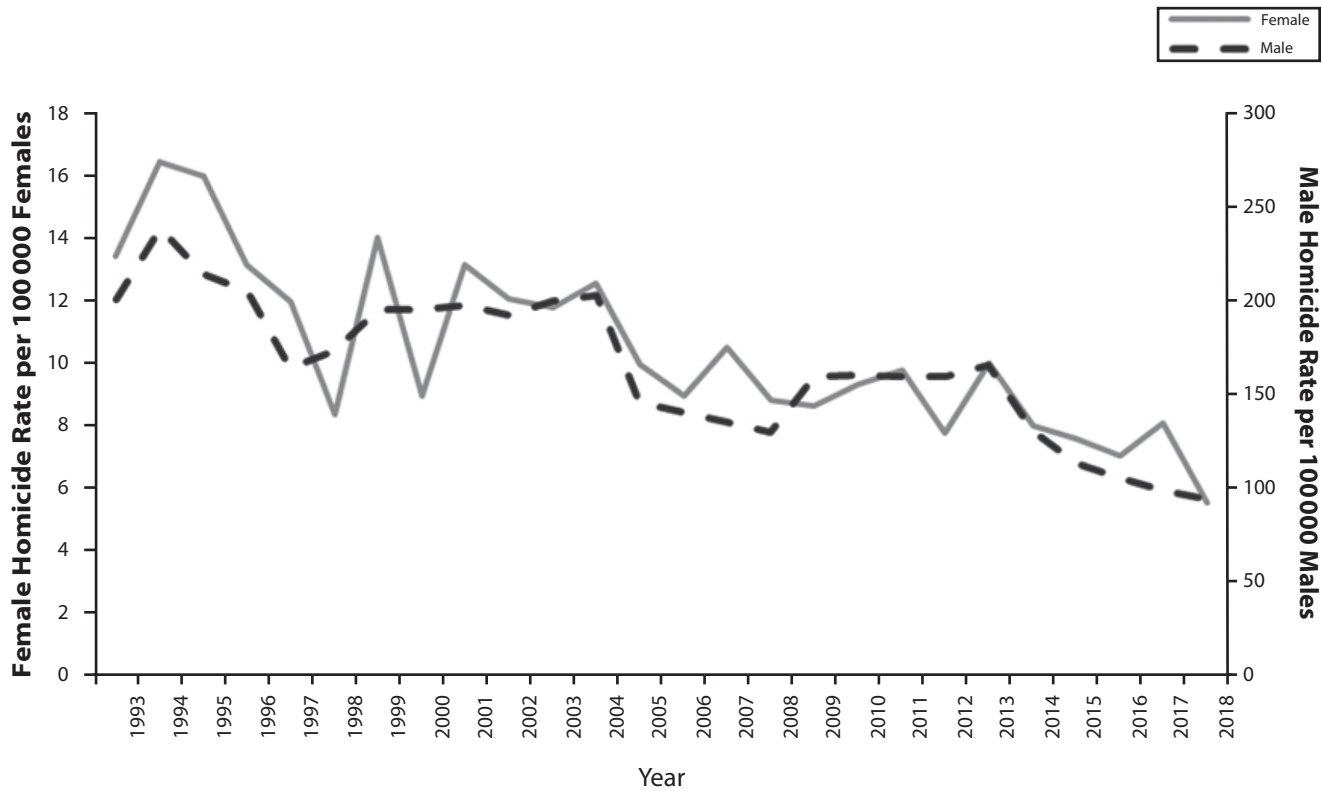
FIGURE 3— Homicide Rate per 100 000 People in Cali, Colombia, by Sex: 1993–2018

Source. Cali Epidemiological Surveillance System (1993–2018).

Cali and Medellín were the Colombian cities most affected by the 2 largest drug trafficking cartels and the confrontation between them: the Medellín cartel, led by Pablo Escobar, and the Cali cartel, led by the Rodríguez Orejuela brothers. Homicide rates per 100 000 increased to 390 in Medellín and 124 in Cali in 1992. By contrast, Bogotá, which did not have such a strong presence of drug cartels, had a homicide rate of 80 per 100 000 in 1992.[8] The increases in homicide rates in Colombian cities are similar to those observed during the 1980s in some large cities in the United States and in other cities in Latin America, such as São Paulo, Brazil.[19] These increases in homicide rates were also found to be associated with the trafficking and use of crack cocaine across communities at economic disadvantage.[20] In Cali, homicide victims

were mostly young adult males from disadvantaged areas, who, compared with females and older adults, usually participated more in street gangs or in organized crime and drug trafficking. This is similar to what has been observed in other countries.[19,21,22]

The reduction of homicide rates observed in Cali and in Colombia since 1994 is likely explained, at least in part, by the reforms undertaken by the central government at the beginning of the 1990s, such as the ones in the national police and the judicial system, and also the strengthening of the armed forces, which led to the dismantling of the Cali and Medellín cartels, and resulted in reaching a peace agreement with the guerrilla group M-19 in 1994.[23] Also, data from the Cali ESS provided timely information on the disproportionately

high numbers of firearm homicides during weekend nights in Cali. This information was used by the city mayor's office, in coordination with the metropolitan police, to implement legislation forbidding citizens to carry firearms on selected weekends that were associated with high alcohol consumption and violence (e.g., weekends after semi-monthly paydays, holidays, and Mother's Days). The city also implemented a policy restricting alcohol sales in public places after 2 AM and on Sundays, periods associated with higher frequency of homicides associated with quarrels and interpersonal problems linked to alcohol consumption.[24] The legislation suspending carrying permits, implemented from November 1993 and throughout 1994, was associated with a 14% reduction in homicides in Cali.[24] Female homicides

also decreased in Cali since 1994, likely in response to these interventions, given their influence on alcohol consumption and use of firearms among violent partners. A few months later, similar legislation implemented in Bogotá showed similar reductions in homicides.[24]

Cali experienced an increase in homicide rates from 1998 to 2003 that was also accompanied by increases in kidnappings.[18] This increase has been attributed to the strengthening and reorganization of guerrilla and paramilitary groups that operated mostly in rural areas but also in many urban areas.[18] From 2003 to 2006, homicide rates declined in Cali and in the rest of Colombia. This reduction in homicides has been attributed, at least in part, to the increased number of military operations against FARC (*Fuerzas Armadas Revolucionarias de Colombia*) and paramilitary groups, and the Demobilization, Disarmament, and Reintegration program offered to paramilitary organizations in 2004.[25] Some of these actions were supported by United States, mainly through the Plan Colombia,[25] a plan with the goal of reducing illicit coca crops, improving economic and social justice, and reducing violence in Colombia.

From 2006 to 2012, homicide rates in Cali once again increased, and the data from the ESS indicated that more than 50% of homicides were mainly related to newly organized criminal groups[7] (data not shown). Cali received support from the national police and from specialized groups from the National Colombian Intelligence Agency and the National Prosecuting Agency to develop intelligence-based actions to identify criminal organizations, their operations, and members, and to prosecute and dismantle these organizations. As a result, from 2012 to 2015, a total of 322 criminal organizations were dismantled

with an estimate of 60% of their members being sent to prison.[7] Homicide rates in Cali declined during this period mainly because of reductions in organized crime–related homicides.[7] There was also a reduction in multiple homicides, which, as mentioned before, are usually the result of unsettled issues and revenge attacks between organized criminal groups.[7] There was a simultaneous slight increase in knife homicides in this period, which can be interpreted as a partial substitution in the type of method.

Additional reductions in homicide rates since 2015 can be partly attributed to the firearm carrying ban in the national territory (since December 2015 onward), the ceasefire and peace agreement with FARC in 2016, and also the improvement in socioeconomic conditions in recent years.[26]

Spatial analysis of homicides indicates a higher concentration of homicides in low-income neighborhoods, where there is usually greater presence of criminal bands and street gangs. Reductions in homicides in Cali since 2013 could also be linked to social interventions implemented in the city. In 2012, Cali designed and implemented the TIO (Territories of Inclusion and Opportunities) project to direct resources in the poorest neighborhoods to improve social and economic conditions in these areas.[27] The project has improved neighborhood conditions through the development of school facilities and early childhood development centers, improving illumination in parks and alleys to increase safety, increasing access to potable water, and improving road conditions. Also, since 2016, Cali implemented a street gang transformation program that favors inclusion and citizen participation and offers job and educational opportunities and skill development to youths involved

in street gangs. The ESS data showed significant reductions (around 80%) in the number of gang-related homicides in targeted communities.[28] This is an important outcome given the previously reported 100% increase in gang-related homicides from 2012 to 2015 in Cali.[7]

Limitations

This study has some limitations. First, the ESS does not regularly characterize homicides according to variables such as the blood alcohol concentration levels of the victim or the aggressor. Missing data on the aggressor, which could be as high as 40% during specific periods (e.g., 2000–2011),[7] also prevent us from examining homicide trends based on categories of homicide types. Currently, the ESS has implemented actions to improve the quality of the data on alcohol and causes of homicides, and it is expected that this information may be incorporated into other studies in the future. Second, the aggregated nature of our analysis limits us from making clear causal statements about the link between legislation and homicide trends.

Public Health Implications

The public health method applied in Cali has been a key tool to improve the quality of homicide data from primary sources and to generate and evaluate policies for the prevention of homicides in Cali. The increase in homicides in Cali since the early 1980s, in addition to being clearly in excess of previous numbers, occurred in a short period, suggestive of a true epidemic.[29] Furthermore, the speed with which they occurred allows us to postulate that those changes are attributable to external causes rather than to a genetic component in this population, whose changes are noticeable in the long

term.[30] The similar, almost parallel, oscillations in Cali and Colombia suggest the presence of common factors. The multiple actions to fight crime and prevent homicide rates in Cali and Colombia seem to have worked to certain extent, as the 2018 homicide rate in Cali was 47.8 per 100 000, the lowest in the past 25 years. However, Cali is still ranked 28th among the cities with the highest homicide rate in the world.[31] Future local administrations must continue working in violence prevention strategies using the ESS data and also developing new methods that can improve the quality of homicide data to better understand the dynamics of homicides in the city. AJPH

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PUBLICATION INFORMATION

CONTRIBUTORS

R. Guerrero-Velasco and J. Santaella-Tenorio developed the design and conceptualization of the study, interpreted the results, and wrote the original draft of the article. V. H. Muñoz and J. Santaella-Tenorio collected and analyzed the data. A. Concha Eastman, A. J. Pretel-Meneses, and M. I. Gutiérrez-Martínez contributed to the interpretation of results and helped draft the article.

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CONFLICTS OF INTEREST

HUMAN PARTICIPANT PROTECTION

Ethics approval was not needed for this work because it used secondary, de-identified data.

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