Research, Society and Development, v. 11, n. 9, e45011931485, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i9.31485

Observational study on cases of sepsis in the State of Pará from 2015 to 2019

Estudo observacional sobre casos de sepse no Estado do Pará ocorridos no periodo de 2015 a 2019

Estudio observacional sobre casos de sepsis en el Estado de Pará de 2015 a 2019

Received: 06/07/2022 | Reviewed: 06/14/2022 | Accept: 07/06/2022 | Published: 07/15/2022

Leticia Maues Marques
ORCID: https://orcid.org/0000-0002-1954-6519
Escola Superior da Amazônia, Brazil
E-mail: leticiamaues01@gmail.com
Paulo Cairo Nunes de Oliveira
ORCID: https://orcid.org/0000-0001-6856-0934
Escola Superior da Amazônia, Brazil
E-mail: paulocairo2017@outlook.com
Larissa de Oliveira Bahia
ORCID: https://orcid.org/0000-0001-6586-6663
Escola Superior da Amazônia, Brazil
E-mail: larissabahia.oliveira@hotmail.com
Stanley Soares Xavier
ORCID: https://orcid.org/0000-0002-4040-4144
Universidade do Estado do Pará, Brazil
E-mail: stanley.xavier@uepa.br
Gabriel de Freitas Santos da Costa
ORCID: https://orcid.org/0000-0001-5867-7717
Escola Superior da Amazônia, Brazil
E-mail: freitasgabriel@gmail.com
Alcinês da Silva Sousa Júnior
ORCID: https://orcid.org/0000-0002-8450-6724
Universidade do Estado do Pará, Brazil
E-mail: alcinesjunior@gmail.com
Ranná Barros Souza
ORCID: https://orcid.org/0000-0001-6980-0290
Escola Superior da Amazônia, Brazil
E-mail: rannasouza560@outlook.com
Larissa Amaral da Costa Lopes
ORCID: https://orcid.org/0000-0002-8845-5004
Instituto de Ensino Superior da Grande Florianópolis, Brazil
E-mail: larissaaclopes@gmail.com
Ericsson Garcia Barros
ORCID: https://orcid.org/0000-0002-0423-1928
Escola Superior da Amazônia, Brazil
E-mail: ericssonbarros16@gmail.com
Amanda Gabrielle dos Santos Amaral
ORCID: https://orcid.org/0000-0002-6005-2078
Escola Superior da Amazônia, Brazil
E-mail: amandaamaraldj@gmail.com
Raiane Cristina Gonçalves Machado
ORCID: https://orcid.org/0000-0002-3471-8542
Escola Superior da Amazônia, Brazil
E-mail: raianemachado0306@gmail.com
Andrey Silva Machado
ORCID: https://orcid.org/0000-0002-9598-799X
Universidade do Estado do Pará, Brazil
E-mail: Andrey.silva.machado@hotmail.com
Adriane Lisboa Pereira
ORCID: https://orcid.org/0000-0003-2019-5637
Escola Superior da Amazônia, Brazil
E-mail: fisioadrianelisboa@gmail.com
Thayse Hage Gomes Machado
ORCID: https://orcid.org/0000-0002-6700-153X
Universidade do Estado do Pará, Brazil
E-mail: thaysehage@yahoo.com.Br
Marcella Mota Macedo e Machado
ORCID: https://orcid.org/0000-0002-4151-5639
Universidade Federal de São Paulo, Brazil
E-mail: marcellamachado@uol.com.br

Abstract
Sepsis can be understood as a set of infections throughout the body. Worldwide, its incidence is estimated at around 15 to 19 million cases annually. Recently, deaths have decreased, reaching an estimated value of 20 to 40% of reported cases. However, in Brazil, according to data from the Instituto Latino Americano de Sepsis (Ilas), death from sepsis corresponds to 65% of all deaths, which is much higher than the world estimate. Thus, in this paper, we will evaluate mortality from sepsis in the State of Pará from 2015 to 2019. An ecological observational study was carried out using the data collected in the Mortality Information System and the Hospital Information System, made available by the Department of Informatics of the Unified Health System in Brazil. During the period investigated, a total of 2,547 deaths from sepsis were recorded. The epidemiological profile of mortality from sepsis presented individuals with the following characteristics: male, mixed race, 1 to 3 years of schooling, marital status: a married, place of occurrence: hospital, and age group from 60 to 79 years. It is of fundamental importance to develop more targeted prevention policies, prioritize educational and population awareness measures, and the continuous improvement of health teams regarding the knowledge of sepsis about early identification and more effective care to reduce mortality from sepsis in the state of Pará, Brazil.
Keywords: Sepsis; Pará; Epidemiology; Mortality.

Resumo
A sepse pode ser compreendida como um conjunto de infecções em todo o organismo. No mundo, sua incidencia é estimada em torno de 15 a 19 milhões de casos por ano. Recetemente o número de mortes diminui, alcançando uma valor estimado de 20 a 40% dos casos relatados. Contudo, no Brasil, de acordo com os dados do Instituto Latino Americano de Sepse (Ilas), a morte por sepse corresponde a 65% dos casos de morte, valor este muito superior a estimativa mundial. Dessa forma, neste paper iremos avaliar a mortalidade por sepse no Estado do Pará durante o periodo de 2015 a 2019. Para isso, foi realizado um estudo observacional ecologico utilizando como informações os dados coletados no Sistema de Informações sobre Mortalidade e do Sistema de Informações Hospitalares, disponibilizados pelo Departamento de Informática do Sistema Único de Saúde do Brasil. Durante o periodo investigado, foram registrados um total de 2.547 óbitos por sepse. O perfil epidemiológico da mortalidade por sepse apresentou indivíduos com as seguintes características: sexo masculino, cor/raça parda, escolaridade de 1 a 3 anos, estado civil: casado, local de ocorrência: hospital e faixa etária de 60 a 79 anos. É de fundamental importância a elaboração de políticas de prevenção mais direcionadas, priorizando-se as medidas educativas e de sensibilização populacional, além de aperfeiçoamento contínuo das equipes de saúde quanto ao conhecimento da sepse em relação à identificação precoce e atendimento mais efetivo, a fim de reduzir a mortalidade por sepse no estado do Pará, Brasil.
Palavras-chave: Sepsis; Pará; Epidemiology; Mortality.

Resumen
La sepsis puede entenderse como un conjunto de infecciones en todo el organismo. A nivel mundial, su incidencia se estima en alrededor de 15 a 19 millones de casos por año. Recientemente, el número de muertes ha disminuido, alcanzando un valor estimado de 20 a 40% de los casos notificados. Sin embargo, en Brasil, según datos del Instituto Latino Americano de Sepsis (Ilas), la muerte por sepsis corresponde al 65% de todas las muertes, muy por encima de la estimación mundial. Así, en este artículo evaluaremos la mortalidad por sepsis en el Estado de Pará durante el período de 2015 a 2019. Para ello, se realizó un estudio observacional ecológico utilizando como información los datos recopilados en el Sistema de Información de Mortalidad y el Sistema de Información Hospitalaria. , puesto a disposición por el Departamento de Informática del Sistema Único de Salud de Brasil. Durante el período investigado se registraron un total de 2.547 muertes por sepsis. El perfil epidemiológico de mortalidad por sepsis presentó individuos con las siguientes características: masculino, mestizo, 1 a 3 años de escolaridad, estado civil: casado, lugar de ocurrencia: hospital y grupo etario de 60 a 79 años. Es de fundamental importancia desarrollar políticas de prevención más focalizadas, priorizando medidas educativas y de concientización de la población, además de la mejora continua de los equipos de salud en cuanto al conocimiento de la sepsis en relación a la identificación temprana y una atención más efectiva, con el fin de reducir la mortalidad por sepsis. en el estado de Pará, Brasil.
Palabras clave: Septicemia; Pará; Epidemiologia; Mortalidad.

1. Introduction

Sepsis, formerly known as septicemia, is a set of severe manifestations throughout the body of a systemic inflammatory response with organ dysfunction due to an inadequate reaction to an infection (Santos et al., 2019). Thus, with the impairment of the function of several organs, the patient may not support it and, consequently, die, characterizing sepsis as one of the leading causes of late hospital mortality (ILA, 2019).

Sepsis has an estimated 15 to 19 million cases per year worldwide, thus characterizing a severe public health problem. Even though mortality has reduced in recent decades, the percentage value remains high, from 20% to 30%, depending on the

diagnosis speed and the treatment quality (Schuetz et al., 2019). However, public awareness related to sepsis is still insufficient.

Therefore, the early diagnosis of sepsis and the identification of the infectious origin leads to immediate and more appropriate treatment, considerably reducing mortality (Jorge et al., 2002).

In Brazil, sepsis corresponds to about 13% of all hospitalizations in Intensive Care Units (ICU), generating high costs in public and private sectors due to the need to use sophisticated equipment and highly high-cost drugs, in addition to requiring a lot of caution from the health team (Morello et al., 2018).

In addition, the number of deaths from sepsis in Brazil increased by around 6% from 2000 to 2010. Data made available by the Instituto Latino Americano de Sepsis (ILAS) show that the mortality rate in Brazil's private and public health facilities varies from 30% to 70%, respectively (Satriano, 2017).

Mortality statistics represent a relevant subsidy for most health indicators, even in so-called developed countries. However, in these countries, it is easier to obtain data on morbidity. Still, the data on mortality is characterized as one of the most important components of these analyses (Jorge et al., 2008).

Thus, epidemiological data on mortality from sepsis in different scenarios point to differences considered necessary between developed countries and countries with limited resources, thus facilitating the understanding of this scenario (ILAS, 2015). Therefore, the investigation and explanation of epidemiological data related to sepsis are of fundamental importance (Pires et al., 2020; Ranzato Filardi et al., 2018).

In this context, the work is justified by the presence of relevant data that characterize mortality from sepsis in the state of Pará, the northern region of Brazil, in a predetermined period (2016 to 2019), in addition, we also have as objectives (i) To characterize the epidemiological profile of morbidity and mortality from sepsis in the state of Pará, Brazil, during the study period; (ii) Present the temporal distribution of the mortality rate from sepsis over the years in the state of Pará and (iii) Understand the spatial distribution of the mortality rate from sepsis in the microregions of the state of Pará. Thus, this study can guide the understanding of mortality trends and indicators and, consequently, the planning and elaboration of public policies.

2. Methodology

2.1 Types of Studies

This is an ecological observational study on mortality caused by sepsis in the state of Pará, northern region of Brazil, during the period from 2015 to 2019 (Alves et al., 1999; Lima-Costa & Barreto, 2003).

Data on death cases were collected at the Mortality Information System (SIM) and Hospital Information System of the Unified Health System (SIH/SUS), Department of Informatics of the Unified Health System (DATASUS).

Data were collected through virtual access to SIM and SIH/SUS, made available by DATASUS, through Tablet, with the theme Sepsis/Septicemia, coded by the International Classification of Diseases (CID 10) in CID 10 – A40 and A41 in May and June 2021 (DATASUS - Ministério da Saúde, 2021).

2.2 Inclusion and Exclusion Factors

2.2.1 Inclusion Criteria

- Male and female subjects were included in our study; including variables cataloged only as follows: individuals of both sexes (male and female), color/race (white, black, yellow, brown, indigenous, and unknown), education (illiterate, 1 to 3 years, 4 to 7 years, 8 to 11 years, 12 years and over, and unknown), marital status (single, married, widowed, legally separated and other), place of occurrence (hospital, other health establishments, domicile, public road, others) and age group in age group (less than 1 year, 1 to 9 years, 10 to 14 years, 15 to 19);

- All cases of death that occurred during the period from 2015 to 2019;
- Only cases obtained in the microregions of the state of Pará were considered;
- All male and female subjects were included.

2.2.2 Exclusion Criteria

- Cases of death due to sepsis outside the state of Pará were not considered in our analyzes
- Individuals older than 20 years of age were ignored.
- Deaths occurring after the year 2019 were disregarded, as well as those obtained before the year 2015
- Data that do not refer to the microregions of the state of Pará established by the IBGE and data from individuals with variables such as sex, color/race, schooling, marital status, place of occurrence, and age grouped into age groups that are inconsistent with the catalogs previously established for analysis.

2.3 Statistical Analysis

Data were analyzed using statistical procedures (comparisons and associations) to correlate them to analyze the space-time distribution of mortality from sepsis. The tables and graphs were processed using the Excel 2013 spreadsheet, and the maps were processed using the Arcgis 10.5 software. The results expressed in the tables were statistically analyzed using the chi-square test of adherence, and for statistical decision criteria, a significance level of 5% was adopted (Hayat et al., 2017).

3. Results

In the state of Pará, during the period from January 2015 to December 2019, a total of 2,547 deaths from sepsis were registered in SIM, according to the data presented in Table 1.

Table 1. Epidemiological profile of mortality from sepsis (p-value <0.0001).

Variables		n=2547	%
Sex	Male	1376	54.02
	Feminine	1171	45.98
color/race	White	478	18.77
	black	177	6.95
	Yellow	7	0.27
	brown	1809	71.02
	Indigenous	14	0.55
	ignored	62	2.43
education	Illiterate	569	22.34
	1 to 3 years	632	24.81
	4 to 7 years	393	15.43
	8 to 11 years	224	8.79
	12 years and over	67	2.63
	ignored	662	25.99
marital status	Single	623	24.46
	Married	663	26.03
	Widower	451	17.71
	Judicially separated	64	2.51
	Other	235	9.23
	ignored	511	20.06
place of occurrence	Hospital	2216	87.00
	Another health facility	171	6.71
	Residence	119	4.67
	Public highway	15	0.59
	Others	26	1.02
Age Group	under 1 year	246	9.66
	1 to 9 years	79	3.10
	10 to 14 years	32	1.26
	15 to 19 years	29	1.14
	20 to 39 years	236	9.27
	40 to 59 years	442	17.35
	60 to 79 years	866	34.00
	80 years and over	612	24.03
	age unknown	5	0.20

Source: Authors.

From January 2015 to December 2019, a total of 2,422,429 confirmed cases of sepsis were registered in the SIH/SUS. The epidemiological profile of morbidity due to sepsis in Pará during the period established for the study is composed of: female sex, mixed-race, and age group from 20 to 39 years (variables of the epidemiological profile of morbidity statistically significant, with p-value < 0.05). As seen in Table 2.

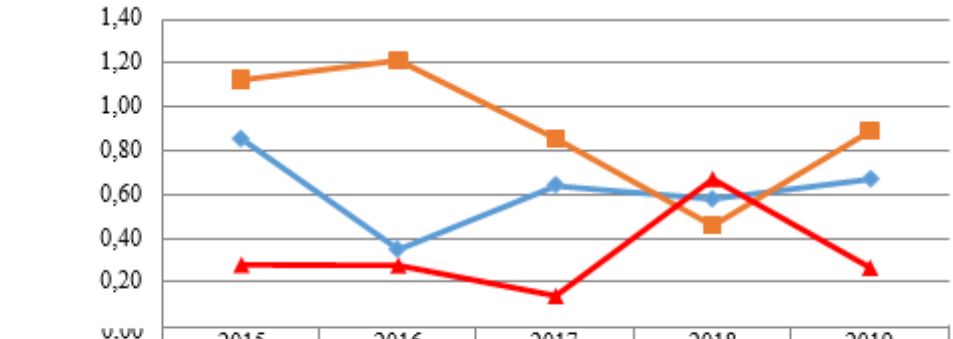
Table 2. Epidemiological profile of morbidity from sepsis, from 2015 to 2019, in the State of Pará, Brazil (p-value <0.0001).

Variables		n=2422429	%
Sex	Male	919983	37.98
	Feminine	1502446	62.02
color/race	White	50557	2.09
	black	22561	0.93
	Yellow	31271	1.29
	brown	1478093	61.02
	Indigenous	10491	0.43
	ignored	829456	34.24
Age Group	under 1 year	138969	5.74
	1 to 9 years	271029	11.19
	10 to 14 years	87643	3.62
	15 to 19 years	262796	10.85
	20 to 39 years	916833	37.85
	40 to 59 years	384797	15.88
	60 to 79 years	283344	11.70
	80 years and over	77018	3.18

Source: Authors.

The analysis of mortality from sepsis in the microregions of the Lower Amazon reveals that the municipality of Óbidos had the highest mortality rate in 2015 (0.86), Santarém in 2016 (1.21), and Almeirim in 2018 (0.67) (Figure 1).

Figure 1. Historical series of the mortality rate from sepsis, from 2015 to 2019, by microregions of the Lower Amazon, in the State of Pará, Brazil. Rates are displayed for 100,000.

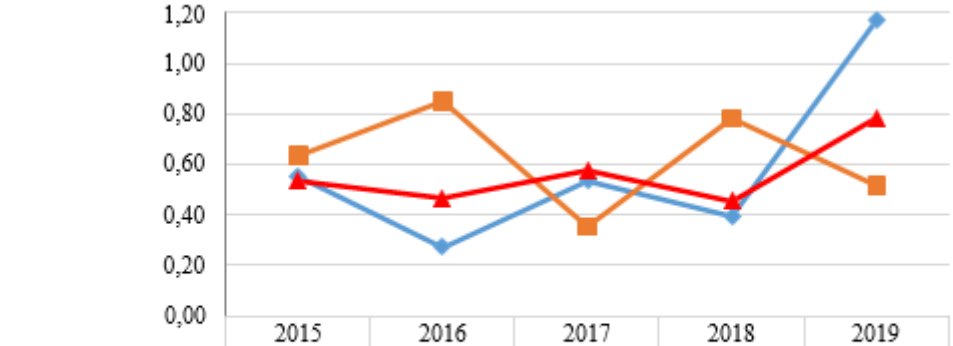


	2015	2016	2017	2018	2019
Obidos	0,86	0,35	0,64	0,58	0,67
Santarém	1,12	1,21	0,86	0,46	0,89
Almeirim	0,28	0,28	0,14	0,67	0,27

Source: Authors.

Regarding the analysis of mortality from sepsis in the microregions of Marajó, Portel shows a considerable increase in the pattern of the mortality rate of the five years of studies in the year 2019 (1.17), Furious de Breves obtained a higher mortality rate in the year of 2016 (0.85) and Arari also in 2019 (0.79) (figure 2).

Figure 2. Historical series of the mortality rate from sepsis, from 2015 to 2019, by microregions of Marajó, in the State of Pará, Brazil. Rates are displayed for 100,000 inhabitants.

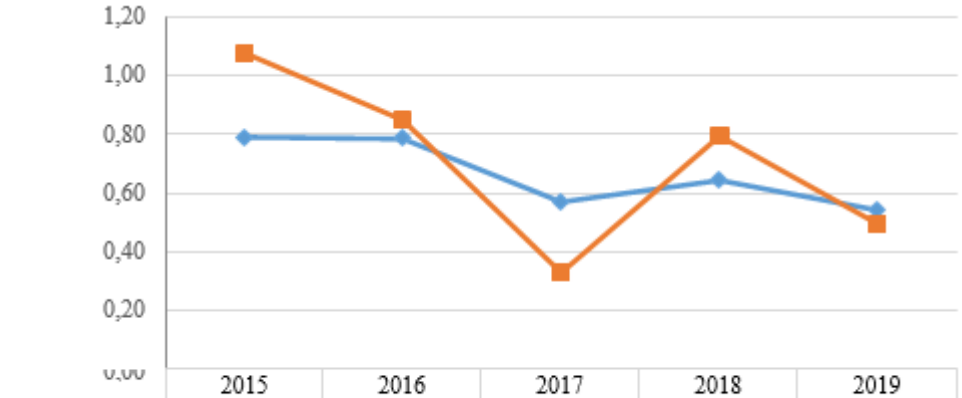


	2015	2016	2017	2018	2019
Portel	0,55	0,27	0,54	0,40	1,17
Furos de Breves	0,63	0,85	0,35	0,78	0,52
Arari	0,53	0,47	0,58	0,45	0,79

Source: Authors.

About the microregions of the Metropolitan Region of Belém, the capital and the Municipality of Castanhal had the peak mortality rate from sepsis in 2015 (0.79 and 1.08, respectively), as shown in Figure 3.

Figure 3. Historical series of the mortality rate from sepsis, from 2015 to 2019, by microregions of the Metropolitan Region of Belém, in the State of Pará, Brazil. Rates are displayed for 100,000 inhabitants.

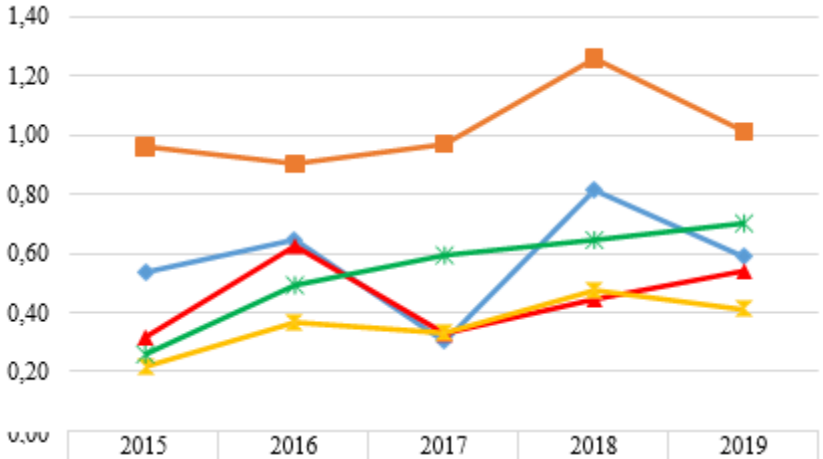


	2015	2016	2017	2018	2019
Belém	0,79	0,78	0,57	0,64	0,54
Castanhal	1,08	0,85	0,33	0,80	0,49

Source: Authors.

The mortality rate from sepsis in the microregions of Northeast Pará shows that Salgado and Bragantina had the highest rate in 2018 (0.82 and 1.26, respectively), Cametá in 2016 (0.63), Tomé-Açu in 2018 (0. 48) and Guamá in 2019 (0.70), as shown in

Figure 4. Historical series of the mortality rate from sepsis, from 2015 to 2019, by microregions of the Northeast, in the State of Pará, Brazil. Rates are displayed for 100,000 inhabitants.

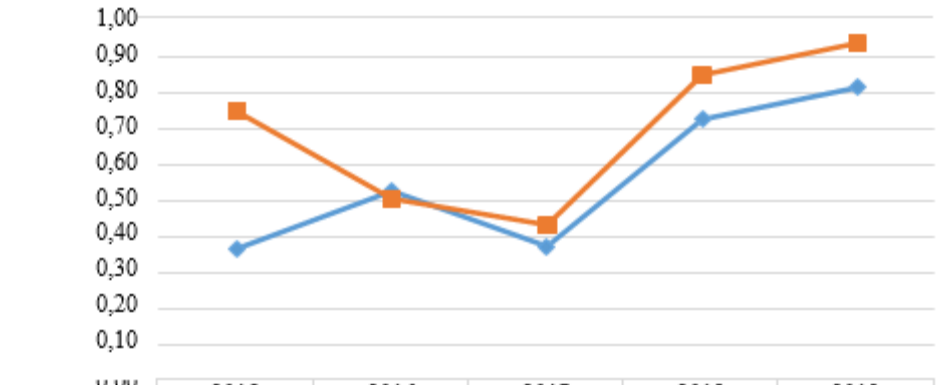


	2015	2016	2017	2018	2019
Salgado	0,54	0,65	0,30	0,82	0,59
Bragantina	0,96	0,90	0,97	1,26	1,01
Cametá	0,32	0,63	0,33	0,45	0,54
Tomé-Açu	0,22	0,37	0,33	0,48	0,41
Guamá	0,26	0,49	0,60	0,65	0,70

Source: Authors.

In the Southwest of Pará, there was a progressive increase in the mortality rate in both Itaituba and Altamira, from 2017 onwards, both with a peak in 2019 (0.81 and 0.94, respectively), as shown in Figure 5.

Figure 5. Historical series of the mortality rate from sepsis, from 2015 to 2019, by microregions of the Southwest, in the State of Pará, Brazil. Rates are displayed for 100,000 inhabitants.

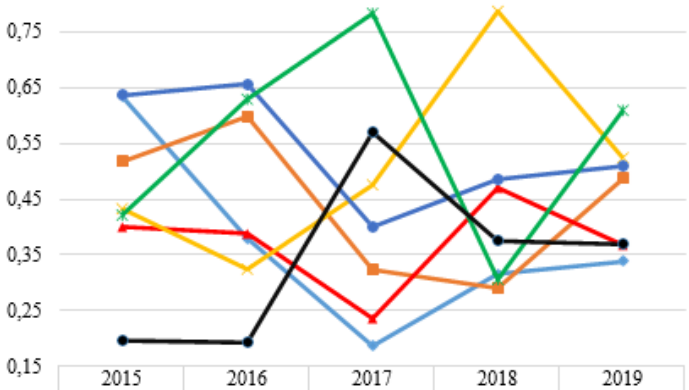


	2015	2016	2017	2018	2019
Itaituba	0,37	0,53	0,37	0,73	0,81
Altamira	0,75	0,50	0,43	0,85	0,94

Source: Authors.

The analysis of mortality from sepsis in the microregions of Southeast Pará shows that Tucuruí had the highest rate in 2015 (0.63), Paragominas in 2016 (0.60), São Félix do Xingu in 2018 (0.47), Parauapebas in 2018 (0.79), Marabá in 2016 (0.66), Redenção and Conceição do Araguaia in 2017 (0.78 and 0.57, respectively) (Figure 6).

Figure 6. Historical series of the mortality rate from sepsis, from 2015 to 2019, by Southeast microregions, in the State of Pará, Brazil. Rates are displayed for 100,000. inhabitants.

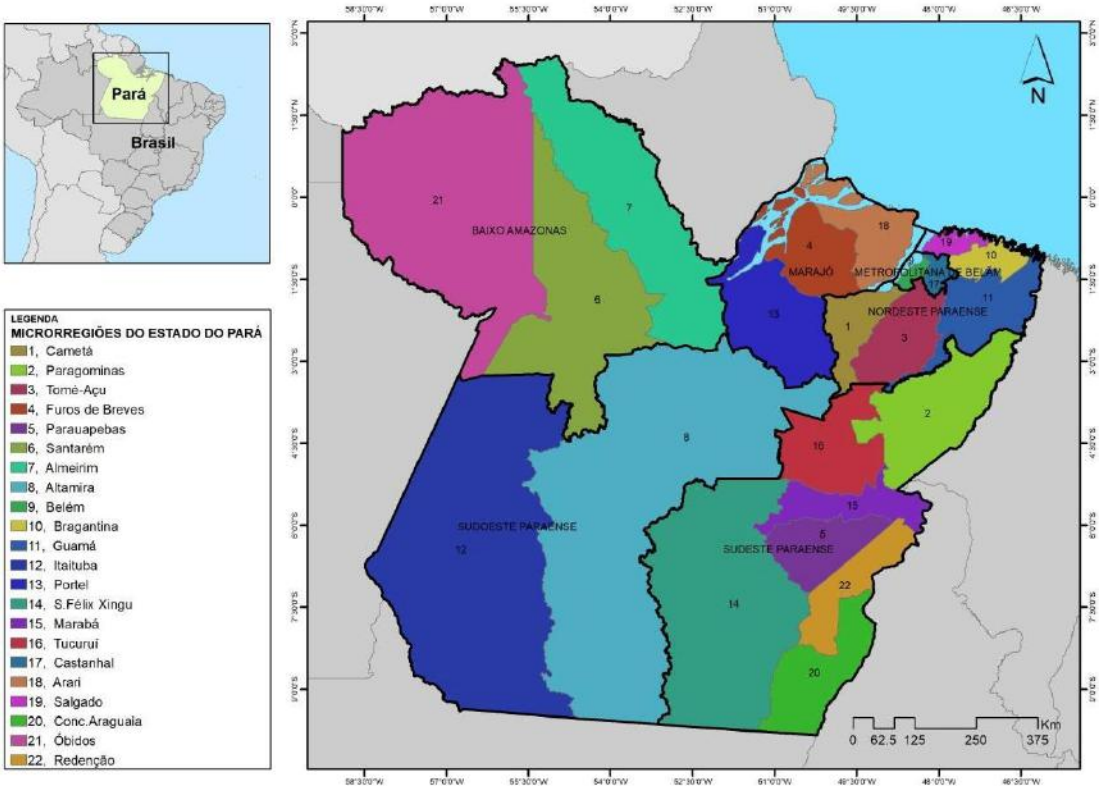


	2015	2016	2017	2018	2019
Tucuruí	0,63	0,38	0,19	0,32	0,34
Paragominas	0,52	0,60	0,32	0,29	0,49
S.Félix Xingu	0,40	0,39	0,24	0,47	0,37
Parauapebas	0,43	0,32	0,48	0,79	0,52
Marabá	0,64	0,66	0,40	0,49	0,51
Redenção	0,42	0,63	0,78	0,31	0,61
Conc.Araguaia	0,20	0,19	0,57	0,37	0,37

Source: Authors.

The study area is composed of the 6 mesoregions of the state of Pará (Baixo Amazonas, Marajó, Metropolitan Region of Belém, Northeast of Pará, Southeast of Pará, and Southwest of Pará), which are subdivided into 22 microregions (GOVERNO DO PARÁ, 2014). The division was used as a spatial delimitation to analyze the number of cases, several deaths, incidence rate, and mortality rate from sepsis in the state of Pará, from 2015 to 2019 (Figure 7).

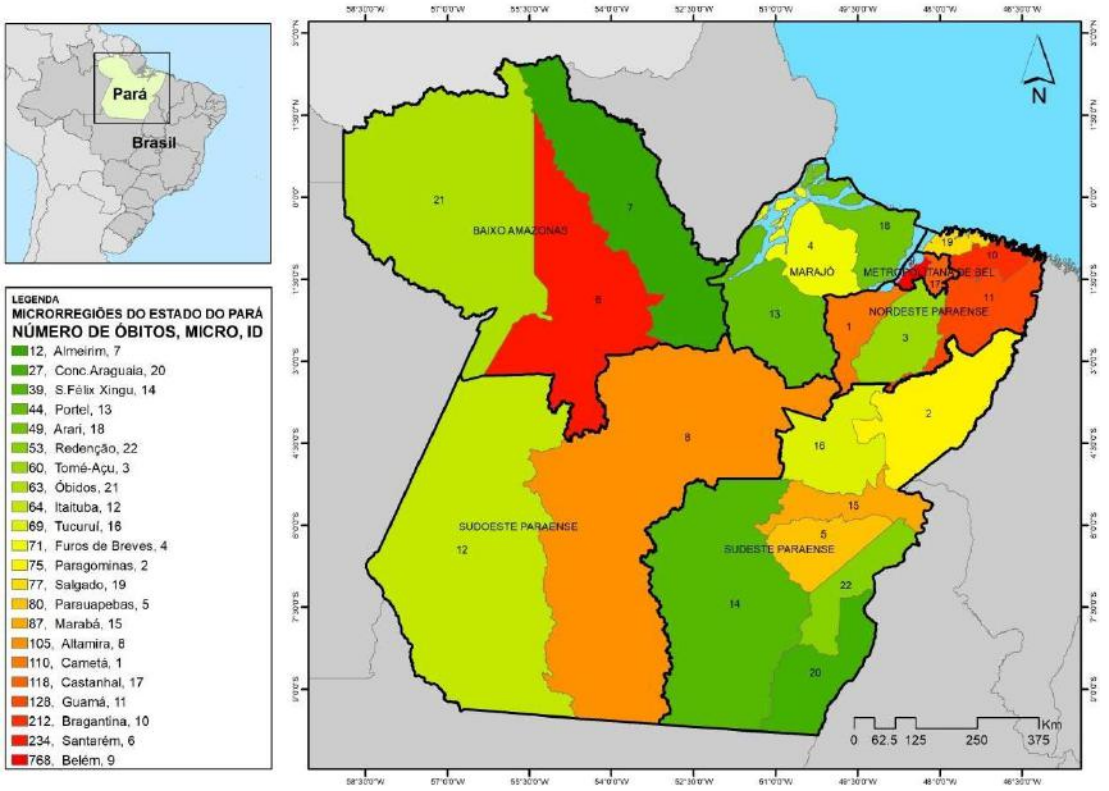
Figure 7. The study area is divided into mesoregions and subdivided into microregions in the state of Pará, Brazil.



Source: Authors.

Regarding the analysis of the number of deaths from sepsis in the mesoregions of the state of Pará, the Metropolitan Region of Belém has the highest rate, with 886 deaths, followed by Northeast Pará (587 deaths), Southeast Pará (430 deaths), Baixo Amazonas (309 deaths), Southwest (169 deaths) and Marajó (164 deaths) (Figure 8).

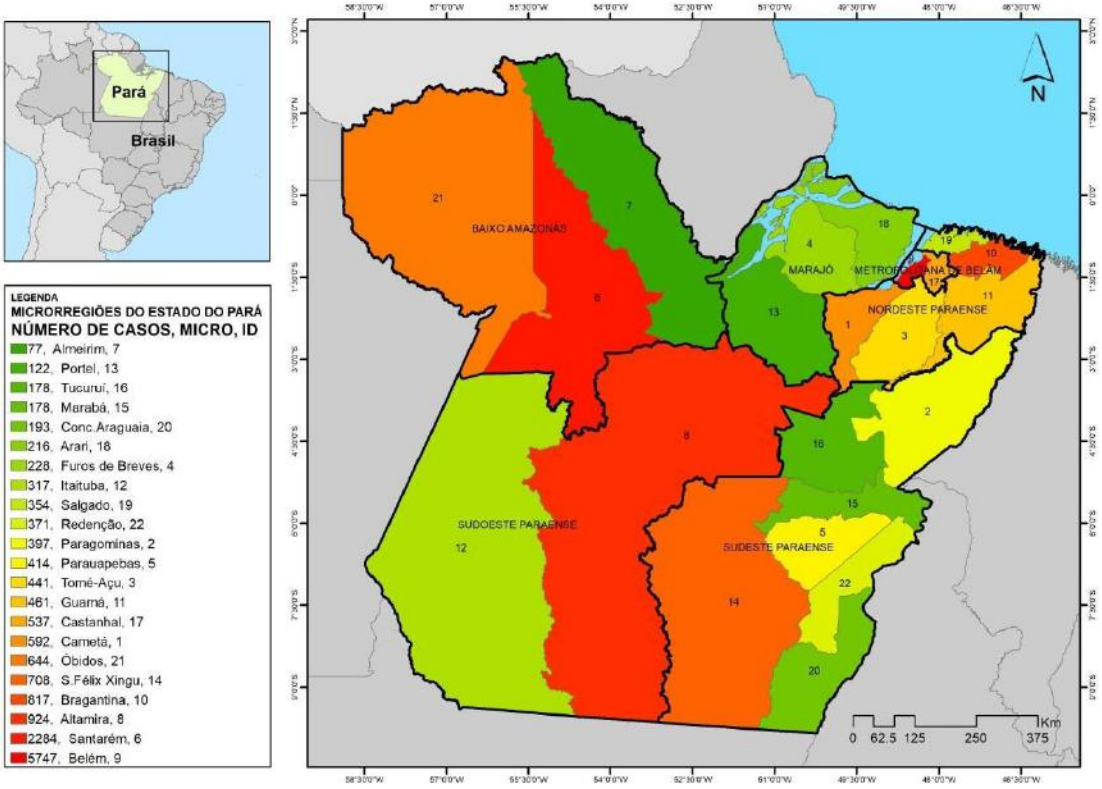
Figure 8. A number of deaths from sepsis in the mesoregions of the State of Pará, Brazil, from 2015 to 2019.



Source: Authors.

In the period from 2015 to 2019, there were more cases of sepsis in the Metropolitan Region of Belém, with 6,284 cases, followed by Baixo Amazonas (3,005 cases), Southeast Pará (2,439), Northeast Pará (1,494), Southwest Pará (1,241) and Marajó (566) (Figure 9).

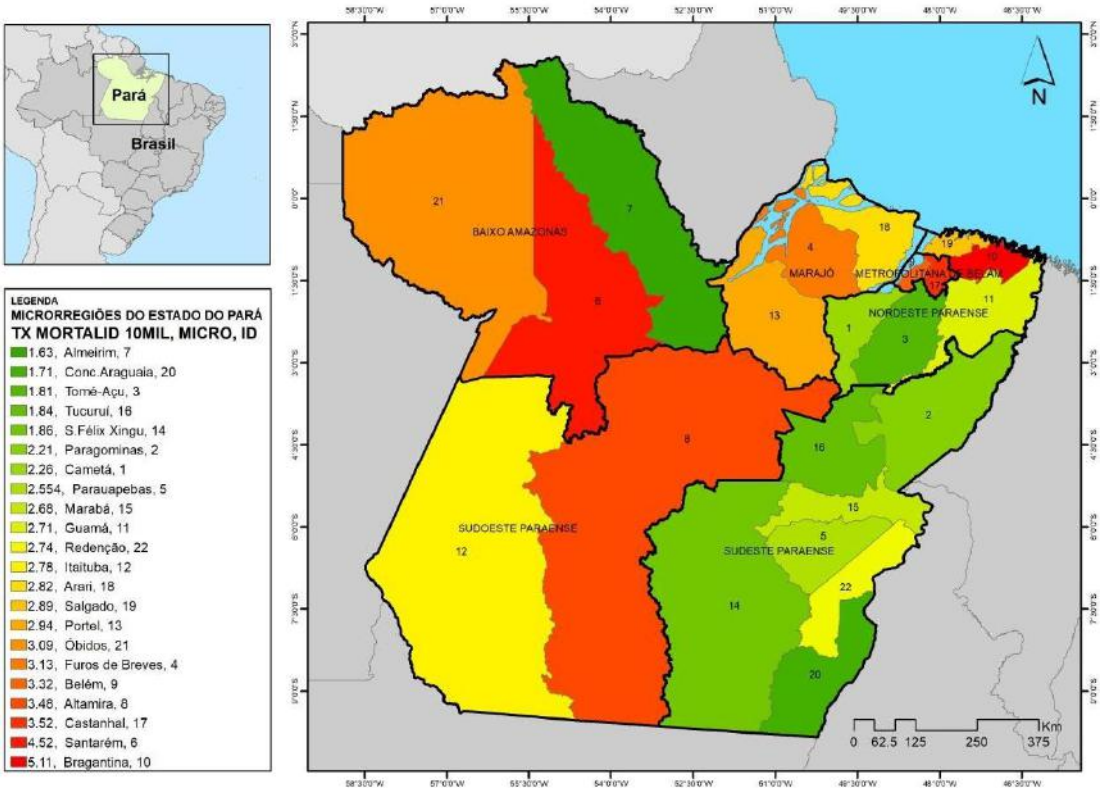
Figure 9. A number of sepsis cases in the mesoregions of the State of Pará, Brazil, from 2015 to 2019.



Source: Authors.

In the Lower Amazon mesoregion, the highest mortality rate from sepsis in the study period was in Santarém (4.52), in the Marajó mesoregion it was in Furos de Breves (3.13), in the Metropolitan Region of Belém it was in Castanhal (3.52), in the mesoregion of Northeast Pará was Guamá (2.71), in Southeast Pará it was Parauapebas (2,554) and in Southwest Pará, it was Altamira (3.48) (Figure 10).

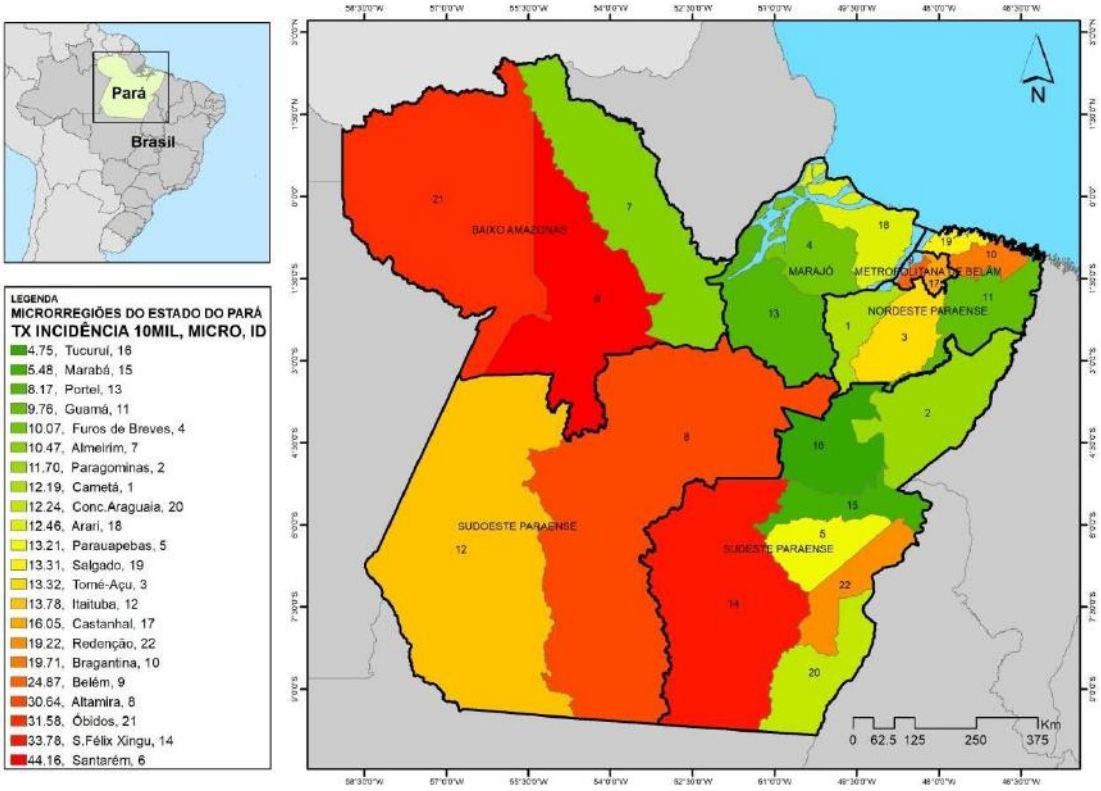
Figure 10. The mortality rate from sepsis in the microregions of the State of Pará, Brazil, from 2015 to 2019.



Source: Authors.

Regarding the incidence rate of sepsis during the study period, in the Lower Amazon mesoregion, the highest rate was in Santarém (44.16), in the Marajó mesoregion it was in Arari (12.46), in the Metropolitan Region of Belém it was Belém (24.87), in the mesoregion of Northeast Pará it was Bragantina (19.71), in the mesoregion of Southeast Pará it was São Félix do Xingu (33.78). In the mesoregion of Southwest Pará, it was Altamira (30.64) (Figure 11).

Figure 11. The incidence rate of sepsis in the State of Pará, Brazil microregions, from 2015 to 2019.



Source: Authors.

3. Discussion

In the field of health promotion, knowledge of epidemiological data and the profile involved in deaths plays a significant role not only in terms of controlling diseases and their vectors but also in improving the health of the population in general, especially in studies focused on the approach to public health issues. Which are predominantly focused on investigating how social characteristics influence and, above all, determine the health-disease process of populations (Ramos et al., 2016).

Tables 1 and 2, referring to the epidemiological profile of mortality and morbidity from sepsis in Pará, from 2015 to 2019, demonstrate that the gender variable differs in the percentage of affected individuals and deaths caused by the complication. 62.2% of the affected individuals were female and 37.98% male. On the other hand, 54.02% of fatalities correspond to males and 45.98% to females.

According to a study carried out by Levorato et al., 2014, in which the objective was to identify the factors associated with the demand for health services and differences between the sexes, the authors obtained as a result that female individuals sought health services 1.9 times more compared to males, thus considering the female sex a predictor of the most prevalent search for health care, which also allows us to infer that the search for health care may be related to the outcome morbidity and mortality (Levorato et al., 2014).

In addition, in a cross-sectional study carried out by Moretti et al., (2019), in which part of the objective was to identify the population's knowledge of the term "sepsis", the authors observed that there was a more significant predominance of understanding of the term in females (76.1%). Furthermore, it was also observed that the participants who had a higher level of education were able to answer about knowledge on the subject. Thus, the study also showed that the education variable is one of the most relevant characteristics that influence the understanding of sepsis.

In this context, the results obtained in the current study about the education variable (Table 1) demonstrate that the highest percentage of deaths is characterized by individuals whose education level was not recorded, that is, ignored education (25.99%). , this is due to the failure to complete the forms in the health information systems in Brazil, with the filling of variables such as education still low (Guimarães & da Cunha, 2020).

However, of the data that were recorded, the education variable (Table 1) stands out for individuals who had 1 to 3 years of schooling (24.81%), followed by illiterates (22.34%). These results suggest that there is an association between the level of education and morbidity and mortality from sepsis in the population. Therefore, this is due to the role of education in the prevention, identification, and understanding of the health-disease process, as well as the convenient search for health care and, sequentially, early diagnosis and treatment (Lages et al., 2019).

However, it is essential to highlight that such data are fundamental in conducting research since data users depend on the integrity and reliability of the record so that their findings are valid and allow decision-making, and resource allocation, in addition to the identification of groups. Subject to greater risk and a better understanding of the origin of the injuries. Therefore, knowledge of the educational level of individuals is essential for understanding the role of social inequality in the risk of illness (Guimarães & da Cunha, 2020).

The color/race variable for both mortality and morbidity of brown individuals (71.02% and 61.02, respectively) (Tables 1 and 2) shows a statistically significant difference from the others. However, this can be justified by the fact that most of the Brazilian population self-declares as brown, according to data from the 2019 National Household Sample Survey (PNAD), in which the research findings showed that 42.7% of the population Brazilian population declares itself white, 46.8% brown, 9.4% black and 1.1% yellow or indigenous (IBGE, 2019).

In addition, the highest percentage of deaths during the period established for analysis refers to married and single individuals (26.03% and 24.46%, respectively). However, according to IBGE data, most of the population, not only in Brazil in general but also in Pará, aged 10 years or older, is single or married, not being considered a causal factor for mortality due to sepsis (IBGE, 2018).

Regarding the place of death, the hospital environment stood out for the highest percentage, characterizing 87.00% of deaths (Table 1). In this sense, it is known that sepsis requires hospitalization for promising treatment of complications and organic dysfunctions, which, consequently, configures the finding in the present study. Therefore, sepsis is one of the main conditions that generate burdens for the public and private sectors due to the need for expensive therapies and drugs (Barreto et al., 2016).

Therefore, it is worth noting that, in Brazil, the data show high lethality, especially in public hospitals linked to the SUS. In 2016 alone, there were 108,259 cases of hospitalization for sepsis, with a mortality rate of 46.36%. At the same time, approximately R$ 17.3 billion annually is used for the treatment of septic patients, with R$ 10 billion of this total intended for patients who die, generating a negative economic impact (Conde et al., 2013; Menezes et al., 2019).

The age group most affected by sepsis in the present study was 20 to 39 years old, representing 37.85% of cases (Table 2), but there were more deaths of individuals aged 60 to 79 years old (34.00%), followed by 80 years old. and more (24.03%), representing more than half of the deaths. In this context, similar results were found in the analysis of the study by Santos et al., 2019, which demonstrates that the age group with the highest attribution of deaths from sepsis was 70 to 89 years.

Furthermore, in a retrospective multicenter cohort study conducted in 2018, the authors found that patients who died from sepsis tended to be older adults. In this case, sepsis disproportionately affects elderly individuals with impaired functionality and associated severe comorbidities. However, some of these elderly patients may receive optimal treatment according to guidelines but still die due to severe sepsis or underlying disease, thus corroborating the findings of the present study (Rhee et al., 2019).

As for the historical series of the mortality rate from sepsis in the microregions of Pará, from 2015 to 2019 (Figures 1, 2, 3, 4, 5, and 6), it is observed that there is no pattern of decline and/or progression of rates, but a significant fluctuation over the years. However, only in Bragantina and Guamá (Microregions of Northeast Pará), is it possible to observe an increase in the mortality rate over the analyzed period.

Furthermore, with the number of deaths and cases of sepsis in the period 2015-2019, as well as the distribution of mortality and incidence rates, it was possible to understand the distribution of sepsis in the state of Pará. This mapping made it possible to discriminate the places with the highest index of trivialized factors. Thus, this identification signals the urgent need to intensify measures to combat sepsis (Jorge et al., 2002).

Therefore, it is essential to improve the population's knowledge for the rapid identification of signs and symptoms, in addition to seeking assistance in health services. However, there is also a need to have qualified professionals to serve this population, with early identification and effective treatment of the septic patient, so that, in this way, it is possible to prevent an increase in cases of sepsis in these municipalities and, consequently, deaths (Moretti et al., 2019).

However, it is worth noting that the accelerated aging of the population has been the most important demographic variant observed in developing countries, such as Brazil. Thus, aspects such as the gradual and continuous aging of the people, the elderly segment identified as the most growth in the country, and the number of older adults at high values, make the country the sixth largest elderly population in a global context. Because of this, this reality has a direct impact on the increase in the demands of health care services throughout the country and, consequently, on the control of essential complications, such as sepsis (Jorge et al., 2008).

4. Conclusion

Considering the findings of the present study, it can be inferred that the spatial and temporal distribution, as well as the marked instability in the control of mortality from sepsis in Pará. Therefore, it is concluded that it is of fundamental importance to develop more targeted prevention policies, prioritizing educational measures and population awareness, in addition to the continuous improvement of health teams regarding the knowledge of sepsis about early identification and more effective care to reduce mortality from sepsis in the state of Pará, Brazil.

References

Alves, P. B., Koller, S. H., Silva, A. S., Reppold, C. T., Santos, C. L., Bichinho, G. S., Prade, L. T., Silva, M. R., & Tudge, J. (1999). A construção de uma metodologia observacional para o estudo de crianças em situação de rua: criando um manual de codificação de atividades cotidianas. *Estudos de Psicologia (Natal)*, *4*(2), 289–310. https://doi.org/10.1590/s1413-294x1999000200006

Barreto, M. F. C., Dellaroza, M. S. G., Kerbauy, G., & Grion, C. M. C. (2016). Sepse em um hospital universitário : estudo prospectivo para análise de custo da hospitalização de pacientes. *Rev Esc Enferm USP*, *50*(2), 302–308.

Conde, K. A. P., Silva, E., Silva, C. O., Ferreira, E., Freitas, F. G. R., Castro, I., Rea-Neto, A., Grion, C. M. C., Moura, A. D., Lobo, S. M., Azevedo, L. C. P., & Machado, F. R. (2013). Differences in Sepsis Treatment and Outcomes between Public and Private Hospitals in Brazil: A Multicenter Observational Study. *PLoS ONE*, *8*(6), e64790. https://doi.org/10.1371/journal.pone.0064790

DATASUS - Ministério da Saúde. (2021). DATASUS - Ministério da Saúde. In *Datasus*. www.datasus.gov.br

Guimarães, L. M., & da Cunha, G. M. (2020). Gender and age differences in the completion of the schooling items in surveillance forms in Brazilian state capitals with higher dengue incidence, 2008-2017. *Cadernos de Saude Publica*, *36*(10). https://doi.org/10.1590/0102-311X00187219

Hayat, M. J., Powell, A., Johnson, T., & Cadwell, B. L. (2017). Statistical methods used in the public health literature and implications for training of public health professionals. *PLoS ONE*, *12*(6), e0179032. https://doi.org/10.1371/journal.pone.0179032

IBGE. (2018). *Produção Agrícola Municipal 2018*. https://www.ibge.gov.br/estatisticas-novoportal/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html.

IBGE. (2019). *Culturas temporárias e permanentes | IBGE*. Instituto Brasileiro de Geografia e Estatística. https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9117-producao-agricola-municipal-culturas-temporarias-e-permanentes.html?utm_source=landing&utm_medium=explica&utm_campaign=producao_agropecuaria&t=destaques

ILA. (2019). *Sepse: um problema de saúde pública. Conselho Federal de Medicina - Pesquisa Google*.

https://www.google.com/search?q=INSTITUTO+LATINO+AMERICANO+DE+SEPSE+(ILAS).+Sepse%3A+um+problema+de+saúde+pública.+Conselho+Federal+de+Medicina&oq=INSTITUTO+LATINO+AMERICANO+DE+SEPSE+(ILAS).+Sepse%3A+um+problema+de+saúde+pública.+Conselho+Federal+de+Medic

Jorge, M. H. P. de M., Gotlieb, S. L. D., & Laurenti, R. (2002). O sistema de informações sobre mortalidade: problemas e propostas para o seu enfrentamento I - Mortes por causas naturais. *Revista Brasileira de Epidemiologia*, *5*(2), 197–211. https://doi.org/10.1590/s1415-790x2002000200007

Jorge, M. H. P. de M., Laurenti, R., Lima-Costa, M. F., Gotlieb, S. L. D., & Filho, A. D. P. C. (2008). A mortalidade de idosos no Brasil: a questão das causas mal definidas. *Epidemiologia e Serviços de Saúde*, *17*(4), 271–281. https://doi.org/10.5123/s1679-49742008000400004

Lages, D. dos S., Kerr, B. M., Bueno, I. de C., Niitsuma, E. N. A., & Lana, F. C. F. (2019). A baixa escolaridade está associada ao aumento de incapacidades físicas no diagnóstico de hanseníase no Vale do Jequitinhonha. *HU Revista*, *44*(3), 303–309. https://doi.org/10.34019/1982-8047.2018.v44.14035

Levorato, C. D., de Mello, L. M., da Silva, A. S., & Nunes, A. A. (2014). Fatores associados à procura por serviços de saúde numa perspectiva relacional de gênero. *Ciencia e Saude Coletiva*, *19*(4), 1263–1274. https://doi.org/10.1590/1413-81232014194.01242013

Lima-Costa, M. F., & Barreto, S. M. (2003). Tipos de estudos epidemiológicos: conceitos básicos e aplicações na área do envelhecimento. *Epidemiologia e Serviços de Saúde*, *12*(4), 189–201. https://doi.org/10.5123/s1679-49742003000400003

Menezes, L. E. F. J. de, Negreiros, L. M. V. de, Maciel, L. B. C., Marques, T. A., Roballo, C. A., & Baffa, A. M. (2019). Perfil epidemiológico e análise da efetividade para prevenção de óbitos de pacientes inseridos em protocolo de sepse TT - Epidemiological profile and effectiveness analysis for the prevention of deaths of patients enrolled in a sepsis protocol. *Rev. Soc. Bras. Clín. Méd*, *17*(1), 25–30. http://fi-admin.bvsalud.org/document/view/cjpz2

Morello, L. G., Dalla-Costa, L. M., Fontana, R. M., Netto, A. C. S. de O., Petterle, R. R., Conte, D., Pereira, L. A., Krieger, M. aurélio, & RAboni, S. M. (2018). Avaliação das características clínicas e epidemiológicas de pacientes com e sem sepse nas unidades de terapia intensiva de um hospital terciário Assessment. *Einstein*, *16*(4), 1–6. https://doi.org/10.31744/einstein

Moretti, M. M. S., Urbanetto, J. de S., Nascimento, A. P. do, Rodrigues, A. G., Silva, D. R. da, Ramos, T., & Rockenbach, V. (2019). Sepse e IAM: conhecimento da população frequentadora de parques e acompanhantes de pacientes. *Revista Gaucha de Enfermagem*, *40*, e20180299. https://doi.org/10.1590/1983-1447.2019.20180299

Pires, H. F. de M., Pereira, F. C., Ribeiro, M. da S., & Silva, J. D. G. da. (2020). Sepse Em Unidade De Terapia Intensiva Em Um Hospital Público: Estudo Da Prevalência, Critérios Diagnósticos, Fatores De Risco E Mortalidade. *Brazilian Journal of Development*, *6*(7), 53755–53773. https://doi.org/10.34117/bjdv6n7-862

Ramos, F. L. de P., Hora, Á. L. da, Souza, C. T. V. de, Pereira, L. O., & Hora, D. L. da. (2016). As contribuições da epidemiologia social para a pesquisa clínica em doenças infecciosas. *Revista Pan-Amazônica de Saúde*, *7*(esp), 221–229. https://doi.org/10.5123/s2176-62232016000500025

Ranzato Filardi, F. L., De Barros, F., Baumgratz, J. F. A., Bicudo, C. E. M., Cavalcanti, T. B., Nadruz Coelho, M. A., Costa, A. F., Costa, D. S. D. P. D. G. A., Goldenberg, R., Labiak, P. H., Lanna, J. M., Leitman, P., Lohmann, L. G., Costa Maia, L., Mansano, V. F., Morim, M. P., Peralta, D. F., Pirani, J. R., Prado, J., … Zuntini, A. R. (2018). Brazilian flora 2020: Innovation and collaboration to meet target 1 of the global strategy for plant conservation (GSPC). *Rodriguesia*, *69*(4), 1513–1527. https://doi.org/10.1590/2175-7860201869402

Rhee, C., Jones, T. M., Hamad, Y., Pande, A., Varon, J., O'Brien, C., Anderson, D. J., Warren, D. K., Dantes, R. B., Epstein, L., & Klompas, M. (2019). Prevalence, Underlying Causes, and Preventability of Sepsis-Associated Mortality in US Acute Care Hospitals. *JAMA Network Open*, *2*(2), e187571–e187571. https://doi.org/10.1001/jamanetworkopen.2018.7571

Satriano, P. de M. (2017). *Evolução das Diretrizes Internacionais de Definição e Identificação da Sepse e Choque Séptico*. 22.

Schuetz, D. A., Bernetti, M., Bertazzo, M., Musil, D., Eggenweiler, H. M., Recanatini, M., Masetti, M., Ecker, G. F., & Cavalli, A. (2019). Predicting Residence Time and Drug Unbinding Pathway through Scaled Molecular Dynamics. *Journal of Chemical Information and Modeling*, *59*(1), 535–549. https://doi.org/10.1021/acs.jcim.8b00614