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Preventable deaths within Brazil's Public Health System in a population from 5 to 69 years old, 2000 – 2013

Mortes evitáveis no Sistema Único de Saúde na população brasileira, entre 5 e 69 anos, 2000 – 2013

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ABSTRACT: *Objectives:* To analyze the mortality trend in the Brazilian population aged between 5 and 69 years old, using the "Brazilian List of Causes of Preventable Deaths". *Methods:* This is an ecological study that uses a time-series analysis of the standardized mortality rate for preventable and unpreventable causes in the period from 2000 to 2013, with corrections for ill-defined causes and the under-reporting of informed deaths. *Results:* There was a decline in the mortality rate in the Brazilian population aged 5 to 69 due to preventable causes (1.6% per year) and unpreventable causes (1.4% per year), in addition to a decrease among all of the groups of causes of preventable deaths in the period from 2000 – 2013. The study draws attention to the increase in deaths from specific causes such as pneumonia (1.9% per year) and transportation accidents (0.6% per year), as well the stability in the number of deaths from aggression and intentional self-harm. Deaths from noncommunicable diseases fell by 2.2% per year and were highest in the age group of 60 – 69 years old in 2013 (209.9/100,000 inhabitants for ischemic heart disease deaths, 157.2/100,000 inhabitants for cerebrovascular diseases and 116.8/100,000 inhabitants for diabetes). *Conclusion:* The rates of preventable deaths are still high, especially for noncommunicable diseases and external causes. These causes of death are sensitive to health promotion interventions and, therefore, this study reinforces the need to remain focused on these causes of illness and death, as well as their risk factors.

Keywords: Premature Mortality. Causes of Death. Chronic Disease. External Causes. Public Health System. Prevention & Control.

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RESUMO: *Objetivos:* **A**nalisar a tendência da mortalidade na população brasileira de 5 a 69 anos, utilizando a "Lista Brasileira de Causas de Mortes Evitáveis". *Métodos:* Trata-se de um estudo ecológico de séries temporais da taxa de mortalidade padronizada por causas evitáveis e não evitáveis no período de 2000 a 2013, com correções para as causas mal definidas e o sub-registro de óbitos informados. *Resultados:* Evidenciou-se declínio da taxa de mortalidade na população de 5 a 69 anos residente no Brasil por causas evitáveis (1,6% ao ano) e não evitáveis (1,4% ao ano), além de queda em todos os grupos de causas de mortes evitáveis no período 2000 – 2013. O estudo chama atenção para o aumento dos óbitos por causas específicas, como a pneumonia (1,9% ao ano) e os acidentes de transporte (0,6% ao ano), além de estabilidade para óbitos por agressões e lesões autoprovocadas intencionalmente. As mortes por doenças não transmissíveis reduziram 2,2% ao ano e foram mais elevadas na faixa etária de 60 a 69 anos em 2013 (209,9/100.000 hab. para as mortes por doenças isquêmicas do coração; 157,2/100.000 hab. para as doenças cerebrovasculares; e 116,8/100.000 hab. para o diabetes). *Conclusão:* As taxas de mortes evitáveis ainda são elevadas, principalmente para as doenças não transmissíveis e as causas externas. Essas causas de morte são sensíveis às intervenções de promoção da saúde e, portanto, este estudo reforça a necessidade de manter o foco nessas causas de adoecimento e de morte, além dos seus fatores de risco.

Palavras-chave: Mortalidade Prematura. Causas de Morte. Doenças Crônicas. Causas Externas. Sistema Único de Saúde. Prevenção e Controle.

INTRODUCTION

Causes of preventable or reducible deaths are defined as those that can be totally or partially prevented by effective health service actions that are accessible in a given place and time[1]. Based on the studies of Ruststein et al.[1], different authors used the concept of preventable deaths in developed countries in the 1980s and 1990s, establishing methodologies that are most appropriate for the classification of causes of preventable death. This, considering that it is possible to prevent a premature death by preventing the onset of a disease or adequately treating it when it occurs[2-5].

Over the years, the lists of causes of preventable deaths has changed depending on how health care practices and technologies available have evolved from changes in morbidity and mortality indicators and the life expectancy of populations[5,6] .

In Brazil, in 2007, the first version of the "List of Causes of Preventable Deaths within the Public Health System (SUS)", which resulted from the consensus of experts from various areas, was published[7]. This list used the studies of Rutstein et al.[1], Tobias and Jackson[4] and Ortiz[8] as theoretical references. In addition, from these studies, it adopted the age of 74 as an age limit and the life expectancy of the Brazilian population.

The analysis of preventable death trends has been considered by different authors as a mechanism to evaluate the effectiveness of health care services[1-6]. There has been a reduction in preventable deaths in Brasil[9-15], however, studies that analyze trends in different age groups are still rare. Most of them are concentrated on an analysis of death in childhood or death due to specific causes. Thus, this paper aimed to analyze the trend of causes of preventable

and unpreventable deaths in the Brazilian population and, specifically, in different age groups within the regions of Brazil.

METHODS

This is an ecological study with a time-series analysis regarding the mortality rate trend in the Brazilian population aged from 5 to 69 years old, according to preventability criteria in Brazil and its regions, from 2000 to 2013. The Mortality Information System (*Sistema de Informação sobre Mortalidade* — SIM) and the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* — IBGE) databases were utilized.

The trend analysis of preventable deaths (2000 - 2013) was performed using the "Brazilian List of Causes of Preventable Deaths" for the population aged 5 to 74 years old [7,14]. The deaths were classified according to the list into:

1. preventable causes and subgroups; and
2. non-preventable causes.

The original list provides for the inclusion of ill-defined causes of death. However, in the present study, these causes have been redistributed proportionally among all the defined causes.

The causes of preventable deaths were divided into five subgroups, according to the type of health intervention, which was based on the technology available through SUS:

1. reducible by means of immunoprevention (subgroup 1);
2. reducible by means of health promotion, adequate prevention, control and attention to infectious diseases (subgroup 2);
3. reducible by means of health promotion, prevention, control and attention to non-communicable diseases (subgroup 3);
4. reducible by means of prevention, control and attention to causes of maternal death (subgroup 4);
5. reducible by means of intersectoral actions and health promotion, prevention and appropriate attention to external causes (accidents and violence) (subgroup 5) [14].

Despite the improvement in the quality of SIM data in recent years, there are still problems with under-registration and non-specific registration, such as poorly defined causes. Thus, two techniques were used in the preparation of the database.

The first technique consisted of correcting unrecorded deaths, as recommended by the study entitled "Active Search for Deaths and Births in the Northeast and in the Legal Amazon: an estimate of SIM and SINASC coverage in Brazilian municipalities", which was developed by Szwarcwald et al.[16]. These data are available on the DATASUS website of the Ministry of Health for the period from 2000 to 2013[17].

The second technique was the correction of ill-defined causes, which used the methodology of proportional redistribution of ill-defined deaths among all known causes, following the

assumption that the distribution of poorly defined causes of death is similar to the distribution of well-defined causes[10,15]. To do this, the methodology proposed by Ducan et al.[15] was adapted, since external causes were included in the redistribution of poorly-defined causes, based on a study by França et al.[8]. This study, which analyzed investigations of deaths due to poorly defined causes, demonstrated that the occurrence of violence and accidents were among the analyzed causes of death[18]. Thus, the redistribution of deaths within the total number of ill-defined deaths, including external causes, was considered.

Both corrections were made for year strata (2000 to 2013), age group (5 to 9, 10 to 14, 15 to 19, 20 to 29, 30 to 39, 40 to 49, 50 to 59 and 60 to 69 years old) and region (North, Northeast, Southeast, South and Midwest). The corrected final mortality rate was standardized using the direct method, by gender and age, using the World Health Organization's (WHO) standard world population.[19]

Defining the age limit at 69 years old was another methodological change, since the previous list was set at 74 years old[7,14]. The conceptual basis aims to maintain comparability with the goals of the WHO[20], the Plan to Tackle Non-Communicable Diseases (NCDs)[21] and the Sustainable Development Objectives (*Objetivos de Desenvolvimento Sustentável* ODS)[22], which establish 30 to 69 years old as the age group for indicating a premature death from NCDs.

The Simple Linear Regression method was used to analyze the trend of mortality rates due to preventable causes and their subgroups, and the trend of mortality rates due to unpreventable causes. Data were presented in Excel spreadsheets for the years 2000, 2007 and 2013, but the regression analysis was calculated using all of the years of the series (2000 to 2013). A residue analysis was used to evaluate the suitability of the model. The software used was the Statistical Package for Social Sciences - SPSS (Statistics Base), version 17. The level of statistical significance of 5% was accepted.

The average annual percentage reduction in mortality rate was calculated by the difference between consecutive year rates and then divided by the rate from the first year of the calculation (multiplied by 100). The mean of the values found was defined as the annual reduction in the period. The percentage of total reduction for the period was calculated by subtracting the mortality rate for the year 2013 from the mortality rate of 2000, and dividing it by the 2000 year rate (multiplied by 100). The values of the mean annual reduction percentage of the period were presented in the tables. The negative value represented the increase in the mortality rate and the positive value represented the decrease in the mortality rate.

This study followed ethical recommendations. A Free and Informed Consent Term (ICF) was not necessary, since secondary data was used that was available on the Ministry of Health's official website. On the website, there is no information that can identify individuals.

RESULTS

In Brazil and all of its regions, there was a reduction in the mortality rate due to preventable deaths because of immunoprevention. It went from 0.8 deaths per 100,000 inhabitants in 2000 to 0.3 deaths in 2013 (p <0.001), with an average annual decline of 5.9% and 62.5% within the period (Table 1). Trends declined in all of the regions (Table 1 and Figure 1A)

Table 1. Mortality rate, annual reduction and reduction percentage in the period from 2000 to 2013, per 100 thousand inhabitants, in the population aged 5 to 69 years old. Brazil and its regions, 2000, 2007 and 2013.

Preventable causes	2000	2007	2013	% annual reduction	% reduction within the period	p-value
Immunoprevention						
North	1.8	1.4	0.9	2.6	50.0	0.001
Northeast	0.7	0.6	0.3	5.2	57.1	< 0.001
Southeast	0.7	0.4	0.3	5.9	57.1	< 0.001
South	0.7	0.4	0.3	4.4	57.1	< 0.001
Mid-west	0.7	0.4	0.3	3.5	57.1	< 0.001
Brazil	0.8	0.5	0.3	5.9	62.5	< 0.001
Appropriate actions to promote health, prevention, control and attention to infectious diseases						
North	39.7	38.9	37.9	0.2	4.5	0.002
Northeast	33.0	28.6	31.4	0.3	4.8	0.008
Southeast	40.2	36.2	36.7	0.7	8.7	0.001
South	28.4	28.3	29.0	-0.2	-2.1	0.227
Mid-west	28.0	28.3	26.7	0.3	4.6	0.600
Brazil	35.8	32.7	33.6	0.4	6.1	0.003
Appropriate actions to promote health, prevention, control and attention to non-communicable diseases						
North	222.6	200.1	176.1	1.8	20.9	< 0.001
Northeast	226.3	213.8	192.2	1.2	15.1	< 0.001
Southeast	257.5	212.1	179.9	2.7	30.1	< 0.001
South	247.5	202.5	175.2	2.6	29.2	< 0.001
Mid-west	236.2	206.7	181.0	2.0	23.4	< 0.001
Brazil	244.8	210.1	182.1	2.2	25.6	< 0.001
Appropriate actions for the prevention, control, and attention to the causes of maternal death						
North	2.4	1.8	1.8	1.7	25.0	0.001
Northeast	2.1	1.6	1.5	2.2	28.6	< 0.001
Southeast	1.0	0.8	0.9	0.6	10.0	0.752
South	1.1	0.9	0.7	3.3	36.4	< 0.001
Mid-west	0.9	0.9	1.1	-2.7	-22.2	0.225
Brazil	1.4	1.1	1.1	1.6	21.4	< 0.001

Table 1. Continuation.

Preventable causes	2000	2007	2013	% annual reduction	% reduction within the period	p-value
Appropriate intersectoral actions for health promotion, prevention, and attention to external causes						
North	91.8	94.2	103.3	-1.0	-12.5	< 0.001
Northeast	91.4	91.5	105.4	-1.1	-15.3	< 0.001
Southeast	90.8	73.0	65.0	2.5	28.4	< 0.001
South	70.0	74.7	69.2	0.1	1.1	0.682
Mid-west	95.6	89.5	96.6	-0.1	-1.0	0.587
Brazil	87.9	81.1	82.3	0.5	6.4	0.001

Source: Mortality Information System – General Coordination of Epidemiological Information and Analysis/Department of Health Surveillance/Ministry of Health (SIM-CGIAE/SVS/MS). Source: Mortality Information System – General Coordination of Epidemiological Information and Analysis/Department of Health Surveillance/Ministry of Health (SIM-CGIAE/SVS/MS).

The mortality rate for the causes that could be reduced by appropriate actions promoting health, prevention, control and attention to infectious diseases in Brazil was 35.8 deaths per 100,000 inhabitants in 2000 and 33.6 in 2013, with a mean annual reduction of 0.4% and in the period, 6.1% (p = 0.003). Insignificant declines were observed in the Midwest and South regions (Table 1 and Figure 1B).

Deaths from preventable causes that could be reduced by appropriate actions promoting health, prevention, control, and attention to noncommunicable diseases ranked first in the causes of death in Brazil, with 244.8 deaths per 100,000 inhabitants in 2000 and 182.1 in 2013. There was an average annual reduction of 2.2% and 25.6% within the period (p <0.001). Decline trends occurred in all of the regions (Table 1 and Figure 1C).

The mortality rate for the causes that could be reduced by appropriate actions promoting prevention, control and attention to maternal diseases in Brazil were reduced 1.6% per year and 21.4% within the period (p <0.001). It went from 1.4 deaths per 100,000 inhabitants in 2000 to 1.1 deaths per 100,000 inhabitants in 2013. There was a downward trend in the South, Northeast and North regions, and a stable trend in the Midwest and Southeast. (Table 1 and Figure 1D).

In the group of causes that could be reduced by appropriate intersectoral actions aimed to promote health, prevention and attention to external causes, there was a small reduction of 0.5% per year and 6.4% within the period, with a mortality rate that changed from 87.9 deaths per 100,000 inhabitants in 2000 to 82.3 deaths per 100,000 inhabitants in 2013, and was ranked second in terms of magnitude (p = 0.001). Only in the Southeast was there a significant decline of 2.5% per year (p <0.001). On the other hand, the Northeast and North regions had a significant average annual increase of 1.1% and 1.0%, respectively (p <0.001). The South and Midwest regions remained stable (Table 1 and Figure 1E).

The mortality rate due to preventable causes in Brazil declined in the period from 2000 to 2013, from 370.6 / 100,000 inhabitants in 2000 to 299.5 / 100,000 inhabitants in 2013, with

an average reduction percentage of 1.6% per year and 19.2% within the period (p <0.001). Non-preventable causes of death diminished from 73.2 to 61.2 / 100,000 inhabitants in the same period, 1.4% per year and 16.4% within the period (p <0.001) (Figure 2).
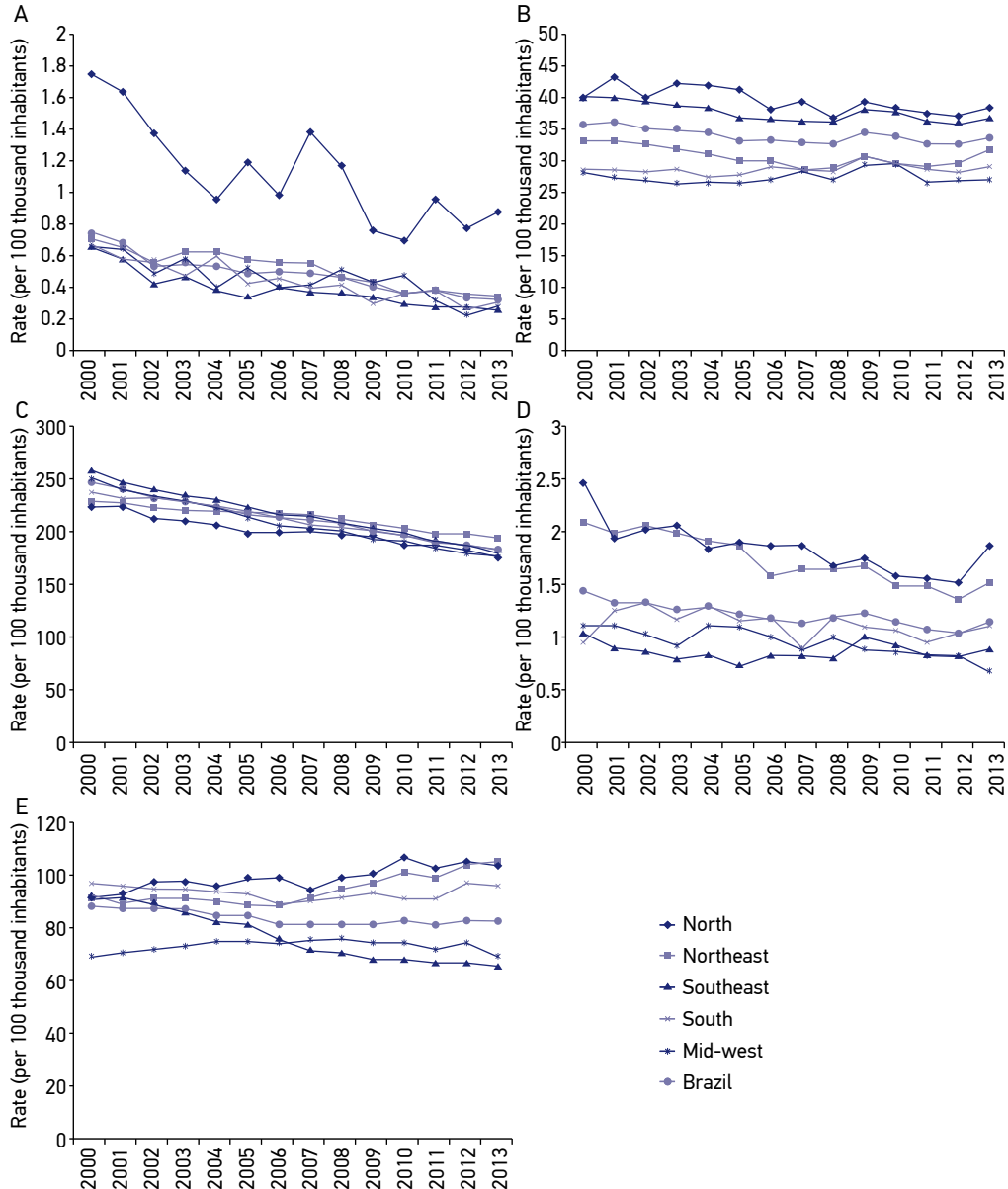
Source: Mortality Information System – General Coordination of Epidemiological Information and Analysis/Department of Health Surveillance/Ministry of Health (SIM-CGIAE/SVS/MS).

Figure 1. Trend of standardized and corrected mortality rates according to a group of causes of deaths that are preventable by the Public Health System, per 100,000 inhabitants, in the population aged 5 to 69 years old. Brazil and its regions, from 2000 to 2013.

Figure 2 (A - E) shows the evolution of mortality in Brazil and its regions during the period from 2000-2013, for the population aged 5 to 69 years old, according to a group of preventable causes. In most groups, the rate in Brazil and its regions declined, except with regard to external causes, which increased in the North and Northeast regions.

The standardized mortality rates for the main causes of specific deaths in each group of preventable deaths for the age range of 5 to 69 years are shown in Table 2. Behavior significantly decreased for all of them except pneumonia and transportation accidents, which had a mean annual increase of 1.9% (p <0.001) and 0.6% (p = 0.009), respectively. Mortality remained stable in the period for aggression (p = 0.256) and intentionally self-inflicted injuries (suicide) (p = 0.194) (Table 2).

Table 3 presents the specific mortality rate in 2013 for the main causes of preventable deaths in each age group of the Brazilian population. The rates for preventable causes of immunoprevention actions (miliary tuberculosis, acute hepatitis B and tetanus) in all age groups are low. Among the causes of attention to infectious diseases, pneumonia occurred more in the age group of 60 - 69 years old. HIV (Human Immunodeficiency Virus) occurred more often in the age group between 40 and 49 years old, and intestinal infectious diseases occurred more often in the age group between 60-69 years old. Non-communicable diseases were the greatest in number. They increased during life, and especially after 40 - 49 years old, reaching higher rates between 60 - 69 years old: 209.9/100,000 inhabitants for ischemic heart diseases, 157.2/100,000 inhabitants for cerebrovascular diseases, and 116.8/100,000 inhabitants for diabetes. The causes of death that are preventable by attention actions aimed at external causes also present high rates. Aggressions predominated in the age group of 15
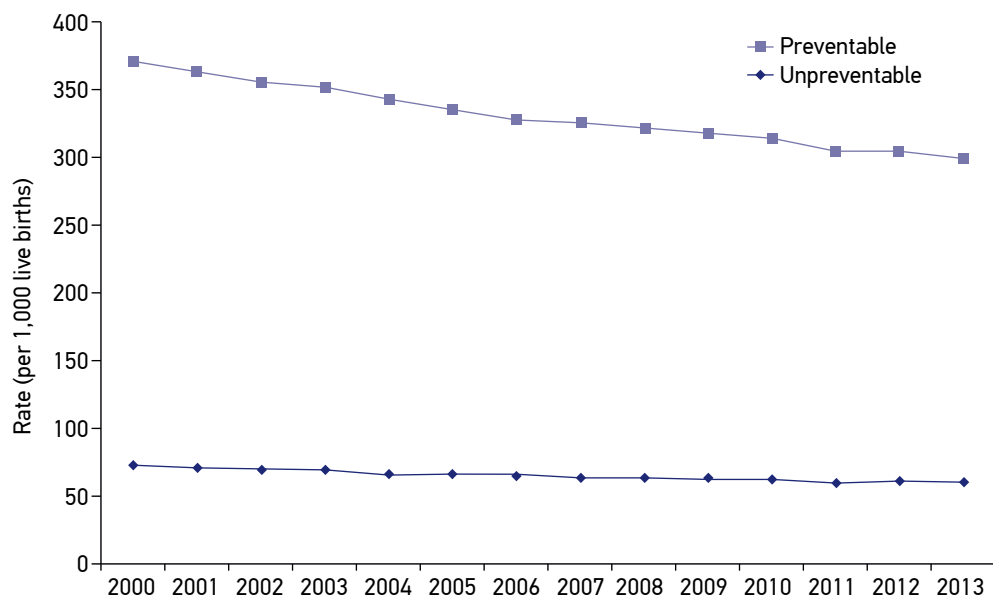

Figure 2. The trend of standardized and corrected mortality rates per 100,000 inhabitants in the population aged 5 to 69 years old, according to preventable and unpreventable causes of death from the Public Health System. Brazil, 2000 to 2013.

to 39 years old, transport accidents, between 15 and 69 years old, and intentionally self-inflicted injuries (suicide), in the range of 20 to 69 years old (Table 3).

DISCUSSION

The study showed a decline in the mortality rate from preventable and unpreventable causes in the Brazilian population aged 5 to 69 between 2000 and 2013. In 2013, a total of 588,675 deaths was recorded in all SIMs in the mentioned population, of which 431,930 (73.4%) were due to preventable causes. The percentage of decline was similar for preventable and

Table 2. Standardized and corrected mortality rates and the percentages of average annual reduction per 100,000 inhabitants, in the population aged 5 to 69 years old, according to the main specific basic causes of death that are preventable by the Public Health System. Brazil and its regions, 2000, 2007 and 2013.

Preventable causes	2000	2007	2013	% average annual reduction	p-value
Immunoprevention					
Miliary tuberculosis	0.3	0.1	0.1	4.2	< 0.001
Acute hepatitis B	0.3	0.2	0.1	4.2	0.003
Tetanus	0.2	0.1	0.1	7.1	< 0.001
Attention actions for infectious diseases					
Pneumonia	10.1	10.7	12.6	-1.9	< 0.001
Diseases from HIV	8.6	7.9	7.5	1.0	< 0.001
Intestinal infectious diseases	1.3	1.0	0.8	3.3	< 0.001
Other infections	5.5	4.4	4.4	1.5	< 0.001
Attention actions for non-communicable diseases					
Ischemic heart diseases	44.2	37.6	32.8	2.2	< 0.001
Cerebrovascular diseases	43.3	31.5	24.0	4.4	< 0.001
Diabetes	20.7	18.2	16.1	1.9	< 0.001
Attention actions for maternal causes of death	1.4	1.1	1.1	1.6	< 0.001
Attention actions for external causes of death					
Aggressions	33.7	31.6	34.7	-0.3	0.256
Transport accidents	23.6	25.0	25.1	-0.6	0.009
Self-inflicted injuries	5.5	5.9	6.1	-0.9	0.194

HIV: Human Immunodeficiency Virus
Source: Mortality Information System – General Coordination of Epidemiological Information and Analysis/Department of Health Surveillance/Ministry of Health (SIM-CGIAE/SVS/MS).

non-preventable causes, however, preventable mortality rates were five times higher than non-preventable mortality rates. In addition, there was a decline within all of the groups with regard to causes of preventable deaths, which reflects an improvements in the services offered by SUS that contribute to the prevention of these deaths.

The number of preventable deaths within the group of non-communicable diseases stands out. It had the highest rates throughout the analyzed period in Brazil and all of its regions. NCDs are one of the greatest public health problems because they cause a high

Table 3. Specific mortality rate for the main specific basic causes of death that are preventable by the Public Health System, per 100 thousand inhabitants, according to the age range in the population aged 5 to 69 years old. Brazil, 2013*.

Preventable causes	2013							
	Age range (years)							
	05 – 09	10 – 14	15 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
Immunoprevention								
Miliary tuberculosis	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.3
Acute hepatitis B	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4
Tetanus	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3
Attention actions for infectious diseases								
Pneumonia	1.4	1.3	2.1	2.8	5.9	13.3	28.2	69.3
Diseases from HIV	0.1	0.1	0.8	5.3	12.5	16.4	11.6	7.1
Intestinal infectious diseases	0.3	0.2	0.2	0.2	0.4	0.8	1.9	4.0
Other infections	0.9	0.6	1.1	1.2	2.0	4.4	10.1	22.7
Attention actions for non-communicable diseases								
Ischemic heart diseases	0.0	0.2	0.8	1.9	7.2	30.5	89.7	209.9
Cerebrovascular diseases	0.3	0.6	1.2	1.9	6.3	22.6	58.8	157.2
Diabetes mellitus	0.1	0.2	0.5	1.2	3.2	11.5	38.4	116.8
Attention actions for external causes of death								
Aggressions	0.7	4.9	63.6	69.9	44.5	28.1	17.9	11.8
Transport accidents	3.7	5.1	23.2	34.7	30.1	30.3	28.8	31.2
Self-inflicted injuries	0.0	0.8	4.4	7.3	7.9	8.7	8.3	8.0

HIV: Human Immunodeficiency Virus; *The maternal mortality rate is not included, since it is a specific rate for the female population.
Source: Mortality Information System – General Coordination of Epidemiological Information and Analysis/Department of Health Surveillance/Ministry of Health (SIM-CGIAE/SVS/MS).

number of premature deaths, a diminished quality of life with many limitations, an incapacity for activities of daily living, as well as economic impacts for families, communities and society as a whole[23,24].

Faced with this worldwide problem, in 2011 the United Nations (UN) established commitments to address NCDs, and in 2012, the WHO approved a global action plan for the prevention and control of these diseases[20]. This global plan defined a priority goal to reduce the premature mortality rate for NCDs between the ages of 30 and 70 years old by 25% until 2025[20].

This global goal is in line with the national goal defined by the 2011-2022 Plan to Tackle Non-communicable Diseases, which aims to reduce premature mortality rates (for people 30 to 69 years of age) by 2% per year by 2022[21].

Studies demonstrate Brazil's ability to achieve this goal and reducing this indicator, since they deal with diseases that are easily effected by health promotion interventions and assistance[25,26]. The current study corroborates this data, as it also found a reduction of deaths due to preventable non-communicable diseases (2.2% per year) in the population aged 5 to 69 years old. This positive result is directly related to the implementation of highly cost-effective SUS interventions, such as the control of tobacco and the distribution of drugs to the section of the population with a high risk of developing cardiovascular diseases[25,26].

On the other hand, the group of preventable deaths due to immunoprevention had the lowest rates compared to the others. In addition, there was a reduction in the number of deaths from these causes in Brazil and all of its federative units (FU). This result demonstrates the advances observed due to the incorporation of numerous vaccines with the implementation of the National Immunization Program (*Programa Nacional de Imunização*- PNI) calendar[27].

Regarding the mortality rate for infectious diseases, there was a significant reduction (0.4%) in Brazil and specifically in the North, Northeast and Southeast regions, while in the South and Midwest, rates stayed the same within the period. Data in Brazil show that, although the proportion of total deaths caused by infectious diseases has dropped from 50% to 5% over the last 80 years, they are still an important public health problem[28]. This reduction has been more pronounced in some infectious diseases rather than in others. Data showing an increase in pneumonia, with very high rates among 60-69 year olds, are worrying.

If, on the one hand, the expansion of access to health services can reduce deaths from infectious diseases, on the other hand, greater access to the hospital system, the use of more-advanced technology and the greater frequency of invasive interventions can lead to the increase of deaths from hospital infections, as in the case of pneumonia[28].

This study demonstrated a reduction in the number of preventable deaths due to maternal causes in Brazil and in the North, Northeast and South regions, while the number stayed the same in the Southeast and Midwest. A phenomenon called "obstetric transition", which is characterized by a change from the predominance of a standard of direct obstetric causes of maternal mortality to a growing proportion of indirect causes associated with chronic-degenerative diseases, aging of the maternal population and a modification in the natural history of pregnancy and childbirth, with a standard of institutionalization of care, increased rates of obstetric intervention, and eventual over-medicalization[29,30].

External causes increased in the North and Northeast regions. First on the list were aggressions, followed by transportation accidents and self-inflicted injuries. The increase in transportation accidents, especially motorcycle accidents in the Northeast region and in small towns, has been highlighted in other studies that analyzed the deaths reported in SIM[31,32]. These deaths have been attributed to the increase in motor vehicles, the lack of inspection, the precariousness of public transport, and infrastructure problems, among others[33]. The country's results differ from those in other countries, such as Australia, France, Japan, Sweden, Canada and the United States[33].

In general, the studies show that deaths due to external causes, aggressions and traffic injuries, predominantly affected black males aged between 20 and 39 years[31]. This can be attributed to the young men's exposure to situations of great risk, such as alcohol consumption, drugs, trafficking, aggressive behavior, urban violence, laborious work activities, and the dangerous driving of motor vehicles. With regard to race, there is a relationship between the higher number of deaths and the vulnerability of black people living within adverse social conditions[31].

The present study considered the age limit of preventability at 69 years old, which is in line with the Action Plan Strategies for Tackling Non-Communicable Diseases[20,21,24] and the ODS' goals for reducing premature mortality – between 30 and 69 years of age for NCDs - by 30 % before 2030[22]. Defining the age limit for the analysis of preventable causes is partially arbitrary as it is motivated in part by the average life expectancy of the population, and cannot be interpreted as the absence of preventable events outside the defined age range[6,7]. Previous studies defined 65 years old to be the upper limit of preventability,[1,2] while others adopted 75 years old[4,5].

Within the limits of this study, the use of preventability lists should be considered. The lists may vary according to advancements in knowledge and the use of new technologies, in addition to the need to answer if, in fact, the proposed causes can be impacted by effective health measures. Another limit refers to the use of SIM data that, even if they are corrected, may still be subject to under-registration.

The study found similar reductions in preventable and unpreventable deaths even though a more expressive reduction of only preventable deaths was expected[2]. This may be due to the general decline in mortality trends in the country, stemming not only from causes of death related to health services, or conditions included on the preventability list, but also from the increase of general improvements in life, such as better economic and social conditions, the reduction of inequality, the investment in social programs related to income distribution, and the decline in fertility, all of which affect causes of death[30]. As such, ecological studies may not explain all social phenomena[6].

CONCLUSION

The present study introduced methodological changes in the application of the "Brazilian List of Causes of Preventable Deaths", such as the correction in underreporting, the redistribution

of ill-defined causes, and the alteration of the age limit for the analysis of preventable deaths, following NCD tackling goals, all of which can be considered methodological improvements.

In Brazil, there was a decline in mortality rates in the age range between 5 and 69 years old in all groups of preventable causes of death related to SUS interventions. There has been a significant decline in non-communicable diseases, which have been the main cause of preventable deaths. This demonstrates the likelihood of achieving global targets set for tackling NCDs. However, the adverse trends of most risk factors present a major challenge and require additional and timely actions and policies, especially legislative and regulatory ones, in addition to those that provide cost-effective attention to chronic conditions for individuals with NCDs[25].

External causes of death present a great challenge and their complexity involves the phenomenon of external causes, which demands joint actions among various sectors (health, education, judiciary, transit services, and social services, among others).

The preventability of deaths due to immunoprevention revealed the advances achieved by the PNI and the improvement in basic care. Preventable death trend studies are a useful methodology for the planning of public policies.

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