**DOI:** 10.1590/1809-4503201400060016

**ORIGINAL ARTICLE /** *ARTIGO ORIGINAL*

# Social determinants and their interference in homicide rates in a city in northeastern Brazil

## *Determinantes sociais e sua interferência nas taxas de homicídio em uma metrópole do nordeste brasileiro*

Geziel dos Santos de Sousa[I,II], Francismeire Brasileiro Magalhães[I,II], Isabelle da Silva Gama[I,II], Maria Vilma Neves de Lima[I,II], Rosa Lívia Freitas de Almeida[II], Luiza Jane Eyre de Souza Vieira[III], José Gomes Bezerra Filho[I]

**ABSTRACT:** ***Objective:*** This paper aims to analyze the possible relationship between social determinants and homicide mortality in Fortaleza (CE), Brazil. ***Method:*** To investigate whether the rate of mortality by homicides is related to social determinants, an ecological study with emphasis on spatial analysis was conducted in the city of Fortaleza. Social, economic, demographic and sanitation data, as well as information regarding years of potential life lost, and Human Development Index were collected. The dependent variable was the rate of homicides in the period 2004 to 2006. In order to verify the relationship between the outcome variable and the predictor variables, we performed a multivariate linear regression model. ***Results:*** We found associations between social determinants and the rate of mortality by homicides. Variables related to income and education were proven determinants for mortality. The multiple regression model showed that 51% of homicides in Fortaleza neighborhoods are explained by years of potential life lost, proportion of households with poor housing, average years of schooling, per capita income and percentage of household heads with 15 or more years of study. The coefficients for years of potential life lost and households with poor housing were positive. ***Conclusion:*** The findings indicate that the mortality by homicide is associated with high levels of poverty and uncontrolled urbanization, which migrates to the peripheries of urban centers.

***Keywords:*** Homicide. Social Inequity. Mortality Rate. Social Conditions. Poverty Areas. Urban Population.

[I] *Universidade Federal do Ceará* – Fortaleza (CE), Brazil.

[II] *IES Associação Ampla Universidade Estadual do Ceará and Universidade de Fortaleza* – Fortaleza (CE), Brazil.

[III] Graduate Program of Collective Health at the association of *Universidade Federal do Ceará, Universidade Estadual do Ceará, Universidade de Fortaleza* – Fortaleza (CE), Brazil.

**Corresponding author:** Rosa Lívia Freitas de Almeida. Universidade Federal do Ceará, Centro de Ciências da Saúde, Departamento de Saúde Comunitária. Rua Prof. Costa Mendes, Rodolfo Teófilo. CEP 60430-140. Fortaleza, CE, Brasil. E-mail: rliviafa@gmail.com

**Conflict of interests:** nothing to declare – **Financing source:** none.

**RESUMO:** ***Objetivo:*** Este artigo tem por objetivo analisar a possível relação entre determinantes sociais e a mortalidade por homicídios em Fortaleza (CE). ***Método:*** Para investigar se a mortalidade por homicídios está relacionada a determinantes sociais, um estudo ecológico transversal foi delineado em Fortaleza. Dados sociais, econômicos, demográficos, saneamento, anos potenciais de vida perdidos e IDH foram coletados. A variável dependente foi a taxa de mortalidade por homicídios no período de 2004 a 2006. A fim de verificar a relação entre a variável desfecho e as variáveis preditoras, foi realizada a regressão linear. O coeficiente de correlação linear de Spearman foi usado na análise bivariada. As variáveis que apresentaram valor de $p < 0,25$ integraram a análise multivariada. ***Resultados:*** Foram encontradas associações entre determinantes sociais e a taxa de mortalidade por homicídios. As variáveis relacionadas com renda e escolaridade se mostraram determinantes para a mortalidade. O modelo de regressão múltipla mostrou que 51% das taxas de homicídio dos bairros de Fortaleza são explicados pelas variáveis: anos potenciais de vida perdidos, proporção de domicílios com habitação precária, média de anos de estudo, renda *per capita* e percentual de chefes de família com 15 ou mais anos de estudo. Já os coeficientes para anos potenciais de vida perdidos e proporção de domicílios com habitação precária mostraram-se positivos. ***Conclusão:*** Os achados sinalizam que os óbitos por homicídios associam-se a um elevado nível de pobreza e urbanização descontrolada, as quais migram para as periferias dos grandes centros urbanos.

***Palavras-chave:*** Homicídio. Iniquidade Social. Taxa de Mortalidade. Condições Sociais. Áreas de Pobreza. População Urbana.

## INTRODUCTION

The influence of social determinants on health has been widely discussed by the scientific community[1-3]. Some issues suffer major influences from that determination. Among them, the violence stands out for its multifaceted and ambiguous character

Homicide mortality rates are considered good indicators to measure the severity of violence in a given population group[4]. Some studies have been conducted in Brazil and in the world to show this relationship[5,6], however, this approach requires further discussions in northeastern Brazil, where rates grow at an accelerated rate, unlike what happens in other regions, where positive developments were identified in indicators[3,7].

Certain of the need for a better understanding of this relationship, we chose to conduct this study, which aims to analyze the interference of social determinants in increased homicide mortality.

## METHODOLOGY

This cross-sectional ecological design study took as the analysis unit 114 official neighborhoods in Fortaleza, seeking to identify the influence of social determinants of health in the behavior of homicide rates in this metropolis.

This is configured as a metropolitan agglomeration in the Northeast of Brazil, ranked the fifth largest city in the country in population, estimated by FIGBE in 2,505,554 million inhabitants for the year of 2009, with an annual growth rate of 2.2%. This estimate considered that 53.2% were female and 35.3% were aged 0 – 19 years.

However, despite being the fifth largest city in number of inhabitants in Brazil, the United Nations (UN) identified Fortaleza as one of four Brazilian cities in which large social differences are reported, in addition to Brasília, Goiânia and Belo Horizonte[8].

When compared to other cities in the world (138), these Brazilian cities only lose to Johannesburg, Buffalo City and Ekurhuleni, all South African. Fortaleza occupied the 17th position in the ranking of the 20 most unequal cities in the world, which has given Brazil a rankings of a Country with high inequality (Gini coefficient of 0.58), losing only to South Africa, Zambia and Namibia[8].

In the operationalization of this study, the 2000 demographic census conducted by FIGBE, the components of the Human Development Index for Municipal Districts (IDHM-B) defined by the Department of Planning in Fortaleza (SEPLA), the Mortality Information System of the Ministry of Health (SIM/MS), obtained at the Department of Municipal Health (SMS) of the city and the data on the deaths of the Medical Legal Institute (IML) of Fortaleza constituted the data sources.

Some criteria were elected in the definition/inclusion of variables. In relation to death, were considered as valid deaths by homicide, residents and occurred in Fortaleza between January 1, 2004 to December 31, 2006 and codified by the X Revision of the International Classification of Diseases (ICD-10) in its Chapter XX8, including codes X91-Y09.

The data extracted from the aforementioned sources originated two blocks of indicators that constituted the predictor variables: the first concerning socioeconomic information, and the second, demographic information, as well as the homicide mortality rate as the outcome.

The first block was composed of the following indicators: average nominal income; per capita income; average years of education; human development index per neighborhood; proportion of households with water supply; proportion of people with early and late literacy; proportion of people with high incomes; proportion of heads of households under the poverty line and below it; proportion of heads of households in relation to years of education; proportion of poor households; proportion of households with garbage collection. The second block was formed by the population and housing density; proportion of youth and longevity.

As independent variables, the attributes age, sex, years of life lost, IDHM-B, data of education and income, water supply and garbage collection were used.

In this study, the indicator of mortality (years of life lost) was used as an explanatory variable in an attempt to show the magnitude of the extermination of young people.

In pursuit of methodological rigor and refining in the quality of information, probabilistic linkage techniques between the SIM database and the IML (Fortaleza) database ensured that purpose by complementing information (deaths by homicide) in the database designed to this study, using the public domain program RECLINK III 3.1.6.3160[9].

Seeking normal variable distribution and stabilization of variance, transformation of the following types was performed: inverse, square root and log-neperian for the outcome (average incidence rate of homicides) and predictor variables. The choice of log-neperian function is justified for demonstrating to be best fit to the data set, as assessed by normality.

The variables included in the multivariate model resulted from the Pearson correlation matrix and presented $p < 0.25$ in the bivariate analysis. In the final model, variables considered significant presented $p < 0.05$.

This study complied with the ethical precepts (Referência da Resolução), and was approved with under protocol n. 257/08 by the Research Ethics Committee of *Universidade do Ceará* (COMEPE).

## RESULTS

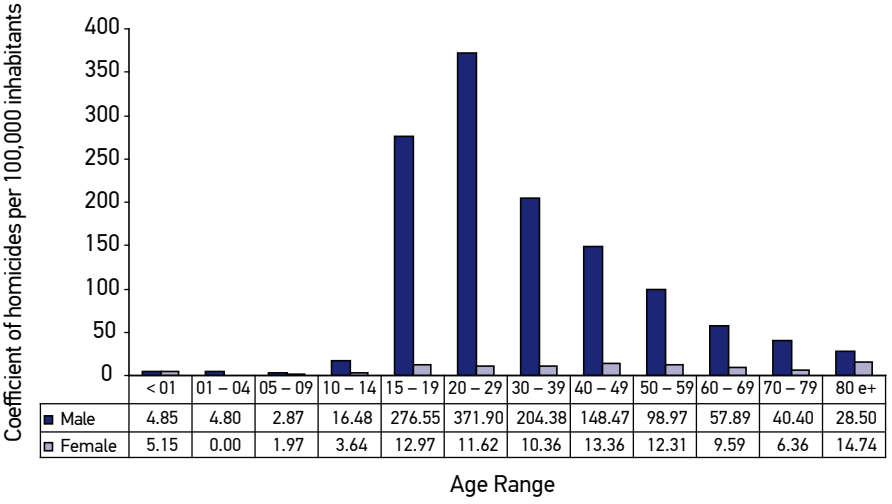
According to information from SIM, between 2004 and 2006, 35,266 deaths of people living in Fortaleza were recorded, of which 1,815 were victims of homicide, which corresponded, for the period, to a proportionate mortality of 5.1.

The average mortality rate for homicide was of 71.9 per 100,000 inhabitants, with a high variability when analyzed by neighborhoods. There was a higher incidence in the 15 – 29 years age group, followed by the 30 – 59 groups. The homicide rate among men is 15.5 times higher than among women in all age groups (Figure 1).

There was a higher percentage of single people (77.5%) among the victims, and 49.4% of them had between 1 – 7 years of education.

The water supply and garbage collection showed an average of over 80%, but in some districts, only 42.26% of households have water and 9.8% have garbage treatment (Table 1).

When the place of occurrence of death is investigated, the severity of the aggression is highlighted by the percentage of deaths in public places and within the household of the deceased, making up more than half of the occurrences. The percentage of ignored age and place signals the need for improvement in the quality of information (Table 2).




| | < 01 | 01 – 04 | 05 – 09 | 10 – 14 | 15 – 19 | 20 – 29 | 30 – 39 | 40 – 49 | 50 – 59 | 60 – 69 | 70 – 79 | 80 e+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male | 4.85 | 4.80 | 2.87 | 16.48 | 276.55 | 371.90 | 204.38 | 148.47 | 98.97 | 57.89 | 40.40 | 28.50 |
| Female | 5.15 | 0.00 | 1.97 | 3.64 | 12.97 | 11.62 | 10.36 | 13.36 | 12.31 | 9.59 | 6.36 | 14.74 |

Source: SIM.

Figure 1. Coefficient of homicides (per 100,000 inhabitants) by age and according to sex in Fortaleza, from 2004 to 2006.

Table 1. Descriptive analysis of homicide rates and potential years of life lost for socioeconomic and demographic indicators according to neighborhood in Fortaleza, 2004 to 2006.

| Variables | Mean | Minimum | Maximum | Standard deviation |
|---|---|---|---|---|
| Educational indicators | | | | |
| Average years of education | 6.99 | 3.49 | 13.05 | 2.25 |
| % of literate residents - 5 – 9 years | 4.92 | 3.19 | 6.75 | 0.58 |
| % of illiterate residents - 10 – 14 years | 0.60 | 0.03 | 2.38 | 0.44 |
| % of illiterate householders | 12.41 | 1.49 | 35.32 | 6.82 |
| % of householders with 1 – 3 years of education | 14.02 | 1.63 | 31.74 | 5.88 |
| % of householders with 4 – 7 years of education | 25.97 | 4.60 | 37.89 | 7.71 |
| % of householders with 8 – 10 years of education | 14.27 | 4.87 | 22.43 | 3.45 |
| % of householders with 11 – 14 years of education | 22.61 | 3.92 | 45.02 | 9.84 |
| % of householders with 15 years or more of education | 11.71 | 0.26 | 60.40 | 13.84 |
| Indicators of housing conditions and sanitation | | | | |
| % of households with poor housing | 0.36 | 0.00 | 6.62 | 0.83 |
| % of permanent private households with water supply | 87.07 | 42.26 | 99.09 | 9.50 |
| % of permanent private households with waste treatment | 88.66 | 9.80 | 99.96 | 16.38 |

Source: SIM and IBGE

Firearms are the most widely used instruments for murder. It is noteworthy that this percentage has been increasing over time, while other causes remain stable. Among the victims younger than 15 years old, this rise is consistent from year to year, increasing from 18,900 deaths/100,000 inhabitants > 15 years in 2004 to 30,400 deaths/100,000 inhabitants > 15 years old in 2006. In second place is assault by sharp object, with coefficients of 6,100 deaths/100,000 inhabitants > 15 years in 2004 and 5,200 deaths/100,000> 15 years in 2006 (Table 3).

As for indicators of income, it was observed that, on average, over 43% of heads of household were below the poverty line, that is, had nominal monthly income of up to two minimum wages. It was also found, on average, 9.4% of household heads with no monthly nominal income, qualified as "below the poverty line", and at the other end, a total of 5.2% householders on average earning over 20 minimum wages, characterizing the municipality with a strong concentration of income.

Regarding demographic indicators, a high population density (9,630.22 inhabitants/km$^2$) was observed, with an average of four people per household. The average proportion of young people aged 15 to 29 years was of 21.1%, and the proportion of people aged over 75 years was 14.3%. Regarding education, just over a quarter (25.9%) of heads of household had 4 – 7 years of education and 14.1% were illiterate (Table 1).

Table 2. Characteristics related to homicides of residents in Fortaleza, 2004 – 2006.

| Variable | 2004 | | 2005 | | 2006 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Level of education | | | | | | | | |
| None | 18 | 3.8 | 23 | 4.3 | 30 | 4.4 | 71 | 4.2 |
| 1 – 3 years | 117 | 24.8 | 173 | 32.0 | 174 | 25.3 | 464 | 27.3 |
| 4 – 7 years | 95 | 20.2 | 130 | 24.1 | 151 | 21.9 | 376 | 22.1 |
| 1 – 7 years | 212 | 45.0 | 303 | 56.1 | 325 | 47.2 | 840 | 49.4 |
| 8 – 11 years | 35 | 7.4 | 48 | 8.9 | 69 | 10.0 | 152 | 8.9 |
| ≥ 12 years | 12 | 2.5 | 11 | 2.0 | 10 | 1.5 | 33 | 1.9 |
| 9 – 11 years | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 1 – 8 years | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Not informed | 139 | 29.5 | 69 | 12.8 | 142 | 20.6 | 350 | 20.6 |
| Unknown | 55 | 11.7 | 86 | 15.9 | 112 | 16.3 | 253 | 14.9 |
| Place of occurrence | | | | | | | | |
| Hospital | 141 | 29.9 | 145 | 26.9 | 214 | 31.1 | 500 | 29.4 |
| Residence | 41 | 8.7 | 66 | 12.2 | 81 | 11.8 | 188 | 11.1 |
| Public places | 205 | 43.5 | 259 | 48.0 | 336 | 48.8 | 800 | 47.1 |
| Other | 34 | 7.2 | 39 | 7.2 | 37 | 5.4 | 110 | 6.5 |
| Unknown | 50 | 10.6 | 31 | 5.7 | 20 | 2.9 | 101 | 5.9 |
| Total | 471 | 100.0 | 540 | 100.0 | 688 | 100.0 | 1.699 | 100.0 |

Source: SIM

Associations between social determinants and the homicide mortality rate were found. Variables related to income and education proved decisive in mortality, emphasizing the strong relationship between homicide mortality, poverty and low education. The multiple regression model adjusted presented R2 = 0.51; F = 21.7, that is, 51 % of homicides in neighborhoods in Fortaleza are explained by the variables "years of life lost", "proportion of households with poor housing", "average years of education", "per capita income" and "percentage of heads of household with 15 or more years of education" (Table 4). The relationship between homicide rates, education and per capita income was negative. In turn, coefficients for potential years of life lost and proportion of households with poor housing were positive. This result points to the unequal distribution of wealth as a strong determinant of violence.

Table 3. Coefficient of homicides (per 100,000 inhabitants) of people older than 15 years by specific cause and according to year in Fortaleza, 2004 – 2006.

| Classification of cause of death | Year of death | | |
|---|---|---|---|
| | 2004 | 2005 | 2006 |
| (X91) Assault by hanging, strangulation and suffocation | 0.1 | 0.1 | 0.4 |
| (X95) Assault by other and unspecified firearm discharge | 18.9 | 23.2 | 30.4 |
| (X99) Assault by sharp object | 6.1 | 5.6 | 5.2 |
| (Y00) Assault by blunt object | 0.4 | 0.4 | 0.0 |
| (Y04) Assault by bodily force | 1.0 | 0.5 | 1.3 |
| (Y05) Sexual assault by bodily force | 0.1 | 0.0 | 0.0 |
| (Y08) Assault by other specified means | 1.0 | 0.5 | 1.2 |
| (Y09) Assault by unspecified means | 1.0 | 1.1 | 1.1 |

Source: SIM

Table 4. Description of the multiple linear regression model for potential socioeconomic determinants of homicide in Fortaleza, 2004 – 2006.

| $R^2$ | R | Factors | Coef. β | p-value | Coef. β adjusted | p-value |
|---|---|---|---|---|---|---|
| 0,.513 | 0.538 | Potential years of life lost | 0.000 | 0.000 | +0.006 | 0.000 |
| | | Per capta income | -9.02 | 0.049 | +0.000 | 0.012 |
| | | Average years of education | -0.001 | 0.141 | -0.006 | 0.027 |
| | | Proportion of heads of household with 15 or more years of education | -0.0194 | 0.001 | -0.018 | 0.012 |
| | | Proportion of poor housing | 0.232 | 0.007 | +0.194 | 0.003 |

## DISCUSSION

The analysis of socioeconomic determinants of homicides allowed to point out the need for a much broader discussion about the determinants of violence and homicide, and of diversified and complementary instruments for its mitigation, in order to subsidize the guidance of integrated interventions by Fortaleza managers, based on the characteristics and realities of each group, thus increasing the possibility of success in interventions for health, housing, safety, education and in improving the income of its residents.

The profile of the homicide victim in Fortaleza is mostly young men between 15 and 29 years old, single, mulatto, with low education levels. This finding characterizes the extermination of the contingent of the working age population group and its relation to the social determinants. Similar to other northeastern capitals, such as Recife (PE), where the profile of mortality by violence follows the trend found in Fortaleza, with higher concentration in metropolitan areas, higher incidence of males and of the group of teenagers and young adults[10].

This emphasizes that the phenomenon occurs similarly in the abovementioned capital, especially because of the rapid population growth characteristic that is peculiar to the two of them, which driven by the rural exodus that "swelled" the peripheries of northeastern capitals with people of low education and income, and that determined the increase in social inequality in these populations. In addition to these social factors, we can also cite the cultural and anthropological question as strong drivers of the extermination of young people that we witness in the Brazilian northeast.

The result of the study is worrisome, because the factors related to poverty, education and youth explain the variation in 51% of the homicide rate, indicating higher risk for poor young individuals with low education.

To Minayo[11], industrialization and urbanization characterize factors that amplify the destructive effects of accelerated social change processes, for they trigger strong migratory flows towards the peripheries of large urban centers, where people are living in conditions of extreme poverty and social disorganization. If, on one hand, the city is a tourism hub, in the peripheral neighborhoods, social inequality and the problems arising from that are evident, and common to several Brazilian capitals. About one third of the population of Fortaleza lives in slums, which exist in almost all regions of the city, and are fueled by continued migration. Therefore, crime is also relevant in the capital and begins to be faced by the government, with enforcement actions 24 hours a day, in all neighborhoods. However, other difficulties also faced are the historical lack of urban infrastructure, transportation systems, sanitation and street cleaning[12].

As to the means used to commit the homicides, nearly a third of deaths caused in Fortaleza was due to firearms. The percentage of use of firearms to cause murder reflects the same profile of the municipalities of Porto Alegre, Recife, Rio de Janeiro

and Uberlandia, where approximately 80% of homicides were caused by this instrument. How do you explain a country with a strict disarmament policy such as Brazil having such a high number of deaths from homicides involving firearms? Many questions must be elucidated, but, to this end, the focus of intersectionality should be worked so that inequities are smoothed by defragmenting public policies, seeking to guarantee citizenship and human rights. Another factor pointed as a determinant for the increase in the number of homicides is characterized by the rising action of drug trafficking, which attracts young people seeking a new perspective on improving their living conditions[13]. Associated with drug trafficking, firearms emerge, becoming more available and influencing homicide rates[14], given the substantial increase in injuries and deaths by firearms, considering that, in the early 2000s, 70% of homicides occurred in Brazil were committed with firearms[15].

Findings from several studies[1,10,13,16] support the assumptions that the distribution of homicides is related to social inequalities. For decades, the gap between rich and poor in the quest to meet the most basic needs such as food, education, health and decent housing were intensified. In this sense, it is important to, on the eve of international events, think about the inequities produced by social inequalities and how this will improve with these events.

## REFERENCES


1. Buss PM, Pellegrini Filho A. A saúde e seus determinantes sociais. PHYSIS: Rev Saúde Coletiva 2007; 17(1): 77-93.
2. Dressler WW. Social Inequality and Health: A Commentary. Medical Anthropology Quarterly 2010; 24(4): 549-54.
3. Viana LAC, Costa MCN, Paim JS, Vieira-da-Silva LM. Social inequalities and the rise in violent deaths in Salvador, Bahia State, Brazil: 2000-2006. Cad Saúde Pública 2011; 27(2): 298-308.
4. Elgar FJ, Aitken N. Income inequality, trust and homicide in 33 countries. European Journal of Public Health 2011; 21(2): 241–6.
5. Barata RB, Ribeiro MCS, Sordi M. Desigualdades sociais e homicídios na cidade de São Paulo, 1998. Rev Bras Epidemiol 2008; 11(1): 3-13.
6. Souza ER, Melo AN, Silva JG, Franco SA, Alazraqui M et al. Estudo multicêntrico da mortalidade por homicídios em países da América Latina. Ciênc Saúde Coletiva 2012; 17(12): 3183-93.
7. Nóbrega-Júnior JM. A dinâmica dos homicídios no Nordeste e em Pernambuco. DILEMAS: Revista de Estudos de Conflito e Controle Social 2010; 3(10): 51-74
8. Organização das Nações Unidas (ONU). Taxa de homicídio global cresce 30% em 20 anos, 2007. Relatório do Desenvolvimento Humano Brasil 2005. PNUD: Brasília (DF); 2005.
9. Camargo Junior KR, Coeli CM. Reclink: aplicativo para o relacionamento de bases de dados, implementando o método probabilistic record linkage. Cad Saúde Pública 2000; 16(2): 439-47.
10. Bastos MJR, Dos Anjos JP, Smarzaro DC, Costa EF, Bossanel RCL, Oliosa DMS et al. Análise ecológica dos acidentes e da violência letal em Vitória, ES. Rev Saúde Pública 2009; 43(1): 123-32.
11. Minayo MCS. Conceitos, teorias e tipologias de violência: a violência faz mal à saúde individual e coletiva. In: Sousa ER, organizadores. Impactos da violência na saúde. Rio de Janeiro: EAD/ENSP; 2007. p. 24-35.

12. Pontes-Filho L. Os desafios de Fortaleza para a Copa 2014: ampliação dos sistemas de transporte e da rede de saneamento básico são os desafios da cidade. Portal 2014. Disponível em: http://www.portal2014.org.br/noticias/291/os+desafios+de+fortaleza+para+a+copa+2014.html (acessado em 10 de abril de 2012).
13. Minayo MCS. A violência social sob a perspectiva da saúde pública. Cad Saúde Pública 1994; (10): S7-S18.
14. Andrade FM, Soares DA, Matsuo T, Souza HD. Homicídios de homens de quinze a 29 anos e fatores relacionados no estado do Paraná, de 2002 a 2004. Cien Saúde Colet 2011;16 (1): 1281-8.
15. Peres MFT, Santos PC. Mortalidade por homicídios no Brasil na década de 90: o papel das armas de fogo. Rev Saúde Pública 2005; 39(1): 58-66.
16. Macedo AC, Paim JS, Silva LMD Da, Costa MCN. Violência e desigualdade social: mortalidade por homicídios e condições de vida em Salvador, Brasil. Rev Saúde Pública 2001; 35(6): 515-22.

**Received on: 05/14/2012**
**Final version presented on: 01/08/2013**
**Accepted on: 06/12/2013**