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Posted Date: 3 June 2025

doi: 10.20944/preprints202506.0151.v1

Keywords: covid-19; SARSCoV-2 virus; telemedicine

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COVID-19 Clinical Predictors in Patients Treated via a Telemedicine Platform in 2022

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Abstract: Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus, whose 2020 outbreak was characterized as a pandemic by the World Health Organization. Restriction measures changed healthcare delivery, with telehealth providing a viable alternative throughout the pandemic. This study analyzed a telemedicine platform database with the goal of developing a diagnostic prediction model for COVID-19 patients. This is a longitudinal study of patients seen on the Conexa Saúde telemedicine platform in 2022. A multiple binary logistic regression model of controls (negative confirmation for COVID-19, or confirmation of other flu-like syndromes) versus COVID-19 was developed to obtain an odds ratio (OR) and a 95% confidence interval (CI). In the final binary logistic regression model, six factors were considered significant: presence of rhinorrhea, ocular symptoms, abdominal pain, rhinosinusopathy, and wheezing/asthma and bronchospasm were more frequent in controls, thus indicating a greater chance of flu-like illnesses than COVID-19. The presence of tiredness and fatigue was 3 times more prevalent in COVID-19 cases (OR=3.631; CI=1.138 – 11.581; p-value=0.029). Our study identified independent predictors that help differentiate between flu-like syndromes and COVID-19.

Keywords: covid-19; SARSCoV-2 virus; telemedicine

1. Introduction

COVID-19 is a viral illness caused by SARS-CoV-2 (Coronaviridae family). In March 2020, the World Health Organization characterized the COVID-19 outbreak as a pandemic [1]. The most common clinical manifestations in COVID-19 patients include fever or chills, fatigue, headache, muscle or body aches, dry cough, pneumonia, and dyspnea [2]. Comparison studies between COVID-19 cases and other common colds highlighted their different symptomatology, which can aid in the diagnosis of this disease [3–5].

During the pandemic, circulation-restricting and social distancing measures were recommended to decrease viral transmission in the population [1]. Early diagnosis allows immediate isolation to be indicated, decreasing the COVID-19 transmission time [6]. The high specificity of RT-qPCR (i.e., the detection of nucleic acids in nasopharyngeal and oropharyngeal samples by reverse transcription quantitative polymerase chain reaction) rendered it the universal diagnostic method [2]. Nevertheless, should this test be unavailable, a combination of clinical and laboratory features can be applied to aid in the diagnosis [3,5].

Restriction measures have changed healthcare delivery, with telehealth providing a viable alternative modality of care during the pandemic [7]. In 2020, elective outpatient care for stable

 doi:10.20944/preprints202506.0151.v1

patients was suspended in public health units in the state of Rio de Janeiro, Brazil, according to SES Resolution No. 2004/2020 of March 18th 2020 [8].

By definition, telemedicine encompasses the remote diagnosis and treatment of patients via telecommunication infrastructures, whereas telehealth encompasses any service used to provide healthcare remotely [9]. The characteristic pattern of patients using telehealth/telemedicine services is similar to that of other healthcare and digital health services [7]. Telehealth is comparable to in-person care for several clinical and process outcomes, [7] and can be associated with cost savings for both patients and the broader healthcare sector [10].

Conexa Saúde is a telemedicine platform that connects patients and healthcare professionals through technological means. During the COVID-19 pandemic, the tool consolidated an extensive clinical database, used herein to evaluate telemedicine as a predictive diagnosis resource.

Therefore, this study aims to analyze the database of a telemedicine platform with the goal of developing a COVID-19 diagnosis prediction model.

2. Materials and Methods

This is a longitudinal study of patients seen via the Conexa Saúde Telemedicine platform in 2022. In this study, a database section comprising 88,287 records was used. Inclusion criteria included patients whose data indicated residence in the state of Rio de Janeiro, and confirmation of COVID-19 or flu-like syndromes (i.e., due to other viral infections yielding similar symptoms). Exclusion criteria included duplicate cases, unconfirmed suspected cases, post-COVID-19 cases, diagnoses unrelated to flu-like syndromes, and records with no description of signs or symptoms. Records that had been reported and confirmed via a diagnostic test were considered as cases. All patients with negative confirmation for COVID-19, or confirmation of any other flu-like syndrome were considered as controls.

This study was approved by the Ethics and Research Committee of the Evandro Chagas National Institute of Infectious Diseases of the Oswaldo Cruz Foundation (Fiocruz), under opinion no. 5.001.681.

Clinical data was collected from Conexa Saúde's telemedicine platform database. Analyses were conducted using Statistical Package for Social Sciences for Windows v. 16.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarize the findings. The simple frequencies of the main signs and symptoms reported among cases confirmed as COVID-19 and controls were described. The association between categorical variables was verified by Pearson's $\chi 2$ test of proportions, or Fisher's exact test. P-values <0.05 indicated statistically significant tests. Statistically significant variables were included in the logistic regression analysis. A binary logistic regression analysis was applied to develop the predictive model for the outcome of interest in this study. A multiple binary logistic regression model, controls v. COVID-19, was developed to obtain an odds ratio (OR) and a 95% confidence interval (CI). Backward elimination with the likelihood ratio test was applied to obtain statistically significant variables. The calibration of each final logistic model was evaluated via the Hosmer-Lemeshow goodness-of-fit test and a p-value > 0.05 indicated good agreement between observed and predicted disease.

3. Results

Data from the telemedicine platform identified 4,600 records from the state of Rio de Janeiro in 2022, of which 1910 (41.5%) were excluded: 390 duplicates, 383 suspected cases, 70 post-covid cases, 100 diagnoses not related to flu-like syndromes, and 967 entries without reported data on signs and symptoms. A total of 2690 patients were included, of which 2559 cases and 131 controls. The presence of rhinorrhea, sneezing and burning nose, ocular symptoms, abdominal pain, fatigue/tiredness, rhinosinusopathy, and wheezing/asthma and bronchospasm were more frequent in controls, showing a negative association with COVID-19. Fatigue/tiredness showed a positive association with COVID-19 cases (Table 1).

 doi:10.20944/preprints202506.0151.v1

Table 1. Main signs and symptoms observed between COVID-19 and control cases.

	Cases (n = 2559) n (%)	Controls (n = 131) n (%)	*p*-Value
Anosmia/Hyposmia	73 (2.9)	2 (1.5)	0.583
Cough	1556 (60.8)	80 (61.1)	0.952
Fever	688 (26.9)	40 (30.5)	0.359
Rhinorrhea	678 (26.5)	50 (38.2)	**0.003**
Nasal congestion	541+ (21.1)	34 (26.0)	0.190
Sneezing/burning sensation in the nose	108 (4.2)	11 (8.4)	**0.023**
Odynophagia	1049 (41.0)	59 (45.0)	0.359
Myalgia	714 (27.9)	38 (29.0)	0.783
Ocular symptoms	22 (0.9)	7 (5.3)	**< 0.001**
Headache	931 (36.4)	47 (35.9)	0.907
Malaise/Indisposition	306 (12.0)	14 (10.7)	0.661
Dyspnea	125 (4.9)	6 (4.6)	0.874
Diarrhea	164 (6.4)	13 (9.9)	0.114
Chills	62 (2.4)	4 (3.1)	0.561
Nausea/Sickness	105 (4.1)	7 (5.3)	0.488
Abdominal pain	47 (1.8)	7 (5.3)	**0.014**
Arthralgia	105 (4.1)	2 (1.5)	0.141
Dizziness	58 (2.3)	4 (3.1)	0.543
Rhinitis	11 (0.4)	1 (0.8)	0.451
Asthenia/Adynamia	149 (5.8)	7 (5.3)	0.819
Prostration	48 (1.9)	1 (0.8)	0.731
Lower back pain	71 (2.8)	4 (3.1)	0.784
Dermatological symptoms	12 (0.5)	2 (1.5)	0.146
Fatigue/Tiredness	207 (8.1)	3 (2.3)	**0.016**
Vomiting	29 (1.1)	2 (1.5)	0.661
Anorexia/Inappetence	18 (0.7)	4 (3.1)	0.020
Tonsilitis	4 (0.2)	1 (0.8)	0.221
Rhinosinusopathy	20 (0.8)	4 (3.1)	**0.027**
Back pain	50 (2.0)	3 (2.3)	0.742
Chest pain/Palpitation	72 (2.8)	2 (1.5)	0.582
Wheezing/Asthma/Bronchospasm	19 (0.7)	4 (3.1)	**0.023**
Insomnia	1 (0.1)	1 (0.8)	0.095
Aphasia/dysphonia	54 (2.1)	4 (3.1)	0.528
Ageusia/Dysgeusia	52 (2.0)	2 (1.5)	1.000
Expectoration/Secretion	39 (1.5)	1 (0.8)	0.720
Throat discomfort (irritation, itching, throat clearing, plaques, globules)	90 (3.5)	1 (0.8)	0.130
Edema	1 (0.1)	1 (0.8)	0.095
Hearing symptoms (tinnitus, ear fullness, hypoacusis)	12 (0.5)	2 (1.5)	0.146

Seven independent variables were entered into a multiple binary logistic regression analysis to identify independent predictors that distinguished COVID-19 from controls. Based on backward elimination, six factors were considered significant: rhinorrhea, ocular symptoms, abdominal pain, rhinosinusopathy, and wheezing/asthma and bronchospasm were more frequent in controls, with their presence indicating a greater probability of a flu-like illness than COVID-19. Tiredness and fatigue were 3 times more prevalent in COVID-19 cases. The Hosmer-Lemeshow goodness-of-fit test showed a good fit of the model to the data (p = 0.978). The results of the binary logistic regression analysis are summarized in Table 2.

 doi:10.20944/preprints202506.0151.v1

Table 2. Multiple binary logistic regression analysis of the factors that differentiate COVID-19 from flu syndromes.

Associated Factors	OR	95% CI	*p*-Value
Rhinorrhea	0.549	0.379 - 0.796	0.002
Ocular symptoms	0.157	0.065 - 0.381	<0.001
Abdominal pain	0.303	0.132 - 0.700	0.005
Fatigue	3.631	1.138 - 11.581	0.029
Rhinosinusopathy	0.213	0.071 - 0.639	0.006
Wheezing/Asthma/Bronchospasm	0.21	0.069 - 0.637	0.006

OR:odds ratio; CI: confidence interval.

4. Discussion

Data from the telemedicine evaluation allowed the identification of factors that can aid in the early diagnosis of COVID-19 by differentiating it from other flu-like syndromes – a challenge arising from non-specific clinical characteristics, and frequently from limited access to specific diagnostics for each virus [5,11–14].

The use of telemedicine data is fundamental as it becomes increasingly ingrained in patient care provisioning. Previous studies have highlighted the high effectiveness of telehealth service data in anticipating new COVID-19 waves, which can both help understand the dynamics of the epidemic and support the surveillance of different diseases [15–17].

The present study revealed that fatigue/tiredness was a characteristic COVID-19 symptom, corroborating studies that indicated fatigue/tiredness as one of its main symptoms [2]. The presence of rhinorrhea, ocular symptoms, abdominal pain, rhinosinusopathy, and wheezing/asthma/bronchospasm were characteristic symptoms of the different flu-like syndromes. Sirijatuphat et al. [5] also observed a difference in rhinorrhea prevalence between COVID-19 and Influenza cases, being more frequent in the latter. Iyadorai et al. [3] observed that patients with influenza virus infection had a higher prevalence of fever (83.0%) and a similar prevalence of cough compared to patients with COVID-19 infection, whereas other clinical symptoms (sore throat, hoarseness, nasal congestion, rhinorrhea, sneezing, headache, and myalgia) were more common in COVID-19 infected patients.

Our results corroborated regarding the sore throat, nasal congestion, headache, myalgia, and cough symptoms, but not fever symptoms (no difference between the two groups) nor rhinorrhea (greater prevalence in flu-like syndrome cases). The main discrepancies may arise from differences between the populations in the different studies, and in the SARS-CoV-2 virus variants. At the start of the pandemic, anosmia was considered a predictor of COVID-19 [19]; however, its prevalence decreased with the different variants of the virus (Cardoso et al, 2022 [20]). Our study demonstrates the decrease in anosmia prevalence in COVID-19 cases in 2022.

In clinical practice, the identification of factors associated with the disease may be used as guidance to healthcare professionals to conduct targeted investigations. They may also be used as an additional tool where diagnostic resources are limited [5,18]. Moreover, early diagnosis allows for the immediate implementation of isolation measures, contributing to disease transmission control and a decrease of its incidence [6].

This study presented some limitations. Approximately 42% of the cases were excluded, mostly for missing data, which demonstrates a lack of structuring of electronic medical records aimed at research. More structured fields and training for doctors in record filling could decrease the occurrence of missing data, while data imputation strategies could be used for future studies. The control group was limited due to the high prevalence of COVID-19 during the study period; clinical manifestations of COVID-19 may vary according to the viral strain (different variants of SARS-CoV-2) and the vaccination status of the patients (partial or complete vaccination schedule). The use of retrospective data may be affected by information bias, yielding less accurate results.

 doi:10.20944/preprints202506.0151.v1

The use of a database from a telemedicine platform was adequate and sufficient to identify significant factors to differentiate COVID-19 from other flu-like syndromes. It is necessary to improve the acquisition of data through telemedicine by developing more structured electronic medical records. Nevertheless, the use of this data has advantages in terms of decreasing cost for studies with a large sample size, ease of conducting studies in adverse situations such as a pandemic, little need for on-site infrastructure, and helping with faster prevention and surveillance actions in the face of worsening conditions.

5. Conclusions

Our study identified independent predictors associated with flu-like syndromes and COVID-19 that could help distinguish between these infections. Fatigue/tiredness is associated with COVID-19, whereas the presence of rhinorrhea, ocular symptoms, abdominal pain, rhinosinusopathy, and wheezing/asthma/bronchospasm are associated with flu-like syndromes.

Author Contributions: Conceptualization, L. F.A.O. and C.M.V; methodology, L.F.A.O., A.P.M..; L.C.F., L.L.B.A., R.K.F.H., L.T.S.; formal analysis, L.AF.A.O.; investigation, L.F.A.O., L.R.N.B.P.; L.C.F., L.L.B.A., R.K.F.H., L.T.S.; resources, C.M.V., L.F.A.O., L.R.N.B.P.; data curation, L.F.A.O., L.R.N.B.P., L.C.F.; writing—original draft preparation, L.F.A.O.; writing—review and editing, A.P.M., G.G.A.S., G.S.W., L.L.B.A., R.K.F.H., L.T.S., C.M.V.; supervision, L.F.A.O., C.M.V., A.P.M., C.M.V., L.C.F.; project administration, C.M.V., G.G.A.S., G.S.W., funding acquisition, C.M.V., L.F.A.O..

Funding: This research was funded by Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001, with support from the Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro (FAPERJ) - Notice No. 25/2021 / Post-Doctorate Grade 10 2021 (Process: 75635131) and support from the Evandro Chagas National Institute of Infectology - Oswaldo Cruz Foundation.

Institutional Review Board Statement: The study was approved by the Ethics and Research Committee of the Evandro Chagas National Institute of Infectious Diseases of the Oswaldo Cruz Foundation (Fiocruz), under opinion no. 5.001.681.

Informed Consent Statement: Patient consent was waived due to this is a retrospective study using electronic medical records, without the need to supplement data with new consultations or medical procedures on the participants.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: We thank staff members of Conexa Saúde and Stricto sensu Postgraduate Program in Clinical Research in Infectious Diseases at the Evandro Chagas National Institute of Infectology (INI) at Fiocruz, for research and administrative support.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

COVID-19	Coronavirus disease
RT-qPCR	Reverse transcriptase- real time PCR
OR	odds ratio
CI	Confidence interval

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