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COVID-19 health indicators in the first four months in the state of São Paulo

ABSTRACT | Objective: To analyze the estimate of the health indicators of COVID-19 in the first four months of the pandemic from the confirmation of the first case. Method: Ecological study. Confirmed cases of COVID-19 from the State of São Paulo (ESP) from February to June were collected from the Center for Epidemiological Surveillance of ESP. Data analysis was carried out based on health indicators and the population was obtained by the ESP State System of Data Analysis Foundation. The study did not go through the Ethics and Research Committee because it is public data. Result: In the first four months of the COVID-19 pandemic in ESP, there was a consecutive increase in the number of affected municipalities, confirmed cases, deaths, incidence and mortality rates and a decline in the lethality rate. Conclusion: We verified a decrease in the deaths of COVID-19 in the ESP and this may be associated with the improvement of the clinical management of the disease.

Keywords: Coronavirus Infections; Pandemics; Epidemiology Descriptive; Ecological Studies.

RESUMEN | Objetivo: Analizar la estimación de los indicadores de salud de COVID-19 en los primeros cuatro meses de la pandemia desde la confirmación del primer caso. Método: Estudio ecológico. Los casos confirmados de COVID-19 del Estado de São Paulo (ESP) de febrero a junio fueron recolectados del Centro de Vigilancia Epidemiológica de ESP. El análisis de los datos se realizó con base en indicadores de salud y la población fue obtenida por la Fundación Sistema Estatal de Análisis de Datos ESP. El estudio no pasó por el Comité de Ética e Investigación por tratarse de datos públicos. Resultado: En los primeros cuatro meses de la pandemia de COVID-19 en ESP, hubo un aumento consecutivo en el número de municipios afectados, casos confirmados, defunciones, tasas de incidencia y mortalidad y una disminución en la tasa de letalidad. Conclusión: Verificamos una disminución de las muertes por COVID-19 en el ESP y esto puede estar asociado a la mejora del manejo clínico de la enfermedad.

Palabras claves: Infecciones por Coronavirus; Pandemias; Epidemiología Descriptiva; Estudios Ecológicos.

RESUMO | Objetivo: Analisar a estimativa dos indicadores de saúde da COVID-19 nos quatro primeiros meses da pandemia a partir da confirmação do primeiro caso. Método: Estudo ecológico. Foram coletados os casos confirmados de COVID-19 do Estado de São Paulo (ESP) dos meses de fevereiro a junho, obtidos do Centro de Vigilância Epidemiológica do ESP. A análise dos dados foi realizada a partir de indicadores de saúde e a população foi obtida pela Fundação Sistema Estadual de Análise de Dados do ESP. O estudo não passou por Comitê de Ética e Pesquisa por se tratar de dados públicos. Resultado: Nos primeiros quatro meses da pandemia da COVID-19 no ESP houve aumento consecutivos do número de municípios afetados, casos confirmados, óbitos, coeficientes de incidência e mortalidade e declínio do coeficiente de letalidade. Conclusão: Verificamos diminuição dos óbitos da COVID-19 no ESP e isso pode estar associado ao aprimoramento do manejo clínico da doença.

Palavras-chaves: Infecções por Coronavírus; Pandemias; Epidemiologia Descritiva; Estudos Ecológicos.

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INTRODUCTION

COVID-19 (English: Coronavirus Disease 2019), caused by the New Coronavirus (SARS-CoV-2), detected in Wuhan in China, is an emerging disease capable of spreading intensely and infecting millions of people.¹⁻³ Since the first case in December 2019, the disease has spread so that the

World Health Organization declared in January 2020 the outbreak as a public health emergency of international interest.⁴

In Brazil, in February 2020, the Ministry of Health declared COVID-19 as a public health emergency of national importance⁵, but due to the advance and expansion on a global level, in March 2020, it was declared a pandemic.⁶

The spread of the causative agent, SARS-CoV-2, and consequently of the pandemic, has progressed so that on September 27th, 2020, 32.730.945 cases and 991.224 deaths of COVID-19 were confirmed worldwide. This series was mainly composed of notifications from the following regions: American (16.233.110 cases/346.864 deaths); European (5.562.875 cases/234.681 deaths); Eastern Mediterranean (2.340.215 cases/60,345 deaths); Western Pacific

(600.891 cases/13.129 deaths), Southeast Asia (6.720.771 cases/110.711 deaths) and Africa (1.172.342 cases/25,481 deaths).⁷

The region of the Americas, led by the United States and second in Brazil, was the main affected in the world, concentrating about 50% of cases and 55% of deaths. In the week of September 21-27 alone, this region was responsible for 52% of the world's deaths.⁷

In Brazil, the monitoring of cases and deaths, carried out continuously through epidemiological surveillance, registered 4.717.991 cases and 141.406 deaths accumulated until September 26th.⁸ Even with the guidance for adopting measures aimed at reducing infection, the reality of the country does not always allow recommendations for physical distance and hygiene to be respected in peripheral locations and in precarious housing, where many residents live in rooms and/or in areas where access to clean water is difficult or where even the need for informal employment prevents taking appropriate preventive measures.⁹⁻¹⁰

Among the main regions affected in Brazil, considering the incidence coefficients per 100 thousand inhabitants until October 3rd, 2020, the Central-West (3.533,2), the North (3.362,4) and the Northeast (2.282,7); the Southeast region, on the other hand, had the lowest incidence coefficient (1.862,2). When detailing the situation in the Southeast region, Espírito Santo recorded the highest incidence coefficient (3.202,8) and in the sequence São Paulo was the second biggest affected (2.114,2).⁸

In relation to mortality, when carrying out the analysis also considering the mortality coefficients per 100 thousand inhabitants, the North, Center-West and Southeast regions are predominantly affected with 80,3; 75,3; and 72,4, respectively. In the State of São Paulo, the capital of São Paulo still draws attention due to the frequency of cases and deaths, despite the expected stabilization trend. The southeast region and, mainly, the state of São

Paulo has been highlighted since the notification of the first case of Brazil and Latin America, in February 2020.^{8,11}



A região das Américas, liderada pelos Estados Unidos e em segundo lugar o Brasil, foi a principal afetada no mundo, concentrando cerca de 50% dos casos e 55% das mortes. Só na semana de 21 a 27 de setembro essa região foi responsável por 52% das mortes mundiais.



In the State of São Paulo, research on COVID-19 is necessary because it is an emerging disease from 2020. In addition, there are still few studies that have carried out analysis of the health indicators of this disease in the country and in the State of São Paulo. Also, more

specifically, no such analyzes were found for Brazil and the State of São Paulo for the first four months of the pandemic. Investigating and understanding in more detail the epidemiology of COVID-19 in the State of São Paulo generates the expectation of being able to contribute, by providing subsidies to health managers for public health decisions.

In view of these assumptions, the present study sought answers to the following question: how did the distribution of COVID-19 health indicators take place in the State of São Paulo in the first four months of this pandemic?

Thus, the objective of this study was to describe the health indicators of COVID-19, from February 26 to June 26th, 2020, which constituted the first four months of the pandemic in the State of São Paulo.

METHODS

Epidemiological, ecological, population-based study. The population of the State of São Paulo was the object of the study, considering its distribution in the 645 municipalities of the State. The sample consisted of confirmed cases of COVID-19, obtained from the public domain database of the Government of the State of São Paulo - State Department of Health - Disease Control Coordination - Epidemiological Surveillance Center "Prof. Alexandre Vranjac" - New Coronavirus (COVID-19) - Epidemiological Situation February 26th to June 26th, 2020, available at: <http://www.saude.sp.gov.br/cve-centro-de-vigilancia-epidemiologica-prof.-alexandre-vranjac/areas-de-vigilancia/doencas-de-transmissao-respiratoria/coronavirus-covid-19/situacao-epidemiologica>.

The first month refers to the period from February 26th to March 25th. The second from March 26th to April 25th. The third from April 26th to May 25th and the fourth from May 26th to June 26th.

For the calculation of health indicators: estimates of the incidence and

mortality coefficients were used the population obtained from the website of the Brazilian Institute of Geography and Statistics (IBGE) 2019.

To estimate the coefficients of incidence and mortality per 100.000 inhabitants, they were calculated from the ratio between the number of confirmed cases

and deaths, respectively (numerator) and the resident population (denominator).

To estimate the lethality coefficient per 100 cases, it was calculated from the ratio between the number of deaths (numerator) and confirmed cases (denominator).

For data analysis, descriptive statistics was used, applying the Softwares TabWin 3.6b, Microsoft Excel 2016.

To make the maps, the software SIGs ArcGis version 10.5 and Qgis10 were used.

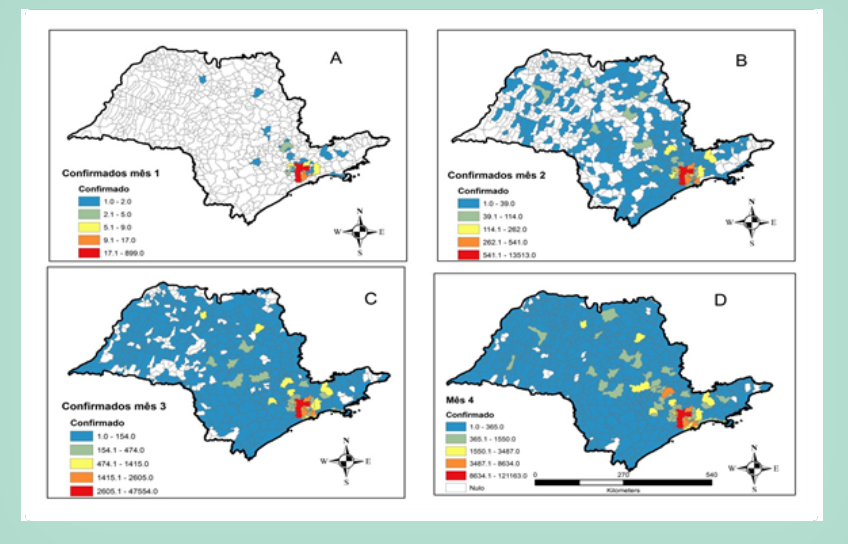
The research did not need to be approved by the Research Ethics Committee, given that the secondary data from COVID-19 obtained for analysis in this study are in the public domain and did not present patient identification, thus following the principles established by Resolution No. 466, of December 12th, 2012, which provides for regulatory guidelines and standards for research involving human beings.

RESULTS

The dissemination of SARS-CoV-2 began in the capital of the State of São Paulo, with the first case published by the Epidemiological Surveillance Center “Prof. Alexandre Vranjac”/Center for Disease Control/State Department of Health/São Paulo State Government on February 26th, 2020. The increase in the number of cases was alarming and after four months of the pandemic by COVID-19 (26 June 2020), the State of São Paulo had already accumulated 258,508 confirmed cases in 616 municipalities (95,5% of the 645 municipalities), with the municipality of São Paulo being the most affected (46,9%) (Figure 1).

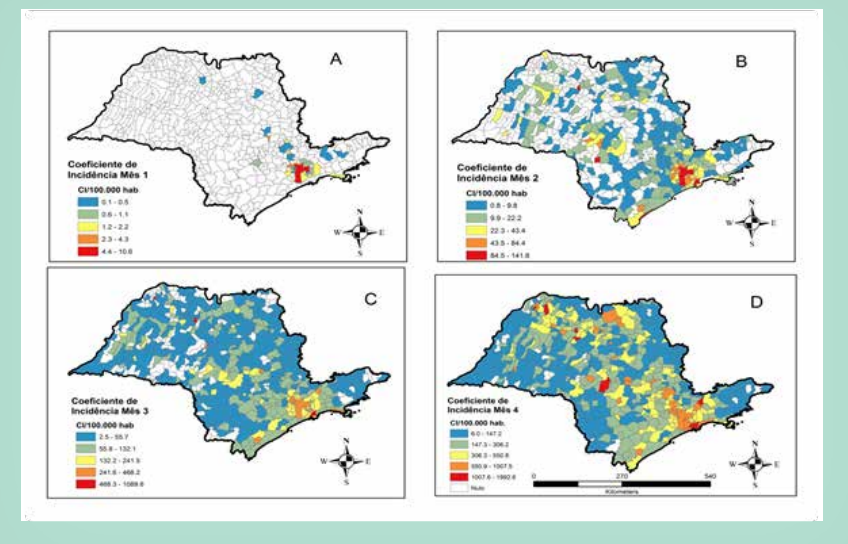
There was a variation of 2.034,84% in relation to the estimate of the incidence coefficient from the first month (2,21 cases/100.000 inhabitants) to the second (44,97 cases/100,000 inhabitants), 8.421,27% from the first to the third month (186,11 cases/100,000 inhabitants), and 25.473,30% from the first to the

Figura 1 – Distribuição dos casos confirmados de COVID-19 (A – 1 mês após o primeiro caso confirmado; B – 2 meses após o primeiro caso; C – 3 meses após o primeiro caso e D – 4 meses após o primeiro caso), segundo município de residência. Estado de São Paulo, 26 de fevereiro a 26 de junho de 2020.



Fonte: Governo do Estado de São Paulo / Secretaria de Estado da Saúde / Coordenadoria de Controle de Doenças / Centro de Vigilância Epidemiológica “Prof. Alexandre Vranjac” – Novo Coronavírus (COVID-19) - Situação Epidemiológica.

Figura 2 – Distribuição do coeficiente de incidência (por 100.000 habitantes) de COVID-19 (A – 1 mês após o primeiro caso confirmado; B – 2 meses após o primeiro caso; C – 3 meses após o primeiro caso e D – 4 meses após o primeiro caso), segundo município de residência. Estado de São Paulo, 26 de fevereiro a 26 de junho de 2020.



Fonte: Governo do Estado de São Paulo / Secretaria de Estado da Saúde / Coordenadoria de Controle de Doenças / Centro de Vigilância Epidemiológica “Prof. Alexandre Vranjac” – Novo Coronavírus (COVID-19) - Situação Epidemiológica / IBGE.

fourth month (562,96 cases per 100.000 inhabitants) in the State of São Paulo.

The municipalities with the highest risk estimates, considering all

four months of the disease, were Santos (1992,56 cases for every 100.000 inhabitants), Igaratá (1520,87 cases for every 100.000 inhabitants), Cubatão

(1518,69 cases for every 100.000 inhabitants), Macatuba (1497,41 cases for every 100.000 inhabitants) and Santa Salete (1423,95 cases for every 100.000 inhabitants) (Figure 2).

The first death by COVID-19 was registered on March 17th, 2020 in the municipality of São Paulo and on June 26th, the State of São Paulo confirmed 13.973 deaths in 352 municipalities (54,57% of the 645 municipalities). The municipality of São Paulo had the highest number of deaths (6.880 - 49,24%) for the period. The variation in deaths between the months of March (57 deaths) and April (1.700 deaths) was 2.982,46%. Between March and May (5.868 deaths) it was 10.294,74%, and between March and June (13.973 deaths) it was 24.514,04% (Figure 3).

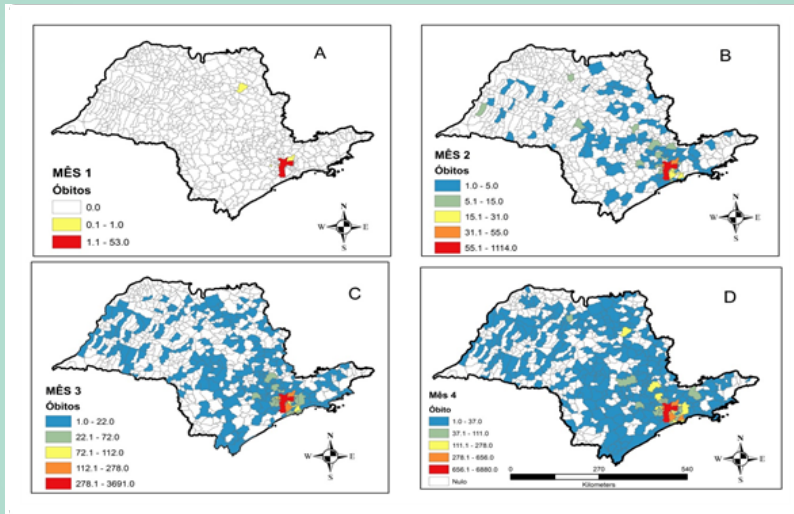
The COVID-19 mortality rate accumulated for the four months in the State of São Paulo was 30,43 deaths per 100.000 inhabitants, with the municipalities with the highest estimates for this indicator: Gastão Vidigal - 166,39; Dolcinópolis - 94,56; Uru - 85,84; Torres de Pedra - 82,92; Santos - 80,31; Nova Castilho - 78,93; Barueri - 70,39; Osasco - 67,87; Santa Salete - 64,72 and Cubatão - 63,50, all for every 100.000 inhabitants, respectively (Figure 4).

The ratio between the number of deaths and confirmed cases (coefficient of lethality) accumulated for four months by COVID-19 in the State of São Paulo was 5,41 for every 100 cases. The municipalities of Álvaro de Carvalho, Coronel Macedo, Arapeí, Turiuba, presented the estimate of 100% lethality by COVID-19. And the municipalities of Alfredo Marcondes, Echaporá, Iepe, Natividade da Serra, Poloni, Sabino, Sales, Santópolis do Aguapeí had an estimated 50% lethality for the disease (Figure 5).

DISCUSSION

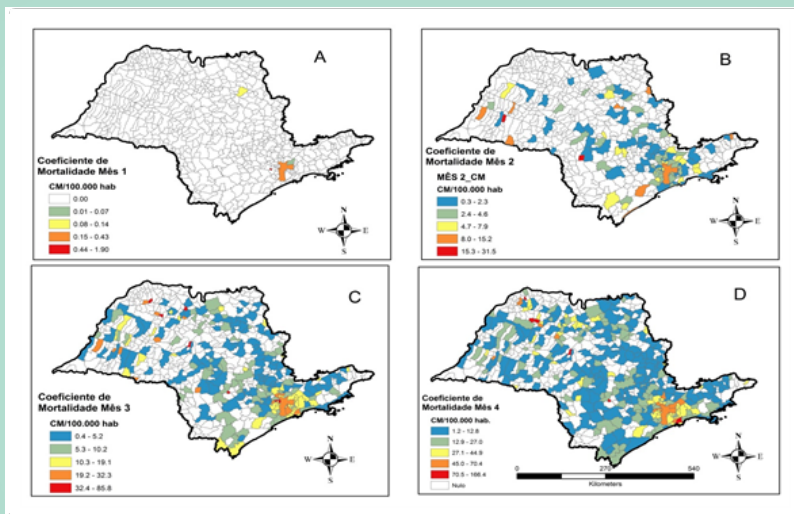
The COVID-19 pandemic for the New Coronavirus (SARS-CoV-2) has presented itself as one of the greatest health

Figura 3 – Distribuição dos óbitos de COVID-19 (A – 1 mês após o primeiro caso confirmado; B – 2 meses após o primeiro caso; C – 3 meses após o primeiro caso e D – 4 meses após o primeiro caso), segundo município de residência. Estado de São Paulo, 26 de fevereiro a 26 de junho de 2020.



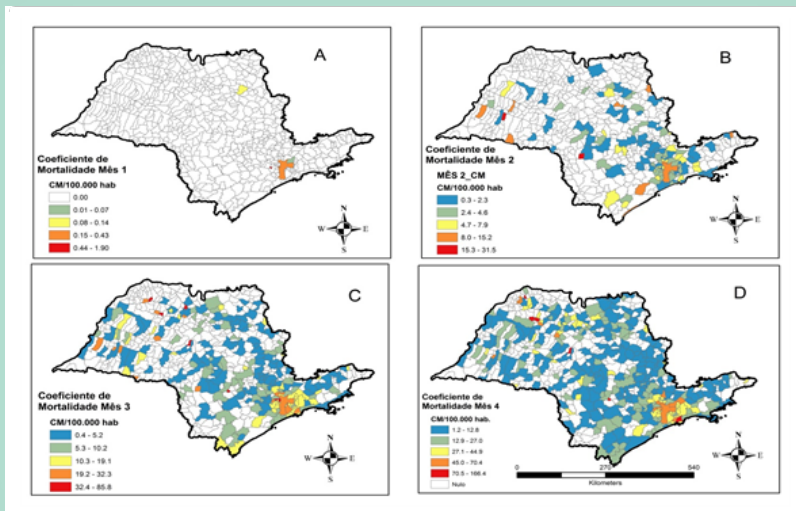
Fonte: Governo do Estado de São Paulo / Secretaria de Estado da Saúde / Coordenadoria de Controle de Doenças / Centro de Vigilância Epidemiológica "Prof. Alexandre Vranjac" – Novo Coronavírus (COVID-19) - Situação Epidemiológica.

Figura 4 – Distribuição do coeficiente de mortalidade (por 100.000 habitantes) de COVID-19 (A – 1 mês após o primeiro caso confirmado; B – 2 meses após o primeiro caso; C – 3 meses após o primeiro caso e D – 4 meses após o primeiro caso), segundo município de residência. Estado de São Paulo, 26 de fevereiro a 26 de junho de 2020.



Fonte: Governo do Estado de São Paulo / Secretaria de Estado da Saúde / Coordenadoria de Controle de Doenças / Centro de Vigilância Epidemiológica "Prof. Alexandre Vranjac" – Novo Coronavírus (COVID-19) - Situação Epidemiológica / IBGE.

Figura 5 – Distribuição do coeficiente de letalidade de COVID-19 (A – 1 mês após o primeiro caso confirmado; B – 2 meses após o primeiro caso; C – 3 meses após o primeiro caso e D – 4 meses após o primeiro caso), segundo município de residência. Estado de São Paulo, 26 de fevereiro a 26 de junho de 2020.



Fonte: Governo do Estado de São Paulo / Secretaria de Estado da Saúde / Coordenadoria de Controle de Doenças / Centro de Vigilância Epidemiológica "Prof. Alexandre Vranjac" – Novo Coronavírus (COVID-19) - Situação Epidemiológica / IBGE.

challenges on a global scale since the beginning of this century.¹² Brazil appeared as the second country in number of confirmed cases and deaths (1.228.114 and 54.971 respectively on June 25th, 2020)¹³, with emphasis on the State of São Paulo.

The present study, when analyzing the pandemic of COVID-19 in the State of São Paulo, identified that the estimates of the coefficients of incidence and mortality for the studied period were, respectively, 562,96 and 30,43 for each 100.000 inhabitants up to 26th June 2020. Considering all cases since the beginning of the pandemic until June 26, the world incidence rate was 121,5 cases per 100.000 inhabitants and the mortality rate was 6,2 deaths per 100.000 inhabitants.¹³

Due to the large population concentration, the most disparate socioeconomic conditions and regions with a large fluctuating population, megacities such as São Paulo were confronted with greater outbreaks that were important in the spread of COVID-19 infection.¹⁴ In addition, it appears that geographically close regions tend to have coefficients

that are more similar than those that are further away.¹⁵ Thus, municipalities close to the capital had high incidence and mortality, a pattern that was not observed for lethality. The movement of the population between the cities of Greater São Paulo and neighboring municipalities is another factor that favors the spread of the disease.¹⁴

There were important differences between the municipalities that had the highest magnitudes for each indicator studied. Twelve municipalities presented estimates of incidence coefficients that exceed the magnitude of the capital in the fourth month of the pandemic and, in decreasing order: Santos, Igaratá, Cubatão, Macatuba, Santa Salete, São João da Duas Pontes, Lencóis Paulista, Estrela d'Oeste, Jaci, Mendonça, Guraújá and Tabapuã. The highest estimates of mortality rates were observed for Gastão Vidigal, Dolcinópolis, Santos, Nova Castilho, Barueri, Osasco, Santa Salete and Cubatão - whose magnitude exceeded that observed for the state capital in the third month of the pandemic - and Uru and Torres de Pedra - which main-

tained the magnitude higher than that of the capital for the indicator.

The municipalities of Santos, Santa Salete and Cubatão stood out for having high magnitudes of incidence and mortality, and due to the fact that they maintained a high magnitude of indicators for the last two months of the pandemic, the municipalities of Santos, Uru and Torre de Pedras.

In countries that have wide restrictions both in testing capacity in the early stages of the pandemic and in coverage of care for critically ill patients, such as the United States and Italy, "vertical isolation" (of patients and those most susceptible to aggravation) was initially. However, once the rapid evolution of the number of cases was carried out, it required, even if late, the introduction of the suppression strategy via "horizontal isolation" (for the population as a whole).¹²

In the fourth month of the pandemic, the four cities in the State of São Paulo that had an estimated 100% lethality were Coronel Macedo, Arapeí, Turiuba and Álvaro de Carvalho, with the first three having no cases until May 26. For the same period, eight cities had an estimated 50% lethality: Alfredo Marcondes, Echaporã, Natividade da Serra, Sabino, Santópolis do Aguapeí, Poloni, Sales and Iepê.

The high estimate of the lethality coefficient in 12 municipalities can be justified by the fact that a very small number of cases of the disease evolved to death. It is also believed that the fact that lethality is high in these municipalities is due to an underestimation of the number of cases.

Detecting and investigating cases is important, as solid, good-quality evidence allows knowledge of the real problem, and thus combats health inequities. Without them, the assessment of health equity will be impossible, which will reduce the impact of disease control efforts. In addition, ensuring opportunities for diagnosis and treatment for all is seen as an important factor for coping and overcoming the disease.¹⁶

The results of this study must be con-

sidered in the light of some limitations. The greatest limitation of the analysis of ecological data conducted in the present study is related to the heterogeneity between municipalities and populations in relation to exposure to the disease¹⁵ and the factors that influence its impact as a public health problem, such as the age structure of the population, the extent of case investigation, timely access to health services, adoption of social isolation measures and other measures to reduce risk of contagion are not known. Such factors were not included in the analyzes.

In addition, conducting a simple comparison of the indicators between the regions studied can be complex, as regions with a small number of observed cases show great variability for the estimated coefficients.¹⁵ Thus, the estimates of the highest coefficients tend to be observed for small municipalities, as it could be observed, probably, due to the clusters of cases.

Finally, this work had limitations due to the use of secondary data, which may be inconsistent in terms of quantity, quality and information processing. And as a strong point, when analyzing the estimates of the health indicators of COVID-19 in the State of São Paulo, areas of higher risk for incidence, mortality and lethality for the studied period were evidenced.

CONCLUSION

Four months after the occurrence of the first case of COVID-19, the pandemic reached almost all the municipalities in the State, a fact that can be justified by several factors, among them: the great power to spread the disease, the presence of a population susceptible, because it is a new type of virus, and the unavailability of a vaccine.

The municipality of São Paulo appears in the first four months as the re-

gion most affected by COVID-19, with 121.163 confirmed cases and 6.880 deaths. However, according to the "ranking" of municipalities in the State, regarding the estimates of the health indicators of COVID-19, the capital is in 13th place in terms of the incidence coefficient (988,92 cases/100.000 inhabitants) and in 12th place in relation to the mortality coefficient (956,12 cases/100.000 inhabitants).

The results of this study suggest assistance to health managers in decision-making, given that the maps allow the visualization of the coefficients of incidence, mortality and lethality, thus allowing the comparison between regions, guiding in decision-making for the control and prevention of the COVID-19 pandemic.

Knowledge of areas of potential concern interferes with prior planning and has gathered sufficient resources that are essential for the formulation of successful public health programs. 🐦

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