ORIGINAL ARTICLE

The influence of social isolation on the incidence of positivity in COVID-19 tests in a metropolitan region of São Paulo, Brazil

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Abstract

Introduction: With the arrival of the SARS-CoV-2 (Coronavirus 2 of severe acute respiratory syndrome) pandemic in Brazil, especially in the city of São Paulo, there was a need to apply social isolation policies associated with testing, covering all municipalities. The Clinical Analysis Laboratory of Centro Universitário FMABC was one of the first laboratories to receive certification and qualification to perform RT-PCR (reverse transcriptase reaction followed by polymerase chain reaction) tests in the metropolitan region of São Paulo.

Objective: Aim to analyze the influence of adopting social isolation on the incidence of positivity in COVID-19 tests in the metropolitan region of São Paulo, Brazil.

Methods: a descriptive study carried out from March to May 2020, epidemiological data were collected from each unit served and organized by the data controllership team of the Clinical Analysis Laboratory of FMABC. Epidemiological, demographic, and laboratory data were extracted from the Matrix® outpatient data management system. Clinically suspected cases and confirmed by laboratory tests (RT-PCR and serological tests) were entered. The tests were divided into serological tests using the RT-PCR molecular test, on samples of nasopharyngeal mucosal scrapings collected with sterile Swab.

Results: It were evaluated PCR test and antibody presence (IgA, IgM and IgG) in blood samples of 16.297 patients. 22.718 tests were performed for the diagnosis of COVID-19, both RT-PCR (10.410 tests) and serological tests to detect anti-SARS-CoV-2 antibodies, IgA, IgM and IgG, a total of 16.297 patients were assessed, 63% women and 37% men. It was observed that the social isolation policies adopted during this period contained the massive expansion of contamination, at least while the social isolation rates were above 55%.

Conclusion: The data of this study demonstrated the effectiveness of social isolation in containing the positive contamination of SARS-CoV-2 in the metropolitan region of São Paulo, at least for the first three months.

Keywords: coronavirus disease 2019, social isolation, Brazil.

Authors summary

Why was this study done?
The present study was carried out to elucidate the influence of social distancing on the incidence of positivity in tests to detect COVID-19 in the metropolitan region of São Paulo.

What did the researchers do and find?
Official data on adherence to social isolation in the first three months of the COVID-19 pandemic in cities in the Metropolitan Region of São Paulo were collected. The data were compared with the positivity indices for detecting this disease, and showed that, while the adherence to social isolation remained above 55% of the population studied, the positivity indices for the COVID-19 tests were contained.

What do these findings mean?
The data of the present study show the effectiveness of social isolation in containing the positivity of COVID-19 tests in the studied region. This endorses the importance of this non-pharmacological measure for inhibiting the spread of the disease.

Highlights
• Social isolation was effective in retaining the positivity of SARS-CoV-2 contamination, showing the impact of the restrictive measures adopted in the State of São Paulo on the positivity of SARS-CoV-2.
• The only study in Brazil that proves the importance of social isolation in reducing the positivity of COVID-19.
• Measures of social restriction contained the massive dissemination of COVID-19.

◼ INTRODUCTION

In late November 2019, a new disease caused by coronavirus-2 (SARS-CoV-2) appeared in Wuhan, China. Infection with this new coronavirus results COVID-19, an acute respiratory syndrome with approximately 4% lethality[1,2]. On March 11th 2020, the World Health Organization (WHO) raised the status of SARS-CoV-2 contamination to pandemic, due to its geographical spread to most continents[3].

Brazil adopted the social distancing as one of the sanitary measures to pandemic control. This social distance is one of the preventive measures to control the extensive dissemination of COVID-19. Thus, these measures of social distancing, as a non-pharmacological intervention to combat COVID-19, are widely used around the world and promote better performance in flattening the COVID-19 pandemic curve. The intervention non-pharmacological to combat COVID-19 are widely used around the world and promote better performance in flattening the COVID-19 pandemic curve of social distancing is effective as a public health measure with individual, environmental and community reach, promoting the isolation of cases, reduced contact between individuals and a reduction in the number of deaths related to COVID-19[4].

In February 2020, the first case of contamination by SARS COV-19 emerged in Brazil, in the city of São Paulo[5]. This patient number 0 was a 61-year-old man who had just returned from the region of Lombardy in Italy a few days before. From this moment on, new cases emerged and the need for restrictive measures became imminent. On March 17th, the first fatal victim of COVID-19 happened in São Paulo; the patient was a 62-year-old man with type 2 diabetes mellitus, hypertension and prostatic hyperplasia[6].

Considering the imminent increase in the number of new cases in Brazil and the possibility of high lethality, the first social isolation policies were introduced in the country. Conceptually, social isolation is the measure applied for the separation of social contact from people considered as 'suspect' cases, or the restriction of social contact of people infected with COVID-19 with uninfected people. Quarantine, in turn, represents the restriction of movement of people who were exposed to a potentially contagious disease[6,7]. At the start of quarantine in Brazil, the population was instructed to remain at home and to have as little contact as possible with people outside their daily interactions, in order to reduce the spread of the virus[8]. On March 16th, an official quarantine status was declared in Brazil. In the state of São Paulo, on that same day, classes and public service activities were suspended. Only services considered essential were kept in operation, such as: supermarkets, pharmacies, food distributors, basic health units and hospitals[6].

At the same time, the increase in testing to facilitate life-sustaining measures had become crucial[9]. In this sense, the Clinical Analysis Laboratory of the Centro Universitário FMABC initiated the validation processes of molecular tests for the detection of SARS-CoV-2 by RT-PCR, the gold standard in the diagnosis of COVID-19, and expanded investments to carry out serological testing for antibody detection. In this way, it could meet a great demand for tests.

São Paulo is the largest city in Brazil, with a territorial area of $1,521.110 km^2$, an estimated population of 12,252.023 people, with a demographic density of $7,398.260$ inhabitants/km^2. The Metropolitan Region of São Paulo comprises 39 cities in total. In this region, the Clinical Analysis Laboratory of the Centro Universitário FMABC/ABC Medical School was one of the first places to receive certification and authorization from the Adolfo Lutz Institute to diagnose COVID-19. This laboratory meets the demand for tests in 13 municipalities in the Metropolitan Region of São Paulo and on the coast of São Paulo. These municipalities have a population of approximately 3,190.000 inhabitants. The importance of studying this region is due to the fact that this is the largest metropolitan region in Brazil and the tenth, in this profile, most populous in the world. It comprises the largest economic hub in Brazil and is closely interdependent in relation to circulation and transport, so we hypothesized that social isolation would influence the increase in COVID-19 positive tests[10].

Considering the importance of social isolation and testing in the possible control of the dissemination of COVID-19. This study aimed to analyze the influence of adopting social isolation on the incidence of positivity in COVID-19 tests in the metropolitan region of São Paulo, Brazil.

METHODS

The diagnostic service performed by the Clinical Analysis Laboratory of the Centro Universitário FMABC met, during the first three months of the SARS-CoV-2 epidemic, the demand of 12 municipalities, these being: São Paulo (capital city), Francisco Morato, Franco da Rocha, Guarujá, Mairiporã, Caieiras, Mauá, Ribeirão Pires, Santo André, São Bernardo do Campo, São Caetano do Sul and Taboão da Serra. Laboratory tests were carried out through collections carried out in the Emergency Care Units (UPAs), Basic Health Units (UBSs), in the Municipal Hospitals of each municipality and University Hospitals, this is a reference laboratory for testing COVID-19 and referenced by the Brazilian Unified Health System.

This was a descriptive study carried out from March 7th, 2020 to May 31st, 2020; epidemiological data were collected from each serviced unit and organized by the data control team of the Clinical Analysis Laboratory at FMABC. The data obtained from each municipality were entered into spreadsheets for further analysis. Thus, it was possible to separate the patients seen at these health units according to the location of collection, age, gender and performed test. Subsequently, we verified the type of test used to detect COVID-19 performed in these regions. This study was approved by the Ethics Committee of Centro Universitário FMABC (process: 4.131.404). We ensure that this study has been carried out in accordance with Declaration of Helsinki.

Epidemiological, demographic and laboratory data were extracted from the Matrix® outpatient data management system. Clinically suspect cases were inserted and confirmed by laboratory tests (RT-PCR and serological tests). We divided the tests performed into serological tests, in which the presence of IgA, IgM or IgG antibodies in the patient's serum can be detected, and the RT-PCR molecular test, which identifies the presence of the SARS-CoV-2 RNA in samples of nasal and oropharyngeal mucosa secretion collected with sterile swab.

Additionally, maps of the city of São Paulo were generated using the Power BI® software with satellite information provided by Bing®, and divided by municipality. We used this data to design spatial databases, and thus, infer the incidence of positive tests for COVID-19 by municipality. To obtain the maps, we linked the databases via a spatial union operation.

Statistical Analysis

A descriptive analysis was performed and the qualitative variables were expressed as absolute and relative frequency. Quantitative variables were expressed as mean±standard deviation from the mean or median, maximum and minimum values. To analyze the quantitative data, we used the GraphPad Prism® 6.0 software and performed an ANOVA of repeated measures and Greenhouse-Geisser curve. Values were considered statistically significant when $p < 0.05$.

RESULTS

Between March 7th, 2020 and May 31st, 2020, a total of 22.718 tests were performed to detect the presence of the SARS-COV-2 virus or for the detection of COVID-19 antibodies in the metropolitan region of São Paulo. A total of 16.297 patients were assessed and the difference between the number of patients and the total number of tests was due to some patients having performed tests on different days or hospitals within this period (table 1). Of the total number of patients assessed, 10.327 (63%) were female and 5.970 (37%) were male (table 2). Among the patients contaminated with COVID-19 in this period, 8.246 were cured, which corresponds to 36%.

Table 1: Total participants assessed and age group (years)

Age group (years)	Quantity
0-5	414
6-20	476
21-40	7.585
41-60	5.635
61 or more	2.187
Total	16.297

Data expressed in absolute values.

Table 2: Total participants by gender and age group

Female	Quantity
Age group (years)	
0-5	211
6-20	287
21-40	5.161
41-60	3.564
61 or more	1.104
Total	10.327
%	63
Male	
0-5	203
6-20	189
21-40	2.424
41-60	2.071
61 or more	1.083
Total	5.970
%	37

Data expressed in absolute values and relative (%).

Were performed a total of 10,410 RT-PCR tests, 3,027 total antibody serologic tests, 9,281 IGM tests and 8,246 IGG tests. The average time in days to perform the RT-PCR tests was 1.5 days (table 3).

Table 3: Types of tests performed during the period

Month	RT-PCR	IgM/IgG
March	387	205
April	3.390	3.666
May	6.633	8.437
Total	10.410	12.308

Data expressed in absolute values.

As for the number of cases accumulated per week, it was identified that from the fifth week onwards, the exponential increase in the curve of accumulated cases in general and in the curve of accumulated weekly growth began (figure 1). At the same time, the growth rate and the weekly accumulation of new cases seen at the ABC Medical School's diagnostic service were compared with the official indexes of social isolation in the metropolitan region of São Paulo.
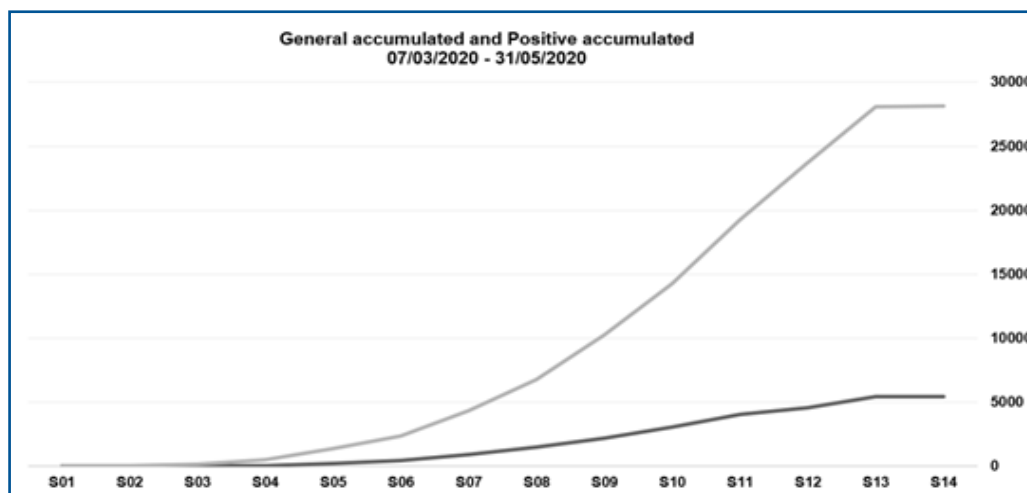

Figure 1: Representative curve of general accumulated cases (light gray line) and positive accumulated cases (dark gray line) in the period from March 7th, 2020 to May 31st, 2020. S= studied weeks

To assess the effect of social isolation in these regions, official data provided by the State Government were evaluated[11]. It was identified that from the first week of quarantine there was better population adherence to these measures. In the first official week of quarantine in the Metropolitan Region there was an adherence of approximately 38%, followed by increasing adherence in the second week (55%), reaching the peak of social isolation in the third week (58%). In the following three weeks, maintenance of these levels was observed, remaining on average at 56%. From the tenth week on, the levels remained below 50%, until reaching 48% in the thirteenth week, the last week of the analyzes in this study (figure 2).

Among the municipalities served by the diagnostic system, it was found that most tests were performed on samples from São Bernardo do Campo, followed by Santo André and São Caetano do Sul. Number of exams during the evaluated period. These results were shown on the map by means of blue circles that identify the municipalities served, and the difference in the size of the circles differentiates the volume of exams per municipality. The number of exams performed in this period was not determined by the total population of the municipalities themselves, but rather by the exams requested by each municipality at that time (figure 3).
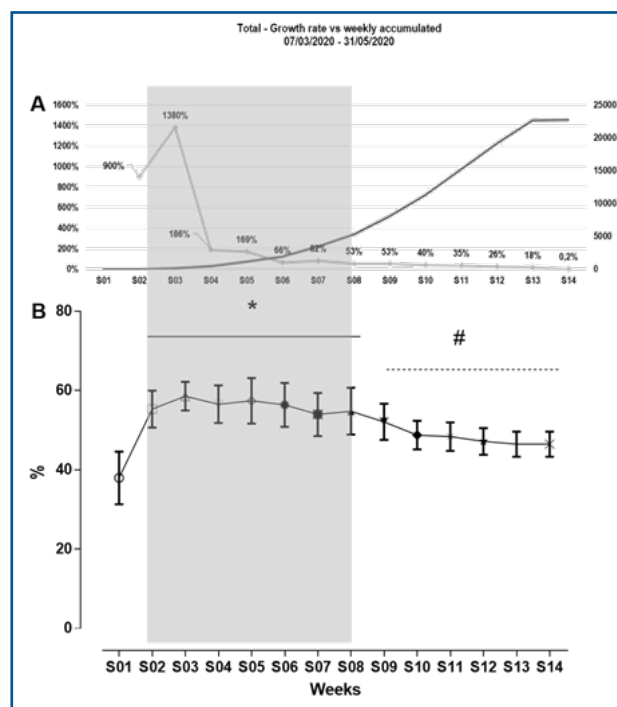

Figure 2: Representative figure of the total accumulated growth rate (dark gray line) versus weekly accumulated cases (light gray) (A). And the percentages of social isolation per week between March and May 2020 in the metropolitan region of São Paulo during the SARS-COV-2 pandemic (B). Values expressed as percentages. One Way ANOVA test (multiple comparisons) with Greenhouse-Geisser correction. *$p < 0.05$ S1 vs. S2, S3, S4, S5. #$p < 0.05$ S5 vs. S9, S10, S11, S12, S13, S14. S=weeks

Figure 3: Representative image of the number of tests performed in the metropolitan region of São Paulo in the studied period (3/7/2020 5/31/2020) and the prevalence by sex in this period (A). Geolocation map of cities tested by the Clinical Analysis Laboratory of Centro Universitário FMABC (B). Blue circles identify the serviced cities and the difference in the size of the colored circles differentiates the volume of tests by municipality. Power BI® software

DISCUSSION

This study demonstrated the influence of social isolation on the positivity of the COVID-19 tests in this population. By observing the growth rate curve, parallel to the social isolation curve, it was noted that the growth rate was contained when the population's adherence to social isolation policies increased. While social isolation was above 55%, the growth curve remained stable. Calculations of mobile regression performed by other researchers proved that the restriction to human mobility is effective in promoting the decline in the acceleration of the growth rate from the first week onward, and that from the sixth week of restriction the rates remain stationary, if isolation is maintained[12,13], this study corroborate these findings.

Studies of geographic distribution are commonly used in epidemiological studies and represents an important visual tool to understand the density of a disease, or, in the case of this study, the demographic location of the highest concentration of tests requested in each city[14]. The use of these supplementary indicators to monitoring the spread of the disease is crucial for decision-making regarding the protocols to be followed, besides collaborating to appropriate management of patients in the hospitals and health units[13,15,16].

As for the observed testing, more serological tests (verifying the presence of anti-SARS-CoV-2 antibodies) than molecular tests (RT-PCR) were carried out in the first three months of the pandemic in the Metropolitan Region of São Paulo. It was emphasized that these tests were performed only at the Clinical Analysis Laboratory of the Centro Universitário FMABC, which comprises only one of the diagnostic systems qualified to perform the tests for the detection of COVID-19 in São Paulo. Official data from the government of the state of São Paulo showed that 26 thousand people were tested in March, 108 thousand in April and 361 thousand in May[17]. Thus, we verified that the diagnostic service of this laboratory was responsible for approximately 5% of the total tests carried out in the entire state of São Paulo. We found an average detection of COVID-19 of approximately 25% against 74% of negative tests for this disease. Mass testing is another fundamental tool for controlling the dissemination of COVID-19, and it needs to be expanded in Brazil.

Since the confirmation of the first case of SARS-CoV-2 contamination in Brazil, in the State of São Paulo in February of 2020, the first policies for the containment of the disease were initiated and, concomitantly, measures for social isolation, hand hygiene and wearing masks were stablished. However, a study that evaluated the profile of the people assessed in this area and the impact of social isolation on the positivity of COVID-19 had not been carried out in the Metropolitan region of São Paulo[18,19].

This study observed a higher prevalence of women, with a higher incidence in the age group from 21 to 60 years. The average age was 42 years for women and 45 years for men. The average age was similar to the averages observed in India[20] and Peru[21] and lower than the averages observed in China[22], Europe[23], Argentina[24] and Australia[25]. The age averages are compatible with the age of the economically active population of the assessed municipalities. The population of the Metropolitan Region of São Paulo is composed of young people, mostly, who transit daily between the municipalities using public transportation, due to the conurbation between municipalities. This is an area with a high concentration of companies and jobs, and most people use public transportation to transit, a fact that facilitates the transmission of infectious diseases, such as SARS-CoV-2[10,18]. The difference between the number of men and women is due to the fact that women have a culture of seeking more health services compared to men and several health professionals were tested, which also has a predominance of the female gender[20,26-27].

This study had as a limitation the impossibility of testing all municipalities in the Metropolitan Region of São Paulo. However, the association of social isolation with testing for COVID-19 in the region was demonstrated.

This study is the only one that shows the impact of the restrictive measures adopted in the State of São Paulo on the positivity of SARS-CoV-2 in the Metropolitan Region of the State. This study suggests that social isolation in a large city, such as the assessed region, is a highly effective protection measure against contamination, if followed properly, and associated with social distancing, it is also suggested that testing be expanded in these regions.

CONCLUSION

The data showed that social isolation reflected directly on the positivity of the SARS-CoV-2 tests in the Metropolitan region of São Paulo, in the municipalities covered by the testing service of the Centro Universitário FMABC. We infer that social restriction measures contained the massive spread of COVID-19. Testing in the studied municipalities favored the understanding of the profile of individuals infected in the region in the first three months of the SARS-CoV-2 pandemic.

Author contributions statements

AJN, GLV, JCSP, CGBOR, AVLS: Formal analysis, data curation, writting the main manuscript, preparation of the figures, review and editting. AJN, GLV, CGBOR, MCP, KCG, LIZ, MAS, GRS, AVLS and FLAF: Data collect. VLL, JRSR, BCAA, GLV: Data curation, writting, review and editting. AJN, GLV JCSP, FLAF: data curation, formal analysis, preparation of the figures, review and editting. All authors reviewed the manuscript.

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Data Availability Statement

The data will be available under reasonable request to e-mail glaucia.veiga@fmabc.br (Glaucia Luciano da Veiga, co-author).

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Resumo

Introdução: com a chegada da pandemia de SARS-CoV-2 (Coronavirus 2 da síndrome respiratória aguda grave) ao Brasil, especialmente na cidade de São Paulo, houve a necessidade de aplicar medidas de distanciamento social associado a testagem, que abrangesse todos os municípios. A região metropolitana de São Paulo compreende 39 municípios e possui uma rede de laboratórios habilitados a realizar a testagem para a detecção do coronavírus, tanto testes sorológicos quanto moleculares. O Laboratório de Análises Clínicas do Centro Universitário ABC/FMABC foi um dos primeiros laboratórios a receber a certificação e habilitação para realizar os testes RT-PCR (reação da transcriptase reversa seguida pela reação em cadeia da polimerase) na região metropolitana de São Paulo.

Objetivo: analisar a influência da adoção do isolamento social na incidência de positividade nos testes de COVID-19 em região metropolitana de São Paulo, Brasil.

Método: estudo descritivo realizado no período de março a maio de 2020, os dados epidemiológicos foram coletados de cada unidade atendida e organizada pela equipe de controladoria de dados do Laboratório de Análises Clínicas da FMABC. Os dados epidemiológicos, demográficos e laboratoriais foram extraídos do sistema Matrix® de gerenciamento de dados ambulatoriais. Foram inseridos os casos clinicamente suspeitos e confirmados por testes de laboratório (RT-PCR e testes sorológicos). Os testes foram divididos em testes sorológicos no teste molecular RT-PCR, em amostras de raspado de mucosa nasofaríngea coletada com Swab estéril.

Resultados: foram avaliados o teste de RT-PCR e a presença de anticorpos (IgA, IgM e IgG) em amostras de sangue de 16.297 pacientes. Foram realizados 22.718 testes para o diagnóstico de COVID-19, tanto RT-PCR (10.410 testes), quanto testes sorológicos para detecção de anticorpos anti-SARS-CoV-2, IgA, IgM e IgG, um total de 16.297 pacientes foram avaliados, 63% mulheres e 37% homens. Observou-se que as políticas de isolamento social adotadas nesse período continham a expansão massiva da contaminação, pelo menos enquanto as taxas de isolamento social eram superiores a 55%.

Conclusão: nossos dados demonstraram a efetividade do isolamento social na retenção da positividade da contaminação do SARS-CoV-2 nas cidades contempladas pelo serviço de testagem do Centro Universitário Saúde ABC, pelo menos nos três primeiros meses.

Palavras-chave: doença do coronavírus 2019, isolamento social, Brasil.