

Original article

## Epidemiological profile of covid-19 cases in a city in northwest São Paulo

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## ABSTRACT

**Introduction:** On March 11, 2020 the World Health Organization (WHO) declared the pandemic of the disease caused by the coronavirus 2019 (covid-19), responsible for causing potentially severe, highly transmissible acute respiratory infection, which increased the number of deaths worldwide. **Methods:** This is a documental, applied research, with quantitative and cross-sectional approach, collecting and assessing data from reported cases of covid-19 in the period from March 2020 to July 2021 in the e-SUS Notifica (flu-like illness cases) and Sivep-Gripe (severe acute respiratory syndrome cases and deaths) systems. The assessed variables were: gender, age, presence of comorbidities and outcome (cure or death). We calculated the general and specific mortality rates, as well as the moving average of cases and deaths per epidemiological week of occurrence. **Results:** 25,475 confirmed cases were obtained, out of which 11,610 were male and 13,865 female. The highest mortality rate occurred in males: 4.16%. The comorbidity with the highest mortality rate was neurological disorder: 50.00%. All vaccinated patients who died were over 60 years old, and 82.87% had at least one risk factor. Furthermore, it was possible to visualize the rising curve infection and death numbers. **Conclusions:** The analysis of the epidemiological profile of those affected, the development of the disease, and its severity was essential for drawing up and adjusting mitigation strategies and planning health actions and health care against SARS-CoV-2 in Araçatuba-SP.

**KEYWORDS:** SARS-CoV-2 Infection; Covid-19; Epidemiology.

## RESUMO

**Introdução:** Em 11 de março de 2020 foi declarada pela Organização Mundial da Saúde (OMS) a pandemia da doença pelo coronavírus 2019 (covid-19), responsável por causar infecção respiratória aguda, potencialmente grave e de alta transmissibilidade, o que elevou mundialmente o número de óbitos. **Métodos:** Trata-se de uma pesquisa documental, aplicada, de abordagem quantitativa e transversal, de coleta e análise de dados de casos notificados, no período de março de 2020 a julho de 2021, nos sistemas e-SUS Notifica (casos de síndrome gripal) e Sivep-Gripe (casos de síndrome respiratória aguda grave e óbitos) do município de Araçatuba (SP), no Noroeste Paulista. As variáveis analisadas foram sexo, faixa etária, presença de comorbidades, desfecho (cura ou óbito) e vacinação. As taxas de letalidade geral e específica foram calculadas, bem como a média móvel de casos e óbitos por semana epidemiológica de ocorrência. **Resultados:** Foram

obtidos 28.890 casos confirmados, dos quais 13.210 do sexo masculino e 15.680 do sexo feminino. Dos 894 óbitos, 482 ocorreram em homens. A letalidade entre pessoas com doença neurológica prévia foi de 50%. Todos os vacinados que vieram a óbito tinham mais de 60 anos e 82,87% possuíam pelo menos um fator de risco. **Conclusões:** A análise do perfil epidemiológico dos acometidos, da evolução e da gravidade foi de fundamental importância para se determinar e adequar estratégias de mitigação e planejamento de ações e cuidados de saúde no combate ao SARS-CoV-2 no município.

**PALAVRAS-CHAVE:** Infecção pelo SARS-CoV-2; Covid-19; Epidemiologia.

## INTRODUCTION

The first globally identified case of the disease caused by the coronavirus, in 2019, was in Wuhan, province of Hubei, in China.<sup>1</sup> The virus, able to cause mass pneumonia, sparked off a severe health crisis, leading the World Health Organization (WHO) to declare, in March 2020, the covid-19 – as the disease was named – a public health emergency of international concern.<sup>1-3</sup>

Officially named as SARS-CoV-2, it is a betacoronavirus belonging to subgenus Sarbecovirus, of the family *Coronaviridae*, the seventh coronavirus to infect human beings.<sup>1</sup> It is currently known that the main cell entry mechanism in hosts is the angiotensin-converting enzyme 2 (ACE2), which acts as a virus receptor in the lower respiratory tract epithelial cells.<sup>2</sup>

Comparing to other coronavirus, the SARS-CoV-2 has high transmissibility occurring primarily through three modes: contact; droplets or aerosol.<sup>1</sup> The disease dissemination can occur directly, through contact with an infected person, or indirectly, through surfaces or objects used by an infected person. It happens predominantly through close contact (less than 1 meter), and especially by respiratory droplets. Despite the incubation period ranges from 1 to 14 days, a virus infected person may transmit the disease up to 48 hours after symptom onset.<sup>1</sup>

Most of the infections caused by the novel coronavirus manifest themselves as an influenza-like illness (ILI), or flu-like illness, characterized by nonspecific symptoms such as cough, persistent fever, abdominal pain, headache, diarrhea, sore throat, and runny nose. Some cases evolve with dyspnea, respiratory distress, persistent chest pressure,

oxygen saturation below 95% in ambient air, and bluish lips or face, characterizing the severe acute respiratory syndrome (SARS). The prognosis of those affected may be related to factors such as age, gender, and the presence of previous comorbidities.<sup>1</sup>

As covid-19 is an infectious disease with a well-known high transmissibility, prevention is essential for controlling SARS-CoV-2 spreading. Therefore, the main recommendations from the Brazilian Department of Health are: social distancing, respiratory etiquette, hand hygiene, mask use, room cleaning and disinfection, isolation of suspected and confirmed cases, and quarantine of covid-19 case contacts, according to medical guidelines. Moreover, the Department recommends the vaccination of priority groups according to the National Operationalization Plan, which was drawn up according to global guidelines from the Pan American Health Organization (PAHO) and the World Health Organization (WHO). Until this article was written, there were four vaccines against covid-19 which were authorized by the National Health Surveillance Agency (Anvisa) in Brazil: two for emergency use (Sinovac/Butantan e Janssen), and two fully-approved (AstraZeneca/Fiocruz e Pfizer/Wyeth). The vaccines from AstraZeneca and Sinovac pharmaceutical companies have been used since the beginning of the national vaccination campaign against the disease, initiated in the country in 2021.

The aim of this study was to define the epidemiological profile of cases and deaths by covid-19, from March 2020 to July 2021, in a city located in the northwest region of the State of São Paulo.

## MATERIAL AND METHODS

This is a descriptive, transversal study. The period of data collection was from March 2020 to July 2021, starting from the first confirmed case in the city of Araçatuba, in the Northwest São Paulo region. Ergo, the studied cases were registered between the 12nd (03/15 to 03/21/2020) and the 30th (07/25 to 07/31/2021) weeks in the 2021 notification epidemiological calendar, outlined by the Brazilian Department of Health.<sup>6</sup>

Data was collected within the e-SUS Notifica system (ILI cases) and the Sivep-Gripe system (SARS and deaths).

The inclusion criteria were the reported cases of covid-19 which were confirmed by laboratory testing, as well as clinical, clinical-epidemiological and medical-imaging criteria, in a total of 28,890 notifications. The mortality rate was calculated by the grand total, age

group, gender, and previous risk conditions and factors. The development of cases and deaths moving average was calculated by notification epidemiological week (EW).

The data used for assessing vaccination against covid-19 were obtained within the Sivep-Gripe system, from its database in XLSX format of Microsoft Excel 2016 software program. The latter was also used to perform calculations, descriptive statistics, tabulations, and general organization of the material.

In accordance with resolutions No. 466, 2012,<sup>7</sup> and No. 510, 2016,<sup>8</sup> of the National Research Ethics Council, this study did not require approval from the Research Ethics Committee because it employed aggregated secondary data that do not allow for individual identification.

## RESULTS

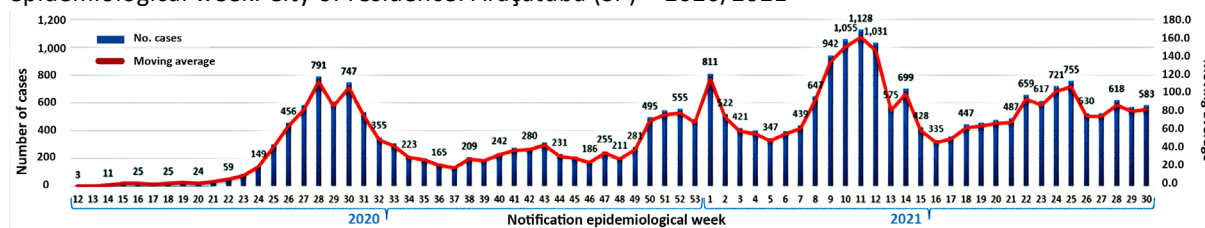
We assessed 28,890 confirmed cases of covid-19 in patients living in Araçatuba. Out of that total, 94.27% (27,235/28,890) were reported by the municipality itself, and 5.83% (1,655/28,890) by other localities. Laboratorial criteria (molecular biology, antigen testing, or immunological testing) confirmed 87.81% (25,369/28,890) of the cases; clinical criteria, 0.0034% (01/28,890); clinical-epidemiological criteria (history of close or household contact within 14 days prior to sign and symptom onset with confirmed case of covid-19), 0.13% (37/28,890); and medical-imaging (tomographic change of ground-glass opacity or reverse halo sign), 0.0034% (01/28,890); confirmation criterion was unknown or blank in 12.05% (3,482/28,890) of the cases. During the study period, 894 covid-19-related deaths were reported, 886 of which were registered in Sivep-Gripe system, and 8 in e-SUS Notifica. The overall mortality was 3.09% ([Table 1](#)).

From the first registered case in EW 12 ([Figure 1](#)), and until EW 20 the number of cases remained stable, increasing soon after, and reaching a peak in EW 28, with 791 confirmed cases and a moving average of 113 per day. EW 11, in 2021, had the largest number of cases (1,128) and a moving average of 161.<sup>1</sup> cases per day. There was a weekly decrease in the number of cases from that date until EW 16, while in EW 25 there was another peak, with 755 cases, followed by a decrease and slight variations from EW 27 onward, with 583 cases and a moving average of 83.3 until the end of the study (EW 30).

**Table 1.** Frequency and percentage of confirmed covid-19 cases and deaths, and mortality rate, according to age group, gender and presence of previous risk conditions and factors. City of residence: Araçatuba-SP – March 2020 to July 2021.

Characteristics	Confirmed cases		Deaths		Mortality rate
	n	%	n	%	%
<b>Grand total</b>	28,890	100.00	894	100.00	3.09
<b>Age group</b>					
0 - 9 years old	949	3.28	1	0.11	0.11
10 - 19 years old	2,003	6.93	2	0.22	0.10
20 - 29 years old	4,893	16.94	5	0.56	0.10
30 - 39 years old	6,312	21.85	51	5.70	0.81
40 - 49 years old	5,670	19.63	105	11.74	1.85
50 - 59 years old	4,547	15.74	174	19.46	3.83
60 - 69 years old	2,614	9.05	209	23.38	8.00
70 - 79 years old	1,315	4.55	184	20.58	13.99
80 - 89 years old	472	1.63	124	13.87	26.27
90 years old or above	92	0.32	39	4.36	42.39
<b>Gender</b>					
Male	13,210	45.73	482	53.91	3.65
Female	15,680	54.27	412	46.09	2.63
<b>Risk conditions and factors</b>					
Asthma	45	0.16	9	1.01	20.00
Diabetes	1,272	4.40	236	26.40	18.55
Cardiovascular disease	1,679	5.81	196	21.92	11.67
Hematological disease	13	0.04	4	0.45	30.77
Liver disease	12	0.04	4	0.45	33.33
Immunosuppressive disease	129	0.45	18	2.01	13.95
Neurological disorder	58	0.20	29	3.24	50.00
Kidney disease	83	0.29	17	1.90	20.48
Pregnancy	18	0.06	0	0.00	0.00
Obesity	325	1.12	96	10.74	29.54
Pneumopathy	32	0.11	8	0.89	25.00
Postpartum period	8	0.03	0	0.00	0.00
Down syndrome	8	0.03	3	0.34	37.50

**Figure 1.** Frequency of covid-19 confirmed cases and moving average, according to notification epidemiological week. City of residence: Araçatuba (SP) – 2020/2021



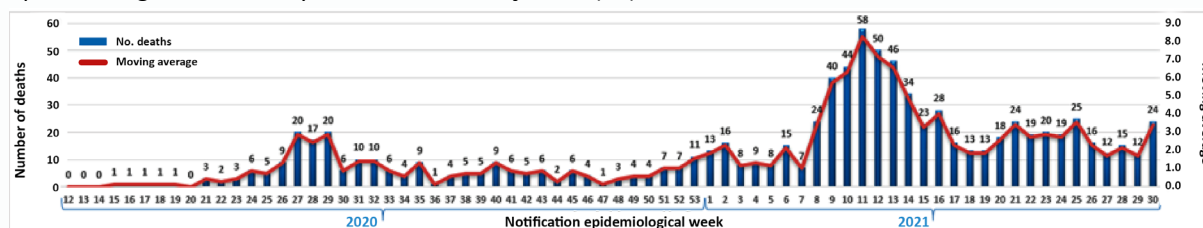
Among the total number of confirmed cases, the average age was 41.06 years old, ranging from under 1 to 104 years old. Most cases—72.76% (21,022/28,891)—occurred in people aged 30 or older, and the 30-49 group age was mostly affected, with 41.47% of the cases (11,982/28,891). Most cases—54.27% (15,680/28,891) (Table 1)—occurred in females ranging from under 1 to 104 years old, average age of 41.48 years old. Males were 45.73% (13,210/28,891) of the cases (Table 1), ranging from under 1 to 100 years old, average age of 40.55 years old. The age average was 39 years old for males, and 40 years old for females. The leading risk conditions and factors were cardiovascular diseases (1,679), diabetes mellitus (1,272), and obesity (325).

The first confirmed death by covid-19 was reported in EW 15, 2020 (Figure 2), three weeks after the notification of the first case. That number remained stable for five weeks, being EW 20 the only one with no reported deaths. From EW 21, 2020, onward there was an upward tendency, and the peak number of deaths in that period was registered in week 11, 2021, with a total of 58 deaths and a moving average of 9.29 deaths. In the same year there was a decrease in the number of deaths, from EW 12 until SE 19. From EW 20 onward there was a new increase, and 24 deaths were reported in EW 30, 2021.

The average age in deaths was 64.32 years old (average of 23.26 older when compared to the average age in the total of cases). From that total, 63.42% (567/894) occurred in people between 50 and 79 years old; the higher mortality rate was registered in 90-year-old individuals, or older (42.39%, 39/92).

Most deaths occurred in males: 53.91% (482/894), while among females accounted for 46.09% (412/894); mortality rates were 3.65% e 2.63%, respectively. In males, the minimum age in deaths was 5 years old, and maximum of 100, with an average of 63.87 years old and a median of 64. In females, the minimum age was 10 years old, and maximum 97, with an average of 64.83 and a median of 66.

**Figure 2.** Frequency of covid-19 confirmed deaths and moving average, according to notification epidemiological week. City of residence: Araçatuba (SP) – 2020/2021



Among the deaths, patients with previous neurological distress showed the higher mortality rate, of 50.00% (29/58). Among the groups of pregnant and postpartum women, no deaths were reported.

The vaccination scheme against the disease was assessed in cases of SARS by covid-19 (Table 2 and [Figure 3](#)). In that system, 2,898 cases were registered, 888 of which resulted in death.

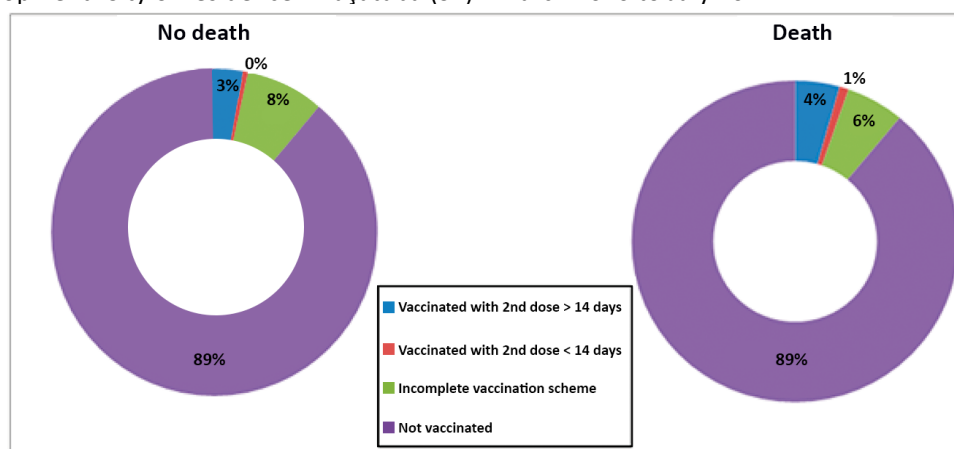
Among the cases resulting in death and having two vaccine shots against covid-19 (Table 2), 55.32% (26/47) were male, and 44.68% (21/47) female. All deaths occurred in people over 60 years old, and 82.97% (39/47) had at least one risk condition/factor. Heart diseases were the leading risk factor, found in 55.32% (26/47) of the vaccinated deceased, followed by diabetes, found in 34.04% (16/47) of deaths.

**Table 2.** Frequency and percentage of vaccination scheme against covid-19 in cases of SARS by covid-19, according to case development. City of residence: Araçatuba (SP) - March 2020 to July 2021.

Esquema vacinal	Casos de SRAG por covid-19				Total
	Não óbito		Óbito		
	n	%	n	%	
Vaccinated with 2nd dose > 14 days	56	2.79	39	4.39	<b>95</b>
Vaccinated with 2nd dose < 14 days	11	0.55	8	0.90	<b>19</b>
Incomplete vaccination scheme	155	7.71	51	5.74	<b>206</b>
Not vaccinated	1,788	88.96	790	88.96	<b>2,578</b>
<b>Total</b>	<b>2,10</b>	<b>100.00</b>	<b>888</b>	<b>100.00</b>	<b>2,898</b>



**Figure 3.** Percentage of vaccination scheme against covid-19 in cases of SARS by covid-19, according to case development. City of residence: Araçatuba (SP) - March 2020 to July 2021.



## DISCUSSION

Brazil stood out worldwide in the pandemic scenario due to the number of infected and dead. Among the Brazilian states, São Paulo came through.<sup>10</sup> Some limitations should be considered when interpreting data from this study, such as underreporting of cases and deaths, which implies an underestimation of the assessment, making impossible to fathom its magnitude.

Northwest São Paulo is made up of 40 cities located in the countryside, and Araçatuba (SP) is the largest one in the region, totaling 199,210 inhabitants.<sup>9</sup>

On February 26<sup>th</sup>, 2020 the first case of SARS-CoV-2 in Brazil was confirmed, coming from Italy and being reported in the city of São Paulo.<sup>10</sup> On March 22<sup>nd</sup>, 25 days after it, all Brazilian states had already reported cases. The first one in Araçatuba territory was confirmed on March 16<sup>th</sup>, 2020.

The general mortality rate in the city (3.09%) was higher than in Brazil (2.79%)<sup>11</sup> in the period of this study. That difference may be credited to the country's continental size, and its socioeconomic inequality. The most affected age group (30-39 years old) in Araçatuba represents more than 50% of the population density; in contrast, less than 10% are over 90 years old, which explains a higher mortality rate.<sup>9</sup>

A Brazilian study has shown that, among the regions, the highest absolute number of confirmed cases concentrated in the Southeast, of which Araçatuba makes part.<sup>14</sup> The North region had the highest incidence rate. The epidemic curves in São Paulo had a more advanced stage than in other Brazilian states.<sup>15</sup> Thus, incidence rates are supposed to have more influence from containment strategies in each state.

A research carried out in the State of Maranhão has found a predominance of confirmed cases among females,<sup>11</sup> corroborating this study; while in other countries such as China, males predominated.<sup>13</sup> In both studies the most affected age group was 30-39 years old, while the most common comorbidities were chronic cardiovascular and immunosuppressive diseases.<sup>13</sup> It is worth mentioning that the Araçatuba region includes small towns with little or no complex structure for advanced life support, such as hospital beds and respirators, increasing the demand and the number of reported cases in the city.

Among the observed risk factors, we could find a higher mortality rate in males (3.65%) compared to females (2.63%). Researches carried out in many states like Maranhão and Minas Gerais pointed out the same pattern.<sup>13</sup> Although the notification criteria are different in other countries, the pattern was noted globally.<sup>14</sup> That increased male mortality is believed to be multifactorial, involving genetic, hormonal, and lifestyle characteristics.

In another research comparing the phases of an epidemic (localized; uncontrolled acceleration; deceleration; and control), most cities had restricted transmission.<sup>14</sup> Nonetheless, comparing Brazilian federative units such as the Federal District and the states of São Paulo, Ceará, and Amazonas, the epidemic phase may be in the transition to deceleration.<sup>14</sup>

Considering the size of the Brazilian territory and its different climates, ranging from tempered to subtropical, in all states the incidence rate was high. That fact coincides with the adopted measures for dealing with the virus high transmissibility such as travel restrictions and mandatory mask use throughout the country.<sup>14</sup>

This study has limited secondary data, as in the face of a novel disease some variables can affect the results—for instance, professional experience, correct diagnosis, lack of covid-19 tests, and reduced laboratorial capacity, leading to underreporting.<sup>12</sup>

Patients with underlying neurological impairment are vulnerable to more severe diseases when infected with covid-19.<sup>15</sup> The ones with pre-existent cerebrovascular disease tend to have a higher risk of ICU admission,<sup>15</sup> as well as overall mortality, especially when infected with SARS-CoV2, corroborating this study. That fact can also be explained because seniors over 90 years old usually have some sort of dementia or another neurological disorder. Age was considered as the main risk factor for a poorer covid-19 prognosis<sup>16</sup> – which is now confirmed with the higher mortality in 90-year-old people or older.

Obesity was another condition with high mortality rate. It is an extremely prevalent comorbidity, related to excess adipose tissue, fat-free mass deficit, insulin resistance, dyslipidemia, hypertension, high levels of inflammatory cytokines, and low essential nutrients intake.

Another condition with a high lethality rate was obesity, an extremely prevalent comorbidity that is related to excess adipose tissue, fat-free mass deficit, insulin resistance, dyslipidemia, hypertension, high levels of inflammatory cytokines, and low essential nutrients intake.<sup>17</sup> All those factors compromise organs and systems functioning in obese individuals, besides causing changes in the innate immune response, extended chronic inflammatory response, and consequent increase in the need for ventilatory assistance – having a strong correlation with those infected by covid-19.<sup>18</sup>

## CONCLUSION

We conclude that the general pattern of covid-19 involvement and mortality observed in the 28,890 cases, between March 2020 and July 2021 in the city of Araçatuba (SP), allows us to characterize the disease and establish associations with the transmissibility profile. Thus, the epidemiological profile of cases and deaths from the disease in the city is built up by individual multifactorial causes.

Therefore, we highlight the importance of this study in drawing up risk mitigation strategies and proposing more efficient measures—based on the community dissemination level, number, kind of outbreaks, community size, and vulnerable population characteristics – against the current pandemic virus.

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Epidemiological profile of covid-19 cases in a city in northwest São Paulo

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