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ORIGINAL RESEARCH

Football Events and Their Association with Interpersonal Violence Deaths

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ABSTRACT

Background: Major sporting events are associated with violence, creating societal and healthcare system burdens. However, these associations have not been objectively evaluated in low- and middle-income countries, where resources for violence prevention and injury control are limited. The objective of this study was to determine whether the days of football events were associated with changes in homicide rates in Cali, Colombia.

Study design: Ecologic study conducted during 2005 to 2008 using a time-series design. Football days were those in which the city's professional teams or the national team played nationally or internationally (279 days). Daily counts of homicides were obtained from the city's fatal injury surveillance system. Homicide rates were computed using population estimates to adjudicate person-years of exposure. In stepwise conditional autoregressive negative binomial regressions adjusted for victims' demographics, known sociopolitical and cultural factors, weekends, holidays, trends and seasonality, homicide rates during football days were compared against homicide rates during non-football days.

Results: There were 1,352 homicides during football days and 4,767 homicides during non-football days (rate, 82 and 68 per 100,000 person-years respectively, $p < 0.001$). There was an increased risk of homicides during home game days (IRR 1.11, 95%CI 1.01-1.21, $p = 0.022$) compared to non-football days. There was an increased risk of homicides during the day after football game (IRR 1.08, 95%CI 1.00-1.16, $p = 0.041$) compared to other days. The outcome of the games was not statistically significantly associated with increased risk of homicides.

Conclusion: This analysis suggests that football days were associated with increased risk of homicides in Cali, Colombia. Violence prevention and injury control efforts should be increased on days of home games and on the next day after football. The healthcare system should allocate and optimize resources these days, given the increased demand for trauma care. Educational and preventive civic interventions should be instituted around these events.

Keywords: Sporting events, Football, Interpersonal violence deaths, Homicides, Cali, Colombia, Ecologic study, Time series, Autoregressive negative binomial regression.

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RESUMEN

Antecedentes: Los eventos deportivos están asociados con la violencia y la consiguiente carga social y de los sistemas de salud. Sin embargo, estas asociaciones no han sido evaluadas objetivamente en países de bajos y medianos ingresos, donde los recursos para la prevención de violencia y control de lesiones, son limitados. El objetivo de este estudio consistió en determinar si los días de partidos de fútbol se asociaron con cambios en las tasas de homicidios en Cali, Colombia.

Métodos: Estudio ecológico realizado durante 2005-2008 utilizando un diseño de series de tiempo. Se definió días de fútbol en los que los equipos profesionales de la ciudad o el equipo colombiano jugó nacional o internacionalmente (279 días). El conteo diario de homicidios se obtuvo del sistema de vigilancia de muertes por lesiones de causa externa de la ciudad. Las tasas de homicidio fueron calculadas usando estimaciones de población para adjudicar personas-año de exposición. En regresiones binomiales negativas con términos auto-regresivos y ajustadas por características demográficas de la víctima, factores socio-políticos y culturales, fines de semana, días festivos, tendencias y estacionalidad, la tasa de homicidios durante los días de fútbol se compararon con la tasa de homicidio durante días sin fútbol.

Resultados: 1.352 homicidios ocurrieron durante los días de fútbol y 4.767 durante días sin fútbol (Tasa, 82 y 68 por 100.000 personas-año, respectivamente, $p<0,001$). Hubo un aumento en el riesgo de homicidios durante los días de partido en casa (IRR 1,11, IC 95% 1.01-1.21, $p = 0,022$) en comparación con los días sin fútbol. Hubo un aumento en el riesgo de homicidios durante el día después de partido de fútbol (IRR 1,08, IC 95% 1.00-1.16, $p = 0,041$) en comparación con otros días. El resultado de los partidos no fue estadísticamente asociado con un mayor riesgo de homicidios.

Conclusiones: Este análisis sugiere que los días de fútbol se asociaron con un mayor riesgo de homicidios en Cali, Colombia. Las actividades de prevención de violencia y control de lesiones se deben aumentar en los días de partidos en casa y al día siguiente después del partido. El sistema de salud debe asignar y optimizar los recursos en estos días, debido a la mayor demanda de atención en trauma. Se deben implementar intervenciones cívicas educativas y preventivas en torno a estos eventos.

Palabras claves: Eventos deportivos, Fútbol, Muertes por violencia interpersonal, Homicidios, Cali, Colombia, Estudios ecológicos, Series de tiempo, Regresión binomial negativa auto-regresiva.

INTRODUCTION

Major sporting events are associated with aggression and violence and are known to increase emergency services demands.[1,2] Football games in the United States (US) are associated with increased domestic violence reports and emergency department (ED) admissions of women.[3,4] Rugby

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and football games in England are associated with aggression and increased alcohol drinking and assaults resulting in ED treatment.[2,5] Sporting events may not only affect the local vicinity of the event, particularly when teams play away or internationally.[1,2] In England, when the national football team played in another country, there was a nearly three times increase in assaults requiring ED treatment.[6,7]

The region of the Americas is the second most violent region in the world, with a homicide rate of 15.6 cases per 100,000 population, more than double the world's average (6.9 cases per 100,000 population).[8] Among this region, homicide rates are not homogeneous; Central and South America have considerably higher homicide rates than North America.[8] A comparison of the distribution of homicide rates in Central and South America countries to global rates placed Colombia in the category of 'very high'.[9] Despite a recent declining trend in Colombia's homicide rate, homicide remains a primary public health problem with the majority of interpersonal violent deaths concentrated in the country's largest cities.[10-12]

Football is a major sporting event in Colombia and, to our knowledge, its association with interpersonal violence has not been objectively evaluated. To balance the scarcity of resources available for violence prevention and injury control, a detailed understanding of the incidence of interpersonal violence is required, especially during events that can cause large fluctuations. This could further contribute to the design of better prevention and control strategies. In addition, this can aid in resource planning and in providing the subsequent ability to maintain healthcare performance and patient care.[1] The objective of this study was to determine whether the days of football events were associated with changes in homicide rates in Cali, Colombia, during 2005 to 2008.

METHODS

Study Design

This ecologic study was conducted in Cali, Colombia, between January 1, 2005 and December 31, 2008. During these 1,461 days, the city's two professional football teams and the national football team played nationally and internationally. These games occurred intermittently throughout the entire study period; therefore, a time-series design was used to compare days with and without football events. Aggregated daily count of interpersonal violence deaths were obtained from the city's fatal injury surveillance system. Mortality rates were computed using population estimates to adjudicate person-years of exposure. Stepwise conditional autoregressive negative binomial regressions with backward elimination were used to compare mortality rates between days with and without football.

Settings

Cali is the third largest city of Colombia, its population estimates increased from 2,119,908 in 2005 to 2,194,695 in 2008.[13] Homicide rates increased from 23 to 92 cases per 100,000 population from 1983 to 1992 and became the city's leading cause of death. In 1993, a fatal injury surveillance system was developed by the city's Mayor.[14,15] The development of this multi-institutional effort has shown some benefits.[12,16] Cali has experienced a reduced trend in homicide rates during the last decade.[17] However, Cali has continued reporting high homicide rates, from 75 cases per 100,000 population in 2005 to 67 cases in 2008; the highest among Colombia's largest cities and approximate two times the country's homicide rates (40 cases per 100,000 population in 2005 and 34 cases in 2008).[17]

Study Data

The city's fatal injury surveillance system is coordinated by the Mayor's office and composed of diverse governmental entities.[14] The system collects demographic and injury-related information of all deaths from external causes, including homicides, suicides, traffic deaths and unintentional injury deaths. De-identified information on demographics (age and sex) and injury characteristics (intent, mechanism, place and date of injury) was requested. Information was analyzed only when the injury that caused the death occurred in the urban and rural areas of Cali and between January 1, 2005 and December 31, 2008. Football information was obtained from archives of public media announcement.

Football Events

The Colombian professional football league is the country's primary competition for association football clubs. Each calendar year, the league is divided in two seasons; from February to June and from July to middle December. Home and away games are played during weekday evenings and weekend afternoons. Winners of each season and the team with the most points at the end of the year qualify for an annual continental competition. This runs from January to July and home and away games are played during weekday evenings. Between 2005 and 2008, there were two teams from Cali that participated continuously in the league. In addition, one team in 2005 and the other team in 2006 reached the continental competition.

The national football team participated in the 2006 and 2010 World Cup qualification rounds, playing home-and-away games in March, June, September, and October of 2005 (seven games); October and November of 2007 (four games); and June, September, and October of 2008 (six games). None of these games were played at Cali. Colombia

did not participate in the 2006 World Cup. Colombia participated (three games) in a continental competition that took place in Venezuela in June/July of 2007.

Football days were defined as those in which the city's two professional football teams or the national football team played nationally or internationally between January 1, 2005 and December 31, 2008 (279 days). Home game days were defined as those in which the city's two professional teams played locally (182 days). There were 143 days in which the city's two professional teams or the national team won a game.

Outcome Measure

Aggregated daily counts of interpersonal violence deaths (homicides) were abstracted from the city's fatal injury surveillance system. Interpersonal violence death or homicide is defined as any intentional killing of a person by another, regardless of the method.[18] Deaths that were self-inflicted, in traffic events and defined as unintentional were not included.

Statistical Analyses

Aggregated daily counts of deaths were collapsed by age groups and sex. Mortality rates were computed using population estimates by age, sex, and year to adjudicate person-years of exposure. The main analyses compared mortality rates during football days against mortality rates during non-football days. Home games and teams' victories have been associated with postgame violence.[2,5] Therefore, mortality rates were compared between days of home games, away games, and non-football and mortality rates were compared between days of winning games, loss/tie games and non-football.

Sixty-five years of age is accepted as a definition of elderly and youths are defined as people between 10 to 29 years of age.[19] Therefore, age was categorized as <10, 10-29, 30-64, and ≥65 years. In Cali, homicide rates are more common on weekends and during holidays.[12,14] Days of the week were categorized into weekdays (Monday to Thursday) and weekends (Friday to Sunday). An additional variable indicated the 72 official holidays decreed by the Colombian government between 2005 and 2008. 'La Feria de Cali' is the city's premier cultural event that is held annually during the end of December and includes bullfights, horse parades and multiple salsa concerts; a new variable indicated its days. In Cali, the mayor of the city is elected to serve a 4-year term. However, between 2005 and 2008, there were four mayors. This was used as a proxy for the sociopolitical context reflecting different government programs that could affect the incidence of homicides by creating dummy variables named administrations. Different policies restricting the hours of alcohol sales and consumption implemented in Cali between 2005 and 2008 were significantly associated with interpersonal violence death rates variations.[20] The effects of these policies were modeled as dummy variables in the analyses.

In order to evaluate the risk of death associated with football days, conditional autoregressive negative binomial regressions were built. These are flexible regression models that use a negative binomial distribution to account for the non-normality and over-dispersion of count data while using an autoregressive structure to account for correlation over time.[21] Some homicides could influence the probability of death in subsequent days (i.e. gang retaliation), therefore, the Bayesian information criterions were used to select the order of the auto-regression; we used lags of 7, 14 and 21 days. Late-night alcohol drinking and violence commonly occur after football events.[1,5,22] This could affect the incidence of homicides the day after football; these days were indicated and included in the analyses. In addition, we accounted for an overall trend during 2005 to 2008 by including two fractional polynomials, and we accounted for seasonality by including a sine-cosine pair with annual periodicity.

Regressions were fitted using Stata (Version 12) software. Covariates were removed in a stepwise manner with backward elimination if the associated regression coefficient had a p-value greater than 0.1. Results are presented as incidence rate ratios (IRR) with 95% confidence intervals (CI) and p-values. This project was reviewed and approved by the institutional review board at the Universidad del Valle in Cali, Colombia.

RESULTS

There were 6,119 homicides in Cali between 2005 and 2008 (Rate, 70.9 cases per 100,000 person-years). Youths between 10 and 29 years had the highest homicide rate among age groups (109.2 cases per 100,000 person-years). Males had higher homicide rates than females (138.7 *vs* 8.8 cases per 100,000 person-years). Homicide rates were higher during weekends than during weekdays (83.2 *vs* 61.7 cases per 100,000 person-years) and during holidays than during non-holidays (85.8 *vs* 70.1 cases per 100,000 person-years). During 'La Feria de Cali' homicide rates were higher than other days (98.1 *vs* 70.5 cases per 100,000 person-years). Homicide rates were higher during the second administration (88.9 cases per 100,000 person-years) and during periods of days when less restrictive alcohol control policies were in effect (92.7 cases per 100,000 person-years) (Table 1).

Table 1: Number of cases and crude incidence rates* of interpersonal violence deaths in Cali, Colombia, during 2005 to 2008

	Person-years of exposure	*Interpersonal violence deaths*	
		Cases	*Rates**
Study period (2005-2008)	8,629,357.0	6,119	70.9
Age of the victim			
Children (<10 years)	1,464,095.0	32	2.2
Youths (10-29 years)	3,102,547.0	3,387	109.2
Adults (30-64 years)	3,214,430.0	2,422	75.3
Elderly (65+ years)	848,285.0	163	19.2
Sex			
Female	4,501,245.0	394	8.8
Male	4,128,112.0	5,724	138.7
Day of the week			
Weekdays	4,932,072.0	3,043	61.7
Weekends	3,697,285.0	3,076	83.2
Holidays			
Non-holidays	8,204,095.0	5,754	70.1
Official holidays	425,261.6	365	85.8
La Feria de Cali			
Non-Feria's day	8,487,603.0	5,980	70.5
Feria's day	141,753.9	139	98.1
Administrations			
First	5,025,777.0	3,695	73.5
Second	83,225.2	74	88.9
Third	1,325,659.0	888	67.0
Fourth	2,194,695.0	1,462	66.6
Alcohol control policies			
Most restrictive	2,215,565.0	1,343	60.6
Moderately restrictive	5,913,404.0	4,312	72.9
Lax	500,388.3	464	92.7
Days of football events			
Non-football days	6,980,942.0	4,767	68.3
Football days	1,648,414.0	1,352	82.0
Away game days	573,506.5	428	74.6
Home game days	1,074,908.0	924	86.0
Loss/tie game days	803,391.8	653	81.3
Winning game days	845,022.7	699	82.7
Day after football games			
Other days	6,980,942.0	4,899	70.2
Day after football	1,648,414.0	1,220	74.0

*Rate per 100,000 person-years

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There were 1,352 homicides during football days and 4,737 during non-football days. Homicide rates were higher during football days than during non-football days (82.0 *vs* 68.3 cases per 100,000 person-years). There were 924 homicides during home game days and 428 homicides during away game days. During days of home games, there were higher homicide rates than during days of away games (86.0 *vs* 74.6 cases per 100,000 person-years). There were 699 homicides during winning game days and 653 homicides during loss/tie game days. During days of winning games, the homicide rates were almost similar during days of winning and loss/tie games (82.7 *vs* 81.3 cases per 100,000 person-years) (see Table 1).

Unadjusted comparisons indicated that, during football days, there was a higher risk of homicide than during non-football days (IRR 1.19, 95%CI 1.11-1.27, $p < 0.001$). During home game days, there was a higher risk of homicide than during non-football days (IRR 1.24, 95%CI 1.15-1.34, $p < 0.001$) and, during away game days, there was not a statistically significantly difference than during non-football days (IRR 1.11, 95% CI 0.99-1.22, $p = 0.074$). During winning game days (IRR 1.19, 95% CI 1.09-1.29, $p < 0.001$) and

Table 2: Incidence rate ratios of interpersonal violence deaths associated with days of football events and the day after the football game in Cali, Colombia, during 2005 to 2008

	Unadjusted analyses		*Regression analyses**	
	IRR (95% CI)	*p-value*	*IRR (95% CI)*	*p-value*
Football *vs* non-football	1.19 (1.11-1.27)	<0.001	1.08 (1.00-1.17)	0.043
Away game *vs* non-football	1.11 (0.99-1.22)	0.074	1.03 (0.91-1.16)	0.628
Home game *vs* non-football	1.24 (1.15-1.34)	<0.001	1.11 (1.01-1.21)	0.022
Loss/tie game *vs* non-football	1.21 (1.09-1.31)	<0.001	1.09 (0.99-1.21)	0.067
Winning game *vs* non-football	1.19 (1.09-1.29)	<0.001	1.06 (0.96-1.18)	0.199
Day after football *vs* other days	1.04 (0.97-1.11)	0.219	1.08 (1.00-1.16)	0.041

IRR: Incidence rate ratio; CI: Confidence interval; *Stepwise conditional autoregressive negative binomial regressions with backward elimination adjusted for age, sex, weekends, holidays, alcohol control policies, day after football, autoregressive term (lag of 14 days), mortality trend, fractional polynomials and sine-cosine pairs with annual periodicity. Covariates 'La Feria de Cali' and administrations were removed from all regressions in the stepwise process ($p > 0.1$).

loss/tie game days (IRR 1.21, 95% CI 1.09-1.31, $p < 0.001$) there was a higher risk of homicide than during non-football days (Table 2).

Regression Analyses

Regressions were adjusted for age, sex, weekends, holidays, alcohol control policies, day after football, autoregressive term (lag of 14 days), mortality trend, fractional polynomials, and sine-cosine pairs with annual periodicity. The covariates 'La Feria de Cali' and administrations were removed in the stepwise process ($p > 0.1$). The adjusted regression analyses indicated that football days were statistically significantly associated with an increased risk of homicides when compared with non-football days (IRR 1.08, 95%CI 1.00-1.17, $p = 0.043$). In addition, day after football were also statistically significantly associated with an increased risk of homicides compared to other days (IRR 1.08, 95%CI 1.00-1.16, $p = 0.041$) (see Table 2).

The adjusted regression analyses also indicated that home game days were statistically significantly associated with an increased risk of homicides compared with non-football days (IRR 1.11, 95%CI 1.01-1.21, $p = 0.022$); during away game days, the risk of homicide was not statistically significantly different than during non-football days (IRR 1.03, 95%CI 0.91-1.16, $p = 0.628$). The risks of homicides during winning game days (IRR 1.06, 95%CI 0.96-1.18, $p = 0.199$) and loss/tie game days (IRR 1.09, 95%CI 0.99-1.21, $p = 0.067$) were not statistically significantly different compared with non-football days (see Table 2).

DISCUSSION

Between 2005 and 2008, the city's two professional football teams and the national football team played nationally and internationally during 279 non-consecutive days. These events were found to be associated with variations in the risk of homicide in Cali during the study period. There was an increased risk of homicides on football days compared with non-football days. The association was even higher when football games were played in Cali. The risk of homicide remained higher the day after the football game compared to other days. The outcome of the game was not associated with interpersonal violence death rate variations.

In time-series analyses, the outcome of interest could be affected by other temporal changes and societal or economic conditions.[21] We address these limitations by including serial correlations, time trends and seasonality terms in our analyses. In addition, we controlled for known socio-political and cultural factors. Football events were played intermittently during non-consecutive days between 2005 and 2008. This provided an opportunity to separate the effect of football events on mortality from other factors' effects. It seems unlikely that unmeasured factors could impact selectively the homicide rate in the same magnitude and direction and following the same temporal pattern of the football events. The exact mechanism in which a football game resulted in variation of the risk of homicide at the individual level was not determined in this study. However, this study attempted to control the determinants of the incidence of homicides in the entire population of Cali as a whole. Ecologic studies testing the effect of exposures on population rates are an important public health approach.[23,24]

Our study results are consistent with studies that link sporting events with violence.[1-7] Football games were associated with increased homicide rates in Cali and the strength of this association was even higher when football games were played at home. Interestingly, the outcome of the game was not associated with interpersonal violence deaths in our study. Previous studies have suggested conflicting associations between the outcome of the game and violent events. A study conducted in Wales indicated that assault injuries resulting in ED treatment were greater when the local team wins, irrespective of the location of the game.[2] Conversely, a study conducted in the US found that upset loses (defeats in which the home team was predicted to

win) were associated with domestic violence after football games.[3]

During sporting events, such as football, crowding increase in and around both stadiums and/or public places. The large number of people attending the events or on public places watching the game indicates a higher likelihood of alcohol drinking, civil disorders and subsequently more violent incidents.[1,2] It could be possible that football games at the event or in public places heightens fans' self-confidence, assertiveness and patriotism, which in turn promotes aggression. Aggression and planned alcohol consumption may not be causally associated but linked by the same underlying cognitive process.[25] Therefore, aggression and alcohol consumption may start even before the football game and could continue regardless of the outcome of the game. In risky environments, it may promote violence and injury.

Our study results are limited to the population of Cali. Whether the findings can be generalized to another society is unknown. To our knowledge, this is the first attempt to examine the association of sporting events with homicide data in a high risk community. Mortality is the best documented form of violence and clearly portrays the magnitude of severe events;[10] however, studies of non-fatal violence have revealed that for every youth homicide there are around 20 to 40 victims of non-fatal youth violence receiving hospital treatment.[19] Studying non-fatal violent injuries could provide a more complete picture of the problem. Finally, societal factors and cultural influences are also important to consider. Football and violence may not have similar associations in places where football and violence and its risk factors are less common. For example, football fans in Denmark are renowned for consuming large amounts of alcohol, a strong risk factor for injury and violence, yet maintaining a cheerful sociability.[26]

CONCLUSION

The study suggests that during the day and the day after of football events, especially at home games, the risk of interpersonal violence deaths in the entire population of Cali was affected irrespective of the outcome of the game. When football games were played away, there was not a significant association with the risk of mortality; nonetheless, it is possible that the risk of non-fatal violent injuries in the population could be affected to the same significant extent as when home games are played. Morbidity data could provide additional information on these regards. These findings are important for community safety. During football days and the day after, violence prevention and injury control strategies should be increased around the vicinity of the game and around public places where people is watching the game on television. Mortality almost certainly underestimates the true burden of interpersonal violence.[19] Therefore, effective emergency medical service systems must develop a plan for resource allocation and optimization during these days to meet the increased demands for trauma care. Educational and preventive civic interventions should be instituted around these events. These could prevent detrimental effects on quality of care and patients' outcomes.

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