ORIGINAL ARTICLE

Mortality from Cardiovascular Diseases: A Comparative Analysis between the Medical and Non-Medical Populations in Brazil

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Abstract

Background: Cardiovascular disease (CVD) is the leading cause of death worldwide, including among physicians. Professional peculiarities increase cardiovascular risk in this population, making it relevant to analyze mortality in the medical population (MPop) and non-medical population (NMPop).

Objective: To compare the CVD mortality coefficient (MC) in between MPop and NMPop in Brazil by analyzing the epidemiological profile and the main causes of deaths from CVD.

Methods: Time-series study with data obtained from the Mortality Information System of the Federal Council of Medicine and the Brazilian Institute of Geography and Statistics, from 2014 to 2018. The variables age group, sex, race, occupation, and CVD that caused the death were assessed in MPop and NMPop. MC, relative risk and odds ratio between the populations were calculated. Tests for difference in proportions, with approximation to the normal distribution, and chi-squared tests were performed, assuming $p<0.01$ as statistically significant.

Results: Both MPop and NMPop had a predominance of men (86.7% and 52.3%), senior citizens (85.9% and 79.7%) and white individuals (86.4% and 52.2%). The MCs of the MPop and NMPop was 92.2 and 255.1 deaths/100,000 individuals, respectively. The main cause of death was acute myocardial infarction (AMI) (32.5% and 24.6% in MPop and NMPop, respectively) followed by cerebrovascular accident (CVA) (5.1% and 10.5% in MPop and NMPop, respectively).

Conclusion: In Brazil, mortality from CVD was more prevalent in white elderly males, and mainly caused by AMI and CVA. Being a doctor, man and over 60 years old represents a greater chance of death from CVD in comparison with non-physicians.

Keywords: Cardiovascular Diseases/physiopathology; Mortality; Epidemiology; Physicians/statistics &numerical data; Non-Physicians/statistics & numerical data; Brazil.

Introduction

The morbidity and mortality statistics of a population are of great relevance in helping to understand its demographic profile. Among them, the most important variable is cause of death,[1] as it is the final outcome of life, besides allowing monitoring the health/disease situation, such as early mortality and its main determining factors.[2] This information is important for the development of action plans and proper allocation of resources.[3]

Physicians' health status, like of the general population, can be estimated by analyzing mortality data. This has received considerable attention in the last 50 years; for example, the Federal Council of Medicine (CFM, *Conselho Federal de Medicina*) has conducted studies on physicians' working conditions interfere with their life and health.[1,4]

It is possible that a greater knowledge about health, as well as the occupation of professionals in more privileged situations and at higher socioeconomic levels, represented by the medical population (MPop),

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are factors that contribute to lower mortality compared to the non-medical population (NMPop). On the other hand, high degree of stress, long working hours, the expectation of maintaining a high standard of living, high exposure to ionizing radiation and contaminated biological materials, in addition to a delay to seek treatment when ill, are factors that can increase morbidity and mortality rates among physicians.[1] Associated with this, just as in the general population, the mortality profile is also influenced by the lifestyle of these professionals,[3] such as diet, exercise, sleep habits, tobacco smoking, and alcohol consumption.[5] In this way, it is possible to ascertain whether physicians apply to their own lives health concepts learned in their training[1] that they should pass on to their patients.

Prospective epidemiological studies have shown that the presence of certain behavioral risk factors including tobacco smoking, unhealthy diet, sedentary lifestyle, alcoholism, and psycho-emotional stress[6] increases the probability of clinical cardiovascular disease (CVD)[7]. These factors are associated with increased risk for cardiovascular complications, such as acute myocardial infarction (AMI), cerebrovascular accident (CVA), and heart failure (HF).[8] On the other hand, regular exercise, along with adequate eating habits, weight control, and not smoking, are preventive factors for these CVDs, that can contribute to the monitoring and even controlling of patients with coronary artery disease (CAD).[9]

According to the Pan American Health Organization (PAHO) and the World Health Organization (WHO), the main causes of global death in the last 15 years are CVA and ischemic heart disease, accounting for 15,2 million deaths in 2016.[9,10] Thus, CVD is considered the leading cause of death in the world[3,8,9] and can be avoided prevented through early diagnosis and treatment and health promotion.[9] In Brazil, 29.4% of the deaths reported per year are caused by CVD, such as CVA and AMI. As a result, Brazil is among the 10 countries with the highest rate of death from CVD.[9]

This fact can also be observed in the medical population; a study conducted in the state of São Paulo, Brazil, showed that diseases of the circulatory system were the main cause of death among physicians, with CAD being responsible for 30.1% of deaths in 2001.[3] In the state of Bahia, a study carried out in 2019 showed that the three main causes of death in the medical population were diseases of the circulatory system (28%), neoplasms (27%), and external causes (12%), similarly to other studies conducted in the country.[11]

Thus, due to a lack of data on medical mortality from CVD in Brazil, the present study aimed to evaluate this issue, in addition to describing the epidemiological profile, identifying the main causes of mortality, and estimating the CVD mortality coefficient in the Brazilian MPop and NMPop.

Methods

This is an epidemiological, observational, time-series study with an analytical approach, using secondary data obtained from the Mortality Information System (SIM, *Sistema de Informação de Mortalidade*) of the CFM and the Brazilian Institute of Geography and Statistics (IBGE, *Instituto Brasileiro de Geografia e Estatística*).[12,13]

Data were collected from Death Certificates (DCs) referring to CVD, of physicians living in Brazil and of the general population between 2014 and 2018. Individuals under 20 years of age were excluded so that a factor of comparability between the groups could be maintained, and because younger age groups are characterized by cardiovascular diagnoses that are not the object of this study.

The variables of interest were: age group (categorized every 10 years, as of 20 years old on), sex (stratified as male, female, ignored), race (white, black, yellow, brown, indigenous, ignored),[14,15] year of death (2014 to 2018), occupation (classified as medical and non-medical), and the CVD that caused the death, according to the International Classification of Diseases and Related Health Problems (ICD-10)[14,15] (Table 1).

The cause of death was determined based on the causes reported in the DCs and the ICD-10 codes, and for this reason, similar pathologies can be described separately. For instance, ICD I25.1, which represents atherosclerotic heart disease, refers to a chronic ischemic disease (such as atheroma, atherosclerosis, sclerosis) of the coronary artery, while ICD I21.9, which represents unspecified AMI, relates to an acute event of the heart as cause of death.

Statistical analysis

The populations of interest were grouped into MPop and NMPop. To determine the number of non-physicians, an estimate was calculated by subtracting the total number of physicians registered in the CFM, considering both active (whose registration was regular, inoperative, partially suspended, or those with partial interdiction)

Table 1 - List of the International Classification of Diseases (ICD-10) codes for cardiovascular diseases used for data collection

Alphabetical order	ICD-10
A	A520
B	B332, B570, B376, B572
C	C380, C381, C382, C383, C388, C452
D	D151
F	F011
G	G932
I	I00, I010, I011, I012, I018, I019, I020, I050, I051, I052, I058, I059, I060, I061, I062, I068, I069, I070, I071, I072, I078, I079, I080, I081, I082, I083, I088, I089, I090, I091, I092, I098, I099, I10, I110, I119, I120, I129, I130, I131, I132, I139, I200, I201, I208, I209, I210, I211, I212, I213, I214, I219, I220, I221, I228, I229, I238, I241, I248, I249, I250, I251, I252, I253, I254, I255, I256, I258, I259, I260, I269, I270, I271, I278, I279, I280, I281, I288, I289, I300, I301, I308, I309, I310, I311, I312, I313, 7I318, I319, I330, I339, I340, I341, I342, I348, I349, I350, I351, I352, I358, I359, I360, I361, I362, I368, I369, I370, I371, I372, I378, I379, I38, I400, I401, I408, I409, I420, I421, I422, I423, I424, I425, I426, I427, I428, I429, I440, I441, I442, I443, I444, I445, I446, I447, I450, I451, I452, I453, I454, I455, I456, I458, I459, I461, I469, I470, I471, I472, I479, I48, I490, I491, I492, I493, I494, I495, I498, I499, I500, I501, I509, I510, I511, I512, I513, I514, I515, I516, I517, I518, I519, I600, I601, I602, I603, I604, I605, I606, I607, I608, I609, I610, I611, I612, I613, I614, I615, I616, I618, I619, I620, I621, I629, I630, I631, I632, I633, I634, I635, I636, I638, I639, I64, I670, I671, I672, I673, I674, I675, I676, I677, I678, I679, I690, I691, I692, I693, I694, I698, I700, I701, I702, I708, I709, I710, I711, I712, I713, I714, I715, I716, I718, I719, I720, I721, I722, I723, I724, I728, I729, I730, I731, I738, I739, I740, I741, I742, I743, I744, I745, I748, I749, I770, I771, I772, I773, I774, I775, I776, I778, I779, I780, I781, I788, I789, I800, I801, I802, I803, I808, I809, I81, I820, I821, I822, I823, I828, I829, I830, I831, I832, I839, I840, I841, I842, I843, I844, I845, I846, I847, I848, I849, I850, I859, I860, I861, I862, I863, I864, I868, I870, I871, I872, I878, I879, I880, I881, I888, I889, I890, I891, I898, I899, I950, I951, I952, I958, I959, I99
K	K763, K766
M	M311, M622, M314
N	N280
O	O100, O101, O102, O103, O109, O11, O13, O140, O141, O149, O150, O151, O152, O159, O16, O223, O225, O265, O870, O871, O873, O903
P	P290, P291, P299
Q	Q200, Q201, Q202, Q203, Q204, Q205, Q206, Q208, Q209, Q210, Q211, Q212, Q213, Q214, Q218, Q219, Q220, Q221, Q222, Q223, Q224, Q225, Q226, Q228, Q229, Q230, Q231, Q232, Q233, Q234, Q238, Q239, Q240, Q242, Q243, Q244, Q245, Q246, Q248, Q249, Q250, Q251, Q253, Q254, Q255, Q256, Q257, Q259, Q260, Q261, Q266, Q268, Q269, Q270, Q271, Q273, Q278, Q279, Q280, Q281, Q282, Q283, Q288, Q289
R	R000, R001, R002, R008, R010,R011, R012, R02, R030, R031, R040, R041, R042, R048, R049, R05, R060, R061, R062, R064, R066, R068, R070, R071, R072, R073, R074, R090, R091, R092, R093, R098, R570, R931
Y	Y840, Y520, Y527, Y529, Y522, Y625

Source: SIM/DATASUS, 2020.

and not active professionals (transferred, retired, total interdiction or whose registrations were cancelled, nullified, or suspended) from the Brazilian population in that given year.[12,13]

For data analysis, the R software, version 3.6.3, was used. Categorical variables were expressed as absolute and relative frequencies. The mortality coefficient was estimated considering the total number of deaths per year for every 100,000 individuals and standardized for age to eliminate the effects of age variation on comparisons.

Statistical analysis was made by means of statistical tests, using odds ratios and measures of association

between exposure and outcome. For comparisons between the two groups (MPop and NMPop), a test for comparing proportions with approximation to normal distribution was employed. The inexistence of difference between the proportions was defined as null hypothesis (H0), and the existence of difference, as alternative hypothesis (H1). The odds ratio between the two populations was calculated, and to analyze the relationship between the variables, the contingency coefficients were measured using the chi-squared test. All p values lower than 1% (0.01)[16,17] were considered statistically significant.

Results

From 2014 to 2018, 2,103 deaths of physicians and 1,819,079 of non-medical individuals due to CVD were recorded in Brazil.

As for deaths by sex, there was a predominance of males in both groups, with 86.7% of men in the MPop and 52.3% in the NMPop, with a statistically significant difference between the sexes (Table 2). Analyzing the odds ratio of deaths from CVD, considering sex and groups, male physicians were found to be more likely to die from CVD [OR 1.72

Table 2 – Frequency of deaths from cardiovascular among physicians and non-physicians in Brazil from 2014 to 2018 by sex, age group and race

Variables	Physicians (n=2,103)	Non-physicians (n=1,819,079)	p-*value**
Sex, n (%)			
Male	1,824 (86.7)	952,271 (52.3)	<0.01
Female	279 (13.3)	866,601 (47.6)	<0.01
Ignored	-	207 (0.1)	-
Age group, n (%)			
20-29	11 (0.5)	15,022 (0.8)	0.16
30-39	37 (1.8)	38,882 (2.1)	0.26
40-49	72 (3.4)	98,958 (5.4)	<0.01
50-59	177 (8.4)	217,006 (11.9)	<0.01
60-69	543 (25.8)	355,555 (19.5)	<0.01
70-79	504 (24.0)	457,615 (25.2)	0.22
>=80	759 (36.1)	636,041 (35.1)	0.29
Race, n (%)			
Yellow	35 (1.7)	10,747 (0.6)	<0.01
White	1,818 (86.4)	950,399 (52.2)	<0.01
Black	29 (1.4)	153,828 (8.5)m	<0.01
Brown	180 (8.6)	638,586 (35.1)	<0.01
Indigenous	-	3,378 (0.2)	-
Ignored	41 (1.9)	62,141 (3.4)	<0.01

**Test for comparing proportions with approximation by normal distribution*
Source: SIM/DATASUS, 2020.

(95%CI 1.49-1.98)] compared to men who were not doctors [OR 0.58 (95%CI 0.50-0.67)] (p<0.01).

With regard to deaths by age group (Figure 1, Table 2), a higher mortality from CVD was observed among elderly people, accounting for 85.9% and 79.7% of all deaths among physicians and non-physicians, respectively. Among the age groups that represent senior citizens, there was a statistically significant difference in the age group from 60 to 69 years, with a higher number of deaths from CVD in the medical population (25.8% vs. 19.5%, p<0.01) (Table 2).

Concerning the other age groups, the proportions of deaths from CVD in the groups 40-49 years, and 50-59 years were statistically higher in the NMPop than in the MPop (3.4% vs. 5.4%, p=0.01; and 8.4% vs. 11.9%, p<0.01; respectively). Analyzing the odds ratio of death from CVD, considering sex and groups, male physicians aged 60 or older were found to be more likely to die from CVD [OR 1.64 (95%CI 1.43-1.89)] compared to men who were not doctors [OR 0.60 (95%CI 0.52-0.70)] (p<0.01).

Considering the deaths from CVD by race, there was a predominance of white people in both MPop and NMPop (86.4% and 52.2%, respectively, p<0.01). In addition, statistically significant differences were observed in the proportion of deaths from CVD between physicians and non-physicians of other races (Table 2). As for the odds ratio of deaths from CVD, considering race and groups, no differences were found between physicians and non-physicians (p=0.6308).

A dependence (albeit weak) was detected between the variables in all crossings, except between race and sex in the MPop (Table 3).

In addition, from 2014 to 2018, the mortality coefficient of the MPop and NMPop was 92.2 deaths/100,000 individuals and 255.1 deaths/100,000 individuals, respectively. The CVD mortality coefficient in the MPop and NMPop, calculated year by year, is shown in Figure 2. No significant variation was found in the mortality coefficients in both populations over the years. However, the MPop had lower CVD mortality rates compared to the NMPop in all years.

A year-by-year analysis revealed that the highest mortality coefficient was observed in the NMPop in 2016 – 261.2 deaths/100,000 individuals. Among physicians the highest mortality rate was observed in 2015, 100.7 deaths/100,000 individuals.

Figure 3 displays the main causes of death from CVD (according to ICD-10) between 2014 and 2018. The main cause of death was AMI (ICD I21.9) in both populations, accounting for 32.5% of deaths among physicians and 24.6% among non-physicians. CVA (ICD I64) ranked second in both populations, with 5.1% of deaths among physicians, and 10.5% among non-physicians. The third main cause of death was Atherosclerotic Heart Disease (ICD I25.1) in the MPop and Essential Hypertension (ICD I10) in the NMPop.

Table 4 presents the mortality rate standardized for age and sex in the MPop and NMPop populations.

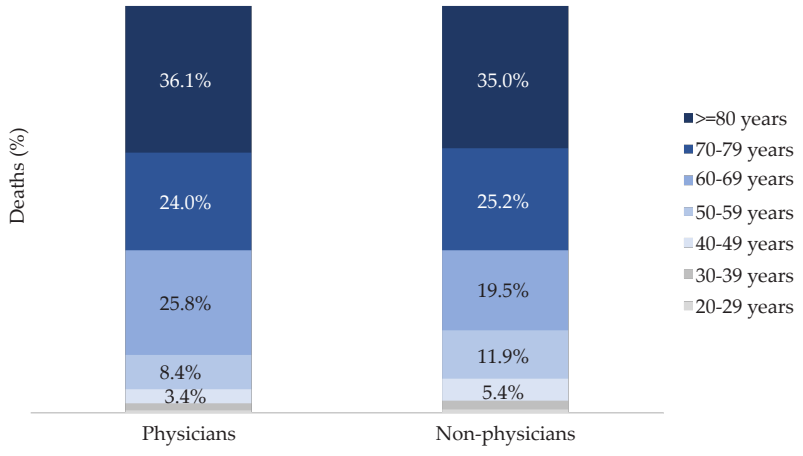

Figure 1 – Deaths from cardiovascular disease among Brazilian physicians and non-physicians between 2014 and 2018 by age groups. Source: SIM/DATASUS, 2020

Table 3 – Contingency coefficients among physicians and non-physicians in Brazil from 2014 to 2018, considering the "Age Group x Sex", "Age Group x Race", and "Race x Sex" crossings

Occupation	Crossing	Contingency Coefficient	p-*value**
Physicians	Group x Sex	0.18	<0.001
	Group x Race	0.17	<0.001
	Race x Sex	0.03	0.67
Non-physicians	Group x Sex	0.17	<0.001
	Group x Race	0.14	<0.001
	Race x Sex	0.06	<0.001

**Chi-squared test for assumption of independence*
Source: SIM/DATASUS, 2020.

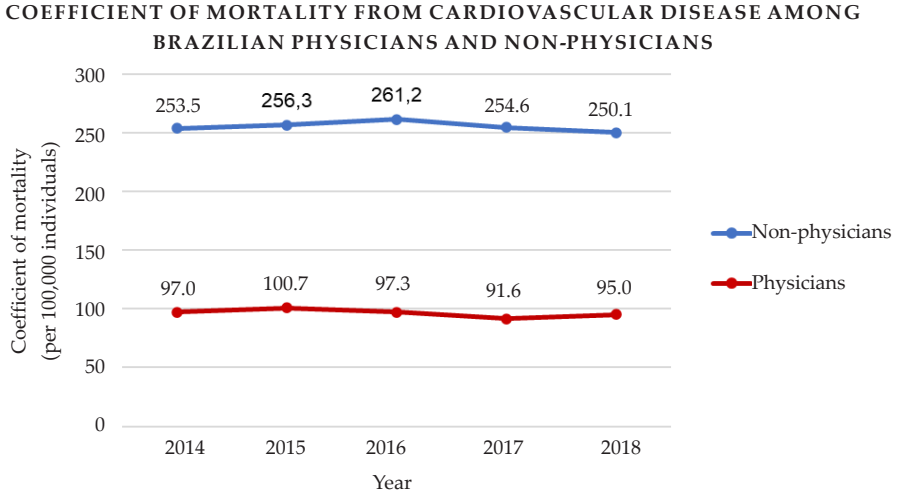

Figure 2 – Coefficient of mortality from cardiovascular disease (per 100,000 individuals) among Brazilian physicians and non-physicians between 2014 and 2018.
Source: SIM/DATASUS, 2020

Discussion

Analyzing the distribution of deaths by sex, mortality from CVD was found to be 6.5 times higher among male physicians than female physicians. The predominance of death in males can be explained by the higher prevalence of men in the medical field, which is associated with a history of greater carelessness on their part with their own health.[11] This finding corroborates other studies on medical mortality in Brazil. Dantas et al.,[11] analyzed the mortality of physicians in the state of Bahia from 2008 to 2017 and showed that 84% of all deaths were of men, with CVD as the most prevalent cause. The Regional Council of Medicine of the state of São Paulo,[3] when investigating trends in the mortality of physicians from 2000 to 2009 in the state, also reported a predominance of men, accounting for 86.7% of deaths. Furthermore, a study in Uruguay reported a mortality rate of 86% in male physicians.[18]

Just as in the MPop, when the NMPop was analyzed, a predominance of males was detected, which corroborates the study by Oliveira et al.,[9] which showed a predominance of deaths from diseases of the circulatory system in males in all Brazilian regions.

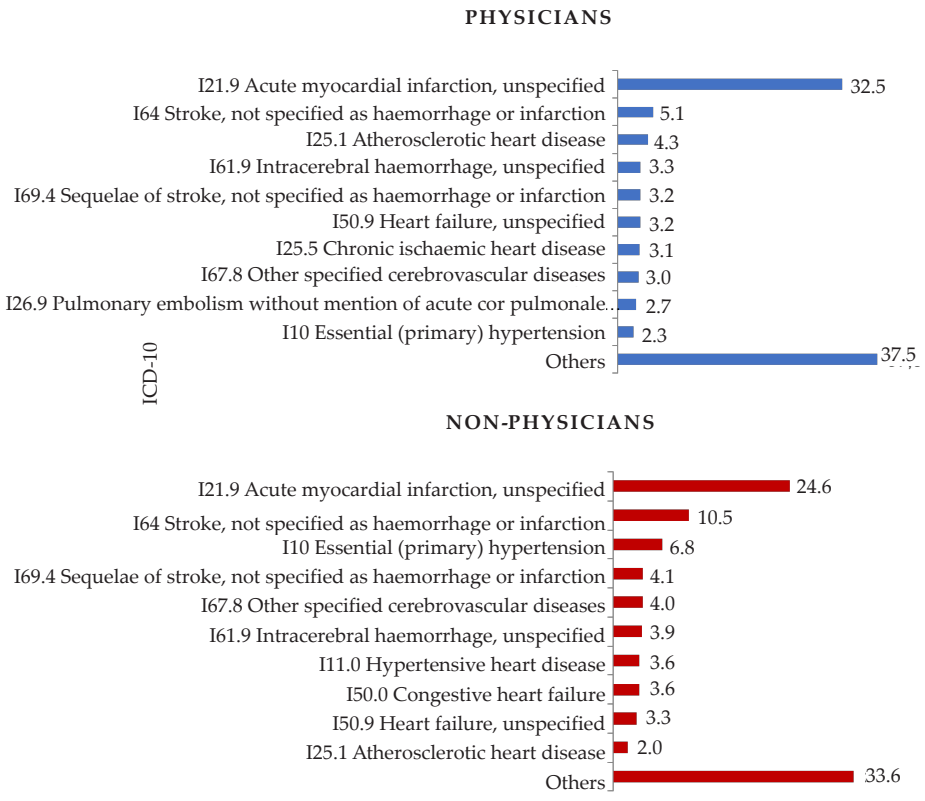

Figure 3 – Relative frequencies of the main causes of deaths from cardiovascular diseases among Brazilian physicians and non-physicians between 2014 and 2018, coded according to the International Classification of Diseases (ICD-10).
Source: SIM/DATASUS, 2020

Table 4 – Age- and sex-standardized mortality rate among physicians and non-physicians in Brazil from 2014 to 2018

Variable	Physicians	Non-physicians	Variation (a/b)%
	Rate (100,000)	Rate (100,000)	
Sex			
Male	872.99	155.42	461.7
Female	147.40	1,309.82	-88.7
Age group			
20-29	191.77	26.82	615.1
30-39	29.63	69.56	-57.4
40-49	91.38	176.88	-48.3
50-59	455.65	38.76	1,075.6
60-69	805.10	63.54	1,167.1
>=70	7,488.88	195.27	3,735.2

Analysis by age group revealed that a greater number of deaths was found among physicians over the age of 80 years, and about three times more deaths occurred in the age group from 60 to 69 years in comparison with 50 to 59 years, which may be a result of the higher prevalence of CVDs in old age.[19] A similar study carried out in the state of São Paulo reported that CVDs were responsible for 29.7% of deaths among physicians from 2000 to 2009; of these, 74.8% occurred after the age of 60, with the peak in the age group from 80 to 89 years,[3] which reinforces the results of this study. On the other hand, analyzing the NMPop, mortality was higher from 50 years of age on.

With regard to race, there was a greater number of deaths from CVD among white individuals, followed by brown and black people. This is probably related to ethnic inequality concerning access to higher education in Brazil, with a markedly smaller number of black doctors in the country. These data corroborate the results of studies conducted in São Paulo[2,3] and Bahia,[11] where a predominance of deaths from CVD among white physicians was shown as well.

Just as among physicians, more white people died from CVD in the NMPop in Brazil, a fact also revealed by Oliveira et al.,[9] These authors also pointed to a higher mortality in the southeast region of the country, which can be explained by the fact that this is the most populous region in Brazil, whose inhabitants are mostly white.[15] It was also evidenced that black people died six times more in the NMPop compared to MPop, which may be influenced by the country's racial historical context, as it limited work and education opportunities for black individuals and caused Medicine to be a mostly white-people profession.

Considering the CVD mortality coefficients described in this study, it was evidenced that, from 2014 to 2018, in Brazil, for every 100,000 physicians, approximately 93 died from CVD, and for every 100,000 non-medical people, approximately 255 died from CVD. This means a CVD mortality coefficient in the MPop of almost 1/3 of the NMPop's coefficient. This disproportion may be linked to the greater access that this population has to health services. Furthermore, no studies assessing CVD mortality coefficients between physicians and non-physicians in Brazil were found. Existing studies have compared the overall mortality coefficient between the two populations and, similarly, found lower levels of mortality in the MPop compared to the general population.[1,11,20]

Over the five years analyzed, no fluctuations were observed in CVD mortality coefficients between physicians and non-physicians. This differs from studies that have analyzed all causes of death between the two populations,[11] or studies that assessed CVD mortality in the general Brazilian population.[21] This discrepancy may be explained by the short period of analysis in our study, in which there were no major changes in the number of inhabitants each year, neither among physicians nor non-physicians.

As the Brazilian population ages, exposure to death from CVD increases, due to a higher risk of diseases affecting the circulatory system. Thus, when assessing the main causes of death from CVD in both populations from 2014 to 2018 AMI ranked first, confirming other studies.[1,19,21,22] However, the present study showed that the MPop was more affected by AMI, despite this group having greater knowledge about the disease and how to prevent it. It is assumed that an exhausting workload leads physicians to neglect their medical needs (e.g., diabetes mellitus, hypertension, and stress) and adopt bad lifestyle habits, such as sedentariness, poor diet, tobacco smoking, and alcohol or drug use, which are risk factors for several CVDs,[1,3] mainly AMI. This hypothesis still needs to be confirmed through studies with primary data and prospective design.

Ranking second among the causes of deaths from CVD, CVA caused twice as many deaths in the NMPop compared to the MPop. Because of this finding, it is suggested that the early diagnosis of CVA favors the survival of physicians, as they are more familiarized with the clinical signs of stroke and have easier and quicker access to cranial computed tomography, differently from the rest of the population. The third most prevalent cause of death from CVD was different between the MPop and the NMPop. Systemic arterial hypertension (SAH) ranked third in the NMPop and only tenth in the MPop, and atherosclerotic heart disease ranked third among physicians, and tenth among non-physicians. This may be explained by the fact that SAH is an asymptomatic disease in its initial stage,[22] and could be diagnosed earlier in physicians due to their greater access to information and diagnostic means in the health system. In contrast, NMPop are likely to suffer a lack of accurate diagnosis of CVD and consequent underreporting. Also, due to factors previously mentioned, the poor quality of life of physicians makes them more prone to develop more severe atherosclerotic heart disease.

Finally, two potential limitations of the study should be addressed. First, since this is a retrospective research based on secondary data, there is a possibility of death underreporting and inaccuracy regarding the cause of death from CVD in the death certificates. Second, selection of the ICD codes was manually made based on the interest of the study, and not restricted to ICD-10 I00 to I99, as proposed by the Brazilian Society of Cardiology.[19]

Conclusion

In Brazil, mortality from CVD among physicians was more prevalent in white elderly males, and mainly caused by AMI and CVA. Additionally, it was shown that being a male doctor, over 60 years of age, represents a greater chance of dying from CVD compared to non-physicians. Nonetheless, the CVD mortality coefficient of the medical population was significantly lower than that of the non-medical population. Given the relevance of the topic, these data point to the need for further prospective studies on medical mortality from CVD in Brazil.

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Author contributions

Conception and design of the research: Matos GG, Pacheco RLCB, Magalhães LBNC, Avena KM. Acquisition of data: Matos GG, Pacheco RLCB. Analysis and interpretation of the data: Matos GG, Pacheco RLCB, Magalhães LBNC, Avena KM. Writing of the manuscript: Matos GG, Pacheco RLCB, Magalhães LBNC, Avena KM. Critical revision of the manuscript for intellectual content: Matos GG, Pacheco RLCB, Magalhães LBNC, Avena KM.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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