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ORIGINAL ARTICLE

Circulation pattern of influenza A/B virus and Respiratory Syncytial Virus (RSV) in Fortaleza, Ceará, after the SARS-CoV-2 pandemic

Padrão de circulação dos vírus influenza A/B e Vírus Sincicial Respiratório (VSR) em Fortaleza, Ceará, após a pandemia de SARS-CoV-2

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KEYWORDS

Epidemiologic Factors
Respiratory Tract Infections
Human Influenza
SARS-CoV-2
Respiratory Sincytial Human Virus

ABSTRACT

Objective: To investigate the circulation patterns of respiratory viruses from January 2023 to May 2024 and to describe their epidemiological characteristics in the city of Fortaleza based on data obtained by molecular tests based on real-time PCR (qPCR).
Method: This retrospective epidemiological study was conducted to investigate patterns of infection by influenza A/B virus, Respiratory Syncytial Virus (RSV), and SARS-CoV-2, and the prevalence and incidence of these respiratory viruses in the city of Fortaleza from January 2023 to May 2024.
Result: There was a significant difference in the distribution of total positive cases and the demand for molecular tests between the periods analyzed ($p<0.05$). A significant difference was also observed between the total number of infections caused by SARS-CoV-2 and infections caused by Influenza ($p=0.0041$) and RSV ($p=0.0012$) in the same period. No significant differences were observed between influenza and RSV during the study period. The monthly infection rates revealed a seasonal trend in the incidence of infections caused by influenza and RSV.
Conclusion: The proportion of SARS-CoV-2 detection in relation to the number of positive results showed a considerable decline in the first half of 2024, with an increase in the number of infections caused by influenza virus and RSV. In this way, we evidenced a change in the pattern of viral circulation of the three respiratory viruses, revealing the reestablishment of the seasonality and incidence of influenza A/B virus and RSV for the first time after the COVID-19 pandemic.

PALAVRAS-CHAVE

Fatores Epidemiológicos
Infecções Respiratórias
Influenza Humana
SARS-CoV-2
Vírus Sincicial Respiratório Humano

RESUMO

Objetivo: Investigar os padrões de circulação para vírus respiratórios no período de janeiro de 2023 a maio de 2024 e descrever suas características epidemiológicas na cidade de Fortaleza, a partir de dados obtidos por testes moleculares baseados em PCR em tempo real (qPCR).

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Método: Foi realizado um estudo epidemiológico retrospectivo para investigar padrões de infecções por influenza A/B, Vírus Sincicial Respiratório (VSR) e SARS-CoV-2, a prevalência e incidência desses vírus respiratórios na cidade Fortaleza de janeiro de 2023 a maio de 2024.
Resultado: Houve diferença significativa na distribuição de casos positivos totais e na demanda por exames moleculares entre os períodos analisados ($p < 0,05$). Também foi observada diferença significativa entre o total de infecções causadas por SARS-CoV-2 e as infecções causadas por Influenza ($p = 0,0041$) e VSR ($p = 0,0012$) em um mesmo período. Não foram verificadas diferenças estatísticas entre as infecções causadas por influenza e RSV nos períodos analisados. As taxas de infecções mensais revelaram uma tendência sazonal na incidência de infecções provocadas por influenza e VSR.
Conclusão: A proporção na detecção de SARS-CoV-2 em relação ao número resultados positivos apresentou considerável declínio no primeiro semestre de 2024, com aumento de detecções de Influenza A/B e VSR. Dessa forma, evidenciamos uma mudança no padrão de circulação de vírus respiratórios, revelando o restabelecimento do padrão de prevalência e sazonalidade dos vírus influenza A/B e VSR na cidade Fortaleza após a pandemia de COVID-19.

INTRODUCTION

The COVID-19 pandemic, caused by SARS-CoV-2, has caused several changes in multiple spheres of society, impacting everything from individual behavior to the dynamics observed in the circulation of other seasonal respiratory viruses[1]. Many studies have frequently reported notable changes in the circulation patterns of influenza A/B viruses and Respiratory Syncytial Virus (RSV), especially during the pandemic period[2-4].

Influenza A and B viruses commonly cause infections in the upper and lower respiratory tracts, and both are responsible for seasonal outbreaks of influenza worldwide. Due to the high mutation rates of these viruses, annual vaccine formulations are required to effectively protect the population[5]. Respiratory syncytial virus (RSV) is also responsible for seasonal respiratory infections, particularly in children[6]. RSV can cause everything from a common cold to more serious complications, such as bronchiolitis and pneumonia, especially in infants, children, the elderly, and immunosuppressed individuals[6,7].

The high prevalence of SARS-CoV-2 throughout the months of the pandemic resulted in a different epidemiological pattern during this period, characterized by low rates of disease caused by influenza A/B and RSV viruses[4]. With the end of the health emergency, it is believed that SARS-CoV-2 will continue to cause disease seasonally, and this hypothesis may indicate the permanence of a new pattern in the circulation of respiratory viruses post-pandemic[8,9].

The main objective of this study was to investigate the epidemiological aspects of viral infections caused by Influenza A/B, RSV, and SARS-CoV-2 viruses in fortaleza, a capital city in northeast Brazil, aiming to characterize the local epidemiology of these viral agents post-pandemic and highlight possible changes in seasonal patterns of respiratory infections.

METHODS

Population and study design

A retrospective epidemiological study was conducted to investigate the patterns of influenza, respiratory syncytial virus, and SARS-CoV-2 infections, as well as the prevalence and incidence of these respiratory viruses in the city of Fortaleza from January 2023 to May 2024. The study population comprised 1,780 individuals of both sexes and different age groups. All data were collected by a private laboratory in Fortaleza, Ceará. The data obtained were the results of molecular detection and demographic information (gender and age).

For this study, the results of tests performed on two different molecular diagnostic platforms based on reverse transcription followed by real-time polymerase chain reaction (RT-qPCR) were selected for the detection of Influenza A/B, Respiratory Syncytial Virus (RSV), and SARS-CoV-2. Tests performed on the GeneXpert® (Cepheid) equipment, capable of detecting SARS-CoV-2, were named with the acronym EXCOV as the laboratory's internal code, while those performed on the QuantStudio™ 5 (Applied Biosystems®) equipment, capable of simultaneously detecting SARS-CoV-2, RSV, and influenza A/B viruses, were identified by the acronym RESP3.

Therefore, to characterize the population sample, participants were initially divided into two groups according to the type of diagnostic test performed, regardless of the result observed: the EXCOV group and RESP3 group. Subsequently, to evaluate only detectable results, individuals with positive results were divided into three groups: SARS-CoV-2, Influenza A/B, and RSV.

Molecular analyses

Molecular analyses were performed using swabs of respiratory samples collected from the nasopharynx and oropharynx of the participants. All swabs were stored in 0.9% saline solution. For the EXCOV tests, approximately 1 mL of the sample was transferred to the Xpert® Xpress CoV-2 plus cartridges (Cepheid). The GeneXpert platform (Cepheid) was then used for molecular diagnosis. For RESP3 tests, an RNA extraction step was required using the commercial MagMAX™ Viral/Pathogen Nucleic Acid Isolation Kit (Applied Biosystems™). Subsequently, the TaqPath™COVID-19, Flu A/B, and RSV Combo Kit (Applied Biosystems™) was used to confirm the presence of SARS-CoV-2, INFLUENZA A/B, and RSV in the tested samples. The RESP3 results were validated using pathogen interpretation software (Applied Biosystems™), according to the manufacturer's instructions.

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Statistical analysis

Descriptive statistics included categorical variables (age group and gender) presented as numbers and percentages (n, %) and continuous variables (age and number of exams per period) presented as mean and standard deviation. To analyze the demographic characteristics of patients tested by "EXCOV" and "RESP3", Student's t-test was performed to verify possible differences in the mean ages between groups. To analyze the age group and gender variables, Pearson's chi-square test was applied. Finally, the Mann–Whitney U test was used to compare the two groups (EXCOV and RESP3) to verify statistically significant differences in the demand for these exams during the same period.

The demographic characteristics of positive cases and viral detection rates in three different periods were analyzed for the same variables. However, to analyze the mean age between the groups "SARS-CoV-2", "Influenza" and "Respiratory syncytial virus", a one-way ANOVA test was applied. Age group was analyzed using Fisher's exact test and the gender variable by Pearson's chi-square test. The mean rate of positive cases among the three viruses was assessed using the nonparametric Kruskal-Wallis test because the data did not present a normal distribution. The normality of the data was verified using the Shapiro-Wilk test.

A $p<0.05$ was considered statistically significant. All statistical analyses were performed using Microsoft Excel version 16.16.2 and GraphPad Prism version 8.0.

Ethical aspects

The study was a survey of data from the laboratory's clinical databases without recruitment or identification of patients and was submitted to the research ethics committee of Centro Universitário Christus - UNICHRISTUS, without the need for informed consent, and approved under decision no. 4,024,941 (CAAE: 75158223.4.0000.5049).

RESULTS

A total of 1,780 individuals of both sexes and different age groups comprised the study population. Initially, all participants were grouped according to the type of test they underwent. Thus, two distinct groups "EXCOV" (n=1,573) and "RESP3" (n=207) were analyzed individually for nominal variables. Data on age, sex, and the number of tests performed per period are presented in Table 1. Table 2 presents the results for individuals with a positive result (n=492), according to the type of virus detected. All groups were analyzed for the same variables.

A significant difference was observed in the mean age between the two groups, with most tests (68.09%) performed by individuals classified as adults (aged 20–59 years) in the EXCOV group, followed by the elderly (≥ 60 years; 26.6%). For the RESP3 group, a more homogeneous pattern was observed in the distribution of individuals according to age groups, with no greater demand for tests for the adult group (18.84%), but there was a greater demand in the elderly group (32.85%) and children (1 to 9 years; 30.1%). There were no statistically significant differences in the proportion of men and women in each examination group. There was a higher rate of requests for "EXCOV" diagnostic tests between January and June 2023 (137.5 exams/period), while there was a higher rate of requests for the RESP3 test between January and May 2024 (25.2 exams/period).

The described results indicate a difference in the demand for diagnostic tests, especially in 2023, when the average number of "EXCOV" examinations was substantially

Table 1 – Demographic characteristics of patients tested by EXCOV and RESP3 and demand for tests in three different periods.

Category	EXCOV (n=1,573)	RESP3 (n=207)	Total Tests (n=1,780)	Results (df)	p-value
[a]Age, mean (SD)	46.7 (18.6)	36.1 (34.3)	45.4 (21.3)	NA	<0.001
[b]Age range (years), n (%)					
Infants (< 1)	3 (0.2)	15 (7.3)	18 (1)		
Children (1 - 9)	30 (1.9)	64 (30.9)	94 (5.3)		
Adolescents (10 - 19)	51 (3.2)	21 (10.1)	72 (4)	476.9 (4)	<0.001
Adults (20 - 59)	1,071 (68.1)	39 (18.8)	1,110 (62.4)		
Elderly (≥ 60)	418 (26.6)	68 (32.9)	486 (27.3)		
[b]Gender, n (%)					
Male	643 (40.9)	97 (46.9)	740 (41.6)	2.7 (1)	0.1
Female	930 (59.1)	110 (53.1)	1,040 (58.4)		
[c]Number of detectable tests/period, mean (SD)					
January to June 2023	137.5 (75.9)	10.8 (12.2)	148.3 (83.9)		
July to December 2023	105.8 (130.4)	2.7 (1.9)	108.5 (131.4)	43 (NA)	<0.001
January to May 2024	22.6 (14.7)	25.2 (27.2)	47.8 (19)		

df: degrees of freedom. NA: Not applicable. SD: Standard deviation. [a]Student's t-test. [b]Pearson's chi-square test. [c]Mann-Whitney test. *p-value < 0.05.

Table 2 – Demographic characteristics of positive cases and viral detection rate between three different periods.

Category	SARS-CoV-2 (n=396)	Influenza Virus (n=62)	Respiratory Syncytial Virus (n=34)	Total of Detectables (n=492)	Results (df)	p-value
[a]Age, mean (SD)	50.6 (19.4)	35.3 (29.9)	8.4 (18.2)	45.8 (23.8)	72.8 (2)	<0.001
[b]Age range (years), n (%)						
Infants (< 1)	1 (0.3)	1 (1.6)	6 (17.7)	8 (1.6)	NA	<0.001
Children (1 - 9)	8 (2)	15 (24.2)	22 (64.7)	45 (9.2)		
Adolescents (10 - 19)	4 (1)	13 (21)	3 (8.8)	20 (4.1)		
Adults (20 - 59)	241 (60.9)	16 (25.8)	1 (2.9)	258 (52.4)		
Elderly (≥ 60)	142 (35.9)	17 (27.4)	2 (6.9)	161 (32.7)		
[c]Gender, n (%)						
Male	154 (38.9)	32 (51.6)	19 (55.9)	205 (41.7)	6.7 (2)	0.031
Female	242 (61.1)	30 (48.4)	15 (44.1)	287 (58.3)		
[d]Number of detectable tests/period, mean (SD)						
January to June 2023	24.2 (32)	3.5 (5.4)	1.8 (2.2)	29.5 (38.9)	15.3 (NA)	<0.001
July to December 2023	38.7 (58.7)	0 (0)	0 (0)	38.7 (58.7)		
January to May 2024	3.8 (2.5)	8.2 (13.4)	4.6 (6.5)	16.6 (16.6)		

df: degrees of freedom. NA: not applicable. SD: Standard deviation. [a]one-way ANOVA. [b]Fisher's exact test. [c]Pearson's chi-square test. [d]Kruskal-Wallis's test.

higher than the average of "RESP3" in the same period. Figure 1 shows variations in the demand pattern of the molecular tests over time. The Mann–Whitney U test revealed a significant difference (p<0.001) in the demand for both examinations between the three periods.

The Kruskal-Wallis test also indicated a significant difference (p<0.001) in the distribution of positive cases between the analyzed periods. The Dunn test post hoc analysis revealed that differences occurred between the SARS-CoV-2 and Influenza groups (p=0.0041) and between the SARS-CoV-2 and RSV (p=0.0012). However, there was no statistically significant difference between the Influenza and RSV groups (p>0.999). The proportion of cases of each virus investigated relative to the total number of detectable results is shown in Figure 2. Monthly infection rates for SARS-CoV-2, Influenza A/B, and RSV are presented in Figure 3. The data indicate a seasonal trend in the incidence of respiratory infections caused by the viruses investigated in this study.

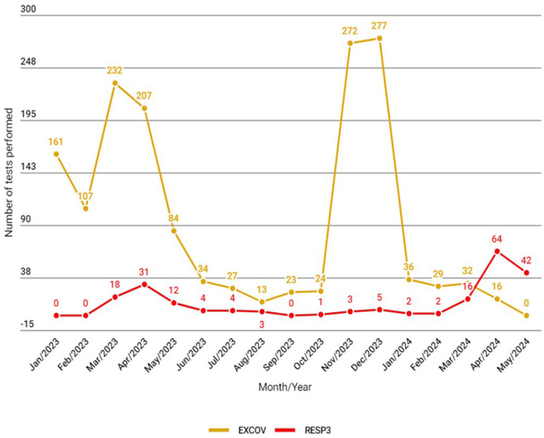

Figure 1 – Demand for EXCOV and RESP3 tests. The graph shows the pattern in demand for tests for molecular diagnosis of SARS-CoV-2, Influenza and Respiratory Syncytial Virus (RSV). The distribution of the total number of EXCOV (yellow) and RESP3 (red) tests requested in each month from January 2023 to May 2024 can be observed.

DISCUSSION

Respiratory infections caused by viruses are potentially dangerous for humans, particularly for the elderly, children, and those with immunodeficiency[6,7]. The widespread adherence to mitigation measures during the high prevalence of SARS-CoV-2 has changed the epidemiological panorama commonly observed for infections caused by other respiratory viruses[10]. This study investigated the circulation patterns of influenza A/B, RSV, and SARS-CoV-2 viruses during and after the COVID-19 pandemic in Fortaleza, northeastern Brazil.

In this study, SARS-CoV-2 was more prevalent among adults (60.9%) and the elderly (35.9%). For influenza A/B, the distribution was more homogeneous among age groups, but a higher prevalence was also observed among adults (25.8%) and the elderly (27.4%). However, the significant difference observed between age groups for influenza A/B may be due to the low prevalence of these viruses in the infant group (1.6%). Conversely, RSV was highly prevalent among infants (17.7%) and children (64.7%). In line with

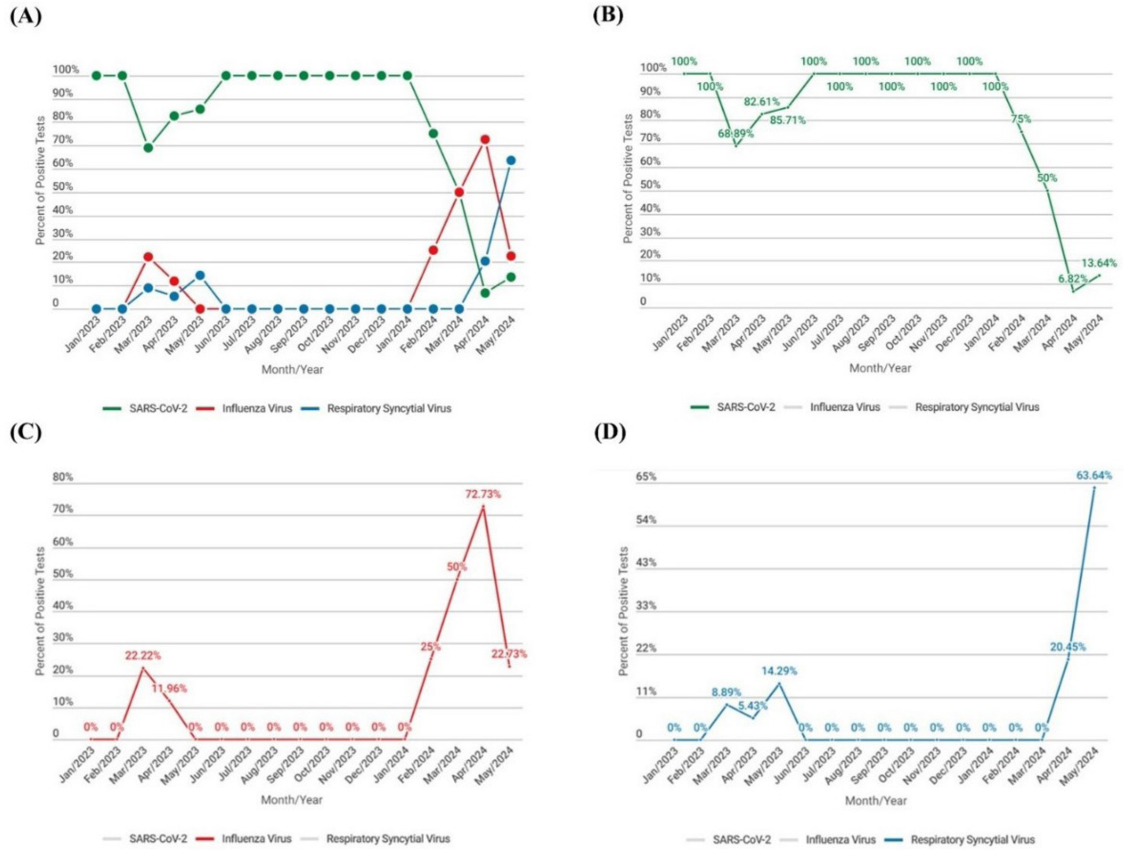

Figure 2 – Percentage of positive tests for SARS-CoV-2, Influenza and Respiratory Syncytial Virus (RSV) over time. (A) Percentage of cases of SARS-CoV-2 (green), Influenza (red) and RSV (blue) among tests with detectable results over the period investigated (January 2023 to May 2024); (B) Percentage of SARS-CoV-2 cases among detectable tests; (C) Percentage of Influenza cases among detectable tests; (D) Percentage of RSV cases among detectable tests.

data released by the World Health Organization (WHO)[11], children and adolescents aged 5–14 years represented only 6.3% of global COVID-19 cases. This percentage is even lower in children under 5 years old, accounting for approximately 1.8% of global cases. In contrast, RSV is an agent of high clinical importance for respiratory tract infections in children[12,13].

Furthermore, the data analyzed in this study showed that women accounted for the highest percentage of EXCOV tests (59.12%), suggesting a preference for specific tests to detect SARS-CoV-2 among women in the sample studied. According to the scientific literature, there is a higher prevalence of SARS-CoV-2 among women, even with a lower number of deaths compared to men[14]. However, in the isolated analysis of detectable results, no statistical significance was found between the viruses investigated and the gender of the individuals. Considering that the highest number of EXCOV tests was performed by individuals classified as adults (68%), it can be inferred that they had greater autonomy in choosing whether or not to perform diagnostic tests. Therefore, there may be bias in the distribution of health services between the sexes because of cultural factors related to the difference in the search for health services between men and women[15].

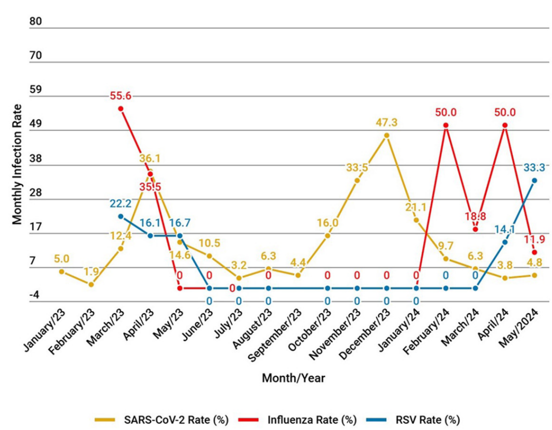

Figure 3 – Monthly rate of SARS-CoV-2, Influenza and Respiratory Syncytial Virus (RSV) infections. The graph shows the monthly rate of SARS-CoV-2 (yellow), Influenza (red) and RSV (blue) infections over the period evaluated.

Since 2000, the Brazilian Ministry of Health has been monitoring the rates of infections caused by respiratory viruses of clinical importance through the Influenza

Syndrome Sentinel Network (SG)[16]. The seasonality of respiratory viruses can pose a challenge for health agencies because of differences in the regions of the country[17]. According to Mello[17], when analyzing data generated by sentinel units from 2000 to 2010, the seasonality of influenza A/B was well defined for the southern and southeastern regions, which mainly have a temperate or subtropical climate. However, the epidemiological data made available by the Ministry of Health indicate that there is no clear definition of the seasonality of influenza A/B viruses in the northern and northeastern regions of Brazil[18].

In Fortaleza, in 2023, the number of detectable cases of SARS-CoV-2 reached its highest peak during the first half of the year in epidemiological week 14 (April)[18]. This study recorded a higher number of medical requests for the EXCOV test (52.45%) between January and June 2023, a period characterized by high rainfall in the northeast region[19]. In addition, high concentrations (36%) of detectable SARS-CoV-2, Influenza A/B, and RSV were observed during the same period. Previously, Moura et al.[19] conducted an epidemiological study and suggested the seasonality of influenza viruses during the rainy season in Fortaleza. According to Gamba-Sanchez et al.[20], seasonal outbreaks of respiratory viral infections in temperate climate regions are mainly associated with low temperatures in winter. However, in tropical regions, these outbreaks are associated with rainy periods. Therefore, similar to what was observed for other respiratory viruses, the increase in SARS-CoV-2 cases in Fortaleza in the first half of 2023 was possibly due to the region's climatic characteristics.

In agreement with the data reported by the Ministry of Health[18], most of the positive results for SARS-CoV-2 found in this study were concentrated in the second half of 2023 (58.6%), with a high number of cases between November and December 2023. According to the Ceará State Health Department (Sesa)[21], the outbreak of SARS-CoV-2 infections in Fortaleza during this period was due to the circulation of the EG.5 variant (Eris variant) in the state. Therefore, monitoring new variants of respiratory viruses represents a point of attention for health agencies because seasonality patterns can be completely modified by these variants, resulting in unforeseen health emergency scenarios[22].

In our data, the percentage of SARS-CoV-2 cases in relation to the total number of positive results showed a considerable decline in the first half of 2024, with an increase in the number of Influenza A/B and RSV detections (Figure 2). In agreement with these data, the epidemiological bulletins released by the State Department of Health and the Ministry of Health in 2024 reported that the number of detectable SARS-CoV-2 tests decreased drastically in Fortaleza and Brazil. In contrast, the number of Influenza A/B and RSV infections increased considerably in the first half of 2024[18-23].

In this study, between January and May 2024, a reduction in the number of specific tests for the detection of coronavirus using qPCR, such as EXCOV, was also observed. However, during the same period, there was a significant increase in the number of medical requests for molecular tests with a broad detection spectrum capable of also detecting RSV and Influenza A/B, such as RESP3. Habbous et al.[24] previously reported an increase in the number of RSV cases in Canada following a reduction in the number of SARS-CoV-224 infections. In agreement, this study showed an increase in the number of new influenza A/B and RSV infections, accompanied by a reduction in COVID-19 cases.

According to a study by Ullrich et al.[25], the pandemic has had an impact on the transmission of virtually all infectious diseases. In recent years, the numbers of new influenza A/B and RSV infections have dramatically decreased[25]. According to the literature, this phenomenon is mainly the result of non-pharmacological measures adopted to prevent the spread of SARS-CoV-2[10]. Throughout the pandemic, many studies have warned of a likely exponential increase in the number of respiratory infections caused by other respiratory viruses due to an "immunity debt"[26,27]. Nasrullah et al.[26] defined "immunity debt" as the absence of immunological memory capable of generating an effective immune response against pathogens due to little or no previous exposure to seasonal pathogens.

According to the Infogripe System[28], between March and May 2024, RSV surpassed SARS-CoV-2 as the primary cause of deaths from severe acute respiratory syndrome (SARS) in children. Respiratory infections caused by RSV represented a challenge for healthcare services, especially due to the high incidence in children and the elderly[6,7]. Currently, the Brazilian public health system offers palivizumab, a monoclonal antibody, as a prophylactic measure, but its use is restricted to high-risk premature infants[29]. Recently, Brazil's National Health Surveillance Agency (ANVISA) approved the first immunizing agent against RSV for national use[29].

The possible seasonality of SARS-CoV-2 is still uncertain and requires further investigation[8]. In this study, there was no significant increase in the number of SARS-CoV-2 cases in 2024, which was sufficient to maintain the epidemiological profile observed in the months of the pandemic evaluated. In fact, the results indicate that the pattern of viral circulation observed in the first half of 2024 was similar to that of the previous pandemic according to the epidemiological bulletins of the MH, indicating the probable reestablishment of the circulation pattern of these viruses[16,17]. In addition, the reported increase in the incidence of respiratory virus infections between January and June suggests that the seasonality of respiratory viruses is strongly associated with the rainy season in the city of Fortaleza[9]. However, the high prevalence of infections caused by SARS-CoV-2 in the second half of 2023 warns of the capacity of new strains to cause even more significant outbreaks of respiratory disease at different times of the year[21,22].

Therefore, given the abrupt change caused by the SARS-CoV-2 pandemic, not only at its beginning but also at its end, the need for strategic planning capable of monitoring the resumption of respiratory virus circulation is evident[1]. Vaccination campaigns against Influenza A/B should be intensified and seasonality between regions of the country should be considered. It is essential to expand access to vaccination against RSV in the public health system for risk groups, especially children who may be even more vulnerable to severe RSV disease after the end of the pandemic because of the absence of previous exposure to the virus[26].

This study has some limitations. All data come from a single city in Brazil, so there may be significant differences between regions of the country that make it difficult to generalize the conclusions of this study to other locations, especially those with very different climatic characteristics from Fortaleza, for example, cities in the south of the country[17]. In addition, the participating individuals are clients of a local private laboratory; thus, the performance of the tests is linked to the payment for the diagnostic test. This factor may have contributed to the less heterogeneous population sample given the high cost of molecular testing.

Furthermore, in this study, there was a heterogeneous distribution between the number of EXCOV and RESP3 type tests performed, making a direct comparative analysis between the results of detectable tests for SARS-CoV-2 and the results of detectable tests for Influenza difficult. This is mainly due to the high demand for specific tests to detect SARS-CoV-2 in 2023 (Figure 1). Therefore, it is probable that the possibility of co-infections and the similarity between the symptoms of respiratory infections may have contributed to a higher percentage of medical requests for the EXCOV molecular test instead of the RESP3 test, resulting in a smaller number of detectable tests of Influenza A/B and RSV[14,17]. Therefore, because the results indicate changes in the incidence of respiratory viruses during the investigated period, it is important to recognize that there may be a significant collision bias.

On the other hand, it is important to highlight that the observed data were from the actual demand of a clinical laboratory between January 2023 and May 2024 and were in accordance with clinical practice. Thus, although the total volume of EXCOV tests performed was considerably higher during the evaluation period, consequently generating a greater representation of positive SARS-CoV-2 results, it is reasonable to consider the impact of the influence of the epidemiological scenario on the choice of diagnostic tests. This is because an increase in the detection rate of a pathogen may also increase the volume of medical requests for tests that can detect it. Therefore, an increase in the demand for a given diagnostic test, as observed in this study (Figure 1), can provide important indications of changes in the established epidemiological pattern.

CONCLUSION

This study analyzed epidemiological data obtained from a local population sample, with results in accordance with those reported in the scientific literature. Our data contribute to identifying the same information described by other studies reporting changes in respiratory virus circulation patterns during the COVID-19 pandemic. However, we observed a gradual return to the usual seasonal patterns of influenza A/B and RSV viruses after the pandemic caused by SARS-CoV-2. In addition, our data help to characterize the circulation patterns of respiratory viruses in Fortaleza, a tropical city in Northeastern Brazil, which has the highest prevalence of these viruses during rainy periods.

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