



Analysis of Deaths Occurred in Households during the Pandemic by COVID-19 in a Brazilian Amazon Region: An Epidemiological Approach

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Authors' contributions

This work was carried out in collaboration among all authors. Author ALSF developed the research project, collected the data, analyzed the data, interpreted the results, and developed the discussion. Authors DMS, PSR, APV and DCL contributed to data analysis and discussion. Authors ECC, RJPSG, LNGCL, PC dos SJ, GTM and KVBL carried out the supervision, guidance and approval of the final version. All authors approved the final version.

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ABSTRACT

In the absence of an analysis of deaths at home from an epidemiological perspective, this study aims to analyze and describe the epidemiological profile of deaths at home assessed by the Death Ceremony Service (DCS) during the SARS-CoV-2 pandemic in the metropolitan region of the Brazilian Amazon, Belém do Pará. A descriptive, quantitative, secondary-based study based on the databases of the Mortality Information System (SIM), referring to the deaths that occurred from March 1 to March 27 June 2020. The variables worked were related to the profile and the causes in the death certificate. The causes of home deaths in 2019 were used to compare with 2020. In the indicated period, 1,203 deaths occurred, an increase of 454% in relation to 2019. The male gender (57.30%), the age group of 60+ (80.80%) and brown race (77.70%) were the most frequent. The main cause of death Acute myocardial infarction (15.05%) followed by COVID-19 (10.29%). During the pandemic, the majority of home deaths were not directly caused by COVID-19, however, they were influenced by it due to the need for social isolation, with the impossibility of obtaining the proper diagnosis or proper treatment, due to the impossibility of on-site care or lack of immediate response.

Keywords: COVID-19; pandemic; home deaths; epidemiology.

1. INTRODUCTION

The novel corona virus SARS-CoV-2 (severe acute respiratory syndrome corona virus 2) causative agent COVID-19 was first identified in Wuhan, Hubei Province, China, causing the pandemic declared on March 11, 2020 by the World Health Organization (WHO) [1].

In Brazil, the first confirmed case of COVID-19 was recorded on February 26, 2020 in São Paulo with rapid advancement across the country, with community transmission declared nationwide on March 20, 2020. The state of Pará registered the first case on March 18 and on July 25, 2020 took the fourth place in absolute number of cases in the country with 148,463 confirmed cases and 5,716 deaths [2,3].

When analyzing the time (in days) between the first implemented measure of social distancing and economic paralysis (full or partial) in Brazil, for 74% of the Federal Units (UF), this time was equal to or less than one week. Comparing the extremes, the states of Mato Grosso do Sul, Santa Catarina and Rio Grande do Sul adopted these groups of measures in a shorter period of time (one to two days difference), while at the other extreme is the state of Pará with 50 days [4], which may have contributed to this accelerated increase in the number of cases, and consequently high mortality rate.

Data from the Mortality Information System (SIM) and the Civil Registry Offices in the Transparency Portal, an online platform managed by the National Association of Natural Person Registrars (ARPEN) showed that

between the months of March and May 2020, the number of deaths from natural causes in Brazil increased by 11.3%, and in Pará there was an increase of 70.65% compared to 2019 [5].

The purpose of the Death Verification Service (DVS) is to investigate the causes of death by unknown or doubtful natural death. This data is essential for public health, since it enables the detection of epidemiological emergencies, isolated diagnosis or outbreaks of emerging and re-emerging diseases and also unusual diseases, guiding the decision making for disease control [6].

Deaths that occur without medical assistance, whether at home, in other facilities, or on public roads (without signs of violence or other external causes, and that are not in an advanced state of putrefaction) should be evaluated by the DVS for issuing the Death Certificate (DO) [5].

Such information is important for the direction of actions and decision-making of Primary Health Care (PHC) in the Unified Health System (SUS) network that can contribute to the mitigation of the effects of epidemics, fulfilling its essential function of ensuring daily and capillary care [7].

Despite the quantitative knowledge of deaths that occurred in households during the pandemic, little is known about the epidemiological profile. In this context, this study aims to analyze the deaths that occurred in households during the pandemic by COVID-19 in the metropolitan region of Belém, Pará, Brazil under an Epidemiological approach.

2. MATERIALS AND METHODS

2.1 Study Design, Location and Period

This is a quantitative, descriptive study, from data of deaths by natural causes that occurred at home in the metropolitan region of Belém (Belém, Ananindeua, Marituba, Benevides, and Santa Barbara) Fig. 1, state of Pará, Brazil, and that were referred to the DVS in the period from March 1 to June 27, 2020 (Epidemiological Week 10 to 26). The quantitative number of deaths from 2019 was used for comparison.

2.2 Epidemiological Data

The epidemiological variables investigated were: age, sex, education, occupation and basic cause of death. The age range was determined from the variable age, defined according to what was made available by the SIM, being the following thirteen age groups (01 to 04, 05 to 09, 10 to 14, 15 to 19, 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, 80+ and Ign). The occupation followed the Brazilian Classification of Occupations (BCO) table and the underlying causes of death according to the tenth revision of the International Statistical Classification of Diseases and Health Problems (ICD10) and for the nonspecific causes the Garbage Codes (GCGC).

GCs consist of ICD10 codes referring to underlying causes of death with undefined or incomplete diagnoses that do not indicate the specific cause of death, compromising the quality of the information on causes of death.

2.3 Data Collection and Analysis

Secondary data [8] regarding the number of deaths from natural causes were collected from

the Mortality Information System (SIM) to build the local database.

The data were analyzed and presented in graphs and tables, by simple descriptive statistics. In the analytical stage for comparison of proportions the chi-square test and G test were used. A 5% significance level was used.

3. RESULTS

Until the Epidemiological Week (SE) 9/2020 (02/29/20), the average number of removals made by the DVS was seven per day. Between SE 10 and 14/2020 (03/01 to 04/04) there was an increase in the number of occurrences, reaching a daily average of nine removals. Between SE 15 and 20/2020 (04/05 to 05/16), the peak of occurrences of deaths in households was registered, with an average of 24 removals per day, and in SE 18/2020 (04/26 to 05/02), the period of highest demand, the DVS registered 66 removals/day. Thus, in the midst of the SARS-CoV-2 pandemic there was an increase in the month of April of 116% in the removal of deaths by the DVS.

When evaluating the number of deaths in the household that occurred during epidemiological weeks 10 to 26 of 2020 (1,302) and the corresponding period in 2019 (235), it can be seen that there was an increase of 454% Fig. 2.

It is observed that most of the deaths were male (57.30%; 746/1,302), in the age group over 60 years (80.80%; 1,053/1,302).



Fig. 1. Metropolitan region of Belém, Pará State, Brazil

Source: https://pt.wikipedia.org/wiki/Regi%C3%A3o_Metropolitana_de_Bel%C3%A9m

Table 1 shows that regarding the variable race/color, the predominance was brown (77.70%; 1,012/1,302), while 31.41% (409/1,302) of the individuals who died had 1 to 3 years of schooling. The variable occupation has a high proportion of "not informed" (21.70%; 283/1,302). Among those who have this information, housewives have the highest number (21.50%; 280/1,302).

Regarding medical assistance before death, 70.80% (922/1,302) did not receive medical follow-up, 23.80% (310/1,302) received follow-up, and 5.20% (68/1,302) were not informed. Regarding the necropsy performed at the DVS, 89.90% (171/1,302) did not undergo this procedure.

The DVS assessed acute myocardial infarction as the underlying cause (15.07%) followed by coronavirus infection of unspecified location (diseases for NE location virus) (10.30%) Table 2.

Among the underlying causes of deaths defined by the DVS, 27% (354) are classified as nonspecific or incomplete underlying causes - Garbage Codes (GC). In comparison with the year 2019 it is identified that there was an increase in the year 2020 of 149% (212) for the main nonspecific underlying causes Table 3.

The DVS assessed acute myocardial infarction as the underlying cause (15.07%) followed by corona virus infection of unspecified location (diseases for NE location virus) (10.30%) Table 2.

The sample data indicate that there is statistical evidence between case distribution by year and underlying cause. The chi-square statistic is 140. The p-value is < 0.05. The result is significant at $p < 0.05$.

Considering the deaths that had COVID-19 as the underlying cause (134 cases), the data show that they were more frequent in males (67.20%; 90/134), married (35.1% 47/134), brown race/color (79.90% - 107/134), with respect to education, they had 1 to 3 years of schooling (26.10% - 35/134) and were over 60 years of age (81.3 - 109/134) Table 4. Family members of 81.30% of the cases (109/134) reported that there was no medical assistance before death.

In this case, spearman's correlation coefficient was the strength of association between the number of deaths per COVID-19 (SESPA) and the moderate number of home deaths (related causes) of the order of 0.56 ($p < 0.05$).

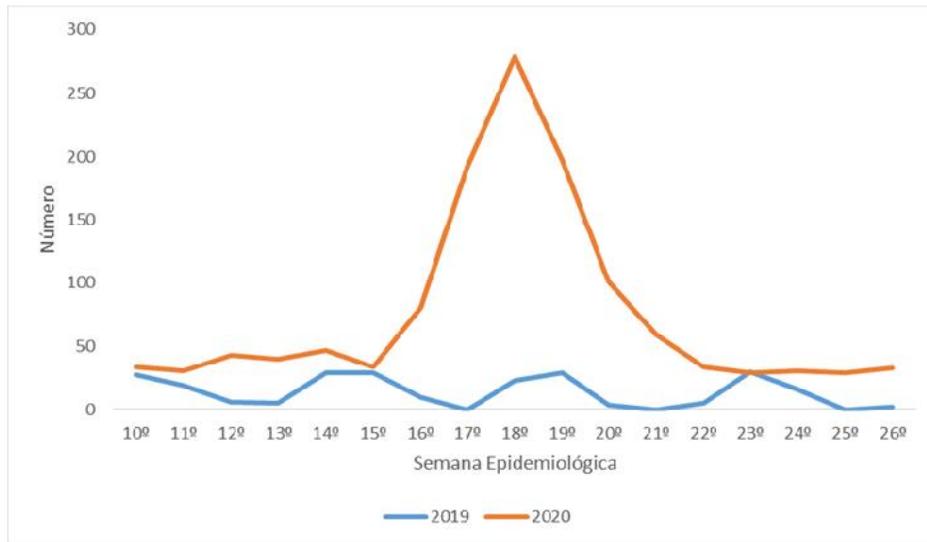


Fig. 2. Distribution of the absolute number of deaths due to natural causes, occurring in households, according to epidemiological week. Metropolitan region of Belém/Pará, March to June 2019* and 2020*

Semana epidemiológica: *epidemiological week

Número: **number

Fonte: SIM 20/08/2020

*Data subject to change

4. DISCUSSION

This study described and analyzed the main epidemiological characteristics of the 1,302 individuals who died of natural causes, in the municipalities of the metropolitan region of Belém and who were evaluated by the DVS for DO issuance, in the period between the 10th and 26th epidemiological week (SE) of the SARS-CoV-2 pandemic, showing an increase of 454% when compared to the same period of 2019. The Technical Report of the Federal Rural University of the Amazon (UFRA) evidenced that the death curve in the state reached its peak in the period from April 28 to May 1 (SE-18) [9].

The panel analysis of excess mortality from natural causes in Brazil in 2020, prepared by the National Council of State Health Secretaries (CONASS) [10] points to a proportional excess mortality of 23% in Brazil and 57% in Pará. A study conducted in Rio de Janeiro identified a 95% increase in deaths in households in April and May 2020, almost double the expected values [11]. This increase in deaths during the pandemic period did not happen only in Brazil. Countries in Latin America, and others such as Spain, Italy and the United States also have a large part of the deaths, mainly from COVID-19, occurring outside of hospitals [12-14].

Table 1. Distribution of characteristics related to race/color, schooling and occupation of individuals who died at home due to natural causes. Metropolitan region of Belém/ Pará March to June 2020

Variables	N	%
Race/color		
White	180	13,8
Black	80	6,10
Yellow	1	0,10
Brown	1.012	77,70
Indigenous	6	0,50
Not informed	23	1,80
Schooling (years)		
Not informed	9	0,69
No	238	18,28
From 1 to 3	409	31,41
From 4 to 7	300	23,04
From 8 to 11	235	18,05
12 and more	53	4,07
Ignored	58	4,45
Occupation		
Not informed	283	21,7
Housewife	280	21,5
Self-employed sales representative	72	5,50
Mason	36	2,80
Retired/pensioner	34	2,60
Farming worker	29	2,20
Administrative assistant	23	1,80
Domestic servant	20	1,50
Multipurpose agricultural producer	19	1,50
Taxi driver	18	1,40
Janitor	17	1,30
dressmaker in the making in series	17	1,30
Retail merchant	15	1,20
General cook	14	1,10
Stone cutter	13	1,00
Marketer	12	0,90
Carpenter	12	0,90
Other	454	34,8
Total per variable	1.302	100

Fonte: SIM (Data subject to change)

Table 2. Distribution of deaths at home according to the underlying cause. Metropolitan region of Belém/ Pará, March to June 2020

Root cause	N	%	p-value
I21 Acute myocardial infarction	196	15,05	
B34 Localization virus disease NE*	134	10,29	
J98 Other respiratory disorders	94	7,22	
I64 Stroke NE* such as ischemic haemorrhage	62	4,76	
G30 Alzheimer's disease	52	3,99	
I63 Cerebral infarction	40	3,07	<0.0001
E14 Diabetes mellitus NE*	38	2,92	
J18 Microorganism pneumonia NE*	35	2,69	
E46 Protein-caloric malnutrition NE*	27	2,07	
J11 Influenza due to unidentified virus	24	1,84	
I694 Sequelae of cerebrovascular disease	21	1,61	
Other.	579	44,47	
Total	1302	100,00	

Fonte: SIM (Data subject to change)

Table 3. Number of deaths in the home with nonspecific underlying causes - Garbage Codes. Metropolitan region of Belém/ Pará, March to June 2019 and 2020

Nonspecific root causes	2019	2020	Total	p-value
J98.8 Other specified respiratory disorders	1	94	95	<0.0001
I64 Stroke NE* such as ischemic haemorrhage	17	62	79	<0.0001
J18.9 Pneumonia NE*	18	35	53	0.0280
I69.4 Stroke Sequelae NE*	8	21	29	0.0259
I10 Essential hypertension	3	13	16	0.0244
R98 Death without assistance	1	5	6	<0.0001
I67.8 Other specified cerebrovascular diseases	1	9	10	<0.0001
R09.2 Respiratory arrest	0	10	10	<0.0001
J18.0 Bronchopneumonia NE*	3	7	10	<0.0001
Other	90	98	188	0.6097
Total	142	354	496	

Fonte: SIM (Data subject to change). * NE - Unspecified

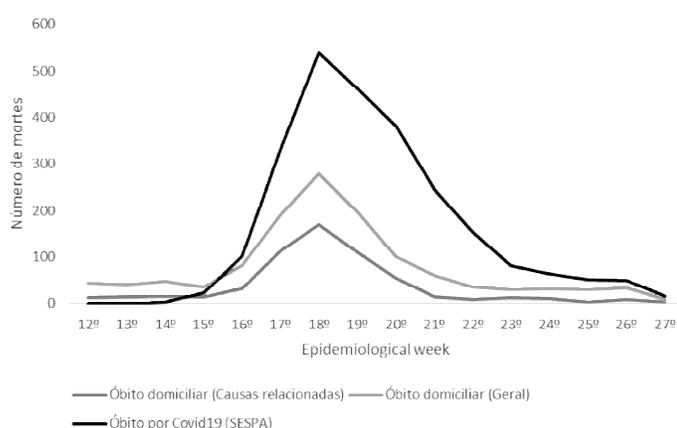


Fig. 3. Comparison of deaths in the general household and causes related to COVID-19, with deaths confirmed by COVID-19 by SESPA

Óbito domiciliar (causas relacionadas): *Home death (related causes), Óbito domiciliar (geral): **Home death (general), Óbito por COVID-19 (SESPA): ***Death by COVID-19 (SESPA).

Fonte: SIM (Data subject to change)

Table 4. Sociodemographic profile of deaths at home with ISCDHP 10 B34 (COVID-19). Metropolitan region of Belém/ Pará, March to June 2020

Variables	April	May	June	Total	%	p-value
Sex						
Male	46	41	3	90	67,2	<0.0001
Female	26	17	1	44	32,8	
Marital status						
Not informed	4	1	0	5	3,7	<0.0001
Single	21	16	3	40	23,9	
Married	23	23	1	47	35,1	
Widower	20	12	0	32	23,9	
Ignored	4	6	0	10	7,5	
Race/color						
White	5	9	1	15	11,2	<0.0001
Black	0	7	0	7	5,2	
Brown	64	40	3	107	79,9	
Indigenous	1	0	0	1	0,7	
Not informed	2	2	0	4	3,0	
Schooling						
Not informed	3	0	0	3	2,2	<0.0001
No	7	10	1	18	13,4	
From 1 to 3	25	10	0	35	26,1	
From 4 to 7	17	14	1	32	23,9	
From 8 to 11	16	16	1	33	24,6	
12 and more	3	3	0	6	4,5	
Ignored	1	5	1	7	5,2	
Age group						
30-39	2	1	1	4	3,0	<0.0001
40-49	7	2	0	9	6,7	
50-59	5	7	0	12	9,0	
60-69	18	14	1	33	24,6	
70-79	17	14	1	32	23,9	
80e +	23	20	1	44	32,8	
Medical care						
Not informed	6	5	0	11	8,2	<0.0001
Yes	11	3	0	14	10,4	
No	55	50	4	109	81,3	
Total by variable	72	58	4	134	100,0	

Fonte: SIM (Data subject to change)

Study conducted in England and Wales highlighted that homes have become the common place to die and recorded that hospital and home deaths had an increase of more than 50% in the pandemic [15].

There is no single cause for the increase in deaths at home. Among the possible explanations are that they may be related to the overload of hospitals that send patients back home, still the fear of people to seek care in health services, due to the risk of becoming

infected by the disease and also, a characteristic observed in some cases of patients with COVID-19 where sudden worsening occurs, causing rapid death [9].

The Transparency Portal also points out that mortality strikes differently in relation to color/race, being 3.4 times higher among black and mixed race people than among whites.

This study identified that the deaths that had COVID-19 as the underlying cause also followed

the same pattern of racial inequality in mortality. In this regard, studies conducted in the United Kingdom pointed out that racial disparity in COVID-19 mortality is a present feature, identifying deaths in the non-white population with higher rates than in the white population [16].

In England and Wales, the odds of dying from COVID-19 for black men is 4.2 times higher than for white men. For black women, the difference is 4.3 times greater than for white women. The studies have not been able to assertively identify the reasons for this inequality. But they propose as possibilities: socioeconomic factors that lead to higher rates of exposure, reduced capacity for social distance, lower access to or quality of care, and also the possibility of the presence of higher rates of serious diseases among infected people [16].

This study corroborates the hypothesis of socioeconomic factors, since most of the individuals who died in the household had 1 to 3 years of education and the most frequent occupation was housewife.

Regarding sex, male deaths accounted for 2.1 times the number of female deaths. This result is in agreement with an analysis of patients with COVID-19 who were treated at the Wuhan Union/China where it was concluded that although men and women have the same susceptibility, men with COVID-19 have a higher risk of worse outcomes and death, regardless of age, and the number of men was 2.4 times that of women in the deceased patients [17].

Still reflecting on the higher frequency of male patients, findings from studies aiming to describe patients hospitalized for SARS due to COVID-19 in Brazil, indicate that males are associated with progression to severe cases of the disease and death [18].

Among the deaths, 70.8% received no medical assistance. The accelerated progress of COVID-19 challenged the capacity of the single health system, in the state and municipal public networks, and also evidenced difficulties of private services that closed their doors when the beds were crowded. According to Khan et al. [19], the control of health care spending, the burden of non-communicable diseases, age profile of the population, greater capacity for medical care is directly related to lower mortality from COVID-19.

Another important aspect to consider is that not all deaths at home were caused by COVID-19. In the metropolitan region of Belém it is a fact that there was a collapse of the public and private health system. In an interview, the state health secretary stated on April 24 that the Para health system was collapsing, as was the funeral system, both in the removal and release of bodies [20]. In this situation, the population had no alternatives in seeking care for their illnesses.

There was still the orientation of the need for isolation and avoidance of crowds. In this sense, individuals with chronic diseases were not undergoing proper treatment due to the need for isolation, the fear of contamination or even the absence of health service, in a way that aggravated their health condition, suggesting that mortality is correlated with the burden of health care [9].

Among the deaths the highest proportion occurred in the 60+ age group, especially those over 80 years old. In the municipality of Rio de Janeiro, between March 6 and April 10, deaths from COVID-19 in the 60+ population accounted for 73.9% of total deaths [21].

A study conducted in Peru found that elderly individuals, males aged 80 years and older, were affected 58 times more than males aged 0 to 9 years by the COVID-19 pandemic [22].

Similarly, England experienced the highest excess all-cause mortality compared to 2015 and 2016. Mortality was highest in the population over the age of 85. This rate being the highest observed in the last five years [23].

In the evaluation of the basic cause of deaths defined by the DVS, the first cause was acute myocardial infarction. In Brazil, according to a survey carried out by the SUS Department of Informatics (DATASUS), circulatory system diseases appear in first place. Of these, the most common are arterial, cerebrovascular and hypertensive, in addition to the Acute Myocardial Infarction (AMI) representing the first cause of deaths, in Pará, in 2019 was also the first cause of mortality by natural cause in the same period of analysis of this study. In Brazil, in 2019 AMI presented 131,130 cases, while in 2020 until the month of June it presented 63,629 cases [24]. Thus, despite the pandemic due to COVID-19, the main cause of deaths in households was

AMI, corroborating the national statistics.

Studies point out that the pandemic caused less demand for health services in relation to cardiovascular diseases, and noticed a 50% reduction in hospitalizations and percutaneous procedures (AMI treatment). However, they pointed out that the patients, when they developed symptoms, did not seek medical help for fear of COVID-19 or because of crowding and lack of adequate care, influenced by the pandemic. Thus, it only reduced the diagnosis and treatment, especially of AMI, but the deaths from this cause continued to lead, as they also highlight that the incidence will be higher in 2020, compared to recent years, mainly due to lack of diagnosis and treatment [25-27].

The Chronic Non-Communicable Diseases (NCDs) have been highlighted as an alarming public health problem in the world scenario. This phenomenon is the result of population aging, which has changed the epidemiological profile of diseases, reducing infectious diseases and increasing chronic diseases. It affects, especially, the most vulnerable populations, such as those of medium and low income and education, due to greater exposure to risk factors or restricted access to information and health services. In this aspect, during the period evaluated, it was recognized as a factor contributing to the increase in deaths in households [28].

Considering that COVID-19 records were assigned to ISCDHP B34.2 (Coronavirus infection of unspecified location), this was the second cause of death in the period from March to June 2020 in the household, with predominance in the month of April. The Technical Note No. 05/DVS/SESPA published on April 04, 2020 guided about the impossibility of performing necropsy on a corpse due to the pandemic and replaced it by verbal autopsy. In cases with suspicion of COVID-19 the collection of nasopharyngeal sample (*swab*) was performed post mortem, which should be performed preferably within the first 6 hours after death [29].

There are uncertainties about the real mortality rate of COVID-19 in Brazil in face of the high number of nonspecific underlying causes in death certificate (149% when compared to 2019). The quality of information on causes of death is questioned, Garbage codes were prominent in the period of this study in household deaths.

These terms should be avoided in the information as the underlying cause of death [30].

In the Protocol of investigation of deaths, seeking to improve the cause of death in Brazil, the MH guides on the need to investigate these deaths and reclassify the basic cause of death in at least 70% of them. In this sense the number of deaths by COVID-19 can increase, in the occurrence of the investigation [31].

The ill-defined causes are related to inequality in access and quality of medical care, i.e., it does not depend only on the physician, since factors such as insufficient clinical information contribute to this indicator, leading to reflection on the need for practices aimed at improving the health situation of the population at all times and even more in the occurrence of a pandemic and the importance of active and integrated health surveillance with other health sectors [32].

Countries with better economic infrastructure in vacant conditions fare well in this pandemic compared to less privileged countries. Policymakers at the international, regional, and governmental levels need to formulate policies to address this imbalance, because a collapse of the health system in one place will put all connected countries at risk.

An increasing number of confirmed cases can overwhelm any health care system; therefore, all possible measures should be instituted to keep it down so that effective services can be provided to affected patients. Measures such as quarantine, isolations, travel restrictions can help keep mortality rates down. Overall, this pandemic, like any pandemic, exposes the gaps in existing systems and provides an opportunity to learn what measures have worked best and how to be prepared for new challenges.

As a learning from this pandemic, among others, Mendonça et al. [33] suggest that Family Health Strategy, the practice of Primary Health Care (PHC) is absolutely central to the local response to COVID-19, thus avoiding an increase in the number of deaths at home.

Furthering this proposal, Medina et al. [7] discuss the continuity of the actions of PHC, including the use of technologies, such as telemedicine with the preparation of schedules, monitoring by

traditional telephone or applications such as WhatsApp, responsive to the frequent demands of users for the renewal of prescriptions and the search for medicines, avoiding the need for them to go to the basic health units (BHU), as well as extending the duration of prescriptions and enabling home delivery of medicines by CHWs.

5. CONCLUSION

In this study it was possible to describe the profile of deaths that occurred at home, evaluated by the DVS in the metropolitan region of Belém, Pará. The predominance was male, over 60 years old and, among the basic causes defined in the DO, acute myocardial infarction, virus disease of NE location (COVID-19) and other respiratory disorders were highlighted. The nonspecific underlying causes that should be investigated were also highlighted.

Although deaths at home were not directly caused by COVID-19, they were influenced by it due to the need to maintain social isolation. Individuals with chronic diseases may not have had the proper diagnosis and treatment for their disease. There is also the possibility that they sought service and were not able to get care in a timely manner.

Thus, the surveillance of deaths in households is an indicator for the development of public policies to combat COVID-19, because we show that the increase is associated with the pandemic, such as lack of assistance and lack of control of the disease in the state and in the country.

6. LIMITATION OF THE STUDY

The limitation of the study is inadequate data entry, which requires investigation for requalification of the underlying causes of death, which may change after investigation.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The data of this study were made available publicly, not containing personal data of patients, thus not presenting risks to the research participants, as well as, being dispensed with the

ethical opinion. This study is in accordance with the Law No. 12.527 of 18/11/2011 (Access to Information Law).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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