



Trends in mortality rates where alcohol was a necessary cause of death in Brazil, 2000–2013

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ABSTRACT

Objective. To analyze trends in mortality due to diseases and conditions fully attributable to alcohol in Brazil.

Methods. This was an ecological time-series study. Proportional, specific, and age-standardized mortality rates between 2000 and 2013 that were due to underlying or contributing causes fully attributable to alcohol use were analyzed by sex, ethnicity/skin color, age group, and region of residence in the country. Data on deaths were obtained from the Brazilian Mortality Information System (SIM). Prais-Winsten regression was used to analyze trends.

Results. Deaths with underlying causes and/or conditions contributing to death fully attributable to alcohol accounted for 2.5% of total deaths in the period. There were more deaths among men (3.8%) than among women (0.7%). In both sexes, there was a higher proportion of deaths in those 40–49 years old (27.9%) and those of black or pardo (mixed race) skin color (48.8%). Between 2000 and 2013, there was an upward trend in specific mortality rates attributable to alcohol in the country as a whole (average annual growth rate (AAGR) = 5.59%; 95% confidence interval (CI) = 3.55%-7.68%), especially in people aged less than 20 years old, in pardos (AAGR = 13.42%; 95% CI = 9.70%-17.25%), and in residents of the North region (AAGR = 17.01%; 95% CI = 14.94%-19.13%), the Northeast region (AAGR = 15.49%; 95% CI = 10.61%-20.58%), and the Midwest region (AAGR = 8.40%; 95% CI = 5.57%-11.32%).

Conclusion. Alcohol is an important and growing cause of premature death in Brazil, especially among men, black/pardo people, and the population living in the most disadvantaged regions. This overall increase in the harmful use of alcohol reflects ethnic and socioeconomic inequalities in Brazil, and it also points to the need for population-based policies to reduce the impact of morbidity and to prevent early mortality.

Keywords Alcohol-induced disorders; alcohol-related disorders; mortality; temporal distribution; time series studies; Brazil.

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The World Health Organization (WHO) has calculated that in 2012 the harmful use of alcohol caused 3.3 million deaths worldwide—or 5.9% of all deaths (1). In addition, alcohol consumption is among the six main risk factors for premature death and disability (2), and it affects a considerable proportion of young people.

In Latin America and the Caribbean, alcohol use was the fourth leading risk factor for premature deaths and disability in 2015 (2). In the population aged 15–49 years, alcohol was the most important risk factor for death, accounting for 27.3 deaths per 100 000 population in 2015 (2). Among Latin American countries, where alcohol is a serious public health problem, a study comparing mortality where alcohol is a necessary cause showed that Brazil was among the five countries with the highest mortality rates (3).

Despite the influence of contextual and cultural factors related to alcohol consumption among countries, alcohol-attributable mortality in the population is unevenly distributed by individual and societal factors. Higher incidences are reported in men and socioeconomically disadvantaged groups; however, a considerable variation has been reported regarding gender and socioeconomic status (3–5).

Alcohol is a causal factor of more than 200 diseases and injuries described in the International Statistical Classification of Diseases and Related Problems, 10th revision (ICD-10) (1, 6). Among these diseases, conditions, and injuries, some of them are fully attributable to alcohol consumption (i.e., alcohol is a necessary cause), and others are partially attributable to alcohol consumption (alcohol is a component cause). Mortality systems can provide information on specific causes of death, and have the potential to provide direct evidence of the impact of alcohol as a necessary cause of mortality in countries. The relation of this mortality cause with sociodemographic indicators can also be analyzed with available data in these systems.

In addition to the illnesses that alcohol consumption causes, it imposes an economic burden that is estimated to be 0.45% to 5.44% of gross domestic product (GDP), according to a systematic review of studies from 12 countries (7). In Brazil, we do not have a similar estimate. However, alcohol use was the third largest risk factor contributing to the burden of

disease in 2013 (2), and the average annual costs for just public treatment of eight selected alcohol-related diseases was estimated at US\$ 8 million (8).

In consideration of the above information and the availability of a good-quality computerized mortality system in Brazil, the objective of this study was to analyze trends in mortality in the country due to diseases, conditions, and injuries where alcohol is a necessary cause, according to sex, age, ethnicity/skin color, and region of the country.

METHODS

This was an ecological time-series study that used data from the Mortality Information System (Sistema de Informação Sobre Mortalidade (SIM)). The data provided by this system is the principal source of information about the causes of deaths in Brazil's municipalities, states, and regions. All deaths occurring in Brazil must be registered on SIM, regardless of whether or not they occurred in hospitals. SIM has improved the quality of data over the years in terms of capturing nonregistered causes of death. This led to a reduction in under-registration and ill-defined codes, from 14.3% of all causes of deaths in 2000 to 5.9% in 2013 (9, 10). For this reason we used the most recent data available, for 2000–2013. No adjustments were made for ill-defined causes and underreporting, which may affect trends analysis.

We adopted the classification proposed by Gawryszewski and Monteiro (3) for alcohol as a necessary cause of mortality or morbidity. That classification included more than 78 ICD-10 categories (three digits) or subcategories (four digits) containing alcohol in their title (3, 6):

E24.0 Alcohol-induced pseudo-Cushing's syndrome
 F10.0–F10.9 Mental and behavioral disorders due to use of alcohol
 G31.2 Degeneration of nervous system due to alcohol
 G62.1 Alcoholic polyneuropathy
 G72.1 Alcoholic myopathy
 I42.6 Alcoholic cardiomyopathy
 K29.2 Alcoholic gastritis
 K70.0–K70.4, K70.9 Alcoholic liver disease
 K85.2 Alcohol-induced acute pancreatitis
 K86.0 Alcohol-induced chronic pancreatitis

Q35.4 Maternal care for (suspected) damage to fetus from alcohol
 P04.3 Fetus and newborn affected by maternal use of alcohol
 Q86.0 Fetal alcohol syndrome (dysmorphic)
 R78.0 Finding of alcohol in blood
 X45.0–X45.9 Accidental poisoning by and exposure to alcohol
 X65.0–X65.9 Intentional self-poisoning by and exposure to alcohol
 Y15.0–Y15.9 Poisoning by and exposure to alcohol, undetermined intent
 Y90.0–Y90.9 Evidence of alcohol involvement determined by blood alcohol level
 Y91.0–Y91.9 Evidence of alcohol involvement determined by level of intoxication

Alcohol as a necessary cause means that the outcome would not have occurred in the absence of alcohol consumption, such as in alcoholic liver cirrhosis (3).

Each death certificate can have one underlying cause and a maximum of two conditions contributing to death. In this study, we analyzed all deaths with a disease or condition fully attributable to alcohol use registered as an underlying cause of death or as a condition contributing to death. A disease, condition, or injury where alcohol is the underlying cause means that the death would not exist in the absence of alcohol consumption. A condition that contributed to the death is a disease or condition related to the death but not directly causing it (11).

The mortality data for 2000–2013 was disaggregated by sex, age, ethnicity/skin color, and region of the country. Linear interpolation taking data from the 2000 and 2010 Brazilian censuses was used to obtain the size of the population in the period 2000–2013. Standardized mortality rates per 100 000 inhabitants were calculated using the direct method, with the aim of enabling mortality rates to be compared between sex, Brazilian region, and ethnicity/skin color over the period. The World Standard Population of the World Health Organization (12) was used for the standardization procedure. Specific mortality rates per 100 000 inhabitants were used to analyze the time series by age. The age groups used were: < 20, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 years and above (80+).

Because of the small number of deaths of other ethnicity/skin colors (0.6% of all deaths in the period) we only used white, black, and pardo in the

time-series analysis. Pardo is a broad category widely used in Brazilian research that includes people with mixed origins. The two other possible categories were East Asians and “indigenous,” meaning Amerindians.

In the time-series analysis, we used a linear regression with the Prais-Winsten estimator to analyze the serial correlation of type AR(1) in the time series, and we used the standardized rate as the dependent variable and the year as the independent variable. We also calculated the average annual growth rates and their confidence interval (CI), using the estimated coefficients of the year in the linear regression. The significance level established in the time-series analysis was 1%.

The study was conducted exclusively with publicly available data on mortality, which does not allow identification of the individuals, in compliance with Brazilian National Health Council Resolution 466.

RESULTS

Between 2000 and 2013, 219 205 deaths where their underlying cause was a disease fully attributable to alcohol and 367 954 deaths where the underlying and/or contributing cause was a disease fully attributable to alcohol were

registered in Brazil. They corresponded, respectively, to 1.5% and 2.5% of the total deaths registered in the SIM in the period. In males, deaths with the underlying and/or associated cause fully attributable to alcohol accounted for 3.8%. In females, this proportion was lower, 0.7% (Table 1).

In Brazil, the standardized mortality rate due to underlying and/or contributing causes fully attributable to alcohol use went up from 12.77 deaths per 100 000 inhabitants in 2000 to 16.93 deaths per 100 000 inhabitants in 2013. Men’s mortality rates due to underlying and/or associated causes fully attributable to alcohol use were almost 10 times as high as those for women in this period. The mortality attributable to alcohol increased over this period in the total population and among men and women ($p < 0.01$) in similar growth rates (Table 2).

Higher specific mortality rates with the underlying or contributing cause fully attributable to alcohol use were seen in both males and females aged 40 and over, in comparison to the youngest age group. There was an increase in all age groups except among men aged <20 ($p = 0.037$) and women and men aged 20-39 for which the trend was stationary ($p > 0.01$). In women, the average annual growth rate was higher among the group under 20 years old

($AAGR_{\text{Women } < 20} = 19.82\%$; 95% CI = 10.06%-30.45%) and, in men, in the group aged 80 years old and more ($AAGR_{\text{Men } 80+} = 18.73\%$; 95% CI = 12.89%-24.87%) (Table 2).

In both sexes, blacks and pardos had the highest proportion of deaths, comprising 47.7% of males and 56.8% of females. The ethnicity/skin color for 27 134 cases of deaths with underlying and/or associated cause fully attributable to alcohol use was unknown and accounted for 7.4% of total deaths registered with these causes.

Black people had the highest mortality rates due to alcohol from 2000 to 2013. Pardo was the ethnicity/skin color with the lowest rates at the beginning of the series, but overtook white in the middle of the analyzed period. All three groups had an increase in the standardized mortality rates between 2000 and 2013, but the one for pardos was the largest, an annual growth rate of 13.4% (95% CI = 9.70%-17.25%) (Table 2).

In terms of the regional distribution, the North had the lowest standardized mortality rates for the whole period but the highest average annual growth rate ($AAGR = 17.0\%$; 95% CI = 14.94%-19.13%). An increase in the standardized mortality rates was also seen in the Northeast and Midwest regions. The South and Southeast regions had a stationary trend (Table 2 and Figure 1).

TABLE 1. All deaths and the percent with a disease, condition, or injury where alcohol was a necessary cause as the main cause, and as the main and/or the contributing cause, by sex, Brazil, 2000–2013

Year	Total			Male		Female	
	No. of deaths	Percent of deaths with alcohol as the main cause	Percent of deaths with alcohol as the main and/or the contributing cause	Percent of deaths with alcohol as the main cause	Percent of deaths with alcohol as the main and/or the contributing cause	Percent of deaths with alcohol as the main cause	Percent of deaths with alcohol as the main and/or the contributing cause
2000	948 666	1.2	1.9	1.9	3.0	0.3	0.5
2001	961 492	1.3	2.0	1.9	3.0	0.3	0.5
2002	982 807	1.3	2.0	2.0	3.1	0.3	0.5
2003	1 002 340	1.3	2.1	2.0	3.2	0.3	0.5
2004	1 024 073	1.4	2.2	2.1	3.4	0.3	0.6
2005	1 006 827	1.5	2.5	2.3	3.8	0.4	0.6
2006	1 031 691	1.5	2.5	2.3	3.9	0.4	0.7
2007	1 047 824	1.6	2.6	2.4	4.0	0.4	0.7
2008	1 077 007	1.6	2.7	2.5	4.2	0.4	0.7
2009	1 103 088	1.5	2.6	2.4	4.1	0.4	0.7
2010	1 136 947	1.6	2.7	2.5	4.2	0.4	0.8
2011	1 170 498	1.6	2.8	2.5	4.4	0.4	0.8
2012	1 181 166	1.6	2.8	2.4	4.4	0.4	0.8
2013	1 210 474	1.6	2.8	2.4	4.4	0.4	0.7
Total	14 882 920	1.5	2.5	2.3	3.8	0.4	0.7

Source: Prepared by authors with data from Brazilian Mortality Information System (SIM).

TABLE 2. Time series for mortality due to diseases, conditions, or injuries where alcohol was a necessary cause as the main and/or the contributing cause, by demographic indicators, Brazil, 2000–2013

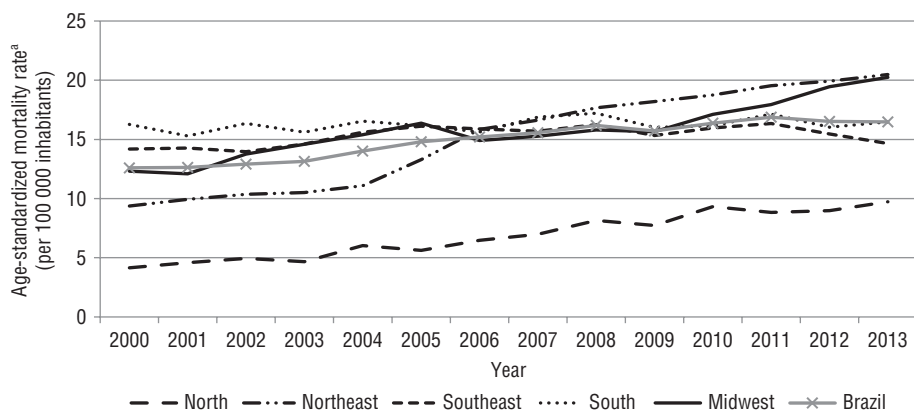
	Mortality rate per 100 000 inhabitants			AAGR ^a (%)	AAGR 95% confidence interval	<i>p</i> value	<i>R</i> ^{2b}	
	2000	2007	2013					
Total ^c	12.77	15.88	16.93	5.59	3.55	7.68	< 0.001	0.99
Sex ^c								
Women	2.62	3.46	3.63	5.75	3.78	7.76	< 0.001	0.99
Men	23.80	29.70	31.90	6.54	3.37	9.81	0.001	0.87
Age group (yr)								
Women								
< 20	0.03	0.05	0.09	19.82	10.06	30.45	0.001	0.72
20–29	0.53	0.68	0.69	5.28	1.14	9.59	0.017	0.60
30–39	3.13	3.35	2.74	-0.01	-1.45	1.46	0.99	0.83
40–49	5.73	7.82	7.84	6.09	3.10	9.16	0.001	0.96
50–59	6.43	7.96	9.50	8.81	6.38	11.31	< 0.001	0.92
60–69	6.24	8.79	9.26	8.96	4.85	13.23	< 0.001	0.90
70–79	5.14	8.20	9.53	14.79	10.36	19.39	< 0.001	0.78
80+	5.96	10.33	11.11	15.96	7.15	25.50	0.002	0.66
Men								
< 20	0.07	0.32	0.33	27.19	1.96	58.67	0.037	0.66
20–29	4.71	6.00	5.23	1.72	-3.21	6.90	0.473	0.87
30–39	23.66	25.64	21.13	-1.92	-4.76	1.00	0.179	0.99
40–49	51.1	57.58	57.13	2.69	1.05	4.37	0.004	0.99
50–59	65.89	79.09	89.75	6.76	5.33	8.22	< 0.001	0.97
60–69	60.79	85.28	99.48	9.37	7.07	11.71	< 0.001	0.99
70–79	50.83	77.24	96.24	13.12	9.83	16.52	< 0.001	0.99
80+	36.23	68.01	89.0	18.73	12.89	24.87	< 0.001	0.96
Ethnicity/skin color ^c								
White	11.20	12.90	12.80	2.80	1.36	4.25	0.001	0.98
Black	19.00	21.80	22.50	2.88	1.23	4.56	0.003	0.97
Pardo	9.60	15.40	19.10	13.42	9.70	17.25	< 0.001	0.97
Region ^c								
North	4.15	6.99	9.73	17.01	14.94	19.13	< 0.001	0.98
Northeast	9.37	16.63	20.48	15.49	10.61	20.58	< 0.001	0.95
Southeast	14.18	15.69	14.66	1.14	-1.45	3.80	0.365	0.98
South	16.26	16.88	16.48	0.81	0.04	1.59	0.042	0.99
Midwest	12.31	15.27	20.24	8.40	5.57	11.32	< 0.001	0.96

Source: Prepared by authors with data from Brazilian Mortality Information System (SIM).

^a AAGR = average annual growth rate.

^b *R*² = Coefficient of determination of linear regression with the Prais-Winsten estimator.

^c Age-standardized mortality rate using the World Standard Population of the World Health Organization.

FIGURE 1. Time series of standardized mortality due to diseases, conditions, or injuries where alcohol was a necessary cause, by region, Brazil, 2000–2013

Source: Prepared by authors with data from Brazilian Mortality Information System (SIM).

^a Age-standardized mortality rate using the World Standard Population of the World Health Organization.

We also analyzed the main causes of deaths where a disease or condition fully attributable to alcohol was alone the main cause, and not a contributing cause to death. The leading cause was alcoholic liver disease (K70.0-K70.4, K70.9), accounting for 54.6% (*n* = 119 657) of deaths in the 2000–2013 period (Table 3). The second main cause was mental and behavioral disorders due to use of alcohol (F10.0-F10.9), accounting for 40.3% (*n* = 88 331) of deaths. The third main cause was alcoholic cardiomyopathy (I42.6), which accounted for 1.9% (*n* = 4 179) of deaths. Deaths caused by intentional or accidental alcohol poisoning (the sum of the deaths that presented as the main cause one of the following

TABLE 3. Distribution of deaths with diseases, conditions, or injuries where alcohol was a necessary cause as the main cause, by cause, Brazil, 2000–2013

Causes ^a	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	%
E24.4 Alcohol-induced pseudo-Cushing's syndrome	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0.00
F10.0–F10.9 Mental and behavioral disorders due to use of alcohol	4 771	5 044	5 096	5 213	5 762	6 351	6 627	6 943	7 313	6 834	7 073	7 335	6 944	7 025	88 331	40.30
G31.2 Degeneration of nervous system due to alcohol	19	36	20	21	29	36	103	86	115	113	115	155	137	133	1 118	0.51
G62.1 Alcoholic polyneuropathy	36	29	28	26	29	28	26	39	38	27	29	38	31	39	443	0.20
G72.1 Alcoholic myopathy	0	0	0	2	0	2	1	0	2	5	2	0	6	2	22	0.01
I42.6 Alcoholic cardiomyopathy	318	289	322	296	397	363	287	280	287	261	283	290	256	250	4 179	1.91
K29.2 Alcoholic gastritis	41	40	34	31	44	44	20	16	31	25	20	28	30	20	424	0.19
K70.0–K70.4, K70.9 Alcoholic liver disease	6 419	6 520	7 053	7 074	7 513	7 974	8 429	8 885	9 394	9 318	9 918	10 311	10 377	10 472	119 657	54.59
K85.2 Alcohol-induced acute pancreatitis	0	0	0	0	0	0	0	0	0	103	346	359	375	401	1 584	0.72
K86.0 Alcohol-induced chronic pancreatitis	117	144	127	127	147	206	154	192	184	184	172	169	181	158	2 262	1.03
P04.3 Fetus and newborn affected by maternal use of alcohol	2	3	5	5	4	5	2	4	5	3	2	3	7	2	52	0.02
Q86.0 Fetal alcohol syndrome (dysmorphic)	1	1	0	1	1	1	1	1	0	1	2	1	0	0	11	0.01
R78.0 Finding of alcohol in blood	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0.00
X45.0–X45.9 Accidental poisoning by and exposure to alcohol	10	15	16	10	15	10	11	7	15	11	22	50	79	121	392	0.18
X65.0–X65.9 Intentional self-poisoning by and exposure to alcohol	8	9	10	21	11	17	21	29	35	23	35	36	41	56	352	0.16
Y15.0–Y15.9 Poisoning by and exposure to alcohol, undetermined intent	12	16	15	19	10	16	18	22	20	21	24	42	56	84	375	0.17
Total	11 750	12 146	12 726	12 846	13 962	15 053	15 701	16 504	17 439	16 930	18 043	18 817	18 520	18 764	219 205	100.00

Source: Prepared by authors with data from Brazilian Mortality Information System (SIM).

^a The listed causes are ones from the International Statistical Classification of Diseases and Related Problems, 10th revision (ICD-10) (11). No deaths with the Y90.0–Y90.9 and Y91.0–Y91.9 codes were identified as the main cause in the period in Brazil.

codes: X45.0-X45.9, X65.0-X65.9, or Y15.0-Y15.9) accounted for 0.5% of deaths ($n = 1\ 119$) fully related to alcohol between 2000 and 2013.

DISCUSSION

From 2000 to 2013, almost 400 000 deaths with underlying and/or associated causes contributing to death fully attributable to alcohol were recorded in Brazil. An increase in deaths from these types of causes was found nationally, with the highest average annual increases among pardos, those under 20 years old, and persons living in the North, Northeast, and Midwest regions.

It must be emphasized that these findings reveal only part of the considerable impact that alcohol consumption has on mortality. That is because the range of diseases and disabilities caused by alcohol goes beyond deaths fully associated with this substance and includes neoplasms, cardiovascular diseases, gastrointestinal diseases, tuberculosis and other infectious diseases, suicide, violence, and land transport injuries (1, 6). The majority of external causes were not included here. Autopsy studies with fatal victims of traffic injuries, for example, show that 50% are due to alcohol (13).

The standardized mortality rates due to underlying or contributing causes fully attributable to alcohol use were higher among men than among women, which is consistent with the literature (1–6). In addition, there is a difference in alcohol consumption between males and females. Men use this substance more frequently and in higher amounts than women do, regardless of the pattern of consumption (1, 13, 14), and men also have a greater frequency of problems related to alcohol consumption (15).

Recent studies have shown an increase in alcohol consumption among women, particularly in the youngest cohorts (16). In Brazil, a study among schoolchildren just 13 to 15 years old found that alcohol use was equal between girls and boys in terms of regular consumption, and with a higher proportion of girls who had ever tried alcoholic beverages (17). This could be a forewarning of more problems among women in the future.

Women are more susceptible to the repercussions of drinking than are men, including from increased breast cancer (18), heart disease and stroke (19), and

brain damage (20). Women also show a more rapid progression to dependency (21) as well as a propensity to develop liver cirrhosis in less time and with lower amounts of alcohol (22). Alcohol use during pregnancy can also lead to toxicity in the embryo and fetal teratogenicity (23). Furthermore, women who drink have been stigmatized by society (24). A systematic review study also found that women with alcohol use disorders have higher mortality risks than men do (25).

With regard to age groups, we found the peak of mortality due to alcohol beginning with those 40–49 years old. In both sexes in this age group, there is an increase in specific mortality rates due to underlying and/or associated causes fully attributable to alcohol. This is a young age group, considering that life expectancy at birth in Brazil in 2010 was 73.8 years (26).

Another concern is the rising mortality rate in people less than 20 years old. That fact highlights the problem of acute alcohol intoxication, which is common among adolescents and young adults and can lead to a fatal outcome. In this study, around 1 000 deaths were directly caused by acute alcohol poisoning. Even though we did not intend to analyze trends for each specific cause, the deaths caused by the codes X45, X65, and Y15 increased from 30 to 261 (i.e., more than eight times) between 2000 and 2013, more than any other cause analyzed. This finding should be explored in further studies.

Moreover, even on occasions when it does not lead to death, being intoxicated is strongly associated with various forms of injuries and violence, especially among young men (27). Repeated intoxication leads to tolerance and the development of dependence as well as a large range of chronic health problems later in life, including premature mortality, as documented here.

The highest mortality rates were found among blacks and pardos. In a review study, Roerecke and Rehm (25) found that there is a greater risk of death among people with disorders due to alcohol use. This may indicate that there is a greater proportion of people who engage in harmful alcohol use in the black and pardo populations. This is on top of their more limited access to health care services, given their relatively lower socioeconomic status in Brazilian society. In a systematic review of epidemiological

studies on interpersonal discrimination and mental health, Goto et al. (28) found a positive association between racial discrimination and disorders related to alcohol consumption (28). Another study (29) has shown higher unemployment and lower wages among black people in Brazil.

A study conducted in Brazil (30) indicated that general mortality in blacks and pardos is almost double that of whites, emphasizing that ethnic and racial inequalities in Brazil also produce health inequalities. The highest mortality due to alcohol use in black people and a pronounced growth in mortality due to alcohol use among pardos found in our study might be related to these inequalities. Pardo people make up more than half of the population of the North and Northeast regions, which are the poorest areas of the country (31). As such, the relation between ethnicity/skin color and alcohol use and dependence deserves to be studied in more depth in the Brazilian context, both to prevent premature deaths and to reduce health inequities. Another important finding from our research was the high mortality rates between 2008 and 2013 in the Northeast region, which, according to the National Health Survey (14), is the area of Brazil with the highest prevalence of heavy episodic drinking in the preceding month. Our study highlighted the importance of alcohol-related mortality in Brazil in a relatively young age group. This is even more relevant when considering national surveys that evaluated alcohol consumption and found a high prevalence of heavy episodic drinking in adults 24–34 years old (14, 32). In addition, the Brazilian National Adolescent School-based Health Survey (PeNSE), showed a high prevalence of alcohol use ever and of use in the last 30 days in schoolchildren aged 13–15 (17). That survey also pointed out that schoolchildren can easily consume or purchase alcoholic beverages: 21.9% of boys and 10.5% of girls who reported alcohol consumption had succeeded in buying at bars, markets, or shops (17). In addition to the easy access to alcoholic beverages by children and adolescents in Brazil, price changes for alcoholic beverages have been relatively stable, remaining below the general price index for food between 1939 and 2010 (33). Another controversial point is alcohol advertising in the country, which is regulated by Law 9.294/1996. That law catalogs as alcoholic

beverages only those with more than 13% alcohol content by volume, thus excluding beer and wine (34).

Our study has some limitations. One is the uncertainty regarding the increase in mortality rates. The improvement of the quality of SIM data related to the reduction of underregistration and ill-defined causes, especially in the North and Northeast regions of Brazil (10), may have influenced the increase in rates shown in our study. However, we have used data from the most recent period, 2000 to 2013, in order to minimize this effect. We recommend future studies be conducted to determine the effect of the improvement in the SIM system on the presented trends. Secondly, the ethnicity/skin color variable and the schooling variables had problems of completeness, which are inherent in secondary studies using vital records databases. Finally, our study does not assess how much of the trends are due to a cohort or period effect, so we recommend future studies using age-period-cohort analysis.

In conclusion, given the magnitude of the problem of alcohol-related mortality in the country, especially in the most vulnerable population, such as blacks and pardos and residents of the most disadvantaged regions, Brazil urgently needs to address alcohol as a public health priority in order to reduce the economic and social costs to the country. Among the priority measures for diminishing harmful alcohol use would be decreasing the availability of alcohol. This could be done by, for example, cutting the hours or days allowed for the sale of alcoholic beverages, reducing the density of alcohol outlets, and creating a licensing system for the sale of alcohol (35, 36). Other recommended steps include controlling marketing and retailing, ensuring the enforcement of drink-driving policy, and guaranteeing continuity of access to alcohol-dependence and alcohol-related-diseases treatment in the public health system (35, 36). These measures, together with the maintenance and strengthening of surveillance systems that include

alcohol consumption and alcohol-related health harm, could help the country to achieve the goals established in the World Health Organization global plan on non-communicable diseases (37). These steps could also help Brazil to achieve targets of the Pan American Health Organization regional plan of action (38) and the national plan (39) on noncommunicable diseases, in which the country has agreed to reduce harmful use of alcohol by 10%, as well as decrease alcohol-related mortality and morbidity.

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REFERENCES

- World Health Organization. Global status report on alcohol and health 2014. Geneva: WHO; 2014.
- Institute for Health Metrics and Evaluation. GBD Compare. Seattle: IHME; 2016. Available from: <http://vizhub.healthdata.org/gbd-compare> Accessed 18 September 2016.
- Gawryszewski VP, Monteiro MG. Mortality from diseases, conditions and injuries where alcohol is a necessary cause in the Americas, 2007–09. *Addiction*. 2014 Apr;109(4):570–7.
- McCartney G, Mahmood L, Leyland AH, Batty GD, Hunt K. Contribution of smoking-related and alcohol-related deaths to the gender gap in mortality: evidence from 30 European countries. *Tob Control*. 2011 Jan;20(2):166–8.
- Probst C, Roerecke M, Behrendt S, Rehm J. Gender differences in socioeconomic inequality of alcohol-attributable mortality: a systematic review and meta-analysis. *Drug Alcohol Rev*. 2015 May;34(3):267–77.
- Rehm J, Baliunas D, Borges GL, Graham K, Irving H, Kehoe T, et al. The relation between different dimensions of alcohol consumption and burden of disease: an overview. *Addiction*. 2010 May;105(5):817–43.
- Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Chaikledkaew U. The economic impact of alcohol consumption: a systematic review. *Subst Abuse Treat Prev Policy*. 2009 Nov;4:20.
- Coutinho ESF, Bahia L, Barufaldi LA, Abreu GA, Malhão TA, Pepe CR, et al. Cost of diseases related to alcohol consumption in the Brazilian Unified Health System. *Rev Saude Publica*. 2016 Jun;50:28. doi:10.1590/S1518-8787.2016050005741.
- Monteiro RA, Vinci ALT, Alves D, Lima CM, Silva MMA. Quality of external cause information held on national health information systems in Brazil. In: Ministry of Health of Brazil, Health Surveillance Secretariat, Health Situation Analysis Department. *Health Brazil 2014: a situational analysis of road injuries and other external causes*. Brasília: Ministry of Health of Brazil; 2015:187–210.
- França E, Teixeira R, Ishitani L, Duncan BB, Cortez-Escalante JJ, Morais Neto OL, et al. Ill-defined causes of death in Brazil: a redistribution method based on the investigation of such causes. *Rev Saude Publica*. 2014 Aug;48(4):671–81.
- World Health Organization. ICD-10: international statistical classification of diseases and related health problems: tenth revision. 2nd ed. (Vol. 2). Geneva: WHO; 2014.
- Ahmad O, Boschi-Pinto C, Lopez A, Murray C, Lozano R, Inoue M. Age standardization of rates: a new WHO standard. Geneva: World Health Organization; 2001.
- Moura EC, Malta DC. Alcoholic beverage consumption among adults: sociodemographic characteristics and trends. *Rev Bras Epidemiol*. 2011 Sep;14(Suppl 1):61–70.
- Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde 2013: percepção do estado de saúde, estilos de vida e doenças crônicas: Brasil, grandes regiões e unidades da federação. Rio de Janeiro: IBGE; 2014.
- Laranjeira R, Pinsky I, Sanches M, Zaleski M, Caetano R. Alcohol use patterns among Brazilian adults. *Rev Bras Psiquiatr*. 2010 Sep;32(3):231–41.
- Berridge V, Herring R, Thom B. Binge drinking: a confused concept and its contemporary history. *Soc Hist Med*. 2009 Dec;22(3):597–607.
- Malta DC, Machado ÍE, Porto DL, Silva MMA, Freitas PC, Costa AWN. Alcohol consumption among Brazilian adolescents according to the National Adolescent School-based Health Survey (PeNSE 2012). *Rev Bras Epidemiol*. 2014;17 (Suppl 1):203–14.
- Singleton KW, Gapstur SM. Alcohol and breast cancer: review of epidemiologic and experimental evidence and potential mechanisms. *JAMA*. 2001 Nov 7;286(17):2143–51.
- Ikehara S, Iso H, Toyoshima H, Date C, Yamamoto A, Kikuchi S, et al. Alcohol consumption and mortality from stroke and coronary heart disease among Japanese men and women. The Japan Collaborative Cohort Study. *Stroke*. 2008 Nov;39(11):2936–42.
- Hommer DW. Male and female sensitivity to alcohol-induced brain damage. *Alcohol Res Health*. 2003;27(2):181–5.
- Chermack ST, Booth BM, Curran GM. Gender differences in correlates of recent

- physical assault among untreated rural and urban at-risk drinkers: role of depression. *Violence Vict.* 2006 Feb;21(1):67–80.
22. Becker U, Deis A, Sørensen TIA, Grønbaek M, Borch-Johnsen K, Muller CF, et al. Prediction of risk of liver disease by alcohol intake, sex, and age: a prospective population study. *Hepatology.* 1996 May;23(5):1025–9.
 23. Martinez-Frias ML, Bermejo E, Rodriguez-Pinilla E, Frias JL. Risk for congenital anomalies associated with different sporadic and daily doses of alcohol consumption during pregnancy: a case-control study. *Birth Defects Res Clin Mol Teratol.* 2004;70(4 PtA):194–200.
 24. Nolen-Hoeksema S. Gender differences in risk factors and consequences for alcohol use and problems. *Clin Psychol Rev.* 2004 Apr;70(4):194–200.
 25. Roerecke M, Rehm J. Alcohol use disorders and mortality: a systematic review and meta-analysis. *Addiction.* 2013 Sep;108(9):1562–78.
 26. Instituto Brasileiro de Geografia e Estatística. Tábuas abreviadas de mortalidade por sexo e idade: Brasil, grandes regiões e unidades da federação 2010. Rio de Janeiro: IBGE; 2013. Available from: <http://biblioteca.ibge.gov.br/visualizacao/livros/liv65137.pdf> Accessed 19 October 2016.
 27. Taylor B, Irving HM, Kanteres F, Room R, Borges G, Cherpitel C, et al. The more you drink, the harder you fall: a systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. *Drug Alcohol Depend.* 2010 Jul 1;110(1–2):108–16.
 28. Goto JB, Couto PFM, Bastos JL. Systematic review of epidemiological studies on interpersonal discrimination and mental health. *Cad Saude Publica.* 2013 Mar;29(3):445–59.
 29. Abram L. Desigualdades de gênero e raça no mercado de trabalho brasileiro. *Cienc Cult.* 2006 Dec;58(4):40–1.
 30. Chor D, Lima CRA. Epidemiologic aspects of racial inequalities in health in Brazil. *Cad Saude Publica.* 2005 Oct;21(5):1586–94.
 31. Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2010: características gerais da população, religião e pessoas com deficiência. Available from: <http://www.sidra.ibge.gov.br/bda/tabela/listabl> Accessed 23 May 2016.
 32. Macinko J, Mullachery P, Silver D, Jimenez G, Libanio Morais Neto O. Patterns of alcohol consumption and related behaviors in Brazil: evidence from the 2013 National Health Survey (PNS 2013). *PLoS One.* 2015 Jul 31;10(7):e0134153.
 33. Yuba TY, Sarti FM, Campino ACC, Carmo HCE. Evolution of the relative prices of food groups between 1939 and 2010 in the city of Sao Paulo, Southeastern Brazil. *Rev Saude Publica.* 2013 Jun;47(3):549–59.
 34. Brazil. Lei 9.294, 15 jun 1996. *Diario Oficial da União Brasília,* 16 jul. 1996. Available from: http://www.planalto.gov.br/ccivil_03/Leis/L9294.htm Accessed 21 August 2015.
 35. Pan American Health Organization. Regional status report on alcohol and health in the Americas. Washington, D.C.: PAHO; 2015.
 36. World Health Organization. Global strategy to reduce the harmful use of alcohol. Geneva: WHO; 2010.
 37. World Health Organization. WHO Global NCD Action Plan 2013–2020. Geneva: WHO; 2013. Available from: http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf?ua=1 Accessed 19 October 2016.
 38. Pan American Health Organization. Plan of Action for the Prevention and Control of Noncommunicable Diseases in the Americas 2013–2019. Washington, D.C.: PAHO; 2014.
 39. Malta DC, Morais Neto OL, Silva-Junior JB. Apresentação do plano de ações estratégicas para o enfrentamento das doenças crônicas não transmissíveis no Brasil, 2011 a 2022 [Presentation of the Strategic Action Plan for Coping with Chronic Diseases in Brazil from 2011 to 2022]. *Epidemiol Serv Saude.* 2011;20(4):425–38.

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RESUMEN

Tendencias en las tasas de mortalidad donde el alcohol fue una causa necesaria de muerte en Brasil, 2000–2013

Objetivo. Analizar las tendencias en la mortalidad debido a enfermedades y condiciones totalmente atribuibles al alcohol en Brasil.

Métodos. Se realizó un estudio ecológico de series temporales. Las tasas de mortalidad proporcionales, específicas y estandarizadas por edad entre 2000 y 2013 que se debieron a causas subyacentes o contribuyentes totalmente atribuibles al consumo de alcohol se analizaron por sexo, raza/ color de piel, grupo de edad y región de residencia en el país. Los datos sobre muertes se obtuvieron del Sistema Brasileño de Información de Mortalidad (SIM). Se utilizó la regresión de Prais-Winsten para analizar las tendencias.

Resultados. Las muertes por causas subyacentes y / o condiciones que contribuyeron a causar la muerte totalmente atribuibles al alcohol representaron el 2,5% del total de muertes en el período en estudio. Hubo más muertes entre los hombres (3.8%) que entre las mujeres (0.7%). En ambos sexos hubo una mayor proporción de muertes entre los 40–49 años (27.9%) y en las personas de piel negra o parda (mestizos) (48.8%). Entre 2000 y 2013, hubo una tendencia ascendente en las tasas de mortalidad específicas atribuibles al alcohol en el país en general (Tasa de Crecimiento Anual Promedio (TCAP) = 5,59%, Intervalo de Confianza(IC) 95% = 3,55% -7,68%), especialmente en personas menores de 20 años, de tez pardos (TCAP = 13.42%, IC 95% = 9.70% -17.25%), y en residentes de la región Norte (TCAP= 17.01%, IC 95% = 14.94% -19.13%), Región Nordeste (AAGR = 15.49%, IC 95% = 10.61% -20.58%) y la región Medio Oeste (AAGR = 8.40%, IC 95% = 5.57% -11.32%).

Conclusión. El alcohol es una causa importante y creciente de muerte prematura en Brasil, especialmente entre hombres, personas de raza negra y parda y la población que viven en las regiones más desfavorecidas. Este aumento general en el uso nocivo

de alcohol refleja las desigualdades étnicas y socioeconómicas en Brasil, y también señala la necesidad de políticas basadas en la población para reducir el impacto de la morbilidad y prevenir la mortalidad temprana.

Palabras clave Trastornos inducidos por alcohol; trastornos relacionados con alcohol; mortalidad; distribución temporal; estudios de series temporales; Brasil.

Tendências nas taxas de mortalidade onde o álcool foi uma causa necessária de morte no Brasil, 2000–2013

RESUMO

Objetivo. Analisar tendências de mortalidade por doenças e condições totalmente atribuíveis ao álcool no Brasil.

Métodos. Este foi um estudo ecológico de séries temporais. As taxas de mortalidade proporcionais, específicas e padronizadas por idade entre 2000 e 2013, decorrentes de causas subjacentes ou contribuintes, totalmente atribuíveis ao consumo de álcool foram analisadas por sexo, etnia / cor da pele, faixa etária e região de residência no país. Os dados sobre óbitos foram obtidos do Sistema Brasileiro de Informações sobre Mortalidade (SIM). A regressão Prais-Winsten foi usada para analisar as tendências.

Resultados. Mortes com causas subjacentes e / ou condições que contribuíram para a morte, totalmente atribuíveis ao álcool, representaram 2,5% do total de mortes no período. Houve mais mortes entre homens (3,8%) do que entre mulheres (0,7%). Em ambos os sexos houve uma maior proporção de óbitos entre 40–49 anos (27,9%) e na cor da pele negra ou pardo (mestiço) (48,8%). Entre 2000 e 2013, houve uma tendência ascendente nas taxas de mortalidade específicas atribuíveis ao álcool no país como um todo (Taxa de Crescimento Anual Média (TCAM) = 5,59%; Intervalo de Confiança (IC) 95% = 3,55% -7,68%), especialmente em pessoas com idade com menos de 20 anos, em pardos (TCAM = 13,42%; IC 95% = 9,70% -17,25%) e em residentes da região Norte (TCAM = 17,01%; IC 95% = 14,94% -19,13%), Região Nordeste (TCAM= 15,49%; IC 95% = 10,61% -20,58%) e região Centro-Oeste (TCAM= 8,40%; IC 95% = 5,57% -11,32%).

Conclusão. O álcool é uma causa importante e crescente de morte prematura no Brasil, especialmente entre homens, negros / pardos e a população que vive nas regiões mais desfavorecidas. Esse aumento geral do uso prejudicial do álcool reflete desigualdades étnicas e socioeconômicas no Brasil e também aponta a necessidade de políticas baseadas na população para reduzir o impacto da morbilidade e prevenir a mortalidade precoce.

Palavras-chave Transtornos induzidos por álcool; transtornos relacionados ao uso de álcool; mortalidade; distribuição temporal; estudos de séries temporais; Brasil.
