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Analysis of the quality of information on mortality by homicide from deaths with undetermined intent. Bahia, Brazil, from 2002–2013

Análise da qualidade da informação sobre mortalidade por homicídio a partir dos óbitos com intenção indeterminada. Bahia, Brasil, 2002–2013

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ABSTRACT: ***Objective*:** To identify patterns in the spatial distribution of homicide death rates, considering the proportion of deaths of undetermined intent in the municipalities of the State of Bahia, from 2002 to 2013. ***Method*:** An ecological study was carried out, using data from the Mortality Information System (SIM). The proportional mortality of undetermined intent on the total external causes and the homicide rate were analyzed in several municipalities of Bahia and considering the Health Macro-regions (HMRs). ***Results*:** A non-random mortality distribution pattern was observed, according to the overall Moran index, which was clearer in the 2005–2007, 2008–2010 and 2011–2013 triennia. The highest proportions of undetermined deaths, ≥ 50%, were concentrated in the State's Western region. On the other hand, the highest homicide rates were observed in the Far South, South and East regions — coastal municipalities. ***Conclusion*:** The same municipalities and regions identified with low homicide rates concomitantly presented high proportions of undetermined deaths, and conversely, where there were high rates, there was also a low proportion of undetermined death. Therefore, it is essential to take into account the quality of information about the underlying cause.

***Keywords*:** Homicide. Mortality. Spatial analysis. Temporal distribution. Health Information Systems.

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RESUMO: ***Objetivo*:** Identificar padrões na distribuição espacial das taxas de mortalidade por homicídio, considerando a proporção de óbitos de intenção indeterminada nos municípios do Estado da Bahia, no período de 2002 a 2013. ***Método*:** Foi realizado um estudo ecológico, utilizando os dados do Sistema de Informação sobre Mortalidade (SIM). A mortalidade proporcional de intenção indeterminada sobre o total de causas externas e a taxa de homicídio foram analisadas, nos diversos municípios baianos e considerando as Macrorregiões de Saúde (MRSs). ***Resultados*:** Observa-se um padrão de distribuição da mortalidade não aleatório, de acordo com o índice de Moran Global, mais claro nos triênios de 2005 a 2007, 2008 a 2010 e 2011 a 2013. As maiores proporções de mortes indeterminadas, ≥ 50%, concentraram-se na região oeste do Estado. Por outro lado, as mais altas taxas de mortes por homicídio foram observadas nas regiões do extremo sul, sul e leste — municípios litorâneos. ***Conclusão*:** Os mesmos municípios e regiões identificados com baixas taxas de homicídios apresentaram, concomitantemente, altas proporções de indeterminada e, inversamente, onde tiveram altas taxas, também houve baixa proporção de morte indeterminada. Portanto, é fundamental levar em consideração a qualidade da informação acerca da causa básica.

***Palavras-chave*:** Homicídio. Mortalidade. Análise espacial. Distribuição temporal. Sistemas de Informação em Saúde.

INTRODUCTION

Recent studies on homicides in the country have shown that states in the North and Northeast Regions with low or medium homicide rates are presenting worrying increases. Between 1998 and 2012, the state of Bahia, for example, moved from the twenty-second to the fifth position in homicide rates according to Federal Units (UFs) in Brazil[1]. In just over a decade, Bahia has more than tripled its average homicide rate, with some of its municipalities leading the country's homicide ranking[2,3].

The use of spatial analysis tools assists in assessing and monitoring regional inequalities, both to identify differences in accessibility to health services and in the design of impacts of certain threats — such as homicide — and to support the planning of actions aimed at the improvement of information systems, which, within a geographical context, may require specific public actions and policies for each region and municipality[3,4].

The evaluation of the quality of information on mortality can be performed both in its quantitative aspect (coverage of deaths) and in the qualitative aspect (reliability of information on the basic cause of death). Thus, when working with mortality from external causes, the limitations of the records in the Mortality Information System (SIM) should be considered[5,6].

In this study, quality of information is considered as the proportion of deaths with undetermined intent, in a given population residing in a certain geographic space, over a period of time. The emphasis on the quality of information from the inclusion of deaths due to undetermined intent is aimed at expressing the general conditions of medical care dispensed in the analyzed municipalities and the quality of the registry of deaths due to external causes, which directly impacts homicide rates. The inaccuracies in the identification of the intentionality of deaths (homicide, suicide, or accident) condition the increase

of the proportion of external causes of undetermined intent, compromising the quality of the indicators of mortality by specific causes[7].

Regarding the basic cause of death, the high number of deaths classified as indeterminate is an obstacle to the construction of more reliable mortality indicators and has a significant and limiting weight in the inferences made on health indicators[8]. The only thing known about these events is that they result from an injury, but one cannot classify the intentionality or the means used for this, therefore they are denominated "events of undetermined intent"[9-11].

Therefore, due to the increasing importance of homicides in the State of Bahia, this study intendeds to identify patterns in the spatial distribution of Triennial Homicide Mortality Rates (HMTs), considering the proportion of deaths of undetermined intent in the municipalities of the State, from 2002 to 2013.

METHODS

This is an ecological study, in which the spatial distribution of HMTs was analyzed in municipalities of Bahia from 2002 to 2013, taking into account the quality of the information which is evaluated herein according to the Proportion of Deaths by Undetermined Intent (PDUI).

The time window was initially based on the year of effectiveness of the International Statistical Classification of Diseases and Related Health Problems (ICD-10), which became effective as of 1996. However, due to the low coverage of deaths and quality of information for the study, the period from 1996 to 2001 was excluded from the analysis. The year 2013 was the last year for which data were available during the collection period.

Data on mortality were extracted from the SIM[12], available on the website of the Department of Information Technology of the Brazilian National Health System (DATASUS). Population estimates and cartographic bases were obtained through documents of the Brazilian Institute of Geography and Statistics (IBGE)[13].

Data on deaths from external causes were collected from residents of several municipalities of the State, selected according to ICD-10, codes V01 to Y98. The focus was on homicides (codes X85 to Y09, which were added to the deaths of the subgroup legal interventions and operations of war - Y35 and Y36 - of ICD-10); and the subgroup events of undetermined intent (codes Y10 to Y34 of ICD-10). The proportional mortality of undetermined intent (proportion of undetermined intent) was analyzed over the total of external causes, in several municipalities of Bahia.

The units of analysis were the 417 municipalities of Bahia, located according to their Health Macro-region (HMR), in order to identify geographically the various localities in the state territory. The nine HMRs, the number of municipalities that compose them and the population of each HMR in the year 2010 are shown in Figure 1.

To explore the spatial distribution of the proportion of deaths with undetermined intent and to compare it to the homicide rates, thematic maps were constructed using intervals

of equal classes. The grouping occurred in three groups, classified as: less than or equal to 10; between 11 and 49; and 50 or more. In the case of proportions, the values range from 0 to 100%; in the case of rates, they can range from null values, where no case was recorded, up to rates over 100 cases per 100,000 inhabitants.

This profile for the categorization of maps was chosen based on the values acceptable for both the proportion of undetermined death (less than 10%) and homicide rates (less than 10 per 100,000 inhabitants); in addition, it favors checking and allows the visual comparison between the patterns of spatial distribution[14]. From this, the distribution of homicide rates and the proportion of undetermined death, as well as their evolution throughout the study period and in the municipalities of Bahia, were initially described. Next, the spatial distribution pattern of HMTs and PDUIs was analyzed.

The existence of spatial autocorrelation was investigated using the Moran Global index on the proportions of undetermined deaths and the triennial homicide rate, with a significance of 99%. According to this index, in case of a null hypothesis, spatial independence is affirmed, with value equal to zero; values between 0 and +1 indicate the presence of positive spatial autocorrelation; and negative values indicate inverse autocorrelation. The statistical significance of the index was determined by the p value. The strategy for building the proximity matrix was the contiguity of neighboring municipalities[4].

In order to reduce instability in the analysis of mortality data by municipality, we sought to soften random fluctuations by grouping the indicators in four triennia (years 2002 to 2004, 2005 to 2007, 2008 to 2010 and 2011 to 2013). HMTs represent the ratio of the sum of the number of deaths in each triennium, divided by the population in the middle of each period, multiplied by 100,000 inhabitants. The PDUIs constitute the ratio of deaths by events of undetermined intent on the total deaths from external causes, multiplied by 100.

For the analysis, the software Statistical Package for the Social Sciences (SPSS©) version 19.0 and the program TerraView 4.2.2 were used[15]. Due to the type of study and the methodology developed, there was no need for approval by a Research Ethics Committee.

RESULTS

Figure 1 shows the distribution of undetermined death rates (PDUIs) and homicide rates (HMTs) in all municipalities of Bahia and the evolution of these indicators over the period analyzed, in four triennia. Figure 1 represents the HMRs where these municipalities are located in the territory of the State. The highest homicide rate recorded in the first triennium (2002-2004) was 180.8 deaths per 100,000 inhabitants in the municipality of Juazeiro, in the Northern HMR. In the last triennium (2011-2013), the rate reached 326.3 in Simões Filho — Eastern region.

Over the triennia, the evolution of the "spot" of high HMTs with values ≥ 50 deaths per 100,000 inhabitants is observed. As for the PDUI, there was an increase in municipalities with values lower than or equal to 10%. In the 2002-2004 triennium, for example, there

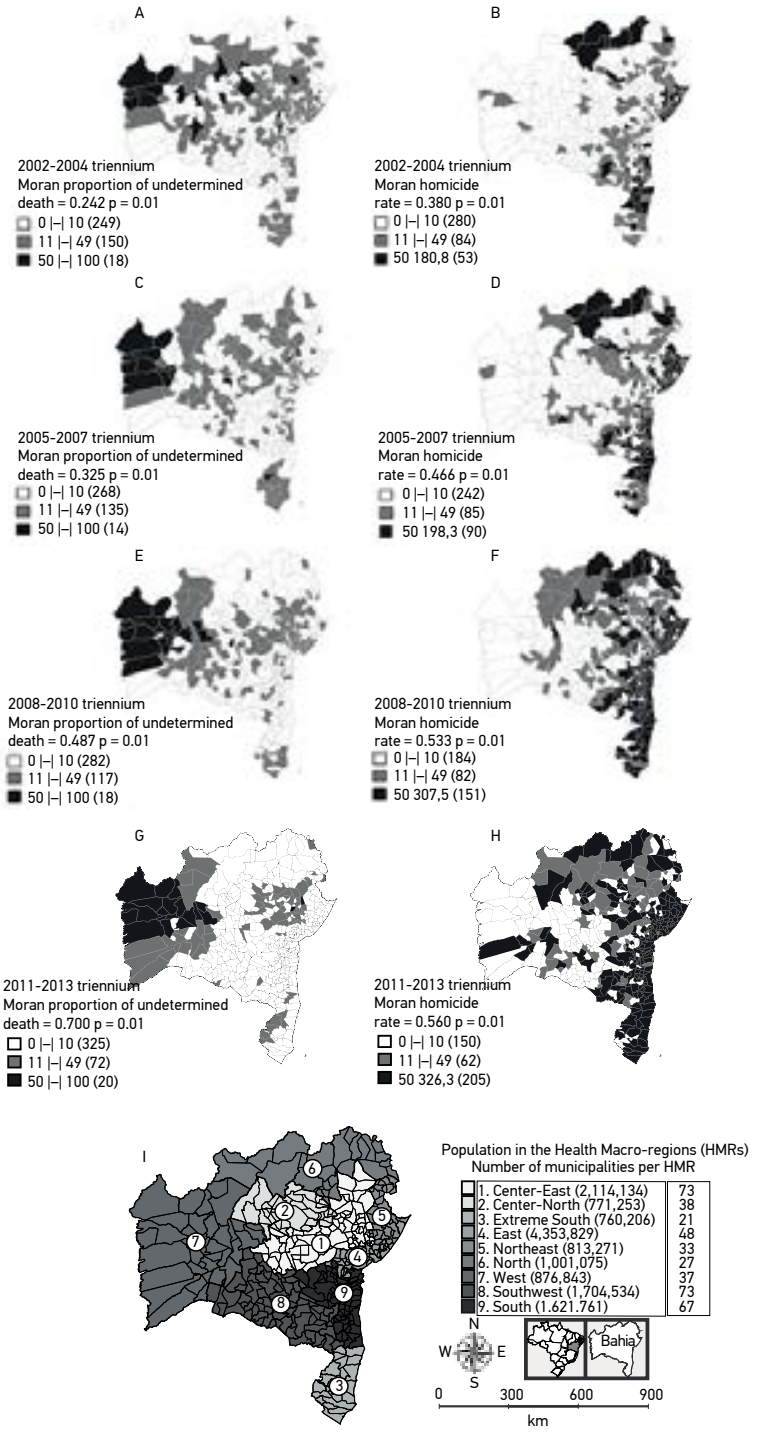

Figure 1. Spatial distribution of the triennial proportion of deaths of undetermined intent and the triennial death rate by homicide, with the respective Moran Global values and their significance, in the municipalities of Bahia, from 2002 to 2013.

were 249 municipalities in this situation; in 2011-2013, there were 325 municipalities with low PDUI, which means that 76 municipalities reduced the proportion of undetermined deaths and began to correctly identify the cause of death.

When comparing PDUI and HMT, in Figure 1, we see that regions with high HMTs are accompanied by low proportions of deaths with undetermined intent and, conversely, when PDUIs are higher than 50%, for example, the HMTs are low or null (equal to 0) (Figures 1A and 1B). This finding can be better evidenced when observing the municipalities of the Western region and the coastal municipalities of the Far South to the East of the State, from Figure 1.

Initially, in the 2002-2004 triennium, there is a diffuse distribution pattern for PDUIs, evidenced by the low value of the Moran index, close to 0 (0.242). From the 2005-2007 triennium, a pattern of non-random distribution, with an aggregate of high proportions of deaths with undetermined intent (≥ 50%) in the Western region of the State (Figure 1C) as opposed to low homicide rates in the same region (≤ 10 cases per 100,000 inhabitants) (Figure 1D).

The proportion of deaths with undetermined intent of 50% or more in the 2008-2010 triennium was evidenced in 18 of the 417 municipalities in the state, 17 of which were in the Western region. These same municipalities of said HMR registered a homicide rate equal to zero (Figures 1E and 1F).

The distribution pattern of mortality becomes clearer in the last triennium analyzed (2011-2013). With a well-located concentration in the Eestern and Center-eastern HMRs, of municipalities that present high PDUI ≥ 50% and between 11 and 49% (Figure 1G). Table 1 shows that 18 of the 20 municipalities with a proportion of undetermined deaths equal to or greater than 50% are from the Western HMRs; of these, only Barreiras registered homicide rate (6.4 deaths per 100,000); as for the others, the rate was equal to 0. In Table 2, of the municipalities with the highest HMTs, there are six municipalities in the Eastern region, five from the Far South, eight from the South and one from the Northeast, all with low PDUI.

Positive spatial autocorrelation was evidenced by both the homicide rate (Moran's I = 0.560) and the proportion of deaths with undetermined intent (Moran's I = 0.700), since, in the triennium of 2011-2013, Moran Global values were close to +1 and highly significant (Figures 1G and 1H). As for the high homicide rates per 100,000 inhabitants, the municipalities of Simões Filho (326.3) and Lauro de Freitas (320.4), in the Eastern region, were the most prominent; Porto Seguro (291.7) and Eunápolis (259.2), in the Far South; Uruçuca (269.8) and Itabuna (250.6) in the Southern HMR.

DISCUSSION

The present study sought to identify different spatial patterns of homicide and proportion of deaths of undetermined intent. Municipalities with low proportion of undetermined deaths (less than or equal to 10%) were considered as having good quality mortality

information. The results showed that the same regions that concentrate high rates of homicide also present low proportions of undetermined death; and, conversely, in regions with high rates of undetermined death, homicide rates are low. The West HMR maintained high proportions of undetermined death throughout the analyzed period and, concurrently, low rates of homicide mortality.

This finding "sheds light" on the interpretation of low homicide rates in the municipalities of this locality, since, certainly, the high proportion of deaths with undetermined intent is generating sub-enumeration of homicides. Therefore, the importance of considering and evaluating the quality of information was a central issue in this study, since the results showed how the problems of classifying the cause of death may underestimate and

Table 1. Classification of the twenty municipalities with the highest Proportions of Deaths of Undetermined Intent, compared to the Mortality Rate for Homicide, in the triennium 2011-2013.

Municipality name	Macro-region	PDUI	HMT
Catolândia	West	100.0	0.0
Angical	West	90.0	0.0
Luís Eduardo Magalhães	West	87.8	0.0
Riachão das Neves	West	86.2	0.0
Cristópolis	West	83.3	0.0
Muquém de São Francisco	West	83.0	0.0
Baianópolis	West	81.5	0.0
Barreiras	West	81.0	6.4
Wanderley	West	79.3	0.0
Santa Rita de Cássia	West	75.0	0.0
Cotegipe	West	75.0	0.0
Formosa do Rio Preto	West	74.6	0.0
São Desidério	West	72.4	0.0
Brejolândia	West	66.7	0.0
Mansidão	West	66.7	0.0
Ibotirama	West	63.6	0.0
Oliveira dos Brejinhos	West	61.5	0.0
Morpará	West	61.1	0.0
Biritinga	Center-east	52.6	0.0
Candeal	Center-east	50.0	0.0

PDUI: Proportions of Deaths of Undetermined Intent; HMT: Homicide Mortality Rate.

affect the sizing of homicides in certain localities, besides generating distortions and "camouflaging" homicide distribution patterns[5,8,9].

Therefore, a more careful analysis of homicide rates in a given location and period is fundamental for understanding the real behavior of the mortality indicator, since it is likely that low rates in certain areas are related to the low quality of information about the underlying cause[8]. In other words, areas, municipalities or regions initially classified as low risk for homicide may present an underestimated picture due to inaccuracies in the cause of death conditioned by the increase in the proportion of external causes with undetermined intent, as observed in the results.

In general, mortality studies always point to limitations on secondary data sources. However, in most researches, the issue of information quality is addressed in an indirect and

Table 2. Classification of the twenty municipalities with the highest Homicide Mortality Rates, compared to the Proportion of Deaths of Undetermined Intent, in the triennium 2011-2013.

Municipality name	Macro-region	HMT	PDUI
Simões Filho	East	326.2	8.3
Lauro de Freitas	East	320.4	8.7
Mata de São João	East	303.4	4.8
Porto Seguro	Far South	291.7	2.1
Pojuca	East	281.5	0.0
Uruçuca	South	269.8	0.0
Eunápolis	Far South	259.2	15.9
Itabuna	South	250.6	4.3
Valença	South	250.2	2.3
Dias d'Ávila	East	237.0	4.7
Santa Cruz Cabrália	Far South	236.6	0.0
Itapebi	Far South	221.2	8.1
Santa Luzia	South	215.0	13.6
Ilhéus	South	214.1	5.6
Camaçari	East	213.1	7.7
Teixeira de Freitas	Far South	211.9	9.0
Ituberá	South	211.7	0.0
Ibirapitanga	South	211.6	0.0
Alagoinhas	Northeast	206.3	4.3
Itacaré	South	205.9	0.0

HMT: Homicide Mortality Rate; PMI: PDUI: Proportions of Deaths of Undetermined Intent.

superficial way. Certainly, studies on homicide have different emphasis and approaches to the issue of quality of information on this mortality indicator. Some highlight the importance of the quality of the indicator, its limitations and the possible sub-enumeration of deaths; others, on the other hand, do not take into account or do not explain how the limitations related to the presence of deaths of undetermined intent were treated[16-19].

It should be noted, however, that the limitations arising from the indeterminacy of the underlying cause of death should be considered centrally, especially in states and regions with coverage and quality problems, since low homicide rates may be hidden by high rates of undetermined cause, which can lead to an erroneous presentation of the epidemiological scenario of homicides.

In this context, Cerqueira[20] points out that, Bahia had the highest rate of deaths of undetermined intent from 2007 to 2010 (12.9/100,000 inhabitants) among the country's States, behind only Rio de Janeiro (18.1). An alternative used by the author to deal with the high indices of undetermined death was to estimate homicide rates based on official data; with this, he observed, after correction of deaths, that there was an increase in homicide rates in municipalities with many deaths of undetermined intent.

This evidence recommends caution when interpreting studies that do not take the quality of the indicators into account, or that do not at least include this information. When the researcher does not point out these limitations, the reader may be led to a mistaken or narrow understanding of the landscape of homicides in a given territory and period[21].

The state of Bahia has presented annual increases in homicide rates and, in 2015, ranked first in the country's homicide rate in absolute terms (followed by São Paulo and Rio de Janeiro), with a total of 5,787 deaths/year[3,20]. The World Health Organization (WHO)[22] recommends efforts to prevent violence at a regional level, which include, among other aspects, strengthening sub-regional organizations to work on collecting and disseminating data in order to reveal the real extent of the problem. In this aspect, this study contributes by considering information quality issues and combining the spatial analysis of the distribution of homicides compared to the distribution of undetermined deaths at the municipal level.

Knowingly, the training of technicians, coders and teams responsible for data on external causes can influence the decrease in the classification of deaths in the group of undetermined intent, before the data are made available by SIM[9,10]. In addition, studies conducted with Brazilian Institutes of Forensic Medicine (IMLs), through consultations of documents and reports, can reallocate the "underlying cause" of deaths and reduce underreporting in a given category, such as homicide, even after disclosure of the data in official databases[5]. Another strategy adopted to deal with the limitations related to the number of undetermined deaths is proportional redistribution and the application of correction factors, generating corrected estimates of mortality rates[23].

It is worth noting, therefore, that other studies should consider homicide as an object of analysis always linked to deaths of undetermined intent, since, in addition to mortality differentials, there are important differences and locoregional inequalities that compromise health information in these regions and which should be considered.

CONCLUSION

The main contribution brought by this study was demonstrating, in a descriptive but objective way, how the scenario of homicides in a given locality — in this case the municipalities of the State of Bahia — can be misinterpreted in terms of spatial distribution and indicator quality (HMT) if the limitations related to scaling and failure to record specific external causes are not considered, by means of the proportion of deaths with undetermined intent[21].

Considering the findings of the present study, it is recommended that future studies consider the evolution of deaths with undetermined intent, considering that this subgroup may compromise the mortality indicator not only in cases of homicide, but also in other specific external causes (accidents , suicide), especially when approaching different periods and locations. Since this study showed that municipalities with a high proportion of undetermined deaths presented a low homicide rate in the same period, when limitations related to the determination of the underlying cause of death are not considered, failures in accurately documenting specific external causes can occur, with consequent underestimation of deaths in certain localities.

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