

## Mortality from Diabetes Mellitus in the state of Bahia in the period from 2012 to 2021

## Mortalidade por Diabetes Mellitus no estado da Bahia no período de 2012 a 2021

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**ABSTRACT | OBJECTIVE:** To describe the profile of mortality due to diabetes mellitus in Bahia between the years 2012 and 2021. **METHOD:** Descriptive ecological study, using time series of secondary data obtained from the SUS Hospital Information System (SIH/SUS) and the Information on Mortality from the Ministry of Health (SIM/MS). The following variables were analyzed using descriptive statistics: year of occurrence, sex, color/race, age group, marital status, education and place of occurrence. **RESULTS:** During the period from 2012 to 2021, a total of 52.307 deaths related to diabetes mellitus were recorded in Bahia, representing a mortality rate of 34.9/100,000 inhabitants. There was an increase in the registration of deaths throughout this period, except for a slight reduction between 2014 and 2015. Deaths were more frequent in the age group of 60 to 69 years (48.2%), among women (55.5%), with a rate of 38 deaths/100,000 inhabitants. Furthermore, brown ethnicity (55.2%), married marital status (28.6%), lack of formal education (31.2%), and the occurrence of deaths in hospital settings (63.9%) were predominant characteristics. **CONCLUSION:** Mortality related to diabetes mellitus in Bahia has increased over the years, mainly during the period from 2012 to 2021, and varies according to sex, age group, color/race and level of education. These results highlight the need for care strategies aimed at higher-risk groups, aiming to reduce mortality associated with this disease.

**KEYWORDS:** Diabetes. Mortality. Health Information Systems.

**RESUMO | OBJETIVO:** Descrever o perfil da mortalidade por diabetes mellitus na Bahia entre os anos 2012 e 2021. **MÉTODO:** Estudo ecológico descritivo, utilizando séries temporais de dados secundários obtidos a partir do Sistema de Informações Hospitalares do SUS (SIH/SUS) e do Sistema de Informações sobre Mortalidade do Ministério da Saúde (SIM/MS). Foram analisadas as seguintes variáveis através da estatística descritiva: ano de ocorrência, sexo, cor/raça, faixa etária, estado civil, escolaridade e local de ocorrência. **RESULTADOS:** Durante o período de 2012 a 2021 foram registrados na Bahia um total de 52.307 óbitos relacionados ao diabetes mellitus, representando uma taxa de mortalidade de 34,9/100.000 habitantes. Observou-se um aumento no registro de óbitos ao longo desse período, com exceção de uma leve redução entre 2014 e 2015. Os óbitos foram mais frequentes na faixa etária de 60 a 69 anos (48,2%), entre as mulheres (55,5%), com uma taxa de 38 óbitos/100.000 habitantes. Além disso, a etnia parda (55,2%), o estado civil casado (28,6%), a falta de educação formal (31,2%), e a ocorrência de óbitos em ambiente hospitalar (63,9%) foram características predominantes. **CONCLUSÃO:** A mortalidade relacionada ao diabetes mellitus na Bahia apresentou aumento ao longo dos anos, principalmente durante o período de 2012 a 2021, e variam conforme o sexo, faixa etária, cor/raça e nível de escolaridade. Esses resultados ressaltam a necessidade de estratégias de cuidados direcionados para grupos de maior risco, visando à redução da mortalidade associada a essa doença.

**PALAVRAS-CHAVE:** Diabetes. Mortalidade. Sistemas de Informação em Saúde.

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## 1. Introduction

Diabetes mellitus (DM) is a chronic non-communicable disease (CNCD) of metabolic character, whose main characteristic is hyperglycemia caused by insulin resistance or autoimmune way. It represents one of the main risk factors triggering ischemic cerebrovascular accident, heart failure, peripheral obstructive artery disease and microvascular disease.<sup>1,2</sup>

DM is one of the fastest-growing diseases worldwide, with a projection of affecting 693 million adults by 2045.<sup>3</sup> Worldwide, it is the ninth cause of death, and the number of people with diabetes mellitus has quadrupled in the last three decades.<sup>4</sup> This growth, both in terms of incidence and prevalence, in the world and in Brazil, has been following the increase in life expectancy of people due to demographic transition.<sup>5</sup>

According to the International Diabetes Federation, about 537 million adults between 20 and 79 years old have diabetes, which represents 10.5% of the world's population in this age group, and the prevalence of diabetes mellitus in people between 75 and 79 years was 24.0% in 2021.<sup>3</sup>

In the Brazilian population context, the reality is also worrying. A Brazilian study that used data from the National Health Survey (PNS - *Pesquisa Nacional de Saúde*), from the National Program for Improving Access and Quality of Primary Care (PMAQ-AB - *Programa Nacional de Melhoria do Acesso e da Qualidade da Atenção Básica*) and data from the Popular Pharmacy (*Farmácia Popular*), found a prevalence of the disease of 9.2%, ranging from 6.3% in the North to 12,8% in the Southeast.<sup>6</sup> The increase in obesity, higher alcohol consumption, inadequate diet and sedentary lifestyle in the population are the factors that contribute most to the increase in its prevalence.<sup>7</sup>

It is possible to classify DM mainly in type 2 DM (DM2), which represents about 90 to 95% of cases, and type 1 DM (DM1), the least prevalent and which corresponds to 5 to 10%.<sup>8</sup> Type 2 diabetes mellitus (DM2) has a complex origin and is multifactorial, with genetic and environmental factors that involve life habits.<sup>1</sup>

DM can cause a number of macro-vascular and microvascular complications, such as diabetic kidney disease, diabetic retinopathy, and neuropathy. These complications in turn can lead to death, a decrease in the quality of life of the patient, in addition to representing costly costs for subsidizing treatments.<sup>9</sup> In several countries, half of the deaths of people with DM are caused by cardiovascular diseases, and although the CVDs represent complications of DM, in the death certificate, they usually appear as the direct cause to the detriment of the primary cause which is diabetes.<sup>1</sup> According to the World Health Organization, the prevalence of DM deaths worldwide grew by about 3% between 2000 and 2019.<sup>2</sup>

Knowing the panorama of DM in terms of mortality in certain regions is relevant, considering that this information can point out important aspects of the distribution of the disease and its impact on the life of the population, and thus think of more effective control strategies. In this sense, this study may provide relevant information about diabetes mellitus mortality in Bahia, which will be important for health professionals and students, in the planning and execution of quality care, mainly in Primary Care, which is preferably the citizen's gateway to the Unified Health System (SUS - *Sistema Único de Saúde*).

Thus, this study aims to describe the profile of diabetes mellitus mortality in Bahia between 2012 and 2021.

## 2. Method

This is a descriptive ecological study, time series, with secondary data, obtained from the Hospital Information System of SUS - SIH/SUS (*Sistema de Informações Hospitalares do SUS*) and Mortality Information System of the Ministry of Health - SIM/MS (*Sistema de Informações sobre Mortalidade do Ministério da Saúde*) available on the website of the SUS Department of Informatics (DATASUS). The SIM data comes from death certificates collected by the Health Departments. This statement contains various information about the person who died, including the underlying cause of death, which has been codified since 1996, using the 10<sup>th</sup> Revision of the International Classification of Diseases - ICD-10.

For this study, the selected underlying cause of death was diabetes mellitus contained in chapter IV and belonging to codes E10 - E14. The study included all records of deaths due to DM in the population of the state of Bahia by place of residence that occurred between 2012 and 2022. Unknown deaths referring to the following variables were excluded: sex, age group and place of occurrence, since they totaled 88 deaths, a number considered small in the universe of 52396. The final study population involved 52,307 deaths.

The variables of interest, already existing in DATASUS, were: year of occurrence (2012, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020 and 2021), sex (male, female), color/race (white, black, yellow, brown, indigenous and unknown), age group (below 1 year, 1 to 4 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, 20 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, 70 to 79 years, 80 years and more), marital status (single, married, widowed, legally separated, other, unknown), schooling (none, 1 to 3 years, 4 to 7 years, 8 to 11 years, 12 years and over, unknown) and place of occurrence (hospital, other health facility, home, street, others).

The ratio between the number of deaths and the population was used to calculate the mortality rate. Regarding the population of the denominator, we used the population estimates of the IBGE from the 2010 Census data, sent to the TCU with last update on 12/15/2021 available on the <https://datasus.saude.gov.br/populacao-residente>.

Considering that the database is a public domain, there is no need for submission and approval by the Research Ethics Committee (REC), following resolution 466/12 of the National Council for Research Ethics.

### 3. Results

In the period analyzed, 52,307 deaths were recorded in the MIS/DATASUS, representing a mean mortality rate of 31.2/100,000 inhabitants. There was an increase in mortality in the years 2020 and 2021, with some oscillations with a small drop in the years 2106, 2018, 2019. The percentage increase in deaths between 2012 (4,444) and 2021 (6,336) was 42.6%. The highest mortality rate was observed in 2020 (42.6/100,000 inhabitants), followed by 2022 (42.2/100,000 inhabitants) (Table 1).

**Table 1.** Diabetes mellitus mortality in Bahia in the years 2012-2021, Salvador, Bahia, Brazil, 2023

Years	Deaths	Mortality rate*
2012	4,444	31.3
2013	4,709	31.3
2014	4,794	31.7
2015	5,102	33.5
2016	4,867	31.8
2017	5,410	35.2
2018	5,159	34.8
2019	5,122	34.4
2020	6,364	42.6
2021	6,336	42.2
Total	52,307	Mean: 34.9

\*Per 100,000 inhabitants.

Source: MS/SVS/CGIAE - *Sistema de Informações sobre Mortalidade* - SIM (2023).

The data in Table 2 show that the highest frequency of deaths occurred in females with 29,048 (55.5%) deaths in the period studied and a mortality rate of 38.0/100,000 inhabitants.

**Table 2.** Mortality due to Diabetes mellitus and sex in Bahia between the years 2012-2021, Salvador, Bahia, Brazil, 2023

Years	Male		Female	
	Deaths	Rate*	Deaths	Rate*
2012	1,936	27.8	2,508	34.7
2013	2,021	27.4	2,688	35.0
2014	2,135	28.7	2,659	34.5
2015	2,213	29.6	2,889	37.3
2016	2,228	29.7	2,639	33.9
2017	2,413	32.0	2,997	38.3
2018	2,302	31.6	2,857	37.8
2019	2,238	30.6	2,884	38.2
2020	2,907	40.0	3,457	45.0
2021	2,866	39.5	3,470	45.0
Total	23,259	Mean: 31.7	29,048	Mean: 38.0

\*Per 100,000 inhabitants.

Source: MS/SVS/CGIAE - *Sistema de Informações sobre Mortalidade* – SIM (2023).

Table 3 shows the number of deaths due to diabetes in the state of Bahia according to race/color, marital status and schooling. The highest frequency of deaths occurred in people aged 60 to 79 years (25,212; 48.2%), in people of brown race/color (28,884; 52.2%), with education level represented by no year of study (16,292; 31.2%) and married status (14,942; 28.6%). Regarding the place of occurrence, the highest record of deaths was in the hospital (33,401; 63.9%).

**Table 3.** Number of deaths from diabetes mellitus according to age group, race/color, education, marital status and place of occurrence in Bahia between the years 2012-2021, Salvador, Bahia, Brazil, 2023

Variables	N	%
<b>Age group</b>		
< 20 years	149	0.3
20 - 39 years	1,270	2.4
40 - 59 years	8,561	16.4
60 - 79 years	25,212	48.2
80 years or more	17,115	32.7
<b>Race/color</b>		
Brown	28,884	55.2
White	10,237	19.6
Black	8,471	16.2
Yellow	194	0.4
Indigenous	105	0.2
Unknown	4,416	8.4
<b>Schooling (years of study)</b>		
None	16,292	31.2
1 - 3	12,039	23.0
4 - 7	5,943	11.4
8 - 11	4,075	7.8
12 years or more	799	1.5
Unknown	13,159	25.2
<b>Marital status</b>		
Married	14,942	28.6
Single	13,366	25.6
Widowed	11,953	22.9
Legally separated	1,617	3.1
Other	2,224	4.3
Unknown	8,205	15.7
<b>Place of occurrence of deaths</b>		
Hospital	33,401	63.9
Home	14,599	27.9
Other health facility	3,287	6.3
Street	397	0.8
Others	623	1.2

Source: MS/SVS/CGIAE - *Sistema de Informações sobre Mortalidade* – SIM (2023).

## 4. Discussion

The findings of the present study allowed observing an overview of DM mortality in the state of Bahia between 2012 and 2021. In addition to the significant number of deaths due to DM, there was an increase in the death rate over the years, corroborating the literature.<sup>10,11</sup> Ecological research conducted in the state of Tocantins also based on secondary data on DM mortality showed that there was an increase in mortality from 26.1/100,000 inhabitants in 2010 to 38.23/100,000 inhabitants in 2020.<sup>12</sup> A study that evaluated hospitalizations and deaths due to DM in the Brazilian Northeast between 2013 and 2017, pointed to Bahia as the state with the highest prevalence of deaths, with 2,717 (36.6%).<sup>13</sup>

The most marked increases in the years 2020 and 2021 can be thought of as an outcome of the lethality of COVID-19 when associated with diabetes.<sup>14</sup> It is known that DM contributes to inflammatory reactions, faster deterioration of the general hemodynamic state increasing the risk of mortality.<sup>15</sup>

It is noteworthy that the fact that Bahia belongs to the Northeast region, which along with the North region has the worst health indicators, many of the complications of diseases and death are attributed to low health coverage, which hinders early diagnosis and access to therapy, including pharmacology, which, in turn, increase lethality due to chronic disease, including DM.<sup>16</sup>

Higher mortality due to DM in females found in this study is according to data from a study conducted in the state of São Paulo that revealed a growth in DM mortality in women and especially in the elderly.<sup>11</sup> This finding can be justified by the higher longevity of women in Brazil, who have a higher life expectancy compared to men<sup>17</sup>, because men die early from external causes, and also because of their insufficient attitudes of self-care.<sup>18</sup>

According to the International Diabetes Federation (IDF), women have statistically higher incidence and prevalence of DM at the peak of their aging compared to men and, consequently, higher mortality rates in older ages.<sup>3</sup> In other countries, such as Mexico, higher DM mortality was also observed in women (95.6/100,000 inhabitants) compared to men (87.7/100,000 inhabitants).<sup>19</sup>

Regarding the age group, mortality affected more people from 40 years, especially in the age group of 60 to 70 years. A study conducted in Fortaleza found that, in 4,394 deaths analyzed, 3,675 cases were of people aged 60 years or more.<sup>20</sup> Increased risk of death in older people can be explained by the fact that, with the aging process physiological changes occur, such as, increase in lipid percentage, gastrointestinal changes with malabsorption, and consequently protein, which associated with glycemic lack of control causes vascular damage and increased risk of lethal outcome.<sup>20,21</sup>

The present study showed that there were more records of deaths due to DM in people of brown race/color. In the state of Bahia, the predominant race/color is brown (56.9%)<sup>22</sup>, which together with black people, composing the black race, also predominates among the population with low socioeconomic status. Therefore, knowing the close relationship between socioeconomic status of individuals and risk factors for mortality due to CNCDs, this finding is expected.<sup>23</sup>

Social vulnerability is one of the factors that most contribute to greater exposure and susceptibility to health and death problems, because it is related to the resources for coping with it.<sup>11</sup> Research data conducted in Argentina show that the distribution of DM in the population has an intensity in terms of morbidity and mortality from the disease in vulnerable populations according to their socioeconomic characteristics.<sup>24</sup>

In this study, deaths predominated in people with low education, represented by the category of "no schooling". A study conducted in Tocantins also found a higher frequency of deaths in the population with low education, many of whom were illiterate (37.4%).<sup>12</sup> As already evidenced in the literature for people with a higher level of education, socioeconomic conditions generally allow greater access to health services and greater control of chronic health problems, while the one with a lower level of education is most affected by loss of quality of life, higher number of years lost and deaths due to DM.<sup>25</sup>

Research data on the Association between Mortality from Chronic Non-communicable Diseases and the Human Development Index in Brazil between 1980 and 2019, points to the correlation of HDI with mortality rates of CNCDs, affirming that, from a high level of human development, mortality rates go into decline.<sup>26</sup>



A study conducted in the Northeast revealed that the highest number of deaths was in married people, about 39%, corroborating the present study in which 28.6% of the deaths were in married people.<sup>27</sup> It may occur that the partners do not share the disease and their concerns regarding treatment, thus generating a negative impact on adherence to treatment when the partner should be a foundation in the treatment of diabetes and a point encouraging adherence to pharmacological and non-pharmacological treatment.<sup>28</sup>

Most of the deaths were registered in the hospital environment. A study conducted with secondary mortality data from the Mortality Information System (SIM) between 2012 and 2016 showed that 67.77% of the deaths studied occurred in the hospital.<sup>29</sup> Diabetes brings a risk of hospitalization 2 to 6 times higher than in non-diabetic individuals, such as hypoglycemia, diabetic ketoacidosis and hyperosmolar hyperglycemic status, which are serious situations that require hospital care, which may explain deaths in the hospital environment being more common.<sup>30</sup>

It is noteworthy that the monitoring of people with DM, especially when there are complications, involves a great financial burden with health expenses and the need for access to treatment, and it is known that it is unequal between developed and developing countries. In Brazil, in addition to regional inequalities, it has been observed that health protocols are not strictly followed, concerning tests, access to health services and their quality, generating a greater number of complications and also more hospitalizations.<sup>6</sup>

Considering the magnitude of morbidity and mortality due to DM, public policies need to offer greater attention to the prevention and control of the disease, and adequate medical care for these individuals needs to be implemented to avoid the worsening of diabetes and serious complications.

This study has some limitations, and the main ones concern the use of secondary data, which may have problems of incompleteness of information, and the high number of unknown information for some variables, which may have interfered with some results representing some bias.

## 5. Conclusions

The present study revealed that Diabetes Mellitus is an important cause of mortality in Bahia, showing growth mainly in the years 2020 and 2021. The highest number of deaths occurred among women, brown people, marital status married, and in the age group of 60 to 69 years.

These findings emphasize the urgent need to address diabetes mellitus as a serious public health problem in Bahia, requiring careful and diligent attention from health managers and professionals.

It is important to recognize that this study has limitations, such as the use of secondary data, which suggests the need for further research, aiming to provide a more effective care direction to patients affected by this condition. The deepening of these investigations can contribute to more targeted prevention, diagnosis and treatment strategies, in order to reduce the mortality associated with diabetes mellitus in the region.

### Authors' contributions

Lima LO participated in the design and operationalization of the project, analysis and interpretation of data, writing of the article and final approval of the version to be published. Palmeira CS participated in the design and operationalization of the project, data collection, statistical analysis and data interpretation, writing of the article and final approval of the version to be published

### Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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