THE IMPACT OF IMMUNIZATION AGAINST COVID-19 IN RIBEIRÃO PRETO-SP

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Abstract: In December 2019 in Wuhan, China, a new type of coronavirus emerged, named by the World Health Organization as SARS-CoV-2, causing the disease COVID-19. In a short time, this virus spread and caused the biggest pandemic of the 21st century. Due to this pandemic scenario, numerous researches were carried out on SARS-CoV-2, concluding that this virus is an enveloped RNA virus with a genome consisting of a single-stranded positive-sense RNA molecule. Work was carried out on the development of vaccines against COVID-19, with the Coronavac, AstraZeneca/Oxford, Pfizer/Biontech and Janssen vaccines being approved in Brazil. However, a portion of the population questions how these vaccines work and whether there really are more benefits than harm to their application. This article aims to analyze the impact of vaccination coverage against COVID-19 on the number of infected people, hospitalizations and deaths due to SARS-CoV-2 in the population of Ribeirão Preto-SP, in order to verify whether there has been a reduction in these variants. This article is an ecological study and to carry it out data from epidemiological bulletins available at the Municipal Health Department of the city of Ribeirão Preto were used, which contained information on the variants analyzed and on vaccination coverage. Epidemiological bulletins from January 2020 to July 2022 were analyzed. The study showed that at the beginning of the COVID-19 pandemic the disease had a high death rate, with the average in 2020 and 2021 being 2.5% and 2.7%, respectively, while in 2022 this rate was 0.7%. Regarding hospitalization, in 2020 the highest rate was 23.7%, and in 2022 the highest rate was 1.7%. Comparing data in the period before and after vaccination of the population, it is noted that immunization against COVID-19 contributed to reducing hospitalization and death rates, being effective in individual and collective health. However, vaccination did not show any effect on reducing the transmissibility of the virus.

Keywords: COVID-19; Vaccination; Ribeirão Preto

INTRODUCTION

In December 2019 in Wuhan, China, a new coronavirus emerged, called SARS-CoV-2, which causes the disease COVID-19, an acute respiratory infection. In a short time, this virus spread globally, causing the biggest pandemic of the 21st century. As of 02/08/2022, 578 million infected people and 6.4 million deaths have been recorded, according to “Our World in Data”. Due to this pandemic scenario, numerous researches have been carried out on COVID-19, concluding that this virus is an enveloped RNA virus with a genome consisting of a single-stranded positive-sense RNA molecule. Its life cycle involves several viral proteins to enter the target cell. To achieve this, the Spike protein (S) binds to cellular receptors for angiotensin-converting enzyme 2 (Eca2) and this complex is translocated to endosomes. In endosomes, there is fusion between the envelope and the cell membrane. After this, the viral RNA is released, the which will undergo replication, translation, synthesis and release of new viral particles. With this knowledge, it is possible to work on the development of vaccines against COVID-19, with the Coronavac, AstraZeneca/Oxford, Pfizer/Biontech/ and Janssen vaccines being approved in Brazil. However, a portion of the population questions whether there really are more benefits than harm in its application and, many, fail to get vaccinated, which is a risk to individual and collective health. For this reason, this study aims to analyze the impact of vaccination coverage against COVID-19 on the number of infected people, hospitalizations and deaths due to SARS-CoV-2 in the population of Ribeirão
Preto-SP, in order to verify whether there was a reduction in these variants.

**GOAL**

The present study aims to analyze the impact of vaccination coverage against COVID-19 on the number of infected people, hospitalizations and deaths due to SARS-CoV-2 in the population of Ribeirão Preto-SP.

**MATERIAL AND METHODS**

An ecological study was carried out based on data made available in the epidemiological bulletins of the Municipal Health Department of Ribeirão Preto - SP, which reported weekly the number of individuals infected by the SARS-CoV-2 virus, deaths and hospitalizations due to COVID-19. In such bulletins, there is no distinction between the individual's race, sex, age and clinical status.

This municipal body also contains data on vaccination coverage against Covid-19, which informs which doses were administered, the number of individuals vaccinated and the total percentage of the population that received the vaccine, only distinguishing the age group. All epidemiological bulletins from January 2020 to June 2022 were verified, with no exclusion for accounting. The analysis of the bulletins took place from March 2022 to August 2022. From them, the total numbers of hospitalizations, deaths and infections were extracted in each month of the years evaluated. Regarding vaccination coverage, public data was scarce for a more detailed analysis of the evolution of vaccine applications in the municipality’s population. With this data, authorial tables were constructed that compared the epidemiological profile of the number of infected people, hospitalizations and deaths in the years 2020, 2021 and 2022 of the entire population of Ribeirão Preto, making the behavior of the numbers of these variants visible. In this study, variables absent in epidemiological bulletins, such as the patient’s clinical status and comorbidities present simultaneously with SARS-Cov-2 infection, were not considered.

In the present study, the hospitalization rate and death rate due to Covid-19 per month were calculated (TABLE 1):

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Calculation</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death rate in the month</td>
<td>Number of confirmed deaths in the month</td>
<td>Ribeirão Preto Municipal Health Department</td>
</tr>
<tr>
<td></td>
<td>Number of infected people confirmed in the month</td>
<td></td>
</tr>
<tr>
<td>Hospitalization rate per month</td>
<td>Total number of hospitalized patients in the month</td>
<td>Municipal Department of Health of Ribeirão Preto</td>
</tr>
<tr>
<td></td>
<td>Number of infected people confirmed in the month</td>
<td></td>
</tr>
</tbody>
</table>

**DEVELOPMENT**

After collecting data from epidemiological bulletins made available by the Municipal Health Department of Ribeirão Preto, from March 2020 to July 2022, it was observed that notifications of Covid-19 infection began on 03/16/2020, with the first case confirmed on 03/21/2020. As of 06/22/2022, 43,669 cases of Covid-19 were registered in the city of Ribeirão Preto. Table 3 records the number of cases per month in the years 2020, 2021 and 2022. Note that the highest number of confirmed cases occurred in January 2022, totaling 24,240. It is important to highlight that on 11/26/2021, a new variant of the SARS-CoV-2 virus was detected in South Africa, the omicron (B.1.1.529), which has a higher contamination speed than SARS- CoV-21. In January, this strain was predominant in the world, and during this period in Brazil it was responsible for the increase in the number of infected people, interrupting the decline in the number of deaths from the disease. According to the SARS-CoV-2 Variant Alert Network, in the 3rd epidemiological week of 2022 (16
to 22/01) the omicron already accounted for 
99.7% of positive samples sequenced in the 
state of São Paulo.

Initially, countless people who became 
infected with Covid-19 needed to be 
hospitalized due to complications from 
Covid-19. At the beginning of the pandemic in 
Ribeirão Preto, in March 2020, 12.5% of those 
infected required hospitalization and 23.7% in 
April, as shown in table 3. During this period 
there were no vaccines available. Compared to 
the year 2022, in January, only 0.33% of those 
infected were hospitalized, a period in which 
91% of the population of Ribeirão Preto 
received the 1st dose, 80% received the 2nd 
dose or single dose and 48% received the 3rd 
dose. Table 1 records the highest number of 
patients admitted in the months of 2020, 2021 
and 2022.

<table>
<thead>
<tr>
<th>Month of notifications</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0</td>
<td>132</td>
<td>81</td>
</tr>
<tr>
<td>February</td>
<td>0</td>
<td>130</td>
<td>112</td>
</tr>
<tr>
<td>March</td>
<td>11</td>
<td>250</td>
<td>26</td>
</tr>
<tr>
<td>April</td>
<td>53</td>
<td>255</td>
<td>9</td>
</tr>
<tr>
<td>May</td>
<td>120</td>
<td>247</td>
<td>21</td>
</tr>
<tr>
<td>June</td>
<td>166</td>
<td>279</td>
<td>50</td>
</tr>
<tr>
<td>July</td>
<td>182</td>
<td>186</td>
<td>-</td>
</tr>
<tr>
<td>August</td>
<td>139</td>
<td>124</td>
<td>-</td>
</tr>
<tr>
<td>September</td>
<td>108</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>October</td>
<td>80</td>
<td>52</td>
<td>-</td>
</tr>
<tr>
<td>November</td>
<td>37</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>December</td>
<td>59</td>
<td>15</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1 - Total number of hospitalizations 
for Covid-19 in patients residing in Ribeirão 
Preto in the years 2020, 2021 and 2022.

Source: own elaboration. Data source: SIVEP-
Gripe, 2022.

In relation to the number of deaths 
confirmed by Covid-19, as of 06/30/2022, 
3372 deaths were recorded, with the highest 
number occurring in 2021 (1992), which is 
also the year of higher lethality (2.7%). Table 2 
records this information.

<table>
<thead>
<tr>
<th>Month of symptom onset</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0</td>
<td>174</td>
<td>181</td>
</tr>
<tr>
<td>February</td>
<td>0</td>
<td>212</td>
<td>69</td>
</tr>
<tr>
<td>March</td>
<td>2</td>
<td>402</td>
<td>10</td>
</tr>
<tr>
<td>April</td>
<td>11</td>
<td>290</td>
<td>5</td>
</tr>
<tr>
<td>May</td>
<td>66</td>
<td>393</td>
<td>26</td>
</tr>
<tr>
<td>June</td>
<td>209</td>
<td>188</td>
<td>44</td>
</tr>
<tr>
<td>July</td>
<td>245</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td>August</td>
<td>176</td>
<td>74</td>
<td>-</td>
</tr>
<tr>
<td>September</td>
<td>136</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td>October</td>
<td>62</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>November</td>
<td>37</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>December</td>
<td>101</td>
<td>11</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2 - Cases of confirmed deaths from 
Covid-19 by month and year of onset of 
symptoms, in patients residing in Ribeirão 
Preto/SP, 2020, 2021 and 2022.

Source: own elaboration. Data source: SIVEP 
and Municipal Health System DVE/DEVISA/ 

Finally, analyzing vaccination coverage 
against Covid-19, it was observed that 
vaccinations in Ribeirão Preto began on 
01/19/2021, initially for health professionals 
and, subsequently, organizing applications 
of vaccines by age group and risk groups. 
As of 07/27/2022, there are 635,872 people 
vaccinated with the first dose (94% of the 
total population), 573,999 vaccinated with the 
second dose (85% of the total population), 
407,860 vaccinated with the third dose 
(66% of the total population) and 151,422 
vaccinated with the fourth dose (51% of 
the total population). Image 1 records this 
information.

With these data in view, it is possible 
to analyze the effect of vaccination against 
Covid-19 on the population of Ribeirão Preto, 
whether there was a decrease in the number of 
infections, deaths and hospitalizations. 
To this end, the number of people infected 
by Covid-19, the percentage of infected
TABLE 3 – Comparison of infected numbers, hospitalization rate and death rate in the years 2020, 2021 and 2022.

individuals who needed to be hospitalized (hospitalization rate) and the percentage of infected people who died (death rate) were compared during the years 2020, 2021 and 2022, which is visible in table 3.

CONCLUSION
Observing the number of infected people, it is noted that vaccination did not interfere in reducing the transmissibility of the disease, since even with vaccination, the numbers of infected people remained high, this fact is due to the omicron variant. Regarding the hospitalization rate, the years 2020 and 2021 remained with high rates. In 2020, the highest hospitalization rate was 23.7 (April) and in 2021, 4.2 (November). In 2022 this value reduced, for example in January 2022 the hospitalization rate was only 0.33, and the highest rate was 1.7 (March).

Finally, in relation to the death rate, it is noted that this value was also high in the years 2020 and 2021, with the average death rate in those years being 2.5 and 2.7, respectively. In 2020, the highest death rate was 5.3 (May) and in 2021, 4.1 (March). while in 2022 the average rate reduced to 0.7%.

Therefore, it is noted that vaccination coverage against Covid-19 reduced the rate of hospitalization and deaths, which is why vaccination is beneficial for both individual and collective health.

With graph 1 in view, it is possible to visualize the falling behavior of variants, hospitalizations and deaths due to Covid-19, as vaccination coverage against the virus increases. However, this scenario does not occur for the number of infected people, due to the virus variants that appeared during the pandemic.
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