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INTERFACES CIENTÍFICAS

SOCIAL ISOLATION MEASURES CAUSE REDUCTION IN THE CONTAMINATION AND DEATHS BY COVID-19? THE CASE OF THE MUNICIPALITY OF ARARAQUARA, SP, BRAZIL

MEDIDAS DE ISOLAMENTO SOCIAL CAUSAM REDUÇÃO DA CONTAMINAÇÃO E MORTES POR COVID-19? O CASO DO MUNICÍPIO DE ARARAQUARA, SP, BRASIL

¿LAS MEDIDAS DE AISLAMIENTO SOCIAL PROVOCAN REDUCCIÓN DE LA CONTAMINACIÓN Y MUERTES POR COVID-19? EL CASO DEL MUNICIPIO DE ARARAQUARA, SP, BRASIL

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ABSTRACT

The SARS-Cov-2 pandemic established the need to adopt restrictive measures to contain the spread of the virus. In 2021, due to the high number of cases of COVID-19 in the municipality of Araraquara, Brazil, and after the exhaustion of hospital vacancies in 2021, a lockdown was announced. We analyzed the effect of social distancing this city, using data provided by the municipal government over a total period of 90 days. We used this data in a life table, an important tool that assesses the impact of diseases on the population dynamics of a species. The results indicated a basic mortality rate of 0.0138 in the period analyzed, and a considerable decrease in the number of infected cases and deaths from COVID-19 after 24 days of isolation. Our results showed the effectiveness of social distancing in stopping the spread of the disease, with an 80% reduction in the number of deaths, as well as the usefulness of the life table as a useful tool for data analysis.

KEYWORDS

Life table. Lockdown. Pandemic. Population ecology. SARS-CoV-2.

RESUMO

A pandemia SARS-Cov-2 estabeleceu a necessidade de adoção de medidas restritivas para conter a disseminação do vírus. Em 2021, devido ao elevado número de casos de COVID-19 no município de Araraquara, Brasil e após o esgotamento das vagas hospitalares em 2021, foi anunciado um bloqueio. Analisamos o efeito do distanciamento social dessa cidade, utilizando dados fornecidos pela prefeitura municipal ao longo de um período de 90 dias. Usamos esses dados em uma tabela de vida, uma importante ferramenta que avalia o impacto de doenças na dinâmica populacional de uma espécie. Os resultados indicaram uma taxa básica de mortalidade de 0,0138 no período analisado e uma redução considerável no número de casos infectados e óbitos por COVID-19 após 24 dias de isolamento. Nossos resultados mostraram a eficácia do distanciamento social em conter a propagação da doença, com redução de 80% no número de óbitos, bem como a utilidade da tábua de vida como ferramenta útil para análise de dados.

PALAVRAS-CHAVE

Tabela de Vida. Pandemia. Ecologia de População. SARS-coV-2.

RESUMEN

La pandemia SARS-Cov-2 estableció la necesidad de adoptar medidas restrictivas para contener la propagación del virus. En 2021, debido al alto número de casos de COVID-19 en el municipio de Araraquara, Brasil, y luego del agotamiento de las vacantes hospitalarias en 2021, se anunció un cierre patronal. Analizamos el efecto del distanciamiento social en esta ciudad, utilizando datos proporcionados por el gobierno municipal durante un período total de 90 días. Usamos estos datos en una tabla de vida, una herramienta importante que evalúa el impacto de las enfermedades en la dinámica poblacional de una especie. Los resultados indicaron una tasa de mortalidad básica de 0.0138 en el período analizado, y una disminución considerable en el número de casos infectados y muertes por COVID-19 después de 24 días de aislamiento. Nuestros resultados mostraron la efectividad del distanciamiento social para detener la propagación de la enfermedad, con una reducción del 80% en el número de muertes, así como la utilidad de la tabla de vida como herramienta útil para el análisis de datos.

PALABRAS CLAVE

Tabla de vida. Pandemia. Ecología de la población. SARS-CoV-2.

1 INTRODUCTION

Since the first reported cases in December 2019 (ZHU *et al.*, 2020) in Wuhan, a Chinese province, the SARS-CoV-2 outbreak rapidly spread to the whole world (SHAO, 2020). COVID-19 is a disease caused by the SARS-CoV-2, a respiratory virus that belongs to Coronaviridae family, which also contains the MERS and SARS-CoV-1 viruses (BENVENUTO *et al.*, 2020). The virus uses the ubiquitous Ace II receptor to entry the cells, (XU *et al.*, 2020) especially those of the respiratory tract (ZOU *et al.* 2020; SUNGNAK *et al.*, 2020). However, many other studies have demonstrated the infection of SARS-CoV-2 in a broad range of cells from different organs (FENRICH *et al.*, 2020; TRYPSTEEN *et al.*, 2020). Due to its fast appearance, and the necessity of an acidic entry, chloroquine was used as a potential treatment for SARS-CoV-2 although without any proven efficacy (PEREZ *et al.*, 2021)

Meanwhile, many other treatments were developed and are applied combined. Currently, there are vaccines, convalescent sera, and monoclonal treatment antibodies available against SARS-CoV-2 (CASADEVALL; PIROFSKI, 2020; SEWELL *et al.*, 2020). However, due to the limitations in implementing these measures to protect the whole population, social distancing is still necessary. Social distancing is a method in which the individuals keep a distance of at least 1.8 meters from each other to avoid contact with potential contaminants such as saliva droplets (MORAWSKA; CAO, 2020). Based on scientific evidence, the social distancing in combination with the use of masks could be an important mechanism to halt the viral dissemination (ANDERSON *et al.*, 2020).

In Brazil, there is disagreement among public managers about the implementation of lockdown to prevent the spread of the virus because of the pressure coming from the economic sector, since lockdown results the paralysis of many productive activities (ALFANO; ERCOLANO, 2020). The country has 12,534,688 million diagnosed cases, with 312,206 thousand total deaths from COVID-19 until March 28, 2021, according to the panel on the status of the pandemic provided by the Brazilian Ministry of Health (BRASIL, 2021).

Despite these disputes, the drastic strategy of social isolation presented positive results in other countries, reducing the daily incidence of COVID-19 in different periods of isolation (LAU *et al.*, 2020; DOMENICO *et al.*, 2020; ALFANO; ERCOLANO, 2020). These results were also observed in some municipalities in Brazil, with a decrease in the number of daily cases and deaths by COVID-19 (HOUVÈSSOU *et al.* 2021).

Life tables help providing information about the population dynamics of a species and on the evaluation about the impacts of natural enemies on these populations (VAN LENTEREN; WOETS, 1988; BELLOWS-JUNIOR *et al.*, 1992, BEGON *et al.*, 2020, CHI *et al.*, 2020). They are generally used to evaluate the growth of a population in which the data are estimated based on growth, survival, fertility, births, and deaths of the population, which are summarized in tables called life tables (BEGON *et al.* 2020). In this study, we used the life table in order to verify the effects of lockdown on reducing the transmission of COVID-19 on the population of the municipality of Araraquara.

Recently, with the worsening of the health crisis caused by Covid-19 in Brazil, the city of Araraquara, in the countryside of São Paulo, issued a lockdown in mid-February 2021 in order to stop the increase in the number of cases and deaths caused by this disease (ARARAQUARA, 2021). As a result,

many debates have been raised about the effectiveness of social distancing, most of them coming from the non-scientific/academic public.

The present study was conducted with the objective of investigating the role of social distance in the Brazilian city of Araraquara, in the state of São Paulo.

2 MATERIAL AND METHODS

2.1 STUDY AREA

The State of São Paulo is located in the Southeast region of Brazil, which concentrates about 22% of the Brazilian population, being the most populous state in the country. The city of Araraquara is located at 21º 47'40" S, 48º 10' 32" W at an altitude of 684m above sea level. The climate is tropical with a dry winter and a rainy summer, classified as Aw (KÖEPPEN, 1948), with an average temperature of 22.3 °C, and average annual rainfall of 1443 mm. It stands out both regionally and nationally due to its high quality of life, with a high HDI of 0.815, an estimated population of 226,508 inhabitants, a land area of 109.88 km², and a demographic density of 206.68 hab/km². Located 270 km from the capital, in the central region of the state, its economy is based on the food industry, civil construction, aeronautics, chemical-pharmaceutical industry, sugar and alcohol agribusiness, commerce, and services, presenting also several universities (CASAGRANDE; JARDIM, 2014).

The lockdown may be classified as complete or partial lockdown. The total lockdown is defined as the "total suspension of non-essential activities with restricted movement of people", with exclusive operation of essential services. In the partial lockdown, some non-essential services may operate, according to strict surveillance criteria (BRASIL, 2021). The lockdown started in the municipality of Araraquara on February 21, 2021, and was still in force until the last day analyzed in this study, April 1, 2021, with the prohibition of vehicles and people circulation throughout the day, except in exceptional cases. Public transportation was interrupted and other essential services were drastically restricted. The measure was adopted because the health network was collapsing, with 100% occupation of public hospitals and serious patients being transferred to distant cities. Thus, the hypothesis that social distancing is effective in preventing the spread of the disease was tested, that is, if there were no contact between individuals, the number of infections and deaths by coronavirus were expected to decrease dramatically (NETTO; CORRÊA, 2020).

2.2 SAMPLING AND DATA ANALYSIS

We used the notifications provided about the number of cases and the number of confirmed coronavirus deaths per day. The notifications were collected from the data provided by the Coronavirus Bulletin of the Coronavirus Contingency Committee in Araraquara, which is part of the city government. The data used for the study were collected from December 31, 2020 to April 1, 2021, except for January 14, 2021 in which there was no collection.

Based on the data collection, we developed a life table according to Begon *et al*. (2020), with daily data on the following parameters: Number of People Infected, considered as the number of people who were tested positive for COVID-19 (Ax); Proportion of People Infected, which is the total number of infected people divided by the total number of infected on the last sampled day- (Lx); Number of Deaths, number of people who died per day due to COVID-19 (Fx); Proportion of Deaths, number of deaths on the day sampled divided by the total number of infected on that same day (Mx); and Basic Mortality Rate, which represents the contribution of each person infected with COVID-19 to the number of deaths from COVID-19, calculated from multiplying the proportion of infected people by the proportion of deaths. Next, the curves of cumulative cases and deaths during the sampling period were plotted in order to investigate the effects of the lockdown. From the first day of the lockdown, they were linearized using the log 10 transformation. A non-hierarchical K-means Clustering Analysis was carried out to divide the plotted data into different groups, i.e., different straight lines. All points were fitted to the equation log y=log a+b log x, where **y** is the cumulative number of cases, **x** is the number of days passed since the beginning of the lockdown, **a** is the intercept (linear coefficient) and **b** is the angular coefficient or slope of the line. The result of the K-means classification was refined by applying a Discriminant Analysis. Once determined, the groups were subjected to an Analysis of Covariance (ANCOVA) to test the differences in their angular and linear coefficients, and whether they can be represented by a single straight line and equation or should be represented by different straight lines and linear equations. Initially, the angular coefficients (b) of the lines were tested, and if there were no differences between them, the linear coefficients (a) were also compared. If there were differences between any of the coefficients, each straight line should be treated as a different sampling group. Differences in the daily number of infected people and daily deaths were tested between the groups obtained in the Analysis of Covariance by the non-parametric Kruskal-Wallis test complemented by the Dunn's test. All analyses were performed using the R software (R Core Team 2020).

3 RESULTS

A total number of 9,094,000 people infected with COVID-19 was recorded from the first day of data collection, on December 31, 2020, to the last day of collection, on April 1, 2021, totaling 90 days of collection. The total number of people infected with coronavirus in the municipality of Araraquara since the beginning of the pandemic was 17,224,000 (Table 1). The number of deaths in the 90-day sampling period was 240. The total basic mortality rate in the municipality was 0.942, obtained from the 2021 data (Table 1).

Table 1 – Number of people infected and deaths from coronavirus in the municipality of Araraquara in the period from December 31, 2020 to March 29, 2021

Date	Number of infected (Ax)	Proportion of infected (Lx)	Number of deaths (Fx)	Proportion of deaths (Mx)	Basic mortality rate (Lx.Mx)
Dec/31	8327	47.8%	0	0.00%	0.0000
Jan/01	8371	48.1%	0	0.00%	0.0000
Jan/02	8428	48.4%	1	0.01%	0.0001
Jan/03	8451	48.5%	1	0.01%	0.0001
Jan/04	8480	48.7%	0	0.00%	0.0000
Jan/05	8531	49.0%	0	0.00%	0.0000
Jan/06	8623	49.5%	1	0.01%	0.0001
Jan/07	8677	49.8%	0	0.00%	0.0000
Jan/08	8736	50.1%	0	0.00%	0.0000
Jan/09	8806	50.5%	0	0.00%	0.0000
Jan/10	8884	51.0%	0	0.00%	0.0000
Jan/11	8920	51.2%	1	0.01%	0.0001
Jan/12	9005	51.7%	0	0.00%	0.0000
Jan/13	9054	52.0%	0	0.00%	0.0000
Jan/15	9198	52.8%	2	0.02%	0.0001
Jan/16	9243	53.1%	0	0.00%	0.0000
Jan/17	9316	53.5%	1	0.01%	0.0001
Jan/18	9369	53.8%	0	0.00%	0.0000
Jan/19	9461	54.3%	2	0.02%	0.0001
Jan/20	9476	54.4%	1	0.01%	0.0001
Jan/21	9579	55.0%	1	0.01%	0.0001
Jan/22	9642	55.3%	1	0.01%	0.0001
Jan/23	9718	55.8%	0	0.00%	0.0000
Jan/24	9783	56.2%	1	0.01%	0.0001
Jan/25	9853	56.6%	0	0.00%	0.0000
Jan/26	9959	57.2%	1	0.01%	0.0001

Date	Number of infected (Ax)	Proportion of infected (Lx)	Number of deaths (Fx)	Proportion of deaths (Mx)	Basic mortality rate (Lx.Mx)
Jan/27	10039	57.6%	4	0.04%	0.0002
Jan/28	10107	58.0%	0	0.00%	0.0000
Jan/30	10272	59.0%	4	0.04%	0.0002
Jan/31	10356	59.4%	2	0.02%	0.0001
Feb/01	10386	59.6%	5	0.05%	0.0003
Feb/02	10590	60.8%	0	0.00%	0.0000
Feb/03	10683	61.3%	0	0.00%	0.0000
Feb/04	10794	62.0%	5	0.05%	0.0003
Feb/05	10894	62.5%	1	0.01%	0.0001
Feb/06	10998	63.1%	0	0.00%	0.0000
Feb/07	11093	63.7%	1	0.01%	0.0001
Feb/08	11118	63.8%	1	0.01%	0.0001
Feb/09	11361	65.2%	1	0.01%	0.0001
Feb/10	11522	66.1%	4	0.03%	0.0002
Feb/11	11639	66.8%	1	0.01%	0.0001
Feb/12	11759	67.5%	6	0.05%	0.0003
Feb/13	11960	68.7%	2	0.02%	0.0001
Feb/14	12127	69.6%	3	0.02%	0.0002
Feb/15	12205	70.1%	2	0.02%	0.0001
Feb/16	12434	71.4%	5	0.04%	0.0003
Feb/17	12631	72.5%	5	0.04%	0.0003
Feb/18	12802	73.5%	4	0.03%	0.0002
Feb/19	12989	74.6%	5	0.04%	0.0003
Feb/20	13237	76.0%	3	0.02%	0.0002
			LOCKDOWN		
Feb/21	13454	77.2%	1	0.01%	0.0001
Feb/22	13493	77.5%	6	0.04%	0.0003

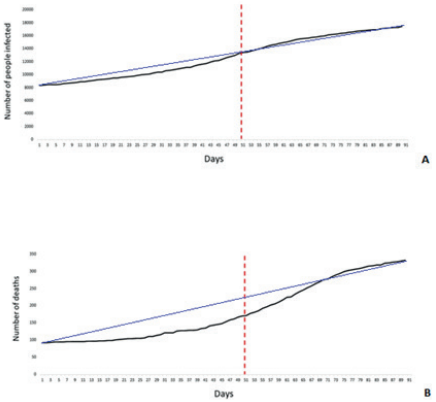
Date	Number of infected (Ax)	Proportion of infected (Lx)	Number of deaths (Fx)	Proportion of deaths (Mx)	Basic mortality rate (Lx.Mx)
Feb/23	13683	78.5%	4	0.03%	0.0002
Feb/24	13822	79.3%	4	0.03%	0.0002
Feb/25	13978	80.2%	7	0.05%	0.0004
Feb/26	14172	81.4%	5	0.04%	0.0003
Feb/27	14377	82.5%	5	0.03%	0.0003
Feb/28	14574	83.7%	3	0.02%	0.0002
Mar/01	14669	84.2%	6	0.04%	0.0003
Mar/02	14854	85.3%	6	0.04%	0.0003
Mar/03	14969	85.9%	7	0.05%	0.0004
Mar/04	15085	86.6%	1	0.01%	0.0001
Mar/05	15214	87.3%	9	0.06%	0.0005
Mar/06	15396	88.4%	6	0.04%	0.0003
Mar/07	15519	89.1%	6	0.04%	0.0003
Mar/08	15577	89.4%	6	0.04%	0.0003
Mar/09	15640	89.8%	6	0.04%	0.0003
Mar/10	15725	90.3%	6	0.04%	0.0003
Mar/11	15809	90.7%	5	0.03%	0.0003
Mar/12	15899	91.3%	7	0.04%	0.0004
Mar/13	15985	91.8%	2	0.01%	0.0001
Mar/14	16159	92.8%	6	0.04%	0.0003
Mar/15	16191	92.9%	5	0.03%	0.0003
Mar/16	16265	93.4%	5	0.03%	0.0003
Mar/17	16345	93.8%	5	0.03%	0.0003
Mar/18	16429	94.3%	3	0.02%	0.0002
Mar/19	16560	95.1%	2	0.01%	0.0001
Mar/20	16622	95.4%	3	0.02%	0.0002
Mar/21	16723	96.0%	2	0.01%	0.0001
Mar/22	16751	96.2%	3	0.02%	0.0002

Date	Number of infected (Ax)	Proportion of infected (Lx)	Number of deaths (Fx)	Proportion of deaths (Mx)	Basic mortality rate (Lx.Mx)
Mar/23	16796	96.4%	3	0.02%	0.0002
Mar/24	16877	96.9%	1	0.01%	0.0001
Mar/25	16914	97.1%	2	0.01%	0.0001
Mar/26	16957	97.3%	0	0.00%	0.0000
Mar/27	17100	98.2%	6	0.04%	0.0003
Mar/28	17161	98.5%	1	0.01%	0.0001
Mar/29	17224	98.9%	2	0.01%	0.0001
Mar/30	17284	99.2%	1	0.01%	0.0001
Mar/31	17284	99.2%	2	0.01%	0.0001
Apr/01	17421	100.0%	2	0.01%	0.0001
Total basic mortality rate from coronavirus from 2021 onwards					**0.0138**

Legend: Ax is the number of people infected by coronavirus; Lx is the proportion of those infected with COVID-19, where the proportion of those infected = Ax/17421; Fx is the number of coronavirus deaths; Mx is the proportion of coronavirus deaths, where the proportion of deaths = Fx/Ax; Lx.Mx is the basic mortality rate, where the basic mortality rate = Lx*Mx
Source: Research Data.

The lockdown started on February 21, 2021, and continued until the last sampling day on April 1, 2021, for a total of 39 lockdown days. The first day of the lockdown was the 51st day of the analyzed series, when the number of infected people was 13,454,000, with 171 coronavirus deaths. Such a measure was taken after a steepening in the slopes of the curves of number of cases and number of deaths (Figure 1). In the final part of the series, a reduction in the number of both infections and deaths per day was observed.

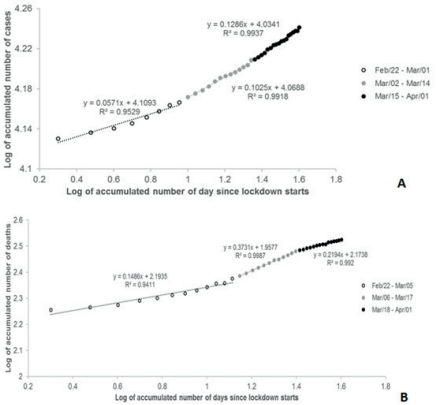
Figure 1 – **(A)** Number of people infected by coronavirus, in the municipality of Araraquara, state of São Paulo, in the study period in relation to the number of sampling days. The dashed line in red indicates the beginning of the lockdown. **(B)** Number of coronavirus deaths, in the municipality of Araraquara, São Paulo state. The dashed line in red indicates the beginning of the lockdown



Source: Research Data.

Based on the cumulative number of new infection cases in relation to the numbers of days analyzed, the period after the beginning of the lockdown was divided into three groups (Discriminant Analysis, $p<0.001$), which are graphically represented by three straight lines, with slopes statistically different from each other (ANCOVA, $p<0.05$) (Figure 2, Table 2). The first group was from February 22 to March 1 (eight days), the second between March 2 and 14 (13 days), and the third, between March 15 and April 1 (18 days).

Figure 2 (A) - Change in the log of the cumulative number of new cases of Covid-19 compared to the log of the number of days since the lockdown began in Araraquara. **(B)** - Variation in the cumulative number of deaths from Covid-19 relative to the log of the number of days since the lockdown began, in Araraquara.



Source: Research Data.

Table 2 – Results of the Covariance Analysis (ANCOVA) for the relationship between number of cumulative new cases and the number of days after the lockdown started, in Araraquara. The data groups were defined based on the K-means Analysis, refined by Discriminant Analysis

		Par (log)	F	P
Accumulated number of cases by day of lockdown	First vs. second part of the lockdown	a	-	-
		b	52	0.000001*
	First vs. third part of the lockdown	a	-	-
		b	46	0.000003*
	Second vs. third part of the lockdown	a	-	-
		b	18	0.000302*

Source: Research Data.

Regarding the increase in the cumulative number of deaths in relation to the number of days, the period after the beginning of the lockdown may also be divided into three groups (Discriminant Analysis, $p<0.001$), represented by three distinct straight lines (ANCOVA, $p<0.05$) (Figure 2, Table 3). However, unlike what was observed for the number of cases, the first group extended from February 22 to March 5 (12 days), the second from March 6 to March 17 (12 days), and the third from March 18 and April 1 (15 days).

Table 3 – Results of the Covariance Analysis (ANCOVA) for the relationship between number of cumulative new cases and the number of days after the lockdown started, in Araraquara. The data groups were defined based on the K-means Analysis, refined by Discriminant Analysis

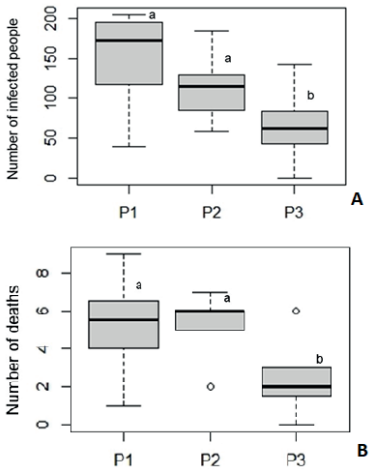
		Par (log)	F	P
Accumulated number of deaths by day of lockdown	First *vs.* second part of the lockdown	a	-	-
		b	72.39	<0.000001*
	First *vs.* third part of the lockdown	a	181.76	<0.000001*
		b	0,02	0.899890
	Second *vs. t*hird part of the lockdown	a	-	-
		b	605.1	<0.000001*

Source: Research Data.

The Kruskal-Wallis test also showed a significant difference in the number of newly infected people. The Dunn's post-test showed that there was no statistical significant difference in the daily number of infected. However, it indicated a significant reduction for the third period ($H= 13.304$; $p<0.05$) (Figure 4).

Regarding the daily number of deaths there was no significant difference between the first and second lockdown periods. However, the third period was statistically significant different (H= 17.869; p>0.05), with fewer deaths in this period (Figure 3).

Figure 3 (A) – Box-plots of median and quartiles of the number of people infected by COVID-19 during the lockdown, in the municipality of Araraquara, state of São Paulo



P1 = first period (February 22 to March 01), P2 = second period (March 02 to March 14) and P3 = third period (March 15 and April 01). Kruskal-Wallis test (P<0.05), Dunn's post hoc test (P<0.05). (B) - Box-plots of the median and quartiles of the number of deaths by COVID-19 during the lockdown, in the municipality of Araraquara, state of São Paulo. P1 = first period (February 22 to March 01), P2 = second period (March 02 to March 14) and P3 = third period (March 15 to April 01). Kruskal-Wallis test (P<0.05), Dunn's post-hoc test (P<0.05). Source: Research Data.

4 DISCUSSION

The life table showed that the basic mortality rate was 0.0138. That is, for every 10,000 contaminated individuals, approximately 138 people may die. This value highlights the high contamination capacity of Sars-Cov2, resulting in a disease that still has no effective treatment. In addition, the number of vaccines available is still very low (ADHIKARI *et al.*, 2020).

The lockdown began on February 21, 2021, with a ban on the circulation of people and vehicles in the city throughout the day, except in exceptional cases. This measure was adopted because the health network was collapsing, with total occupation of the hospitals (ARARAQUARA, 2021). Our results showed that eight days after the lockdown the rate of growth in the number of cases started to slow down (Figure 2), and after 24 days this slowdown intensified, with a reduction in the daily number of new infections

and in the number of deaths from COVID-19 (Table 1, Figure 3). In some places in the world the number of infections by coronavirus reduced 14 days after the start of the lockdown (HOUVÈSSOU *et al.*, 2021), a shorter time than that found in our study. That corroborates the positive results observed in China about the reduction of COVID-19 infections after the adoption of this initiative (LAU *et al.*, 2020).

Between February 21 and March 6, 2021, Brazil was among the countries with the worst indicators regarding COVID-19, with accelerated growth, corresponding to 9.5% and 10.3% of total number of cases and deaths worldwide, respectively. Actually, the country never achieved a significant reduction of its transmission curve, accumulating new records of daily cases and deaths (FIOCRUZ, 2021). In the study conducted in Araraquara, the rate of growth in the number of deaths was slower, taking more time to be affected by the lockdown. The reduction in the daily number of deaths only showed a significant reduction 24 days after its onset (FIGURE 3). Normally, the average time from the onset of symptoms until intubation is 14.5 days, and from this period until the worsening of the disease resulting in death is 4 to 5 days (WANG *et al.*, 2020; ZHOU *et al.*, 2020). Thus, the deaths that occurred during much of the lockdown period may refer to infections that occurred before the onset of this restrictive measure.

Similar results to those of Araraquara on the positive effect of the lockdown were observed in China, France, South Africa, Germany, Spain, Italy, and New Zealand, which showed a reduction in the growth of the number of confirmed cases of COVID-19 after the implementation of lockdown restriction measures (HOUVÈSSOU *et al.*, 2021). In Brazil, the impact of the implementation of strict containment measures was observed in four municipalities in the northeast region of the country, showing a reduction of 16.77% (Belém/PA), 33.4% (Fortaleza/CE), 21.76% (Recife/PE) and 37.85% (São Luís/MA) in the rate of contamination and deaths by COVID-19 (SILVA *et al.*, 2020). These results were a consequence of the reduction in circulation and proximity between people, since the virus spreads mainly from person to person through close contact and respiratory droplets (MORAWSKA; CAO, 2020). However, if the virus does not find a host, the disease terminates and thus the success of the prevention depends on the inflection of the pandemic (SCHUCHMANN; ZHANG, 2020).

In this study, we showed that the table of life used in ecological studies is an efficient tool in the analysis of data in pandemics, since we can illustrate the proportions of infected people and deaths more clearly, also providing data to verify the basic mortality rate, which can be compared with other studies in any region of the world. Based on the life table, we verified that the lockdown in a municipality with just over 100,000 inhabitants in the countryside of Brazil was an effective measure, because there was a flattening of the curve of infected people and deaths.

We believe that the decisions taken by the health agencies and their professionals highlight the need of support to social isolation as a tool to deal with the pandemic, especially while effective pharmacological measures do not exist (HOUVÈSSOU *et al.*, 2021).

Despite the difficulty in evaluating the number contacts people usually have, the estimates presented help to understand the need for isolation, since the data shown in this study revealed that social isolation during the lockdown performed in the city of Araraquara was efficient both in reducing the number of infected people and the number of deaths. Although social isolation actions do not eliminate the virus, they are useful tools for providing good healthcare services, besides reducing the burden on nurses and health professionals (SILVA, 2021).

5 CONCLUSIONS

In our study, we found that the life table was an effective tool for analyzing the infection data, since it made it clear that the restrictive lockdown resulted in the control of the coronavirus by promoting the reduction of the number of infected people by 80% and the number of coronavirus deaths only 24 days after its onset. The total basic mortality rate in the city was 0.138. We recommend the use of the life table for future studies in other municipalities, since it is a powerful tool in Ecology that can be used in the interpretation of pandemic data.

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