Social inequalities and the rise in violent deaths in Salvador, Bahia State, Brazil: 2000-2006

Desigualdades sociais e crescimento das mortes violentas em Salvador, Bahia, Brasil: 2000-2006

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Abstract

An ecological study was carried out using information zones as units of analysis in order to assess the evolution of socio-spatial inequalities in mortality due to external causes and homicides in Salvador, Bahia State, Brazil, in 2000 and 2006. The Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE) and the City Health Department (Secretaria Municipal de Saúde) provided the data sources, and causes of death were reviewed and reclassified based on reports from the Institute of Legal Medicine (Instituto Médico Legal). The information zones were classified into four social strata according to income and schooling. The ratio between mortality rates (inequality ratio) was calculated and confirmed a rise of 98.5% in the homicide rate. In 2000, the risk of death due to external causes and murders in the stratum with the worst living conditions was respectively 1.40 and 1.94 times greater than in the reference stratum. In 2006 these figures were 2.02 and 2.24. The authors discuss the implications for intersectoral public policies, based on evidence from the study's findings.

Social Inequity; Violence; Homicide

Introduction

Over the last three decades, there has been a re-emergence of interest in social inequality within several scientific disciplines and among governmental institutions worldwide, particularly in view of its relationship with health-disease processes, making it a universal and persistent phenomenon [1,2]. Several studies have demonstrated that in those countries with higher relative inequalities in living conditions and income distribution there is a marked disparity in health indicators between social classes. One of the explanations for this fact is that these societies generally tend to be less cohesive, with negative effects on health conditions of disadvantaged populations [3,4,5,6,7]. Indeed, in recent years, social inequalities in health between countries and internally within each country have increased [8].

A range of authors, who have dealt with this theme from different theoretical perspectives and in empirical research [9], have noted the relevance of analyzing this factor in studies regarding the incidence of illnesses within populations. Such inequalities are important factors in establishing the profile of morbidity and mortality indicators from external causes, including homicides [10,11,12,13]. The World Health Organization (WHO) estimated the homicide rate of 155/100,000 for the Americas, in 2004, with a large differential between those with a high income (18/100,000) and those with a low income (137/100,000) [14,15].

In Brazil, mortality due to external causes had risen from fourth place at the beginning of the 1980s to second place by 1989. In 2002, the risk of death from these causes was 71.6/100,000 inhabitants, which constituted 12.6% of all causes of death [16]. It is also worth noting that homicide is the principal cause of premature death, and has the greatest impact on young males [17]. A linear increase can be seen in homicides between 1979 and 2001 with an increase in the involvement of firearms from 43% to 69% [18].

Urban violence is most apparent in the capital cities and metropolitan regions, affecting the population with the worst living conditions. In 2003, the risk of violent death increased to 28.9/100,000 with a significant discrepancy between capital cities, the lowest being Natal (18.5/100,000) and the highest Recife (66.4/100,000) [16]. Investigations carried out in Brazil point to social inequality as one of the main factors responsible for the growth in urban violence, and also demonstrate differentials in mortality due to violence in terms of gender, race, age group, social class and place of residence [12,19,20,21].

The monitoring of the intra-urban differentials of violent deaths identified zones in Salvador, Bahia, with much higher mortality rates due to external causes as compared to other localities in Brazil [22]. Studies carried out in this municipality revealed an unequal socio-spatial distribution, with the highest rates occurring in populations with the worst living conditions. Homicides remained stable from the 1990s to 2000 reaching a rate of 33/100,000 in 2001. However, these rates increase when sex, age group and socio-spatial distribution are taken into account [23,24,25,26]. In 2000, the total rate for homicides in some poor neighborhoods in the city was in excess of 100/100,000 [22]. Moreover, between 1998 and 2003, mortality due to external causes was of 14,507 potential years of life lost/100,000 inhabitants, of which 62% were due to homicides [27].

The magnitude and relevance of the problem of violent deaths in Salvador reveal the importance of maintaining up-to-date information about social inequalities as they occur, especially given the fact that since the second half of the 20th century, the city has undergone transformations in its urban space and became a complex conurbation, fraught with problems, including urban violence [28]. On the other hand, certain reductions in homicide rates have been observed across Brazil and in some capital cities, as well as a certain "ruralization" of violence, which affects small and medium sized towns and cities. On this basis, this study sought to investigate the recent situation in Salvador in order to verify whether the observed inflection in national averages is also taking place in this capital. The objective of this study was, therefore, to examine the evolution of socio-spatial inequalities in mortality from external causes (in total and by homicide) within Salvador, in the years 2000 and 2006.

Methods

An ecological study of mortality due to external causes (International Classification of Diseases – ICD-10, chapter XX, codes V01-Y98), particularly homicides, was carried out, in 2000 and 2006, among residents from Salvador, with zones of information and social strata as the units of analysis. The information zones correspond to the subdivision of the municipal territory in areas defined by the Company for the Development of the Metropolitan Region of Salvador (Companhia de Desenvolvimento da Região Metropolitana de Salvador – CONDER), according to physical-urban, administrative and planning criteria. These areas are compatible with the census sectors of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE).

The City Health Department (Secretaria Municipal de Saúde – CHD) supplied the data on deaths in digital format, whilst information about socio-economic variables (head of household's income and schooling) were distributed by census sectors and came from the 2000 Demographic Census (IBGE. http://www.ibge.gov.br). The residential addresses of the deceased were geo-referenced by information zone, through the use of the LOCALIZA software (Instituto de Saúde Coletiva, Universidade Federal da Bahia, Salvador, Brazil). Maps and Google Earth (http://www.google.com.br/intl/pt-BR/earth/index.html) were also used when address records were incomplete.

To improve the quality of information concerning the nature of death (when this was not clearly specified on the Death Certificate) a review was conducted for the years 2000 and 2006 through consultation with expert reports, police reports and other documents available at the Nina Rodrigues Institute of Legal Medicine (Instituto Médico Legal Nina Rodrigues – IMLNR). The data contained in the police forms and technical reports on each death were transferred to a database established for that purpose. From this information, the underlying causes of death were coded in an attempt to establish, in general, the circumstance of death, and the object that caused the injury and, whenever possible, the legal cause of death. If there were no details in the

Technical Police Department (Departamento de Polícia Técnica – TPD) report and if the police forms mentioned two or more causes, the first option was considered. If there were discrepancies between the TPD reports and the police forms in relation to the type of violent death, it was classified as "injuries that are ignored if they were accidentally or intentionally inflicted". Other details are described elsewhere [21].

The data collected in the special form, including the recoded underlying cause, were classified using Epi Info software (Centers for Disease Control and Prevention, Atlanta, USA) and formed a complementary database linked to the original by the recorded number of death certificates received from the CHD. Thus, for every death from external causes, it was possible to identify the code for the cause established by CHD and also the new code set from the access to IMLNR records.

The existence of social inequalities in the spatial distribution of mortality by external causes and by homicides was evaluated using the same methodology as in previous research [30] using two proxy variables for living conditions: economic capital and cultural capital. These constructs were developed by Bourdieu [31], according to whom, classes and sub-divisions of classes of individuals place themselves in defined positions within the social space, particularly through the quantity and composition of their economic and cultural capital. Those variables were used by Bourdieu [32] himself in his book where he analyzed the relations between lifestyle and social space. Although his concept of cultural capital is much more complex, he found that cultural capital was greater as school grades improved. Part of this cultural capital is obtained within the family, part taught in school and part not taught at school. He explained this phenomenon with what he called the "*noblesse obligée*" effect or the effect of school title. People search for knowledge and develop cultural tastes that school does not teach because the social position they attain through their title creates that obligation.

The following stratification was established for economic capital and cultural capital: low economic capital (proportion of heads of household with an income up to the value of two minimum wages), medium economic capital (proportion of heads of household with an income of between two and five minimum wages), high economic capital (proportion of heads of household with an income greater than the value of five minimum wages); low cultural capital (proportion of heads of household with either no schooling or up to 7 years of schooling), medium cultural capital (proportion of heads of household with 8-14 years of schooling) and high cultural capital (proportion of heads of household with 15 years of schooling or more). A second stratification was subsequently carried out according to the composition (greatest proportion in the zones of information) of economic capital and cultural capital: high social stratum (high cultural capital – HCC/high economic capital – HEC), intermediate social stratum (medium cultural capital – MCC/high economic capital – HEC), low social stratum (medium cultural capital – MCC/low economic capital – LEC) and very low social stratum (low cultural capital – LCC/low economic capital – LEC), which will henceforth be called strata I, II, III and IV respectively. Taking zone of information 2 as an example of how this allocation was carried out, we see that it was composed of 12.8% of heads of household in LEC, 8.7% in MEC and 78.4% in HEC; 9.9% in LCC, 37.3% in MCC and 52.8% in HCC, and was thus classified as high social status (HCC/HEC), i.e. it was allocated to stratum I. Zones of information in which the difference between the proportion of heads of household for economic capital or for cultural capital was less than 10% were distributed systematically in order to ensure that half of the zones of information were allocated to each stratum. Zone of information 1, for example, had 41.9% of heads of household in the MCC stratum and 48.7% in the HCC and was randomly allocated to HCC.

We calculated crude and age-standardized mortality rates from external causes and homicides during the years of the study, and their respective percentage changes according to social strata. We used the population of Salvador in 2000 as standard. The age-standardized rates of each social stratum were represented on thematic maps using the ArcView 3.2 (Environmental Systems Research Institute Inc.; http://www.esri.com/software/arcview/) application. We estimated the inequality between the mortality of different social strata by calculating the ratio between the mortality rates (inequality ratio – IR) by external causes (total, homicides), allowing for a 95% confidence interval (95%CI) and using the stratum of best socio-economic status as a reference. Epi Info 6.0 software was used for processing and data analysis.

This research proposal was submitted to and approved by the Ethics Research Committee at the Institute of Collective Health of the Bahia Federal University (Instituto de Saúde Coletiva, Universidade Federal da Bahia – ISC/UFBA) under registration nº. 049/09.

Results

In Salvador the mortality rate due to external causes per 100,000 inhabitants was 58.9 in 2000 and 65.1 in 2006, representing a rise of 10.5%. In the same period this group of causes of death represented 10.9% and 12.9%, respectively, of total deaths. For homicides, the rate was 20.0 per 100,000 in 2000, rising to 39.7 per 100,000 in 2006, an increase of 98.5%. This cause, which in 2000 was responsible for 33.8% of the total deaths from deaths due to external causes, reached 60.9% in 2006. On the other hand, while violent deaths of indeterminate nature (ICD-10, chapter XX, codes Y10-Y34) contributed 16.3% of deaths by external causes in 2000, this rate fell to 2.6% in 2006. It was also observed that the proportion of deaths due to external causes for females was reduced from 17.7% in 2000 to 14.2% in 2006, while the homicides increased from 8.3% to 14.5% in the same period.

In Table 1 we can see that, in the two years of the study, the mortality rates due to external causes were greater in the strata representing the worst living conditions, and that there was a percentage reduction in the two best social strata of 13.7% (stratum I) and 3.4% (stratum II) at the same time as a rise of 21.6% in stratum III and 13.4% in stratum IV. These differences are confirmed in the IR (Table 2), where we can see that the risk of death from external causes in stratum IV was 1.52 times higher compared to stratum I in 2000 and that this difference rose to 2.11 in 2006; these differences are statistically significant.

In respect of homicides (Table 3) we can see that, in 2000, strata I and IV presented, respectively, rates of 9.5 and 23.2 per 100,000 inhabitants. In 2006, the equivalent rates were 16.3 and 45.8 per 100,000 inhabitants. Between 2000 and 2006, social stratum I presented the lowest rise (71.6%). The largest increases were in strata II (+102%) and III (+ 121.7%), while stratum IV, which represented the worst social conditions, showed a rise of 97.4%. As regards the IR, there was a rise in stratum III from 1.94 (95%CI: 1.10-3.43) to 2.24 (95%CI: 1.52-3.29), whilst stratum IV showed a trend toward stability.

One can also see differences in the inter-urban distribution of deaths due to external causes and homicides, of which the highest rates per stratum were concentrated mainly around the suburban railway and the "core" of the city (known as the *miolo*), areas in this municipality that present a higher concentration of poverty (Figures 1 and 2).

Discussion

The increase in mortality due to external causes observed in Salvador in the period 2000-2006, especially in the sharp rise in homicides, for which the risk almost doubled over this short space of time, places this city amongst the most violent in the country and emphasizes the importance of this worsening problem both in terms of public health and public safety. In addition to the gradient presented, which shows an increase in the risk of death for this group of causes, moving across the population strata from the best to the worst living conditions, we should add the fact that while mortality rates due to external causes increased in the latter strata, the reverse was observed in the aggregates of better social indicators. Over the years studied, a worsening of inequalities in these causes of death can thus clearly be observed and is possibly related to social determinants. In turn, the increase of homicides among women has also been attributed to their greater involvement with illegal drug trafficking [33].

The significant increase in the relative weight of homicide in the total number of deaths from external causes between 2000 and 2006 is striking when compared to previous years [21,24]. However, the hypothesis that at least a certain amount of this increase is explained by the reduction of deaths from external causes of an "undetermined nature" is plausible, and it may be due to improved coding for cause of death.

Mortality due to homicides also followed a social gradient, since the increase in its occurrence also took place in inverse ratio to the population aggregates for living conditions. Notably, during the period of this study, although the risk of death from this cause increased across all social strata, the highest increases were registered in those with the worst living conditions. Thus, the inequality ratio remained unchanged in stratum IV (very poor living conditions) and increased in stratum III (poor living conditions). Although amounts were lower when compared to measurements obtained in a similar study [25] conducted in Salvador in 1991 and 1994, there was a trend toward intensification of the IR across the years of this study.

One can conclude from these findings that residential populations living in socially disadvantaged areas in Salvador have a higher risk of being victims of violent death, especially from homicide, which could indicate the existence of a homology between social space and the space of interaction and confrontation, expressed here in "forms of violent death".

The involvement of social inequalities in the incidence of deaths from external causes and

Table 1

Crude and age-standardized rates of mortality due to external causes (per 100,000 inhabitants) and percentage variation (Δ%) according to social strata. Salvador, Bahia State, Brazil, 2000 and 2006.

Social strata	2000		2006		Δ% 2000-2006	
	Crude	Standardized	Crude	Standardized	Crude	Standardized
I	41.3	32.9	36.2	28.1	-12.3	-13.7
II	48.3	41.4	47.7	40.0	-1.2	-3.4
III	58.0	55.5	72.9	67.5	+25.7	+21.6
IV	62.8	64.4	75.4	73.0	+20.0	+13.4

I: HCC/HEC (high cultural capital/high economic capital); II: MCC/HEC (medium cultural capital/high economic capital); III: MCC/LEC (medium cultural capital/low economic capital); IV: LCC/LEC (low cultural capital/low economic capital).

Table 2

Inequality ratio * (IR) of death by external causes and homicides and 95% confidence intervals (95%CI) according to social strata. Salvador, Bahia State, Brazil, 2000 and 2006.

Social strata	2000				2006			
	External causes		Homicides		External causes		Homicides	
	IR	95%CI	IR	95%CI	IR	95%CI	IR	95%CI
I	1.00	-	1.00	-	1.00	-	1.00	-
II	1.10	0.81-1.49	1.10	0.58-2.07	1.31	0.96-1.79	1.20	0.78-1.84
III	1.40	1.06- 1.86	1.94	1.10-3.43	2.02	1.52-2.69	2.24	1.52-3.29
IV	1.52	1.17-1.97	2.44	1.43-4.17	2.11	1.61-2.77	2.43	1.68-3.49

I: HCC/HEC (high cultural capital/high economic capital) – reference; II: MCC/HEC (medium cultural capital/high economic capital); III: MCC/LEC (medium cultural capital/low economic capital); IV: LCC/LEC (low cultural capital/low economic capital).
* Rates were standardized by age.

Table 3

Crude and age-standardized rates of mortality due to homicides (per 100,000 inhabitants) and percentage variation (Δ%) according to social strata. Salvador, Bahia State, Brazil, 2000 and 2006.

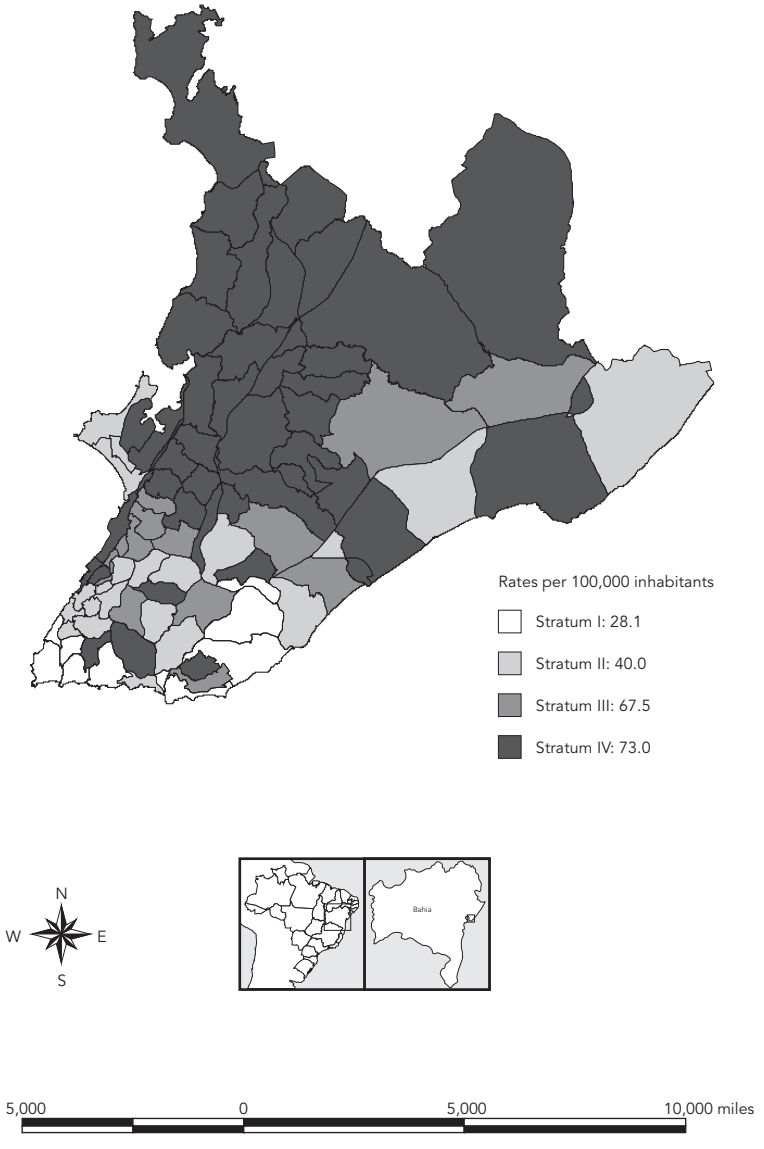
Social strata	2000		2006		Δ% 2000-2006	
	Crude	Standardized	Crude	Standardized	Crude	Standardized
I	9.5	9.5	19.4	16.3	+72.6	+71.6
II	10.4	10.1	24.2	20.4	+132.7	+102.0
III	18.4	18.4	44.0	40.8	+139.1	+121.7
IV	23.8	23.2	47.2	45.8	+98.3	+97.4

I: HCC/HEC (high cultural capital/high economic capital); II: MCC/HEC (medium cultural capital/high economic capital); III: MCC/LEC (medium cultural capital/low economic capital); IV: LCC/LEC (low cultural capital/low economic capital).

homicides can also be observed in other cities in Brazil and also in other countries. Even with different methodologies, research conducted in cities in different regions of the country, such as Pernambuco, Rio de Janeiro, Sao Paulo, Paraná and Rio Grande do Sul consistently show that

Figure 1

Age-standardized mortality rate due to external causes according to social strata. Salvador, Bahia State, Brazil, 2006.

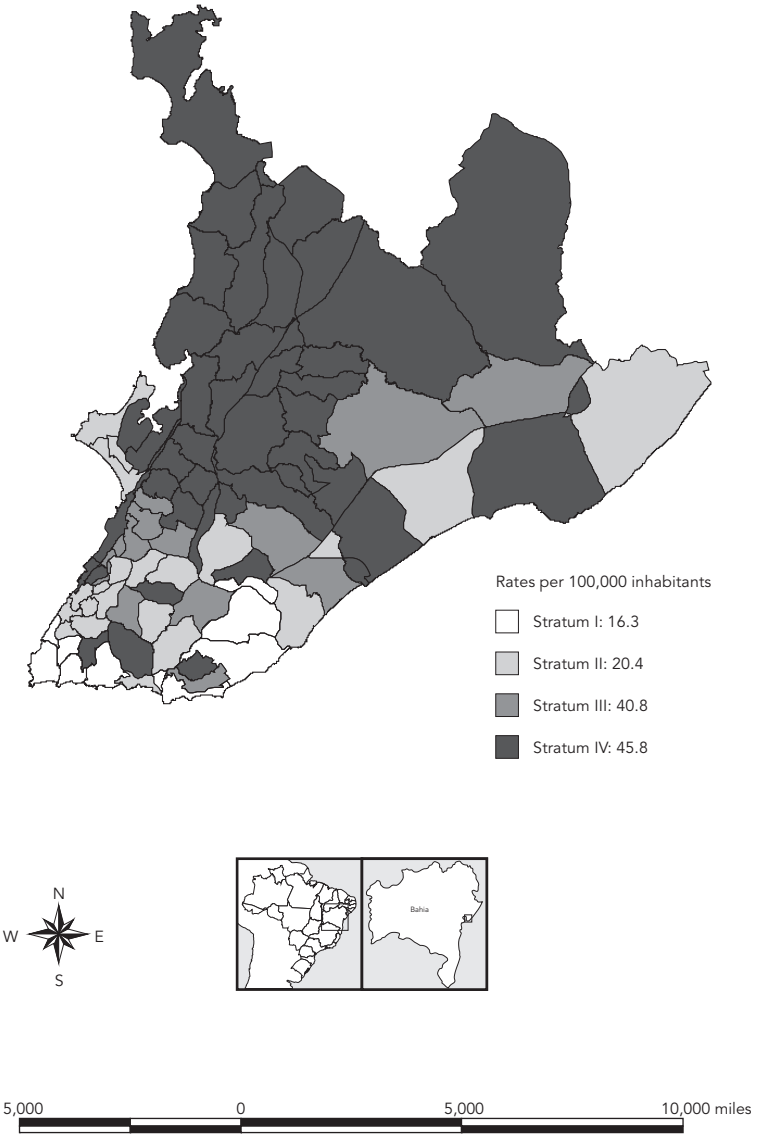


differences in living conditions represent a significant determinant in the socio-spatial distribution of violent deaths [13,14,20,34,35,36,37]. Likewise, international investigations conducted in other socio-cultural contexts, even using different methodologies and theoretical approaches, indicate that local disadvantaged groups have a higher risk of violence, suggesting an association between inequality and homicide [38,39,40,41].

A transnational study also found that countries with high levels of inequality measured by the Gini index when controlling for other socio-demographic characteristics, displayed comparatively higher rates of homicide [42]. Also, a study comparing data from 33 countries showed a strong association between homicide rates and income inequality [43]. Other research, conducted in the USA from 1974 to 2000, found that there

Figure 2

Age-standardized mortality rate due to homicides according to social strata. Salvador, Bahia State, Brazil, 2006.



were greater reductions in crime rates among the rich compared to the poor, thus increasing disparity, and also demonstrated that the poor are victims of more severe crimes such as homicide [44].

Despite an improvement in some social indicators in Salvador in the last two decades, such as the rise in the Human Development Index (HDI), increased per capita income, a reduction in the illiteracy rate and improved access to basic services and consumer goods, these advances do not, so far, seem to have had any positive impact on violence. A finding that is more consistent with the results of this study is that of worsening social inequality measured by an increase, albeit slight (0.65 in 1991 to 0.66 in 2000), in the Gini coefficient [45].

Of particular note here is that the increase in violence, as seen in Salvador, in addition to social inequalities, possibly points to several determinants acting together, such as unemployment,

organized crime, trafficking and drug abuse, a lack of confidence in the State's role as mediator in conflicts, devaluation and corruption of the justice system and the police force, the easy availability of firearms, and a lack of social support for disadvantaged populations, amongst other reasons highlighted in the literature [13,34,35,46]. Thus, further studies are needed for a broadening of knowledge regarding the causes of this phenomenon in this city in order to improve the targeting of potential interventions.

While acknowledging the complexity of the relationships established between poverty, urban decay and violence [47], studies have found a non-random spatial distribution, the result of a historical process of fragmentation and segregation, itself the result of changes in the urban fabric of Brazilian cities, including Salvador. Poverty, *per se*, does not explain the high homicide rates; it can be explained by the set of social disadvantages to which the poor population is subjected [48]. Thus, although one can speak of a "geography of violence" [29], we must remember that the relationship between violent deaths and areas with precarious living conditions involve multiple factors, that do not permit uncritical and linear linkages such as "violent places", poverty and violence or, much worse, poor people and violence. We can conclude that populations living in areas with the worst living conditions are the greatest victims of lethal violence.

Therefore, the relationship between inequalities in living conditions and homicide should not be treated as univocal, since other measures should also be considered, even though they may not always be quantifiable. The absolute (or relative absence of) state involvement in these territories, and the expansion of the business of drug trafficking, especially with the proliferation of crack, are variables that cannot be overlooked. This study and others that have been carried out do not demonstrate that poverty, in itself, generates violence, but the evidence indicates that social inequalities provide an explanatory matrix of the intra-urban differentials for homicide rates in the city.

Mutatis mutandis, one can also point out some similar elements in the analysis of violence in black American ghettos studied by Wacquant [48] and the outskirts of large Brazilian cities, including Salvador. According to this author, areas inhabited mainly by poor blacks in large cities of the USA suffered an uncivilizing process, ie a trend reversal of the historical transformations that occurred in the western world, which according to Elias [49], resulted in a gradual pacification of society. The factors that may contribute to this transformation include the pacification of daily life, the erosion of public space, the absence of public services, unemployment and a growing informal economy.

Some issues should be considered in respect of this research, given that it is an ecological study aggregated by areas. Although ecological studies are regarded by some authors as appropriate and even necessary for the investigation of structural, contextual and macro-social factors in health [50], they are subject to the effects of scale and aggregation of areas, as well as the definition of their borders, which means that the spatial definition of the area affects statistical results. As Schwartz [51] states, an aggregated variable can measure different constructs. Because of this, the unit of analysis should be the most homogeneous possible, in order to reflect the real situation of the subgroups it represents. To achieve this, the formation of small aggregates, that are as homogeneous as possible, is recommended [50,52]. However, we should take into consideration the fact that reducing the units of analysis to very small groups raises the issue of obtaining random effects in the rates, or in other words, a loss of measurement stability [53].

Therefore, as other authors have pointed out regarding this type of research, the results of this study should be interpreted with caution, given the limitations arising from the use of pre-defined geographical and administrative divisions as the unit of analysis, rather than areas that are more homogeneous in respect of socio-economic conditions. The heterogeneity of the urban area of Salvador, where slums and middle and upper class neighborhoods co-exist, is a potential source of distortion in the classification utilized here [25,26,54].

As with any study developed from secondary data, this study is influenced by the quality of such data. To minimize this problem, with regard to the quality of diagnosis of type of death from external causes, the primary causes of death were reviewed and collated with information recorded at the ILMNR, as cited in the *Methods* section. Thus, we reiterate the need to review the autopsies and police reports from the ILMNR to determine the primary cause of death and reduce indices of violent deaths of an undetermined nature, thereby allowing the delineation of an epidemiological profile of mortality by external causes and homicides that is closer to reality. Thus, it is imperative to improve the generation of data (the full completion of the data registration instruments referred to above, including the Death Certificate) and a greater degree of consistency, integration and dissemination of the information systems related to morbidity-mortality by external causes and homicides.

The current picture of violence in the country has prompted debates and plans involving various sectors of society [55,56,57], although it has not resulted in any effective and integrated long-term security policies. The reduction in levels of mortality due to external causes, particularly homicides, requires the integration of inter-sectoral planning involving health, justice, public safety, education, urban planning and the participation of social movements, interacting in synergy, prioritizing the relationship between social inequality, territory and violence in order to reduce the large numbers of preventable deaths and to advance the promotion of health and the reduction of iniquity, establishing ethical and political commitments to address a problem which has caused so much damage to society.

In contrast to what was observed in Salvador between 1997 and 2000, which witnessed a decrease in homicides across all strata of living conditions and a persistence in the inequalities amongst risks for this cause of death [23], this study shows a rise in violent deaths in this decade, contrary to both the national trend and that of certain other Brazilian capital cities. Hence the relevance of reflecting on this potential conclusion: "*Good governments save lives and bad governments kill people.* (...) *All the actions and omissions of governments in relation to crime and violence must be understood as political choices* (...) *no matter the reasons – ignorance, doubts about effectiveness, fear of innovation or opposing interests* (...). *Inaction, in any form, including maintaining the status quo, is just as political as action, good or bad*" [18] (p. 177).

Resumo

Com o objetivo de analisar a evolução das desigualdades socioespaciais na mortalidade por causas externas e homicídios em Salvador, Bahia, Brasil, entre 2000-2006, foi realizado um estudo ecológico, tendo as zonas de informação e estratos sociais como unidades de análise. O Instituto Brasileiro de Geografia e Estatística (IBGE) e a Secretaria Municipal de Saúde foram fontes de dados. As causas básicas de óbito foram revisadas e reclassificadas com base em relatórios do IML. As zonas de informação foram classificadas em quatro estratos sociais a partir da renda e da escolaridade. Calculou-se a razão entre as taxas de mortalidade (razão de desigualdade). Verificou-se aumento de 98,5% na taxa de homicídios no período. Em 2000, o risco de morte por causas externas e homicídios no estrato de piores condições de vida foi, respectivamente, 1,40 e 1,94 vezes maior que no estrato de referência. Em 2006, esses valores foram de 2,02 e 2,24. Os autores discutem as implicações para as políticas públicas intersetoriais evidenciadas pelos achados do presente estudo.

Iniquidades Social; Violência; Homicídio

Contributors

All the authors participated in the conception, design and execution of the project, as well as in the data analysis, in writing up the article, critical revision of intellectual content and approval of the final version.

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