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Major Article

Transition of the morbidity and mortality profile in a municipality in the interior of the Brazilian Amazon

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Abstract

Introduction: The morbidity and mortality profile in a given region reflects its quality of life and provides tools for improving public health policies in that region. **Methods**: A cross-sectional epidemiological study was performed using secondary mortality data collected from the Monte Negro municipality of the Brazilian Western Amazon from 2000 to 2011. These data were compared with data from similar municipalities in other Brazilian macro-regions. Data were obtained through the *Departamento de Informática do Sistema Único de Saúde* (DATASUS) information system. **Results**: The number of deaths reported over the study period was 606. The most common cause of death was external causes of morbidity and mortality [International Classification of Diseases (ICD)-10 chapter 20], followed by diseases of the circulatory system (ICD-10 chapter 9). Among the causes of death according to age group, infectious and parasitic diseases were the most common for 2- to 9-year-old children; external causes of disease were the most prevalent for 10- to 59-year-old people; and circulatory diseases prevailed in individuals over 60 years of age. Eleven percent of deaths were due to unknown causes. **Conclusions**: These results point to a fragility in the public policies for prevention and awareness of this problem. Infectious and parasitic diseases contribute only 4.5% of deaths, but had the third highest Disability-Adjusted Life Year score (1,190 days). Improving support to the Estratégia Saúde da Família (Family Health Strategy) program and implementing a death verification service would significantly aid in reducing the occurrence of non-transmissible chronic diseases and clarifying unknown causes of death.

Keywords: Cause of death. Mortality. Amazon.

INTRODUCTION

Knowing the morbidity and mortality profile of a region is an important means to understanding its epidemiological profile. It reflects the quality of life of that population, and may provide key information for planning and designing public health policies as well as preventing health hazards[1] [2] [3] [4].

The Legal Amazon region includes nine states and covers approximately 61% of Brazil's territory. Most of its population lives in large urban centers; however, there are a significant number of inhabitants living in peri-urban zones. Despite its large geographic area, only 12% of inhabitants live in the Legal Amazon[5]. In the Amazon region, the mortality profile of the resident population is still faulty and often distorted due to the under-reporting of cases mainly occurring in municipalities far from the state capital. The intense migratory influx that occurred in the State of Rondônia in the 1980s and 1990s caused a more than two-fold increase in the local population. This region has a so-called *double burden* of disease. Despite great progress in reducing mortality rates due to infectious and parasitic diseases through vaccination and control of endemic diseases, such as malaria, these diseases remain an important cause of morbidity[5] [6] [7]. In addition, there is an increasing prevalence of non-transmissible chronic diseases (NTCDs)[5] [6] [7] [8].

In the 1980s, the Northern Brazilian region displayed a mortality profile with an important proportion of deaths from infectious and parasitic diseases (21.7%), second only to circulatory diseases (23.4%)[9]. Thus, this study aimed to analyze mortality data from the Monte Negro municipality in the State of Rondônia, Brazil, from a recent 11 year period and to characterize changes in its profile.

METHODS

This was a cross-sectional epidemiological study using secondary data on causes of mortality in the Monte Negro municipality, State of Rondônia, from January 2000 to December 2011. Data from Monte Negro were compared with data from municipalities from the five other macro-regions

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of Brazil, each with a population and human development indices (HDI) similar to Monte Negro. These comparison regions included the following: São Francisco do Pará/State of Pará (15,196 inhab/HDI=0.608), Mucambo/State of Ceará (14,102 inhab/HDI=0.607), São Domingos/State of Goiás (11,236 inhab/HDI=0.597), Divino/State of Minas Gerais (19,131 inhab/HDI= 0.605), and Dom Feliciano/State of Rio Grande do Sul (14,380 inhab/HDI=0.587). Mortality data were obtained from DATASUS (www.datasus.gov.br/DATASUS), and HDI data were obtained from the Atlas of Human Development in Brazil (Atlas de Desenvolvimento Humano no Brasil) for 2010[10].

This study was carried out in Monte Negro, located in the Brazilian Western Amazon 250km to the Southeast of the state capital, Porto Velho (63º 29' W, 10º 40' S). The climate is characterized by two well-marked dry and rainy seasons. In 2010, it had a population of 14,090 inhabitants, of which an estimated 40% are estimated to live in rural areas, and the HDI was 0.607[11] [12]. Its economy is based on crop cultivation (coffee, maize, and rice), livestock production (beef and dairy cattle) and timber harvesting. Several scattered tin and topaz-mining areas also exist[11] [12].

The variables studied were as follows: year of death, age group, and cause of death. We considered NTCDs (diseases of the circulatory system, neoplasms, and respiratory diseases) and external causes of diseases (accidents and violence). Microsoft Excel 2010 and BioEstat 5.3 were used for statistical analysis. The level of significance was 0.05.

The impact of mortality and morbidity of a given disease (transmissible or not) on the quality of life of the population was assessed using the disability-adjusted life year (DALY), which provides the impact of several diseases on days of life lost or lived with disability[13]. The years of life lost are calculated by multiplying the number of deaths from a disease by the average number of years of life lost in relation to the life expectancy of that population; in this study, the life expectancy in Brazil for 2011 (74.2 years) was used[14]. Years lived with disability are calculated by multiplying the prevalence of the disease by the burden of disability that it triggers[13].

RESULTS

During the period studied, there were 606 deaths reported. Of these, 160 (26.4%) were due to external causes (especially transportation accidents), and 153 (25.2%) were due to diseases of the circulatory system (**Table 1**). Most deaths (56.1%) were reported for individuals above 49 years of age (**Figure 1**). When causes of death were compared among municipalities, it became evident that the percentage of deaths due to external causes in Monte Negro was higher than that in the other five municipalities, while the number of deaths due to the remaining causes were approximately similar to what was observed in the other five municipalities used for comparison (**Table 1**).

The main cause of death in individuals aged 10 to 19 years, 20 to 29 years, and 30 to 49 years was external causes (68.9%, 68.1%, and 52.2%, respectively); of those, 47% were due to violence, and 33% were due to traffic accidents. For individuals

TABLE 1
Causes of death in the municipalities studied and in Brazil, from 2000 to 2011.

Municipality/State	Cause of death n (%)												
	infec	**neop**	**endoc**	**psyc**	**nerv**	**circul**	**resp**	**digest**	**genit**	**obstet & peri**	**ext**	**undef**	**others**	**total**
Monte Negro/RO	27 (4.5)	64 (10.6)	24 (4.0)	0 (0.0)	5 (0.8)	153 (25.2)	37 (6.1)	21 (3.5)	8 (1.3)	37 (6.1)	160 (26.4)	67 (11.0)	3 (0.5)	606
São Francisco do Para /PA	26 (4.1)	54 (8.4)	31 (4.9)	3 (0.5)	6 (0.9)	150 (23.6)	46 (7.2)	24 (3.8)	13 (2.1)	34 (5.3)	64 (10.0)	181 (28.4)	5 (0.8)	638
Mucambo/CE	53 (5.1)	145 (14.1)	58 (5.6)	22 (2.1)	7 (0.7)	315 (30.5)	122 (11.8)	44 (4.2)	18 (1.7)	42 (4.1)	74 (7.2)	124 (12.1)	8 (0.8)	1,032
São Domingos/GO	61 (12.0)	46 (9.1)	9 (1.8)	14 (2.8)	5 (1.0)	119 (23.5)	25 (4.9)	18 (3.5)	4 (0.8)	24 (4.7)	74 (14.6)	103 (20.3)	6 (1.2)	507
Divino/MG	71 (4.3)	173 (10.6)	111 (6.8)	11 (0.7)	29 (1.8)	433 (26.7)	160 (9.9)	48 (2.9)	19 (1.2)	108 (6.6)	128 (7.9)	329 (20.3)	21 (1.3)	1,623
Dom Feliciano/RS	19 (1.6)	207 (18.0)	37 (3.2)	7 (0.6)	21 (1.8)	373 (32.5)	207 (18.0)	48 (4.2)	9 (0.8)	27 (2.4)	97 (8.4)	87 (7.6)	9 (0.8)	1,148
Brasil	4.5	14.6	5.6	0.9	1.7	28.4	9.9	4.9	1.8	4	12.5	10	1.1	12,49 1,280
Standard dev.	3.2	3.4	1.6	0.9	0.5	3.4	4.3	0.6	0.5	1.4	6.7	7.4	0.2	-
Coefficient of variation (%)	62.4	28.4	37	91.4	40.1	12.6	45.3	16.7	36.1	29.8	53.9	47.8	30.2	-

infec: infectious and parasitic diseases; **neop:** neoplasms; **endoc:** endocrine and metabolic diseases; **psyc:** psychiatric diseases; **nerv**: diseases of the nervous system; **circul:** diseases of the circulatory system; **resp:** diseases of the respiratory system; **digest:** diseases of the digestive system; **genit:** diseases of the genitourinary system; **obstet & peri:** obstetric and perinatal diseases; **ext:** external causes of morbidity and mortality; **undef:** undefined disease. **DATASUS:** *Departamento de Informática do Sistema Único de Saúde*. Source: DATASUS.

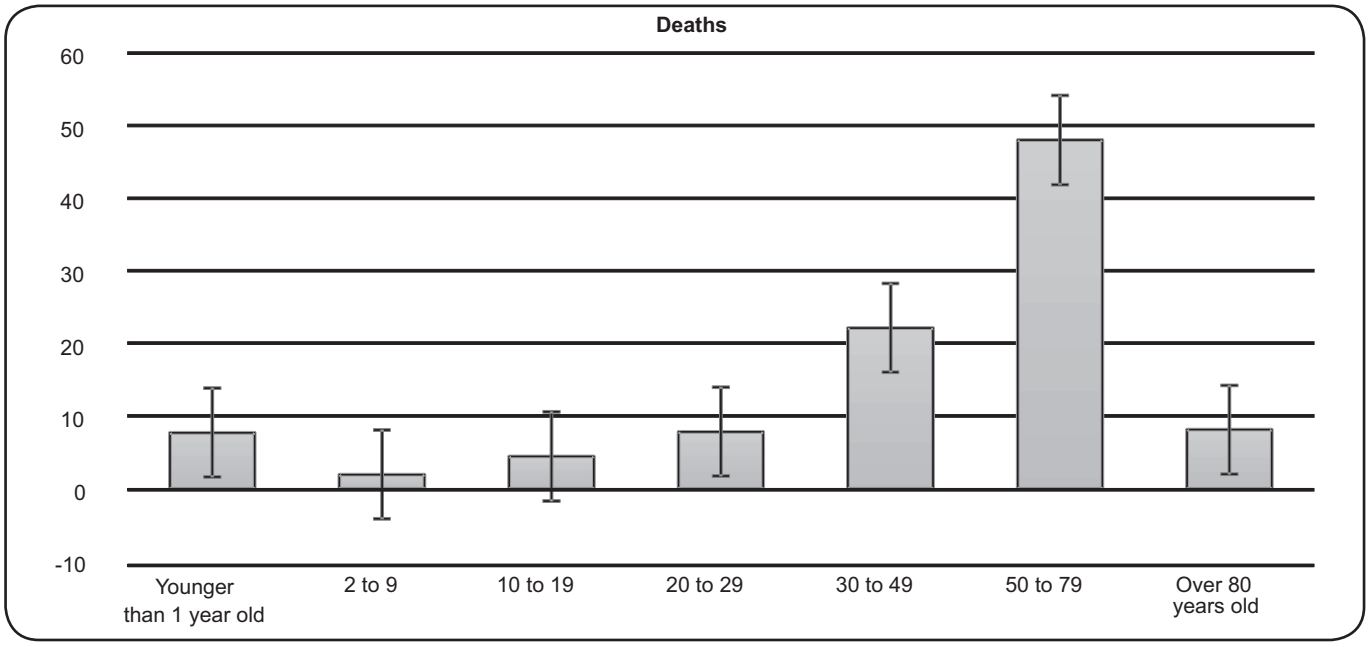

FIGURE 1. Percentage of deaths by age group in the municipality of Monte Negro, Rondônia, 2000-2011. **DATASUS:** Departamento de Informática do Sistema Único de Saúde. **Source:** DATASUS.

above 49 years of age, the most common causes of death were NTCDs [circulatory diseases (ICD-10 Chapter 9), 40.4%; neoplasms (ICD-10 Chapter 2), 12.3%; and respiratory diseases (ICD-10 Chapter 10), 7.5%]. Infectious and parasitic diseases (ICD-10 Chapter 1) accounted for 3.9% of deaths in this age group. In children younger than 1 year, the highest percentage of deaths was due to obstetric and perinatal causes (76%; ICD-10 Chapters 15, 16 and 17). For individuals age 2 to 19 years, the most common cause of death was external causes (61%; ICD-10 Chapter 20), and infectious and parasitic diseases were responsible for 9% of deaths.

Concerning proportional mortality in children younger than 1 year, the municipality of Monte Negro presented the highest rate (7.6%) among the municipalities examined, occurring mainly during the perinatal period ($p< 0.001$) (**Table 2**).

As for DALY values, the ICD-10 chapter with the greatest DALY value was circulatory diseases (2,760.7 years), followed by respiratory diseases and infectious and parasitic diseases (1,191.1 and 1,190 years, respectively) (**Table 3**).

DISCUSSION

Due to its geographic, social, and political characteristics, Brazil is a country of contrasts manifested by poor income distribution, lack of equal access to healthcare, poor quality public education, and an inefficient public administration

TABLE 2

Types of infant mortality in the municipalities studied, from 2000 to 2011.

	Types of infant mortality				
Municipality/State	**perinatal n (%)**	**early n (%)**	**late n (%)**	**% in relation to the total**	***p*-value***
Monte Negro/RO	32 (69.5)	4 (8.7)	10 (21.8)	7.5	
São Francisco do Para/PA	21 (47.6)	7 (16.0)	16 (36.4)	6.8	
Mucambo/CE	24 (37.5)	15 (23.5)	25 (39.0)	6.2	0.0004
São Domingos/GO	18 (60.0)	4 (13.4)	8 (26.6)	5.9	
Divino/MG	74 (62.7)	9 (7.6)	35 (29.7)	7.2	
Dom Feliciano/RS	13 (27.6)	10 (21.3)	24 (51.1)	4	

Perinatal deaths were between 22 weeks of pregnancy and 6 days old. Early deaths were between 7 and 27 days old. Late deaths were between 28 and 365 days old. *ANOVA test. **ANOVA:** analysis of variance; **DATASUS:** *Departamento de Informática do Sistema Único de Saúde*. **Source:** DATASUS.

TABLE 3

Years of life lost, years lived with disability and DALY in individuals older than 59 years in Monte Negro, from 2000 to 2011.

	Years of life lost		Years lived with disability		DALY	
Diseases	**rank**	**n (%)**	**rank**	**n (%)**	**rank**	**n (%)**
External causes*	1	6,041 (42.9)	-	-	-	-
Respiratory	4	1,189 (8.4)	3	2.1 (1.7)	2	1,191.1 (20.9)
Infectious and parasitic	5	1,131 (8.4)	1	59 (48.7)	3	1,190 (20.8)
Circulatory	2	2,702 (19.1)	2	58.7 (48.5)	1	2,760.7 (48.6)
Obstetric and perinatal[1]	9	193 (1.4)	-	-	-	-
Neoplasms[1]	3	1,470 (10.4)	-	-	-	-
Endocrine	6	552 (3.9)	4	1.3 (1.1)	4	553.3 (9.7)
Digestive[1]	7	427 (3.1)	-	-	-	-
Genito-urinary[1]	10	152 (1.1)	-	-	-	-
Neurologic[1]	8	202 (1.3)	-	-	-	-

*Lack of information about the years lived with disability. **DALY**: disability adjusted life years; **DATASUS:** *Departamento de Informática do Sistema Único de Saúde*. **Source:** DATASUS.

system. Due to its large territory, each macroregion of the country has its own peculiarities and development model, giving rise to different *Brazils*. There are regions with relatively high economic indices and HDIs, and extremely poor regions with very low HDIs. Several municipalities in the Amazon region, Monte Negro among them, have an intermediate HDI[15]. This is in agreement with the Swaroop-Uemura Indicator, which is an indicator for evaluating life and health conditions of a population. The municipality of Monte Negro has an index of 56.1% (deaths of individuals older than 49 years), average economic development, and regular organization of healthcare services[16].

After the 1960s, due to decreases in child mortality indices and an increase in the life expectancy of Brazilians, the phenomenon of *epidemiological transition* started[17], culminating in the aging of the population. This change led to an increase in chronic diseases and their comorbidities[17][18]. NTCD, cardiovascular diseases in particular (coronary, hypertension, and cerebrovascular diseases), became the leading causes of mortality, which generated a high burden for the Unified Health System [*Sistema Único de Saúde* (SUS)] due to the high number of hospital admissions and disabilities. In 2007, in the State of Rio Grande do Sul, circulatory diseases accounted for 30.2% of deaths[19], while, in this study, 25.2% of deaths were caused by circulatory disease, a percentage slightly below the national rate (28.4%). This highlights the need for improvements in public policies directed to this problem, towards reduction of NTCDs[20].

In a study on proportional mortality due to basic causes in Montes Claros, MG, between 1996 and 2005, circulatory disease were a leading cause of death (28.2% of all deaths), followed by neoplasms (15.6% of all deaths), and external causes (12.7% of all deaths)[21]. In this study, NTCDs affected predominantly individuals 15 to 49 years of age. However, in individuals older than 49 years, circulatory causes increased. In this study, the same trend was seen for the elderly population; there was a high percentage of deaths due to circulatory disease, which also has the highest DALY value[21]. This is due to the aging of the population and the changing survival profile of the population. In the 1970s and 1980s, the region was formed mostly of young adults aged between 20 and 39 (29.4%); in the 2000s, the proportion of seniors (59 years and above) started to increase substantially, from 8.5% of individuals in 2000 to 10.1% in 2010[22].

In this study, only 4.5% of deaths were due to infectious and parasitic diseases, although these diseases present a high DALY. This result showed that infectious and parasitic diseases, despite having a low mortality, still have a large impact on the quality of life of the population. Low-income individuals have a 1.9 relative risk of dying due to some parasitic disease, compared with high-income individuals[23]. Low-income individuals have also a higher probability of death by cardiovascular causes than do high-income individuals, with a 20% higher death rate and a relative risk of 1.2[23]. Although the municipality of Monte Negro is in the Amazon region, which has a high rate of tropical and parasitic diseases, the mortality induced by those diseases was similar to that observed in the other municipalities and to the national rate, with the exception of São Domingos, State of Goiás.

Among individuals above 59 years of age, respiratory diseases were the second leading cause of hospital admissions, and, in Monte Negro, respiratory diseases in these individuals accounted for 8.7% of deaths, for which tobacco smoking is a major risk factor. The vaccine against the H1N1 virus is highly effective in preventing influenza and pneumonia in this population, which may have kept mortality rates from respiratory diseases low in this population[24]. Low adherence to vaccination by seniors, however, is a contributing factor to low vaccine coverage in this age group, as observed in a study carried

out in Londrina, State of Paraná; the main complaints by the elderly were fear of side effects and lack of trust in the vaccine's effectiveness. This resulted in decreased vaccination coverage in the elderly population[24]. Telarolli Jr, and Loffredo[25] studied death in the elderly of the city of Araraquara, State of São Paulo, in 2011; 32.8% of individuals above 60 years died from diseases of the circulatory system, 18% from diseases of the respiratory system, 11.9% from neoplasms, and 4.3% from endocrine causes. Circulatory diseases were the main cause of death and the main reason for hospital admissions of elderly people in Brazil[26].

In a study entitled Global Burden of Disease by the World Health Organization and World Bank[13], which estimates the DALY values of several world countries, it was reported that NTCDs are have the highest impact on mortality and decrease in life expectancy in this population, and therefore the highest DALY. Diseases with the highest DALY are, in ascending order: ischemic heart disease, chronic obstructive pulmonary disease, respiratory airway cancer, major depression, musculoskeletal changes, cerebrovascular accidents, and diabetes. Six out of 7 in this list are NTCDs. Risk factors related to the highest DALYs, in ascending order, are: increase in arterial blood pressure, tobacco smoking, pollution, low ingestion of fruits, alcohol abuse, obesity, and increased glycemia. All of these risk factors are associated with NCTDs, especially cardiovascular diseases[13]. In this study, NCTDs also have the highest DALY indices, demonstrating the potential impact on the healthcare system caused by the elevated morbidity and mortality of these diseases.

In developed countries, the reduction of infant mortality (calculated as deaths below 1 year for every 1,000 live births) demonstrated the importance of perinatal care, as it is mainly during the perinatal period that most child deaths occur[27]. In this study, 7.6% of deaths in Monte Negro were individuals younger than 1 year of age, with the main cause of death being perinatal or obstetric problems (6.1%). When compared to other study municipalities, Monte Negro had the highest rate of deaths, while the municipality of Dom Feliciano, State of Rio Grande do Sul, had the lowest rate. Perinatal mortality was the main cause of infant death, which indirectly reflects the quality of prenatal care provided by the Family Health Strategy [*Estratégia Saúde da Família* (ESF)] program. However, according to data from the Ministry of Health, in 2000, Monte Negro had 56% coverage by the ESF program, and, in 2010, this number increased to 100%[28]. Thus, the number of healthcare teams increased, in theory expanding the population coverage. However, we may suppose that, while the number of healthcare teams increased, the ratio of cases properly attended to and the quality and degree of effectiveness and completeness of care provided by those teams in relation to the quality of prenatal care, has not increased, as indicated by the percent of deaths in this age group. According to Bhutta et al.[29], some precautions may directly aid the reduction of this type of death, such as improvements in maternal nutrition during pregnancy, prevention and treatment of post-partum hemorrhages, neonatal resuscitation units, improvements in newborn nutrition, and identification and treatment of serious diseases in newborns (diarrhea, pneumonia, meningitis, and malaria). Late deaths, which mainly reflect vaccination and basic sanitation and issues with these matters, accounted for 21.8% of infant deaths in Monte Negro. The improvement in coverage by the National Immunization Program in the State of Rondônia in this period allowed increasing access to vaccination for infants, reducing mortality in this group by almost 600%[30] [31]. This decrease in infant mortality rate is a phenomenon occurring all over Brazil. For instance, in the State of Bahia, infant mortality rates decreased from 44.8 deaths/1,000 live births in 1997 to 27.3 deaths/1,000 live births in 2006[20], owing to measures focusing on primary healthcare, such as oral hydration therapy, vaccination of children and pregnant women, and increased awareness concerning breastfeeding and prenatal care[33].

In 2009, external causes were the 3rd cause of death in Brazil (36% homicides), and most common in 15 to 49 years (87% of cases)[31]. In this study, deaths due to external causes were the most prevalent cause of death, accounting for 26.4% of all cases. This percentage was much higher than that reported in the other municipalities analyzed, and more than 2-fold higher than the national rate. According to Macinko et al.[32], preventive and educational actions had no effect on the reduction of homicide rates in the Northern region of Brazil. Perhaps this could explain the high rates observed in Monte Negro. Among the external causes, traffic accidents are an important cause of death; in this study, 33% of deaths by external causes were due to traffic accidents. Approximately 1.2 million persons around the world die by this cause, and 90% of these deaths occur in underdeveloped and developing countries. Besides causing deaths or sequelae, traffic accidents result in a heavy burden on taxpayers[33]. According to Bacchieri and Barros[34], from 1998 to 2008, deaths related to motorcycle accidents increased by over 700%. In this period, the mortality rate of motorcycle riders increased from 3% to 23% and of bicycle riders from 1% to 4%. The motorcycle became the most common private transport in the country; however, the driving behavior and greater vulnerability of motorcycle drivers and their passengers lead to an increase in the death rates of these individuals, who are mostly male[35]. Thus, motorcycle riders are a priority group for public education and traffic accident prevention programs, since they have a 7-fold higher risk of death, 4-fold higher risk of body injury, and 2-fold higher risk of running over pedestrians compared with car drivers[36].

Another point that merits attention in this study is the number of *undefined* deaths (11%). This is a reflection of the low resolution capacity of the healthcare system regarding the availability of diagnostic systems and the efficacy and quality of filling out declarations of death by the health professional. The ESF units and medical professionals themselves must routinely perform death notifications and strive for proper completion of these declarations[35] [36]. Another exacerbating factor is that rural areas in Rondônia include farms, districts, and backroads ("linhas"), far from the urban areas. People often die before arriving to the hospital. Since there is no medical examiner service in the state, a significant number of those deaths remain without a final diagnosis.

Disease Information Systems are very important for assembling epidemiological and social profiles of a region, and for simplifying the management of political, social, and health service actions according to the needs of that population. Increases in life expectancy of Brazilians resulted in aging of the population, leading to changes in the death profile. Circulatory diseases and external causes were the most common causes of death in Monte Negro and Brazil overall. On the other hand, infectious and parasitic diseases made a low contribution to those death rates, highlighting the *epidemiological transition* phenomenon occurring in the municipality of Monte Negro and Brazil. However, the most remarkable observation was the high rate of death by external causes in the Monte Negro municipality, which reinforces the importance of public policies for accident and violence prevention. Due to the high number of *undefined* cases, the presence of a death verification service is of paramount importance to the State, in order to clarify poorly defined causes of death, and subsequently allow for improved of public health policies.

Conflict of interest

The authors declare that there is no conflict of interest.

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