

Homicide in children and adolescents: a case-control study in Recife, Brazil

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Objective The homicide rate for children and adolescents in Recife, Brazil, mostly caused by firearms, is one of the highest that has been reported. The present case-control study was designed to identify factors that were potentially modifiable through preventive interventions.

Methods Cases were 255 homicide victims under 20 years of age, who had died in 1997 and been identified at the Institute of Forensic Medicine, Police Department, Recife, and whose relatives were interviewed by two community health workers when they claimed the corpse. The 255 controls were neighbours of the cases, paired by age and sex to them, and identified within one week of identification of each case, and whose relatives were interviewed by a third community health worker.

Findings The overall homicide rate in Recife for under-20-year-olds in 1997 was 49 per 100 000; among males aged 15–19 years it was 324 per 100 000. Firearms were responsible for 97% of deaths. After multivariate logistic regression, history of personal police records (odds ratio (OR) = 18.65; 95% confidence interval (CI) = 1.91–182.50), use of illicit drugs (OR = 7.48; 95% CI = 1.86–30.17), tap water at home (OR = 7.30; 95% CI = 1.80–29.59), and maternal age at birth over 26 years (OR = 3.98; 95% CI = 1.79–8.84) were identified as risk factors, while higher education (OR = 0.22; 95% CI = 0.11–0.43), religious practice (OR = 0.25; 95% CI = 0.10–0.65), and presence of the father in the household (OR = 0.28; 95% CI = 0.09–0.81) were protective factors.

Conclusion Public health authorities should plan preventive interventions based on the findings of this study and should control the acquisition, possession and carrying of firearms.

Keywords: homicide; child; adolescence; risk factors; socioeconomic factors; case-control studies; Brazil.

Mots clés: homicide; enfant; adolescence; facteurs de risque; facteurs socio-économique; études cas-témoins; Brésil.

Palabras clave: homicidio; niño; adolescencia; factores de riesgo; factores socioeconómicos; estudios de casos y controles; Brasil.

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Introduction

Violence is a global problem and mortality associated with it is particularly high in the Americas. In Brazil, for example, external causes are the second leading cause of death overall and the principal cause among those aged 15–19 years, where they account for about 80% of all deaths; homicide is the main cause of death, being responsible for close to 30% of deaths among

this age group, with the vast majority of deaths (93%) occurring among males (1). Between 1977 and 1994 the specific death rate due to homicide increased by 160% nationwide. Firearm-related mortality is particularly high in large urban centres and is alarmingly so in Rio de Janeiro and Recife (2, 3); the highest incidence is reported among males aged 15–19 years, but younger age groups are also seriously affected (4). Such a high rate of homicide and violence is a burden for health and health services (5).

The main cause of violence is poverty, and the reduction of poverty is the most important preventive intervention. But what can be done to reduce homicide among children and adolescents at the moment? The risk factors associated with homicide and violence and potentially effective primary prevention strategies have recently been reviewed in the USA (6), where firearm-related death rates

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among teenagers are up to 20 times higher than those in Europe (7) and are by far the highest among industrialized and upper-middle-income countries (8, 9). But risk factors and preventive strategies differ according to the setting, despite some similarities in violence and homicide rates. The objective of this study was to identify modifiable factors associated with homicide in children and adolescents that could be used for preventive interventions in Recife and possibly other similar areas of Brazil.

Materials and methods

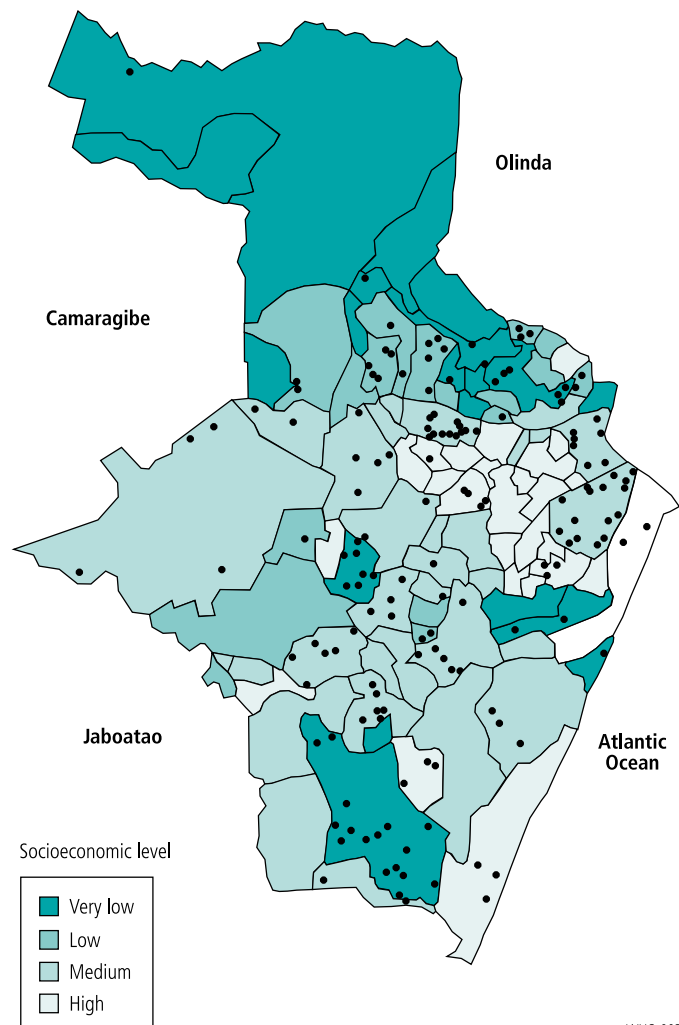
The study was conducted in the city of Recife (population, 1.35 million) in the state of Pernambuco, north-east Brazil. The estimated mid-year population in the age group 0–19 years in 1997 was 518 000. For the present study, the cases were homicide victims under 20 years of age, who had been identified at the Institute of Forensic Medicine (IFM), Metropolitan Police Department, Recife, between 1 January and 31 December 1997. They represent most of the homicide victims among under-20-year-olds in Recife in 1997, since only those corpses that disappear from a murder scene (number unknown but probably low) do not end up at IFM for autopsy. The controls were identified (1:1 ratio with cases) among children and adolescents living in the same neighbourhood as the cases, and were paired by age and sex. In practice, after identifying the residence of a case, the control was the first individual of the same age and sex identified after walking to the right from house to house in the same road up to a maximum distance of 500 m. If no control was found to the right, the procedure was repeated to the left. All controls were identified within one week of identification of each case.

After a pilot phase in late 1996, during which an unsuccessful attempt was made to first interview the relatives of the cases at home and gather data through the police officers at IFM, we concluded that the most reliable data collection tool was an anonymous questionnaire administered by female community health workers. As members of the community trained to deal with common child health problems, these workers are well accepted by families mainly because they share the same language and culture. For the purpose of this study, they were issued white uniforms by the Instituto Materno Infantil de Pernambuco, a well-known non-profit hospital in Recife, to demonstrate that they had no connection with police activities. Two interviewers handed a questionnaire to the closest available relative of each case at IFM on the day the family came to claim the corpse after the autopsy. A third interviewer handed a questionnaire to the closest relative of each control at home. The interviews were conducted after informed consent had been given following a simple explanation of the nature and objectives of the study. During the pilot phase, the interviewers were trained by one of the authors (*G.H.F.*) to administer the ques-

tionnaire. *G.H.F.* also had weekly meetings with the three interviewers until completion of the study, to review the questionnaires and any problem identified during the week.

The questionnaire, pre-tested during the pilot phase, gathered information on demographic and social variables, family structure, health, education, possession and carrying of weapons, use of licit (alcohol and tobacco) and illicit drugs, previous police records, previous episodes of violence within or outside the family, and affiliation to youth gangs. Whenever possible, the reliability of data was checked through direct observation and review of records. During the study, data were entered into a dBase III+ program, and analysed subsequently using EpiInfo and SPSS software; all the cases were plotted on a map of Recife using MapInfo software. A bivariate analysis was carried out first to estimate odds ratios and confidence intervals; statistical differences were analysed using Yates, Pearson and Fisher χ^2 tests. For the multivariate logistic regression analysis, data were recoded, where necessary, into binary variables, except for maternal

Fig. 1. Map of Recife's districts by socioeconomic level and spatial distribution of cases (one dot per case)



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Table 1. **Distribution of variables that were statistically significant in a bivariate analysis**

Variable	Cases	Controls	Odds ratio
	n/N	n/N	
Primary education at least	46/164 (28) ^a	168/216 (78) ^a	0.11; <i>0.07–0.18^b</i>
School attendance	113/146 (77)	202/213 (95)	0.19; <i>0.09–0.38</i>
Unemployment	86/212 (41)	42/210 (20)	2.73; <i>1.77–4.22</i>
Two or more family members employed	135/224 (60)	203/253 (80)	0.37; <i>0.25–0.56</i>
Family income >US\$ 100 per month	130/200 (65)	199/251 (79)	0.49; <i>0.32–0.74</i>
Mother less than 20 years at birth of child	40/173 (23)	85/243 (35)	0.56; <i>0.36–0.87</i>
Mother with primary education at least	62/235 (26)	107/251 (43)	0.48; <i>0.33–0.71</i>
Father with primary education at least	69/230 (30)	98/247 (40)	0.65; <i>0.45–0.95</i>
Foster child	18/227 (8)	5/253 (2)	4.27; <i>1.56–11.70</i>
More than five residents in the household	144/232 (62)	182/246 (74)	0.58; <i>0.39–0.85</i>
Evangelic religion	9/239 (4)	40/255 (16)	0.21; <i>0.10–0.44</i>
No religion	28/239 (12)	2/255 (1)	16.79; <i>3.95–71.29</i>
Practised religion	31/221 (14)	94/245 (38)	0.26; <i>0.17–0.41</i>
Affiliation to a youth gang	42/234 (18)	4/254 (2)	13.67; <i>4.82–38.79</i>
Use of illicit drugs	82/237 (35)	8/253 (3)	16.20; <i>7.63–34.41</i>
Use of illicit drugs in the family	20/241 (8)	4/252 (2)	5.61; <i>1.89–16.67</i>
Involved in drug trafficking	14/229 (6)	5/254 (2)	3.24; <i>1.15–9.15</i>
Alcohol use	115/234 (49)	38/254 (15)	5.49; <i>3.57–8.44</i>
Alcohol use in the family	104/237 (44)	84/254 (33)	1.58; <i>1.10–2.28</i>
Psychiatric disease in the family	15/225 (7)	2/238 (1)	8.43; <i>1.91–37.29</i>
Previous police record	75/239 (31)	4/254 (2)	28.58; <i>10.26–79.65</i>
Previous police record in the family	35/240 (15)	5/255 (2)	8.54; <i>3.28–22.19</i>
Father in the household	111/161 (69)	190/223 (85)	0.39; <i>0.23–0.63</i>
Mother living with the family	188/209 (90)	232/239 (97)	0.27; <i>0.11–0.65</i>
Previous violence in the family	24/244 (10)	7/253 (3)	3.83; <i>1.62–9.07</i>
Tap water at home	200/227 (88)	179/247 (72)	2.81; <i>1.73–4.59</i>

^a Figures in parentheses are percentages.

^b Figures in italics are the 95% confidence intervals.

age, for which quartiles were used, and education, for which three categories were used: lower than primary school, primary school and secondary school or higher. All these variables were entered and re-entered into the logistic regression model using a stepwise method (entry *P* value = 0.25; remove *P* value = 0.1; re-entry *P* value = 0.05) (10).

Finally, after the aggregation of associated variables (e.g., all those related to drugs) and the assignment of a score to each one, a discriminant analysis was performed.

Results

Of the 258 cases identified, three were excluded because their identity and/or residence were unknown. Data from the remaining 255 cases and 255 controls, the great majority of whom were males (95%) aged 15–19 years (93%), were analysed. The youngest case was 2 years of age. The overall calculated mortality rate for homicides among under-20-year-olds in 1997 in Recife was 49 per 100 000; among males aged 15–19 years of age it was 324 per 100 000. Fig. 1 shows the distribution of cases plotted on a map of Recife, with districts classified into four different socioeconomic levels. Cases were spread throughout the year (only four weeks had no cases), with peaks around New Year, Mardi Gras and major religious events. About 57% of homicides occurred at weekends, mostly at night (76%) and in the street (83%). Firearms were responsible for 97% of deaths; 71% of the fatal shots being to the head, and 23% to the chest.

Table 1 shows the distribution among cases and controls of the variables that exhibited a statistically significant difference in the bivariate analysis. There was no significant difference between cases and controls for the following variables: Catholic religion (83% among cases vs 82% among controls), tobacco use (29% vs 24%), tobacco use in the family (36% vs 37%) and adequate excreta disposal (86% vs 89%). More responses were available from controls than from cases. This was due partly to the relationship of the respondent to the case (i.e., the person interviewed was often unaware of or ignored some of the requested information) and partly to the nature of the information. For example, only seven cases and one control admitted to possessing firearms, all of which were acquired on the illegal market, but it is likely that this greatly underestimates the true situation.

Table 2 shows the variables that were independently associated with homicide according to the multivariate logistic regression analysis. There was no significant interaction among variables, and the combined odds ratio (OR) for two or more simultaneously present factors could therefore be calculated as the product of the individual ORs of each factor. For example, an adolescent using illicit drugs and born to a mother who was over 26 years of age had an OR of $7.48 \times 3.98 = 29.77$; the product of a protective and a risk factor compounded the individual effect of each variable. In the discriminant analysis, the questionnaire showed a sensitivity of 79%, a specificity of 87%, a positive predictive value of 1.8% and a negative predictive value of 99.9% for the identification of cases of homicide. For example, use of the questionnaire in a

population of 100 000 with a rate of homicide of 300 per 100 000, which is similar to the rate found in the male study population aged 15–19 years, would identify 240 out of 300 expected cases and result in 60 false-negative and 12 900 false-positive responses.

Discussion

Although the identification of cases among the study population may have been incomplete because some homicide victims might not have ended up at IFM, the estimated homicide rate of 324 per 100 000 males aged 15–19 years is one of the highest that has been reported. The highest rate reported in the USA is 247 homicides per 100 000 among Afro-American males aged 15–24 years in 1990–91 in New York City (11). More commonly, homicide rates among adolescents aged 15–19 years vary between 8.4 and 20.0 per 100 000 (12). Taking into consideration all children and adolescents aged 0–19 years, the homicide rate of 49 per 100 000 in Recife is much higher than the rate reported in Connecticut (6.6 deaths per 100 000 caused by injuries from firearms, of which 68% were homicides) (13). Comparison with the situation in other industrialized countries, such as Italy for example, reveals even wider differences. In Italy, the total mortality rate for adolescents aged 15–19 years in 1994 was 41 per 100 000, with the mortality rate for external causes, including homicide but mainly consisting of traffic and other accidents, being 24 per 100 000 (14).

Many factors have been reported to be associated with violent death in non-war situations: use of drugs (11); race and ethnicity (15); mother unmarried; being a teenager and not having graduated from high school (16); dropping out of school; household without a biological parent; relative or friend shot (17); and affiliation to youth gangs (18). Males are affected more than females in every setting. Exposure to violent television programmes has also been associated with an increased homicide rate (19). Alcohol and tobacco use, illicit drug abuse, and high-risk sexual behaviour in adolescents are all associated with violence (20). Many of these factors were also associated with homicide in the bivariate analysis of this study, but the calculated odds ratios may be either overestimated or underestimated because of differences in the completeness of information between cases and controls.

The multivariate logistic regression model produced four variables as risk factors and three variables as protective factors, some of which have been reported previously (6, 20). The model seems to deviate from intuition for only two of the variables: increase in the risk of homicide with the presence of tap water at home and with maternal age over 26 years at birth. The only plausible explanation for the first of these variables is that the families of cases were actually wealthier than were those of the controls, perhaps because of unreported and non-reportable

Table 2. Variables independently associated with homicide after logistic regression analysis

Variable	β coefficient	Standard error	P-value	Odds ratio
Previous police record	2.9257	1.1638	0.0119	18.65; 1.91–182.50 ^a
Use of illicit drugs	2.0126	0.7726	0.0092	7.48; 1.86–30.17
Tap water at home	1.9874	0.7143	0.0054	7.30; 1.80–29.59
Mother over 26 years at birth of child	1.3806	0.4077	0.0007	3.98; 1.79–8.84
Educational level	–1.5373	0.3536	0.0000	0.22 ^b ; 0.11–0.43
Religious practice	–1.3669	0.4763	0.0041	0.25; 0.10–0.65
Father in the household	–1.2817	0.5487	0.0195	0.28; 0.09–0.81

^a Figures in italics are the 95% confidence intervals.

^b Between subsequent categories ("primary school" to "less than primary school"; "secondary school" to "primary school").

source of income (about 20% of cases' families withheld information on income); wealthier families in a poor neighbourhood would probably tend to have an improved water supply. For the second variable, the likely explanation is that, in this setting, an older mother has more children and a higher probability of having been abandoned by her husband and hence may have less time and resources to devote to the care of her children, including adolescents.

The possession and carrying of weapons is probably an important factor associated with homicide, but we were unable to confirm it in our study because of the low response rate to this question. Laws limiting the diffusion of firearms could probably have an effect on the homicide rate (21). A potentially effective intervention that has been proposed is that paediatricians could provide advice on gun storage (22), but this has not been widely implemented (23). Such an intervention would be very difficult to implement in Recife, where most doctors work in hospitals and clinics and where an extension programme for family and community physicians is just beginning. A better approach would be if interventions on weapon safety awareness, as well as plans to involve children and adolescents in safe and supervised activities (24), were undertaken in Recife by non-medical health workers or the community itself. Community leaders and lay people might be more effective than health professionals in carrying out these tasks and they should at least work in close collaboration with them.

What strategies should therefore be recommended to the government and public health authorities in Recife to reduce the rate of homicide in children and adolescents and the associated level of violence? In addition to control of firearms and community activities for safer neighbourhoods, the results of this study should be taken into account and the following proposals implemented: social assis-

tance should be provided to families of children and adolescents with police records; completion of primary education and further school attendance in deprived areas and among poor families should be encouraged; and programmes to reduce the use of alcohol and illicit drugs should be enforced. The stimulation of religious practice among children and adolescents in poor neighbourhoods may also

represent an effective intervention insofar as it enhances the effect of the other strategies; although actively promoting religious activities in a community is strictly speaking not a health intervention (25). Increasing the presence of fathers in deprived families may also be an important way of reducing homicide, but an effective intervention for this is difficult to devise. ■

Résumé

Homicides chez les enfants et les adolescents : étude cas-témoins à Recife (Brésil)

Objectif Le taux des homicides chez les enfants et les adolescents à Recife, au Brésil, essentiellement dus aux armes à feu, est l'un des taux les plus élevés qui aient été signalés. La présente étude cas-témoins avait pour objet de recenser les facteurs qui pourraient être modifiés au moyen de mesures préventives.

Méthodes Les cas représentaient 255 victimes d'homicides de moins de 20 ans, décédées en 1997 et identifiées à l'Institut de médecine légale du Département de la Police, à Recife, et dont la famille avait été interrogée par deux agents de santé communautaires lorsqu'elle était venue réclamer le corps. Les 255 témoins étaient des voisins des cas, appariés par âge et par sexe, recensés dans la semaine suivant l'identification de chaque cas, et dont la famille avait été interrogée par un troisième agent de santé communautaire.

Résultats Le taux global des homicides à Recife chez les moins de 20 ans en 1997 était de 49 pour 100 000 ; il

était de 324 pour 100 000 dans la population masculine de 15-19 ans. Les armes à feu étaient responsables de 97 % des décès. Une étude de régression logistique multivariée a fait apparaître comme facteurs de risque des antécédents de casier judiciaire (odds ratio (OR) = 18,65 ; intervalle de confiance à 95 % (IC) : 1,91-182,50), l'usage de drogues illicites (OR = 7,48 ; IC 95 % : 1,86-30,17), l'eau courante à domicile (OR = 7,30 ; IC 95 % : 1,80-29,59) et la mère >26 ans à la naissance (OR = 3,98 ; IC 95 % : 1,79-8,84) ; et comme facteurs de protection des études supérieures (OR = 0,22 ; IC 95 % : 0,11-0,43), une pratique religieuse (OR = 0,25 ; IC 95 % : 0,10-0,65) et la présence du père au foyer (OR = 0,28 ; IC 95 % : 0,09-0,81).

Conclusion Les autorités de la santé publique devraient planifier des mesures de prévention en s'appuyant sur les résultats de cette étude, et contrôler l'acquisition, la possession et le port des armes à feu.

Resumen

El homicidio entre los niños y adolescentes: estudio de casos y testigos en Recife (Brasil)

Objetivo La tasa de homicidios entre niños y adolescentes en Recife (Brasil), explicable principalmente por el uso de armas de fuego, es una de las más altas de que se tiene noticia. El presente estudio de casos y testigos se emprendió con objeto de identificar factores potencialmente modificables mediante intervenciones preventivas.

Métodos Se consideraron los casos de 255 víctimas de homicidio menores de 20 años, fallecidas en 1997 e identificadas en el Instituto de Medicina Forense del Departamento de Policía de Recife; dos agentes de salud comunitarios entrevistaron a sus parientes al acudir a reclamar el cadáver. Los 255 testigos eran vecinos de los anteriores, emparejados por edad y sexo, e identificados dentro del plazo de una semana tras la identificación de cada caso; sus familiares fueron entrevistados por un tercer agente de salud comunitario.

Resultados La tasa general de homicidios en Recife entre los menores de 20 años fue en 1997 de 49 por

100 000; entre los hombres de 15-19 años fue de 324 por 100 000. Las armas de fuego causaron el 97% de las defunciones. La regresión logística multifactorial identificó como factores de riesgo los antecedentes policiales (OR = 18,65; IC95%: 1,91-182,50), el consumo de drogas ilícitas (OR = 7,48; IC95%: 1,86-30,17); la disponibilidad de agua corriente en la vivienda (OR = 7,30; IC95%: 1,80-29,59) y una edad materna al nacer superior a 26 años (OR = 3,98; IC95%: 1,79-8,84), y reveló asimismo los siguientes factores protectores: mayor nivel educativo (OR = 0,22; IC95%: 0,11-0,43), prácticas religiosas (OR = 0,25; IC95%: 0,10-0,65) y presencia del padre en el hogar (OR = 0,28; IC95%: 0,09-0,81).

Conclusión Las autoridades de salud pública deberían planificar intervenciones preventivas basadas en los resultados de este estudio, y controlar la compra y la tenencia de armas de fuego.

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