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THE ROAD TOWARDS A BETTER VITAL REGISTRATION SYSTEM: changes in the mortality profile, under-registration of death counts, and ill-defined causes of deaths in Brazil

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THE ROAD TOWARDS A BETTER VITAL REGISTRATION SYSTEM: changes in the mortality profile, under-registration of death counts, and ill-defined causes of deaths in Brazil

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SUMÁRIO

ABSTRACT

This paper examines the spatial pattern of ill-defined causes of death across Brazilian regions, and its relationship to the evolution of completeness of death counts registration and the changes in the mortality age profile. We make use of the mortality database available at the Brazilian Ministry of Health Database - Datasus and Population Censuses from 1980 to 2010. We applied traditional demographic methods to evaluate the quality of mortality data for 137 small areas and correct for death counts under-registration when necessary. The second part of the analysis uses linear regression models to investigate the relation between changes in death counts coverage and age profile of mortality to changes in the reporting of ill-defined causes of death. The completeness of death counts coverage increase from about 80% in 1980-1991 to over 95% in 2000-2010 at the same time the percentage of ill-defined causes of deaths reduced about 53% in the country. The analysis suggests that efforts from the central and local governments to improve data quality in Brazil are being successful, and they will allow a better understanding of the dynamics of health and mortality transition in Brazil.

Keywords: mortality, death counts under-registration, spatial analysis, demographic methods

RESUMO

Este artigo analisa o padrão espacial das causas mal definidas de morte em todas as regiões brasileiras, e sua relação com a evolução da integralidade da morte registro contagem e as mudanças no perfil etário da mortalidade. Nós fazemos uso do banco de dados de mortalidade disponíveis no Ministério da Saúde - Datasus e Censos da População de 1980 a 2010. Nós aplicamos métodos demográficos tradicionais para avaliar a qualidade dos dados de mortalidade por 137 pequenas áreas e corrigir o sub-registro de óbitos, quando necessário. A segunda parte da análise utiliza modelos de regressão linear para investigar a relação entre as mudanças na cobertura do registro de óbitos e o perfil etário da mortalidade em relação às mudanças no registro de causas mal definidas. Os resultados mostram que a cobertura do registro de óbito no Brasil saltou de 80% em 1980-1991 para mais de 95% em 2000-2010. Ao mesmo tempo, o percentual de causas mal definidas de mortes reduziu cerca de 53% no país. A análise sugere que os esforços dos governos central e local para melhorar a qualidade de dados no Brasil estão sendo bem-sucedido, e que irá permitir uma melhor compreensão da dinâmica da saúde e da transição da mortalidade no Brasil.

Palavras-chave: mortalidade, sub-registro de óbitos, análise espacial, métodos demográficos

JEL: J10, J11, J14, J18

INTRODUCTION

In Brazil, mortality estimates and the knowledge of levels and trends of mortality are limited by the quality of data[1-4]. The most common problems faced are incomplete coverage of vital registration systems, errors in age declaration for both population and death counts, and lack of information on causes of deaths[1,4,5]. According to international standards, Brazil is characterized by high levels of ill-defined causes of death[6] and regular levels of death counts registration[7-10]. Information on causes of death is of fundamental importance because they provide subsidies to assess the health status of populations and for planning, monitoring and health evaluation, especially at sub-national levels[6,11]. The high concentration of ill-defined causes of death reflects the lack of access to basic health services and the quality of healthcare[12] and is also considered an indicator for assessing the quality of the death registration system[1,6,11]. If the relative number of ill-defined causes of death is high, it will then harm the study of epidemiological and health transitions, especially across regions and over time[12].

In the last three decades, the Brazilian government has made significant investments to improve the coverage of death records and quality of death counts registration[13,14]. Although, the vital registration system is showing clear signs of improvement in recent years, the quality of death counts coverage and information on causes of death varies widely by region[1,3]. In this context, this paper aims to examine the spatial pattern of ill-defined causes of death across Brazilian regions, and its relationship to the evolution of completeness of death counts registration and the changes in the mortality age profile.

This study rests on two working hypotheses: (i) that there is a relation between improvements in death counts registration and declining percentage of deaths reported as ill-defined; and (ii) that population aging and concentration of deaths at older ages increases the percentage of deaths reported as ill-defined. We argue that regions with better death counts coverage present better quality of reports causes of death and, for other regions, as well as the mortality coverage improves, the percentage of ill-defined causes decreases. However, the quality of death causes registration is hampered by the concentration of deaths in ages 65 and above. Thus, the main objective of the present study is to test these two hypotheses by analyzing the temporal evolution of the quality of causes of death registration and its relation to the evolution of distribution of deaths above age 65 and coverage of death counts between 1980 and 2010.

DATA

We make use of the mortality database available at the Brazilian Ministry of Health Database – Datasus[1,15]. The data are collected by age, sex and causes of death at the municipality level. Population by age and sex comes from national household census conducted by the National Statistics Office in 1980, 1991, 2000 and 2010. The deaths and ill-defined death causes information are provided by the ninth and tenth revision of the International Classification of Diseases.

We aggregated municipalities by comparable small areas, using the National Statistics Office (IBGE) definition of comparable meso-regions. These regions are constructed utilizing regional and

socioeconomic similarities. The meso-regions serve only for statistical purpose; therefore, they do not represent a political or administrative entity. The main advantage of working with these comparable areas is that they have not changed their boundaries over the period of analysis. Thus, we are able to follow and study 137 small areas between 1980 and 2010.

METHODS

Coverage of death registration

To evaluate the coverage of reported deaths we use traditional demographic methods, called Death Distribution Methods – DDM henceforth[16-18]. The DDM are commonly used to estimate adult mortality in a non-stable population and analyze mortality data quality in intercensal periods[16,19,20]. They make several strong assumptions: 1) that the population is closed to migration; 2) that the completeness of recording of deaths and population are constant by age; and 3) that ages of the living and the dead are reported without error. There is a large body of literature on the methods, for reasons of space they will not be discussed in detail here.

The assumption that the population is closed to migration is important to Brazilian regions, since the country is marked by significant migration flows between its regions[21]. The DDM method uses information on deaths and growth rates accumulated above a series of ages x. If there is some age x above which net migration is negligible, the performance of the methods above that age will be unaffected[16,22]. We use the age range 30+ to 65+ as suggested elsewhere[16,23] to avoid possible problems regarding migration and to overcome limitations as a result of old age reporting errors (referring to age declaration). The inverse of estimated coefficient can also be used to adjust the number of deaths by age and provide better estimates of mortality and life expectancy[16].

The second part of the analysis studies the changes in the quality of mortality data between the periods of 1991-2000 and 2000-2010. We investigate the relationship between the changes in the percentage of ill-defined causes of death and changes in the percentage of completeness of death counts coverage and in the percentage of deaths above age 65. We study this relationship after controlling for other confounding effects such as regional and socioeconomic differences. Region plays an important role in the model since Brazil is marked by large regional differences in terms of development and socioeconomic indicators[24]. This variable also captures other unobserved variables that could affect the quality of health data. The model has the following specification (1) and it is estimated for each period and for males and females separately.

$$\Delta Y_{ill-defined.mortality} = \Delta\beta_{coverage} + \Delta\beta_{elderly.mortality} + \Delta\beta_{household.income} + \beta_{region} + \varepsilon \quad (1)$$

DESCRIPTIVE ANALYSIS

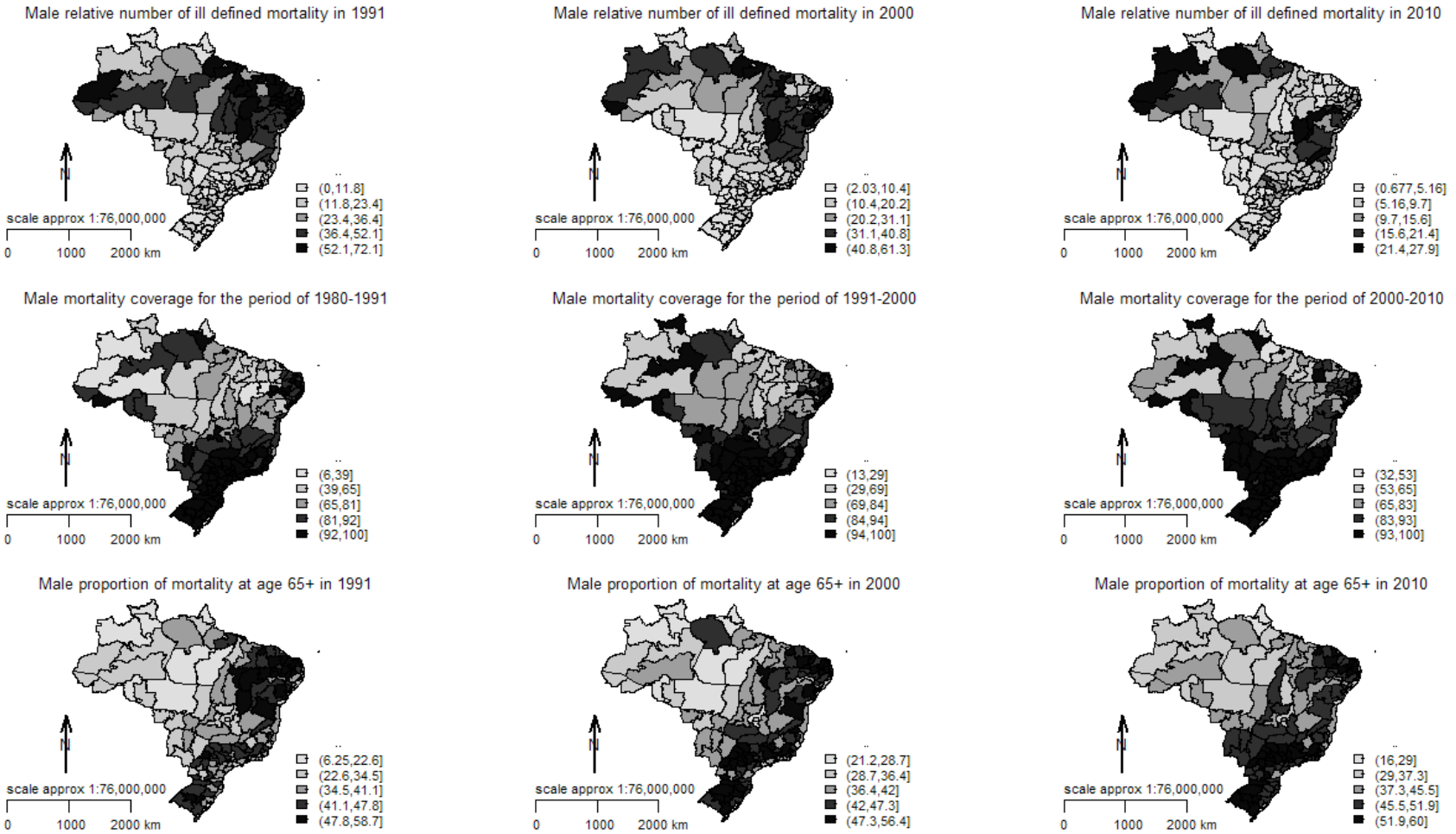
Figure 1 shows the evolution of the percentage of deaths recorded as ill-defined, death counts coverage for each intercensal period and percentage of deaths above age 65. The spatial trends and levels are very similar for both sexes, for simplicity we only show results for males. The information on % of ill-defined and % above age 65 is presented for each census year.

The results indicate a reduction in the overall levels of deaths registered as ill-defined in Brazil. In 1991, 28% of deaths were registered as ill-defined compare to an average of 9% in 2010. The relative percentage of ill-defined death records is still high for international standards, but recent investments led to a clear improvement in the data quality. Figure 1 also indicates cluster of ill-defined death causes in the less developed Northern and Northeastern parts of the country, and better vital registration system in the South and Southeast.

Completeness of death counts increased from 80 % in 1980-1991 to 95% in 2000-2010, but a large regional variation still persists in a similar pattern to the distribution of ill-defined causes of death. Figure 1 shows that in 1980-1991 coverage ranged from 6% to 100% and only the meso-regions in the South and Southeast presented reasonable quality. In the intercensal period of 1991-2000 data quality improved to other parts of the country, except specific areas of the Northeast and North. Between 2000 and 2010, the degree of coverage varies from 32% in the worst area of the Northeast and North to 100% in several meso-regions of South and Southeast. The estimated coefficients indicates that a large number of regions in Brazil does not collect complete information on the number of deaths that occurred in the region, this leads to overestimation of life expectancy and might mislead public health policies.

Finally, the demographic and epidemiological transitions combined lead to an increase in the percentage of deaths above age 65, for males and females. In 1980, some parts of the Northeast and most of the South and Southeast had a high concentration of deaths for individuals above age 65. In 2010, we observe that in addition to the South, Southeast and Northeast, other regions in the Mid-West also present a large concentration of deaths above age 65. Similar process was observed in other countries[25] and could have direct impact on the quality of mortality data across Brazilian regions. Some authors identify that a significant percentage of ill-defined deaths occurred at home without an attending physician making it more complicate to identify the correct cause of death[1]. As population ages and older individuals live alone[26,27] there will be an increasing demand for accessing the quality of death information for older individuals.

FIGURE 1 - Evolution of the Quality of Mortality Data, Males, Brazil, 1980 - 2010



Source: DATASUS, 2012 and Population Censuses (1980, 1991, 2000, 2010).

REGRESSION ANALYSIS

We then look at how variations in the percentage of ill-defined causes of deaths are related to changes in the completeness of death counts coverage and age pattern of mortality (deaths over age 65). Tables 1 and Table 2 show the results of the regression models for each intercensal period and each sex.

TABLE 1

Linear regression models of the variation of percentage of ill-defined deaths, males, Brazil, 1991-2000 and 2000-2010

Variation between 1991 and 2000	Beta	Sig.	Variation between 2000 and 2010	Beta	Sig.
Intercept	-13.77	***	Intercept	-12.32	***
Variation in mortality coverage between 1980/1991 and 1991/2000	-0.24	***	Variation in mortality coverage between 1991/2000 and 2000/2010	0.13	
Variation in percentage of deaths at +65 years old between 1991 and 2000	0.61	***	Variation in percentage of deaths at +65 years old between 2000 and 2010	0.55	***
Variation in average household income per capita between 1991 and 2000	0.04	**	Variation in average household income per capita between 2000 and 2010	0.03	*
Southern/Southeastern region ref.	-	-	Southern/Southeastern region ref.	-	-
Northern region	4.84		Northern region	-4.70	*
Northeastern region	-4.22		Northeastern region	-16.58	***
Mid-Western region	0.99		Mid-Western region	-1.03	
R-squared: 0.42			R-squared: 0.57		
p < 0.01***, p < 0.05 ** and p < 0.1*					

Source: DATASUS and Population Censuses.

TABLE 2

Linear regression models of the variation of percentage of ill-defined deaths, females, Brazil, 1991-2000 and 2000-2010

Variation between 1991 and 2000	Beta	Sig.	Variation between 2000 and 2010	Beta	Sig.
Intercept	-11.81	***	Intercept	-8.28	**
Variation in mortality coverage between 1980/1991 and 1991/2000	-0.16	*	Variation in mortality coverage between 1991/2000 and 2000/2010	0.19	
Variation in percentage of deaths at +65 years old between 1991 and 2000	0.32	*	Variation in percentage of deaths at +65 years old between 2000 and 2010	0.03	
Variation in average household income per capita between 1991 and 2000	0.03		Variation in average household income per capita between 2000 and 2010	0.02	
Southern/Southeastern region ref.	-	-	Southern/Southeastern region ref.	-	-
Northern region	7.12	**	Northern region	-8.79	***
Northeastern region	-7.19	**	Northeastern region	-21.84	***
Mid-Western region	-1.16		Mid-Western region	0.09	
R-squared: 0.33			R-squared: 0.56		
p < 0.01***, p < 0.05 ** and p < 0.1*					

Source: DATASUS and Population Censuses.

From 1991 to 2000, the results indicate that an increase in 1% in the completeness of death counts coverage for males reduces in 0.24% the percentage of ill-defined causes of deaths. The result is statistically significant at the 1% level. Thus, improvements in the data collection of death counts occur together to enhancements in reports of death causes. For females, the relationship is also valid (coefficient of -0.16), but somewhat weaker and statistically significant at the 10% level. We argue that this difference is related to the historical low levels of death counts completeness for females in Brazil[1,3,28]. In the more recent period, we do not find any strong relation between changes in the completeness of death counts coverage and quality of causes of death information for both sexes. It seems that more recent period changes in declaration of causes of death are more related to changes in the mortality age profile.

In relation to the concentration of death at elderly ages, the results point to a positive relationship between the percentage of deaths above age 65 and the percentage of deaths recorded as ill-defined. For males, an increase in 1% in concentration of deaths above age 65 increases by 0.61% the number of ill-defined death causes from 1991 to 2000. In the last decade, this relation reduces its strength, 0.55% increase of ill-defined deaths for 1% increase in concentration of deaths above age 65. The results for males are significant at the 1% level. Contrary to males, for recent period, we find no evidence that an increase in the percentage of deaths over age 65 for females have impact on the quality of causes of death information. These results are probably related to the different use males and females have of health services in Brazil[29,30], since females have a longer and more regular medical history, it is possible that health workers have more reliable information to determine the cause of deaths than for males. Also, males tend to die more often outside health facilities what reduces the chances of determining the cause of death[31].

The results also indicate that changes in the data quality in the Northeast are slower than changes observed in other parts of the country, and regional differences in both periods are more pronounced for females than for males. It is important to mention that socioeconomic developments do not have a strong impact on the observed improvements in the past two decades, it seems governmental and administrative investments in collecting vital records are the main reason for the recent improvements in the Brazilian vital statistics system.

DISCUSSION

Death counts and causes of death data are fundamental information to plan public health measures in most country, and the evaluation of data quality is an important step to achieve high levels of quality[11]. Previous studies have showed the improvement in the vital registration system in Brazil, but to the best of our knowledge, this is the first study to investigate the issue covering the last three decades and analyzing small areas. The main finding of this paper is the improvement in the collection of mortality data in Brazil. The completeness of death counts coverage increase from about 80% in 1980-1991 to over 95% in 2000-2010 at the same time the percentage of ill-defined causes of deaths reduced about 53% in the country. There are still large regional differences; the South and Southeast have much better data quality than the rest of the country. However, we observed clear improvements

in the data quality of the less developed regions in Brazil[1]. However, contrary to what could be expected, the improvements in data quality are not very close related to regional socioeconomic indicators. The observed improvements seem to be very close related to investments in the public health care system and administrative procedures to collect vital statistics[1,32,34]. Thus, the quality of mortality data for adults seems to have expressively improved through the years and across many regions. At the same time, we find that in areas where mortality is concentrated at older ages the percentage of deaths registered as ill-defined also increase. Some authors also emphasize the role of the physicians while they fill out the death certificates. According to them, the most relevant factor that contributes to high proportion of ill-defined deaths at old ages in Brazil is an inadequate report by the physicians of the actual causes of death (underlying, associated and complications) in the death certificates[27,34].

These results make room for discussion about how ill-defined mortality can be seen as an indicator of data quality. Previous studies showed that higher proportion of ill-defined causes of death are found among the elderly and small children, are more concentrated in less-developed regions of the country and most happened outside a health facility[1,27,31,34]. We should expect that the number of ill-defined causes of death will decrease as improvements in disease-diagnosis develop over time. On one hand, as senescence progresses new diseases might appear and more investments in the diagnostics processes might be necessary. On the other hand, some authors argue that the concept of senescence could be accepted as a cause of death for the very old and, therefore, should not be considered as indicative of poor quality mortality data[33]. In this case, to ensure the quality of mortality data for the elderly will require more care and investments in the health care of this particular age group, especially because of these deaths could occur outside a health facility[1].

Although the study has important findings for the planning of public health measures in Brazil, the results should be viewed with caution. The main limitation is the application of the death distribution methods for small areas[16,35]. The methods make strong assumptions about closed population and constant quality of declaration across age that is more limited for smaller areas. We believe that this is an important area of future research. In this paper, we have followed similar approach performed by others[16,35] and we considered them to be reasonable based on the relative pattern of completeness across regions. Despite these limitations, we believe that the study gives important insights about the evolution of data quality in Brazil and indicates that the South, Southeast and Centre-West regions have good mortality data and the North and Northeast are improving consistently in recent years.

The analysis suggests that efforts from the central and local governments to improve data quality in Brazil[32,34] are being successful, and they will allow a better understanding of the dynamics of health and mortality transition in Brazil. It is clear, however, that more investments are necessary in some parts of the country that are still lagging behind in this area. It is important continuous study and evaluation of data quality, especially for small areas and investments for all administrative levels to improve health information in Brazil. However, further analysis should also be done at what is happening at the local level, since ill-defined causes of death records are considered to be an indicator or poor data quality and health services, workers in the health sector might be induced to report any cause of death to avoid reporting the event as ill-defined. In this area, continuous investments in the

Brazilian Family Health Program[35] could have important impacts on the improvement of mortality data quality in Brazil since its personnel works closely to the community and follows the health status of several individuals under their jurisdiction.

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