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SEROLOGICAL SURVEY FOR RESEARCH OF COVID-19 INFECTIONS IN THE ADULT POPULATION OF NORTH PIONEER, PARANÁ-BRAZIL

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ABSTRACT

Introduction: The pandemic caused by COVID-19 affects millions of people in the worldwide and extensive testing makes it possible to intensify the physical isolation of infected people and to know the evolution of the virus transmission in the community. The objective of this research is to present the proportion of people with SARS-CoV-2 infection. **Methods:** A cross-sectional observational study was conducted in 14 municipalities in the pioneer north of Paraná, from June 11 to August 11, 2020. The sample consisted of 609 adult people. The independent variables were sociodemographic and epidemiological and the dependent variable was the presence of IgM and IgG antibodies against COVID-19. Data collection was performed through a questionnaire and analysis of capillary blood with a serological rapid test kit. **Results:** 527 volunteers came and took the test and 82 fouts or refusals. The average age of the participants was 36.9 years, 60.4% of the sample was composed of women and 39.6% by men. The presence of antibodies was detected in 45 participants, making up a percentage of 8.5% (95% CI 6.2%; 10.9%). **Conclusion:** there is still a significant portion of the population vulnerable to infection by the SARS-CoV-2 virus.

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INTRODUÇÃO

COVID-19 is caused by the SARS-CoV-2 virus, a new virus of the *Coronaviridae* family, identified on January 7, 2020, in China (WHO, 2020a), and declared as a worldwide pandemic on March 11 (Unasus, 2020). Nine days later, the Brazilian Ministry of Health reported, the state of community transmission of the coronavirus throughout the territory (COVID-19) (Brasil, 2020a). Worldwide, by August 11, 2020, more than 20 million people were confirmed for COVID-19 and more than 742 thousand deaths were attributed to disease (WHO, 2020b; John Hopkins University, 2020). In Brazil, 3,109,630 cases were confirmed up to the same period and 103,026 deaths were recorded (Brasil, 2020b).

In the State of Paraná, 94,882 confirmed cases and 2,414 deaths. In the pioneer north region of the state, were of 43 municipalities in the extent area of the 18th and 19th Health Regions, 2,970 cases and 88 deaths were confirmed (Secretaria de Estado da Saúde do Paraná, 2020). It stands out that there is a scenario of uncertainty in Brazil and in the world, about the total number of infected people, due to the low availability of tests to confirm the diagnosis. Data from USP's COVID-19 Observatory, in May this year, show that Brazil had performed 296 tests / 1 million inhabitants. In comparison, with the same denominator, Germany performed more than 20,000 tests, Italy 18,481, South Korea 10,426, United Kingdom 5,876 and Peru 3,318 (Observatório Covid-19 Brasil, 2020). Countries that performed a lot of testing for COVID-19, had a lower number of deaths from the

disease, highlighting the example of countries such as Iceland, Australia and Chile⁸. Some studies show (Lung et al., 2020; Dias et al. 2020), with aextensing testing can it possible to intensify isolation practices of infected people, notedly asymptomatic cases. A study carried out in Brazil (Hallal et al., 2020), estimated at the moment that the number of people infected by COVID-19, among the survey population, would be approximately seven times greater than the data confirmed by the epidemiological bulletin (Silveira et al., 2020). Thus, and with different methodologies, studies have shown that the total number of cases of COVID-19 infection in Brazil can be estimated at 15 (Observatório Covid-19 Brasil, 2020) or up to 20 times higher than the numbers presented in official bulletins (Forçatarefa de modelagem da Covid-19, 2020). In Paraná, a predicted is that the number of people infected by COVID-19 is 12 times greater than the amount notified by the health system (676 cases notified on 11/04/2020 versus 8,047 cases estimated by the mathematical model) (Observatório Covid-19 Brasil, 2020). Accordingly, knowing the evolution of the virus transmission in the community, becomes a necessary strategy to obtain information about the clinical course of the disease, once it is estimated that 60% of people infected with SARS-CoV-2 could be asymptomatic or oligosymptomatic (Nature, 2020). Provide information on the number of people infected in the field for surveillance and support health authorities, reformulation and implementation of actions recommended by WHO, Ministry of Health, State and Municipal Health Secretariats, all at the community level. So, this research has a goal to present the prevalence of serological for SARS-CoV-2 infection in the pioneer north region of Paraná- Brazil.

METHOD

The study was carried out in partnership between the State University of Northern Paraná (UENP), Federal Technological University of Paraná (UTFPR), 18th and 19th Health Regional and Municipal Health Secretariats of the North Pioneer Region of Paraná, with the support of FioCruz. Guided by the following question: What percentage of people who live in the pioneer north region, who had work activities, how many have antibodies present for COVID-19?

To answer the question, was conducted a cross-sectional study design, carried out in the coverage area of the 18th and 19th Health Regions of Paraná, which comprises a territory with 43 municipalities, with an estimated population of 511,603 people (DATASUS, 2020). Considering the eligible age group for this research, 18 to 59 years, there are 294,874 inhabitants in the region, which represents approximately 58% of the population. The selection of municipalities followed the population criterion (small municipalities II - greater than 20 thousand inhabitants) or the occurrence of confirmed cases for COVID-19. Of the 43 municipalities in the region, 14 were selected for serological survey. (Andirá, Bandeirantes, Barra do Jacaré, Cambará, Carlópolis, Cornélio Procópio, Leopoldina, Quatiguá, Ribeirão do Pinhal, Santa Mariana, Santana do Itararé, Santo Antônio da Platina, Sertaneja and Siqueira Campos). For established sample size, the population estimate was used for prevalence studies. The percentage of detection used as a reference was 10%, based on the positivity index of RT-PCR tests analyzed in the state of Paraná- Brazil and published in the epidemiological bulletin of 04/15/2020. The precision was 2.5%, with a 95% confidence level and an increase of 15% was considered for eventual sample losses and errors. So, the consolidated sample number was 650 individuals. The inclusion criteria were: an eligible age group (18 to 59 years); not having flu symptoms or any symptoms of COVID 19 in the last 72 hours of data collection; having remained in work activities considered essential under State Decree-Paraná 4317/2020; accept, by signing the Informed Consent Form, to participate in the study. Exclusion criteria: people have severe or decompensated heart disease; severe or decompensated lung diseases; immunodepressed; chronic kidney patients in advanced stages (3, 4 or 5); people with Diabetes mellitus and pregnant women. These criteria were proposed to preserve the guidelines of the Ministry of Health of social distancing, especially of the people who

make up the risk group. The data collection of the 527 participants was carried out between June 11, 2020 and August 11, 2020. Three strategies were adopted to guide the data collection:

- Recruitment and registration of volunteers: the recruitment of participants was in two steps, initially by volunteering and by random sampling. In each municipality, dissemination was made through the available mode of communication and posters fixed at public agencies with the telephone numbers available for sending the applications. The average divulgation and recruitment period was three to four days, via telephone calls. For each municipality, a list was drawn up with the volunteers registered in order of subscription.
- Selection of participants: by simple random sampling and researcher who was not aware of the volunteer list, with the support of the computational software R.
- Interview and serological analysis: performed by nurses, medical and nursing professionals at a technical level. The interview form was prepared for this research and reviewed by a group of health professionals, regarding its relevance.

The serological analysis of the first 26 participants was performed with the Nutriex® type kit. The other tests, that is, of the 501 participants, were performed with the TR DPP® Covid-19 IgM / IgG Bio-Manguinhos kit (Registration with ANVISA nº 80142170039). The procedure for performing the fast serological test was performed according to the manufacturer's instructions. The result was interpreted with the Micro Reader DPP® equipment. According to the manufacturer, this kit has a sensitivity of 79% for IgM and 95% for IgG and specificity of 98% for IgM and 97% for IgG (TR DPP® Covid-19 IgM / IgG, 2020). The report on the accuracy of diagnostic tests for COVID-19, prepared by the Department of Management and Incorporation of Technologies and Innovation in Health, of the Ministry of Health Study, pointed out that the TR DPP® Covid-19 IgM / IgG Bio-Manguinhos kit presents sensitivity of 88.9% and specificity of 100% (Brasil, 2020c). To emphasize that the interview and serological analysis was conducted in two ways: scheduled at a health facility provided by the Municipal Health Department or in an open place, with the participant remaining in the vehicle, based on the Drive Thru system. The collection strategy was defined according to the characteristics of the municipality and proposed by the Department of Health. Regardless of the format, all were guided by biosafety precepts (Brasil, 2020d). Then, the result was informed to the participant by the health professional who performed the collection. Participants received advice and guidance. Those who were positive for COVID-19 antibodies were referred for consultation at the municipal reference unit for COVID-19. The dependent variable of the study is the presence of the IgM and IgG antibody for SARS-CoV-2, which was measured from a biological sample (blood) by puncturing the participant's digital pulp and analyzed by the rapid test kit approved by ANVISA, this is prevalence of COVID-19. The independent variables are sociodemographic and epidemiological (Brasil, 2020e). They were collected by consulting a health professional in a private place. The data were registered into a Microsoft Excel spreadsheet. Qualitative variables were expressed as frequency and percentage, whereas quantitative variables were expressed in terms of mean and standard deviation. The project was approved by the Human Research Ethics Committee (No. 4.029.737 on May 15, 2020)

RESULTS

The survey was conducted in 14 municipalities out of 43 in the region. Data collection by 60 days, were 1,356 people enrolled as volunteers for the study, of which 609 were randomly selected. Of the total sample, 527 volunteers came and took the test, 80 missed and 2 attended but chose not to take the test. The percentage of participation in the study was 86.5%. The average age of the participants was 36.9 years (standard deviation of 9.5 years), 60.4% of the sample was composed of women and 39.6% by men, 66.6% declared themselves white, 18, 2% brown, 6.3% black, 0.2% indigenous, 0.8% others and

Table 1. Sociodemographic characteristics of the participants and quantify of the presence of antibodies to COVID-19 in the variables. Paraná-Brazil. 2020

Characteristics	Presence of antibodies		PrevalenceRatio	CI 95%
	Presence n (%)	Absence n (%)		
Age group ^a				
18 to 30 years	7 (4.7)	143 (95.3)	Ref.	Ref.
31 to 45 years	21 (7.7)	253 (92.3)	1.64	0.71 a 3.77
46 to 59 years	17 (16.5)	86 (83.5)	3.54	1.52 a 8.22
Sex ^b				
Female	23 (7.4)	288 (92.6)	Ref.	Ref.
Male	20 (9.8)	184 (90.2)	1.33	0.75 a 2.35
Raça/Etnia				
White	29 (8.2)	323 (91.8)	Ref.	Ref.
Black / Brown	14 (10.9)	115 (89.1)	1.32	0.72 a 2.41
Others	0 (0)	5 (100.0)	IS	IS
Place of residence ^c				
Urban	40 (8.7)	419 (91.3)	Ref.	Ref.
Rural	3 (10.7)	25 (89.3)	1.23	0.40 a 3.73
Healthcare professional				
No	30 (9.0)	305 (91.0)	Ref.	Ref.
Yes	15 (11.4)	117 (88.6)	1.27	0.71 a 2.28

Legend: n = frequency. % = percent. ^a 41 individuals who do not declare age. ^b 12 individuals who do not declare their sex. ^c 40 individuals do not declare place of residence. IS= Insufficient information to do calculations.

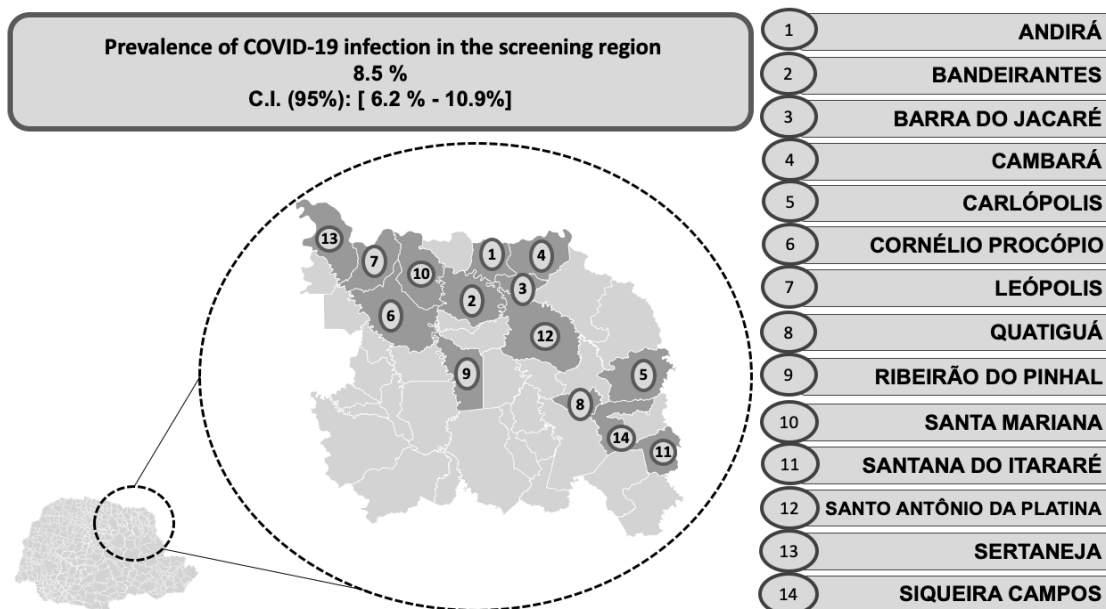


Figure 1. shows the percentage of the sample that resulted in a serological reagent for antibody detection

8% did not report. 87.1% live in the urban area, 5.3% in the rural area and 7.6% did not report their home environment. The average number of people living in the same household as 3 people, including the participant. Participants reported having no history of travel abroad in the last 14 days from the date of participation in the survey and 44% reported traveling to another location. 1/3 of the participants reported that they had contact with a suspected person or that they had confirmation for COVID-19. Table 1 presents a brief characterization of the participants. According to Figure 1, the prevalence of adult people with antibodies to COVID-19, in the region, from June 11 to August 11, 2020, was 8.5% (95% CI 6.2 to 10.9). Based on these sample values, the population forecast is that 25,064 adults (18 to 59 years old) from the pioneer north region of Paraná- Brazil have antibodies against COVID-19, with a 95% confidence interval that this estimate may be between 18,282 to 32,141 people.

DISCUSSION

All participants with positive results in the screening test (reagents) were referred to the municipality's health service, thus ensuring continuity of health care. From the sociodemographic variables studied, it was observed that an age group from 46 to 59 years old

expresses a higher prevalence of serology for COVID-19 in relation to the age group of young people (18 to 30 years old), with statistical evidence (CI (95 %): 1.52 to 8.22) and possible increase in prevalence according to age. This is worrying, since the severity of clinical manifestations is proportional to age (Batista et al., 2020). The laboratory criteria for researching suspected cases is based on the Reverse Transcription examination followed by Polymerase Chain Reaction (RT-PCR) in real time, which identifies the genetic material of the virus, being the test of choice for the acute phase of the disease, between the 3rd and 7th day after the onset of symptoms or infection. Serological tests for the determination of immunoglobulin M (IgM) and immunoglobulin G (IgG), are screening tests and diagnostic assistance and their authorization for use at the national level by the National Health Surveillance Agency (ANVISA). The sensitivity of the RT-PCR and serology tests correlates the inverse with the evolution of the infection. RT-PCR presents greater sensitivity in the acute phase and serology from the 15th day on, which highlights their complementary character (Zhao et al., 2020). Compared to RT-PCR, serological tests are faster, cheaper, easier to use and accessible to professionals without training in laboratory practices (Xiang et al., 2020). During the immune response against a pathogen, IgM is before IgG (Xiang et al., 2020). However, two other seroconversion patterns were also observed, one with the simultaneous production of IgM and

IgG and the other with production of IgM after IgG. The titers of patients in clinical patients who were more severe clinicians were higher than those in those with moderate symptoms or levels (Long et al., 2020). A study conducted in patients with COVID-19, admitted to Union Hospital, Tongji Medical College found that IgM seroconversion increased rapidly from the 9th day and IgG from the 11th day (Xiang et al., 2020). Its in turn, a survey of 285 patients with COVID-19 admitted to three hospitals in the city of Chongqing, China, found that the median time for seroconversion, for both IgM and IgG, was 13 days, with the titration plateau observed on the 19th after the onset of symptoms (Long et al., 2020). Comparing the estimate of adult people in the region with probable exposure to the virus and the number of confirmed cases for COVID-19 in the SESA-PR bulletin on August 11, it is estimated that the actual number of people exposed to the virus in the region is approximately 8 times higher than the number indicated in the epidemiological bulletin, and could be range from 7 to 10 times. It stands out that the projection of the research is for the population aged 18 to 60 years and the epidemiological bulletin informs the total number of confirmed cases covering the entire age group. For this reason, it is forecast that this difference may be greater. In Brazil, a study conducted in Rio Grande do Sul, aimed to estimate the percentage of the population in this state that presents antibodies for SARS-CoV-2 (Hallal et al., 2020). In the first three phases of the study, carried out from 11 to 13 March, 25 to 27 March and 9 to 11 May, a percentage of seroprevalence was detected in the population of 0.048%, 0.135% and 0.222%, respectively, with an increasing trend of the presence of the antibody (Silveira et al., 2020).

The Hospital das Clínicas of the Ribeirão Preto Medical School (USP) and the Municipal Health Secretariat of Ribeirão Preto-SP, with support from the Butantã Institute, carried out a large epidemiological survey in the population of Ribeirão Preto-SP to estimate the percentage of the population who had infection with the SARS-CoV-2 virus. The researchers performed virological and serological tests. The tests were carried out between May 1 and 3, 2020, in a sample of 709 people, and found that 1.21% (95% CI 0.43; 2.00) of the population had already been infected by the virus. The study points out that no sample was positive for both tests, serological and virological (Passos et al., 2020). A study carried out in Baixada Santista by the State Government of São Paulo, UNIFESP and other institutions, called EPICOBs (Epidemiologia da Covid-19 na Região Metropolitana da Baixada Santista) performed 2,442 serological tests during the period from April 29 to June 20, and identified 160 participants with reactive results. The results of antibody detection in the sample was 6.6% (Epicobs, 2020). Still, in the state of São Paulo-Brazil, a study entitled Soroepi-MSP, carried out in the municipality of São Paulo, on July 20 and 29, evaluated 1470 volunteers and showed that 17.9% already had antibodies for COVID-19. The study also highlighted that, when using 2 kits to perform serological tests, the percentage of detection of antibodies increased by 56% (Soroepi-mSP, 2020). According to the Committee to Combat COVID-19 in Foz do Iguaçu, a serological survey carried out on 2279 participants living in this city, points out that 27.83% had antibodies for COVID-19 (Comitê de Combate à Covid-19 de Foz do Iguaçu, 2020). The seroprevalence of antibodies to COVID-19 in residents of cities in Germany and Switzerland, between March and April, was 14% (70/500) and 4.06% (35/760), respectively. In the United States of America, in April, in the cities of Chelsea, San Miguel County, Santa Clara County and Los Angeles County, the percentage identified was 31.5% (63/200), 2.01% (96/4757), 1.66% (43/2583) and 4.05% (35/863), respectively (Levesque and Maybury, 2020). The representativeness of the seroprevalence rate of the studies depends on the sample selection, the accuracy of the screening tests (Dias et al., 2020; Levesque and Maybury, 2020) and the variation in the intensity of the pandemic at different times between communities. It is worth reiterating that serological surveys based on cross-sectional studies are a picture of the momentary situation and that the pandemic is not stabilized and may have its epidemiological profile modified over time.

CONCLUSION

The research concludes that the proportion of the adult population in the pioneer north region of Paraná-Brazil that had antibodies to COVID-19 from June 11 to August 11, 2020, was 8.5%. This paper has as contribution to public health services, the presentation of the prevalence of the adult population in work activities, resident in the pioneer north of Paraná, with the presence of antibodies. This information is relevant for assessing strategies for confront with the pandemic. There is still a large part of the population vulnerable to infection by the SARS-CoV-2 virus, which causes COVID-19. For this reason, the importance of maintaining protective measures is emphasized, as well as coherent, accurate and reliable information, so that people make correct decisions and adopt positive, supportive and effective behaviors for their personal protection and that of their community.

Conflict of Interest: There are no conflicts of interest between the authors of this research.

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