ABSTRACT

Aims This study aimed to identify the symptoms associated with early stage SARS-CoV-2 (COVID-19) infections in healthcare professionals (HCPs) using both clinical and laboratory data.

Methods A total of 1297 patients, admitted between 18 March and 8 April 2020, were stratified according to their risk of developing COVID-19 using their responses to a questionnaire designed to evaluate symptoms and risk conditions.

Results Anosmia/hyposmia (p<0.0001), fever (p<0.0001), body pain (p<0.0001) and chills (p=0.001) were all independent predictors for COVID-19, with a 72% estimated probability for detecting COVID-19 in nasopharyngeal swab samples. Leucopenia, relative mononcytosis, decreased eosinophil values, C reactive protein (CRP) and platelets were also shown to be significant independent predictors for COVID-19.

Conclusions The significant clinical features for COVID-19 were identified as anosmia, fever, chills and body pain. Elevated CRP, leucocytes under 5400×10^9/L and relative mononcytosis (>9%) were common among patients with a confirmed COVID-19 diagnosis. These variables may help, in the absence of reverse transcriptase PCR tests, to identify possible COVID-19 infections during pandemic outbreaks.

INTRODUCTION

The COVID-19 pandemic caused by the outbreak of the novel SARS-CoV-2 represents a significant and urgent threat to global health. By 6 October 2020, Brazil ranks third in the number of COVID-19 cases (4 927 233) and second in number of deaths (146 675) in the world.1 Outbreaks of this magnitude lead to significant increases in demand for hospital beds, medical equipment, and human resources. Additionally, healthcare professionals (HCPs) working on the frontline are among the groups most affected by the pandemic; in Italy, for example, 20% of these HCPs were affected by COVID-19,2 contributing to an even greater burden on the health system.

Despite public health responses aimed at containing the disease and delaying its spread, several countries have been challenged with an intensive care crisis, and this crisis is imminent in Brazil. In this context, attention to the health and well-being of HCP is essential to maintain the integrity and functionality of the health system that allows for both population care and pandemic surveillance.

In this study, we investigated the clinical features of 1297 individuals, mostly HCP (80%), associated with the presence of the SARS-CoV-2 (COVID-19) during the period immediately following the declaration of the pandemic in Brazil.

MATERIALS AND METHODS

Patient selection and characteristics

A total of 1297 individuals visited the Piquet Carneiro Polyclinic at the Rio de Janeiro State University (UERJ), a designated diagnostic site for personnel working in the Brazilian public health system, for screening of COVID-19 between 19 March and 8 April 2020. Here, they found three levels of assistance. First, both HCP and clinical patients were asked to identify their general symptoms. Following this, asymptomatic patients and HCP who had appointments scheduled at various specialised clinics were provided with a white bracelet and allowed to enter the medical centre for their consultation. Then, symptomatic patients were referred to the care of the nursing and medical teams. All patients with dyspnoea, high fever, chest pain and abnormal pulmonary auscultation were then prescribed chest ultrasound to identify if hospital admission was necessary. Individuals were then immediately assigned to various clinical grades in accordance with those patients who presented with a fever (>37.5°C) or poor O2 saturation (<94%) and were assigned yellow or red bracelets. After this evaluation, patients with red bracelets were directed to the hospital when necessary, and the rest of the patients were asked to complete the interview questionnaire. They received the necessary medical assistance, and laboratory samples were collected. All patients with yellow or red bracelets received a full clinical and laboratory screening.

The questionnaire was used to identify high-risk comorbidities and influenza vaccine status and to facilitate the contact tracing over the previous 2 weeks (table 1). Signs and symptoms, nasopharyngeal swabs (NPs) and blood samples for the
complementary biochemistry (n=1297) and haematology tests (n=1211) were also collected from all the patients.

Real-time PCR SARS-CoV-2 detection and laboratory testing
RNA was extracted from the samples according to both the COVID-19 infection and laboratory detection for the SARS-CoV-2 guidelines.1 Specific real-time reverse transcription PCR (RT-PCR) assays were performed using commercial kits or previously designed nCoVrt-PCR kits (Biomanguinhos, Fiocruz, Rio de Janeiro, and Instituto de Biologia Molecular do Paraná, Paraná) approved by the Brazilian Vigilance (ANVISA) group within the Histocompatibility and Cryopreservation Laboratory at UERJ.

Peripheral blood tests were performed by the Pathology Service of the Piquet Carneiro Polyclinic using several automated systems. The complete blood counts were carried out using a SYMEX XT1800i, while the C reactive protein (CRP; immunoturbidimetric), creatinine (picrate kinetic), lactate dehydrogenase (LDH; kinetic enzymatic), aspartate and alanine aminotransferases (AST and ALT; kinetic enzymatic), and creatine phosphokinase (CK, kinetic enzymatic) assays were performed using the Architect c8000 Equipment from Abbott.

Data collection
All the questionnaire, nursing and medical consultation records, and laboratory findings were added to the electronic media files for each patient. These data were then used to ascertain the epidemiological and symptom data for the larger cohort. All data were checked by two independent physicians (LCP and IB).

Statistical analysis
The quantitative peripheral blood tests were compared using analysis of variance or the Mann-Whitney U test and the Kruskal-Wallis tests when appropriate. The categorical variables were expressed as numbers (%) and compared using the Fisher’s exact test. Differences were considered significant at a p value of <0.05 using a one-tailed test. Tukey or Dunn test was applied when multiple comparisons were analysed, respectively, for normal or non-parametric variables. The date of testing was also grouped by week. In the multivariate analyses, binary logistic regression (LR) was used to identify the clinical, laboratory and independent signs or symptoms that could explain (or predict) the presence of the SARS-CoV-2 in each sample. The selection process was applied using a stepwise process, which allowed us to select the smallest subgroup of independent variables that best explained any particular outcome. All analyses were performed using the SPSS V.26.0 software.

RESULTS
Demographic and laboratory characteristics linked to positive COVID-19 test results
Risk factors related to the COVID-19 NPS results are summarised in tables 2 and 3. Cough, headache, body ache (including myalgia at rest or during minimal physical effort), fever, sore throat, corvza and tiredness were common symptoms present in more than a third of the patients in the cohort. These symptoms were common to both the undetected, inconclusive and SARS-CoV-2 positive groups. However, chills, anosmia or hyposmia, nausea or vomiting and abdominal pain, although less frequent, were more common in individuals with the SARS-CoV-2 positive results (p<0.001) than in patients with no detectable infection.

The respiratory and cardiac frequencies, temperature, O2 saturation, and laboratory results for this cohort are summarised in table 4. CRP, LDH, AST and ALT levels were all shown to be elevated in COVID-19 patients, while leukometry values were shown to differ between individuals regardless of the SARS-CoV-2 SNF detection result.

When we applied the LR, we observed that anosmia/hyposmia (OR: 2.38, 95% CI 1.78 to 3.19, p<0.0001), fever (OR: 2.13, 95% CI 1.63 to 2.79, p<0.0001), body pain (OR: 2.11, 95% CI 1.59 to 2.82, p<0.0001) and chills (OR: 1.70, 95% CI 1.23 to 2.34, p<0.001), in this specific order, were independent predictors for COVID-19. The other signs and symptoms did not make a significant contribution, when evaluated using the 95% CI. The estimated probability of COVID-19 detection in patients presenting with these four signs and symptoms (fever, body pain, anosmia-hyposmia and chills) was 72% when evaluated using a model adjusted for LR.

When the laboratory test results (906 complete records) were evaluated using LR, leucocytes (p<0.0001), monocytes (p<0.0001), lymphocytes (p<0.0001), CRP (p<0.0001), LDH (p<0.0001), AST (p<0.0001) and ALT (p<0.0001) were the main contributing parameters.

Table 1 Characteristics of individuals attended for COVID-19 detection from 18 March to 8 April 2020 at Polyclinic Piquet Carneiro, Rio de Janeiro

<table>
<thead>
<tr>
<th>N</th>
<th>HCP</th>
<th>Non-HCP</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1001</td>
<td>266</td>
<td>1297</td>
<td>-</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>755 (58.2)</td>
<td>155 (75.4)</td>
<td>910 (71.8)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Age (x±SD)</td>
<td>41.3±10.6</td>
<td>42.4±11.8</td>
<td>0.956</td>
<td></td>
</tr>
<tr>
<td>BMI, median (25–75)</td>
<td>26.5 (23.8–30.4)</td>
<td>28.3 (24.7–33.2)</td>
<td>0.0009</td>
<td></td>
</tr>
<tr>
<td>Colour–race, n (%)</td>
<td>935</td>
<td>244</td>
<td>1179</td>
<td></td>
</tr>
</tbody>
</table>

White | 532 (56.9) | 99 (40.6) | 631 (53.5) | 0.0004 |
Brown | 248 (26.5) | 85 (34.8) | 333 (28.2) |
Black | 135 (14.4) | 55 (22.5) | 190 (16.1) |
Asian | 11 (1.2)   | 3 (0.1)   | 14 (1.2)   |
Not declared | 8 (0.8) | 2 (0.1) | 10 (0.8) |
Indigenous | 1 (0.0) | 0 (0) | 1 (0.0) |

Education (years), n (%) | 953 | 243 | 1196 |
Less 9 | 73 (3.1) | 36 (14.8) | 39 (3.3) | <0.0001 |
9–12 | 185 (19.4) | 92 (37.9) | 277 (23.2) |
12–16 | 355 (37.2) | 85 (35.0) | 440 (36.8) |
>16 | 410 (43.0) | 30 (12.3) | 440 (36.8) |

Vaccine status
Influenza vaccine in 2019 | 636 (76.0) | 114 (46.9) | 750 (63.8) | <0.0001 |
Influenza vaccine in 2020 | 375 (47.7) | 53 (31.1) | 428 (44.8) | <0.0001 |
Medical history, n (%) | 1001 | 266 | 1297 |
Arterial hypertension | 180 (17.9) | 65 (24.4) | 245 (19.3) | 0.012 |
Medicine drugs (in use) | 154 (15.3) | 28 (10.5) | 182 (14.3) | 0.025 |
Chronic sinusitis | 81 (8.0) | 36 (13.5) | 117 (9.2) | 0.006 |
Asthma | 86 (8.5) | 18 (6.7) | 104 (8.2) | 0.203 |
Contractive (n=1052) | 78 (10.3) | 22 (14.1) | 100 (8.9) | 0.106 |
Diabetes | 58 (5.7) | 20 (7.5) | 78 (6.1) | 0.184 |
Tobacco use | 44 (4.4) | 29 (10.9) | 73 (5.9) | <0.0001 |
Obesity | 42 (4.2) | 30 (11.2) | 72 (5.6) | <0.0001 |
Chronic bronchitis | 50 (5.0) | 14 (5.2) | 64 (0.5) | 0.481 |
Alcohol addiction | 47 (4.7) | 7 (2.6) | 54 (4.2) | 0.090 |
Hypothyroidism | 43 (4.3) | 3 (1.1) | 46 (3.6) | 0.007 |
Cardiovascular disease | 19 (1.9) | 6 (2.2) | 25 (1.9) | 0.432 |
Tuberculosis | 10 (1.0) | 4 (1.5) | 14 (1.1) | 0.336 |
Mental disease | 4 (0.4) | 4 (1.5) | 8 (0.6) | 0.065 |
Neoplasia | 5 (0.5) | 1 (0.3) | 6 (0.5) | 0.631 |
Liver disease | 3 (0.3) | 3 (1.1) | 6 (0.5) | 0.111 |
Rheumatoid arthritis | 5 (0.5) | 0 (0) | 5 (0.3) | 0.307 |

Data expressed as mean±SD, compared with analysis of variance or median (25%–75%). Bold values are p<0.05. BMI, body mass index; HCP, healthcare professionals; non-HCP, non-healthcare personnel.
(p<0.0001), eosinophils (p<0.0001), CRP (p=0.001) and platelets (p=0.003), in this specific order, were significant independent predictors for COVID-19. The other laboratory variables did not make a significant contribution to predicting a SARS-CoV-2 positive sample at 95% CI.

For the final model, we considered the following variables: age, sex, onset of symptoms, education, laboratory results, and clinical signs and symptoms. Table 5 provides the final regression model, using 770 complete records to link specific data to clinical signs and symptoms.

DISCUSSION
Although COVID-19 is known for its wide variety of clinical symptoms, we were able to identify some differences between casual and continuous reports. Findings of fever, anosmia or hyposmia, body pain and chills were found to be linked to a 72% probability for a positive diagnosis, making these the most reliable clinical symptoms of infection.

Characteristics of patients
While this initiative was initially designed to support HCP at our institution, the dire need of expansive clinical support and diagnosis for COVID-19 meant that, from week 2, we included patients from other public institutions and patients frequently treated at our facility in our testing cohort. This meant that while most of the individuals (80%) evaluated and tested at our institution, the dire need of expansive clinical support and diagnosis for COVID-19 meant that, from week 2, we included patients from other public institutions and patients frequently treated at our facility in our testing cohort. This meant that while most of the individuals (80%) evaluated and tested at our site were HCP, 20% of the study cohort comprised non-HCP patients.
The HCP group predominantly comprised self-identified white professionals (55.5%) with at least 12 years of study (80.1%), while only 42.2% of the individuals in the non-HCP group identified as white. The non-HCP group had a higher frequency of obesity (11.1% vs 4.4%) compared with that in the HCP group, which was reflected in the BMI values (non-HCP: 29.2±6.0 vs HCP: 27.4±5.2). Additionally, smoking was also more frequent in the non-HCP group, and there were also differences in adherence to the influenza vaccination schedule between these two groups.

As of 8 April 2020, the deadline for data collection, Brazil had reported a total of 15,927 confirmed cases of COVID-19. The state of Rio de Janeiro had 1938 cases with this study representing 21.6% of all the cases reported in this state, with the majority of these cases being reported in HCP. 

SARS-CoV-2 NPS results

Here, we noted that detection of the SARS-CoV-2 RNA in NPS is associated with the onset of COVID-19 symptoms. These data are consistent with previous studies that identify that the virus is detectable within the first 8 days of symptoms and reinforce the need for a differentiated strategy for determination of eligibility for NPS SARS-CoV-2 testing, especially where the health system is constrained in terms of both human resources and the availability of test kits. Early recognition of COVID-19 is critical for reducing its transmission and subsequently the number of cases.
critical for the isolation of infected persons and the mitigation of community spread.7 The ability to rule out COVID-19 earlier enables more effective public health containment measures and frees up resources by reducing isolation time in suspected cases.

Table 4  Laboratory results from COVID-19 nasopharyngeal swab individuals attended from 18 March to 8 April 2020 at Polyclinic Piquet Carneiro, Rio de Janeiro

<table>
<thead>
<tr>
<th>Variable</th>
<th>Detected</th>
<th>Inconclusive</th>
<th>Undetected</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>410</td>
<td>94</td>
<td>763</td>
<td></td>
</tr>
<tr>
<td>CRP, mg (Q1–Q3) ng/L</td>
<td>5.63 (3.22–11.49)</td>
<td>4.52 (1.72–11.27)</td>
<td>2.71 (1.12–7.37)</td>
<td>&lt;0.0001*†</td>
</tr>
<tr>
<td>ALT, mg (Q1–Q3) µkat/L</td>
<td>0.37 (0.32–0.47)</td>
<td>0.35 (0.27–0.48)</td>
<td>0.30 (0.25–0.37)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>AST, mg (Q1–Q3) µkat/L</td>
<td>0.37 (0.30–0.48)</td>
<td>0.35 (0.22–0.63)</td>
<td>0.30 (0.25–0.37)</td>
<td>&lt;0.0001*†</td>
</tr>
<tr>
<td>Creatinine µmol/L</td>
<td>76.02±14.14</td>
<td>75.14±15.03</td>
<td>76.91±14.14</td>
<td>0.177</td>
</tr>
<tr>
<td>LDH, µkat/L</td>
<td>3.05±7.62</td>
<td>3.10±8.77</td>
<td>2.95±7.65</td>
<td>0.031*</td>
</tr>
<tr>
<td>CPK, mg (Q1–Q3) µkat/L</td>
<td>1.27 (0.94–1.91)</td>
<td>1.32 (0.89–1.95)</td>
<td>1.39 (0.95–2.09)</td>
<td>0.106</td>
</tr>
<tr>
<td>N</td>
<td>376</td>
<td>91</td>
<td>744</td>
<td></td>
</tr>
<tr>
<td>Red cell 10¹²/L</td>
<td>4.8±0.4</td>
<td>4.8±0.5</td>
<td>4.8±0.5</td>
<td>0.834</td>
</tr>
<tr>
<td>Haemoglobin, g/L</td>
<td>137±12</td>
<td>136±13</td>
<td>138±14</td>
<td>0.655</td>
</tr>
<tr>
<td>Haematocrit, %</td>
<td>42±3.4</td>
<td>41.5±3.6</td>
<td>41.9±3.7</td>
<td>0.530</td>
</tr>
<tr>
<td>MCV, fL</td>
<td>87.8±5.2</td>
<td>87.9±5.7</td>
<td>87.8±5.3</td>
<td>0.987</td>
</tr>
<tr>
<td>MCH, g/L</td>
<td>28.7±1.8</td>
<td>28.8±2.3</td>
<td>28.8±2.2</td>
<td>0.609</td>
</tr>
<tr>
<td>MCH, µmol/L</td>
<td>326±10</td>
<td>328±10</td>
<td>328±10</td>
<td>0.064</td>
</tr>
<tr>
<td>RDW, %</td>
<td>13.6±1.1</td>
<td>13.6±1.1</td>
<td>13.7±1.2</td>
<td>0.891</td>
</tr>
</tbody>
</table>

Data expressed as means SD compared with analysis of variance or by median and IQR (m (Q1–Q3) and compared with Kruskal-Wallis test and Tukey or Dunn tests for multiple comparison. Bold values are p<0.05.

*Detected versus undetected (p<0.05).
†Undetected versus inconclusive (p<0.05).
‡Detected versus inconclusive (p<0.05).

Table 5  Logistic regression final signs with symptoms and laboratory results independent predictors for detected COVID-19 in nasopharyngeal swab

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef±SE</th>
<th>OR</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucocytes, m (Q1–Q3)×10¹⁰/L</td>
<td>4320 (3620–5360)</td>
<td>4850 (4000–6520)</td>
<td>6160 (4905–7445)</td>
<td>&lt;0.0001*‡</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
<td>53 (45–63)</td>
<td>55 (49–65)</td>
<td>59 (52.5–65)</td>
<td>&lt;0.0001*†</td>
</tr>
<tr>
<td>Neutrophils (Abs), m (Q1–Q3)×10¹⁰/L</td>
<td>2379 (1827–3353)</td>
<td>2909 (2161–4116)</td>
<td>3780 (2799–4781)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>34 (27–42)</td>
<td>34 (26–41)</td>
<td>31 (28–38)</td>
<td>&lt;0.0001*†</td>
</tr>
<tr>
<td>Lymphocytes (Abs), m (Q1–Q3)×10¹⁰/L</td>
<td>1580 (1278±2014)</td>
<td>1920 (1495±2305)</td>
<td>2057 (1663±2473)</td>
<td>&lt;0.0001*‡</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>10 (7.9±13)</td>
<td>8 (7±10)</td>
<td>7 (6±9)</td>
<td>&lt;0.0001*‡</td>
</tr>
<tr>
<td>Monocytes (Abs)×10¹⁰/L</td>
<td>473±196</td>
<td>470±167</td>
<td>503±192</td>
<td>0.027*†</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
<td>0 (0–1.5)</td>
<td>1 (0–2)</td>
<td>1 (0–2)</td>
<td>&lt;0.0001*‡</td>
</tr>
<tr>
<td>Eosinophils (Abs) m (Q1–Q3)×10¹⁰/L</td>
<td>0 (0–62)</td>
<td>47 (11±88)</td>
<td>77 (10–151)</td>
<td>&lt;0.0001*‡</td>
</tr>
<tr>
<td>Basophils (%)</td>
<td>0±0.2</td>
<td>0±0</td>
<td>0±0</td>
<td>0.329</td>
</tr>
<tr>
<td>Platelets×10¹²/L</td>
<td>235±62</td>
<td>248±67</td>
<td>285±68</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

NPS-negative patients. These are well-known signs and symptoms of various viral infections, and COVID-19 testing should be reliant on a combination of these symptoms and a comprehensive understanding of the patients’ local, regional and travel history especially in resource-constrained conditions. HCP should treat any patient with these symptoms and a high likelihood of exposure as SARS-CoV-2 positive even in the absence of an appropriate test. Zhang et al. observed fever (91.7%), cough (75.0%), fatigue (75.0%) and gastrointestinal symptoms (39.6%) in their COVID-19 cohort.

In a meta-analysis, Li and colleagues8 reported that fever (88.5%), cough (68.6%), myalgia or fatigue (35.8%), expectoration (28.2%) and dyspnoea (21.9%) were all primary indicators of COVID-19. In this study, we also investigated if the combination of signs and symptoms could help in developing a decision-making rationale for ordering laboratory tests. Curiously, an increase in the frequency of anxiety and ‘difficulty in swallowing’ was observed among those patients with inconclusive SARS-CoV-2 NPS results. Psychological aspects and global mental health have already been the subject of a number of studies, as the mental toll of the patient becomes more evident.8–10 In China, more than 70% of the patients experienced moderate to high levels of psychological symptoms, specifically elevated scores for obsession compulsion, interperson sensitivity, phobic anxiety and psychoticism.11 Our results did not corroborate those of Zhang and colleagues,12 who showed a higher prevalence of insomnia (38.4% vs 30.5%, p<0.01) and anxiety (13.0% vs 8.5%, p<0.01) in non-HCP (n=1255)
patients, while we found no differences in the prevalence of anxiety between HCP and non-HCP in our study. This may be due to the methodology used, as this study was not designed to compare these two groups. It is not possible to further characterise the work and professional activity of our participants, but it is worth noting that there have been other studies that have identified differences in anxiety and stress among medical and nursing staff.1

Anosmia is a frequent symptom13 of COVID-19 and is often the only indicator in asymptomatic carriers.14 This symptom is transient, and it has been suggested that this anosmia is linked to the destruction of the epithelial cells in the nose. These cells have a high expression of ACE 2, the receptor for SARS-CoV-2, which allows the virus to penetrate the system.15

Dyspnoea is a well-characterised symptom of COVID-19 and has been shown to be closely related to the severity of the disease and mortality rates.16 17 Our study did not evaluate disease severity but rather focused on identification of clinical and laboratory data that could be used to predict COVID-19 infection in HCP, in an effort to allow for their rapid isolation to prevent wide spread infections among the hospital staff.

Our results showed that anosmia/hyposmia (p<0.0001), fever (p<0.0001), body pain (p<0.0001) and chills (p=0.001), in this specific order, were independent predictors for SARS-CoV-2 NPS detection. Moreover, the combination of these symptoms has a prognostic capacity of around 72% for SARS-CoV-2. This information should guide healthcare workers in determining the course of evaluations including laboratory testing, while allowing for the fact that the COVID-19 pandemic may contribute to revisions in the state and municipal health authority guidelines for clinical testing and isolation.

The laboratory results indicate that the total leucocytes, % of monocytes, eosinophils, CRP and platelet counts were all independent predictors of COVID-19. These factors were also identified in several previous COVID-19 studies.6 18 19 In this study, we were able to combine signs, symptoms and laboratory results in an LR analysis that identified various independent predictor values that could be used to supplement RT-PCR testing in resource-scarce environments. Leucocyte counts of under 5400/µL, relative monocytosis (>9%), eosinopenia and elevated CRP within the first 7 days from the onset of fever, anosmia/hyposmia and body pain were the main independent variables associated with positive RT-PCR results. Although platelets also appeared to be an independent predictor, the range for this value remained within the clinical reference values and would need to be compared with previous results from the same patient to be of a significant value. Additionally, the cut-off points for leucocyte counts and percentage of monocytes may also guide the interpretation of the complete blood cell count during the first days of infection. Additionally, these results may also be used during follow-up for hospitalised patients when AST, ALT, gamma-GT, LDH and alpha-HBDH are all markedly altered.20

The risk factors reported here may be used in future studies to evaluate associated medical interventions, hospitalisation and mortality rates. This cohort should also be expanded, and new longitudinal evaluations should be undertaken to better understand the condition of these patients in a postpandemic future.

Nonetheless, we were able to confirm a greater risk for infection in HCP. It is well known that HCP are subject to far greater continuous exposure to COVID-19 than the general public, thus increasing their infection rates. Noteworthy, this screening started at the beginning of the epidemic in Brazil and that the number of detected cases in this study retained a linear scale, suggesting that early infections with COVID-19 were more prevalent among HCP, and for this reason, close monitoring of this population might be crucial to reducing the burden on the healthcare system.

This study has several limitations associated with the fact that it is a cross-sectional, ongoing study, with an increasing number of patients. Although limited in number, data here may support other studies so that in the long term, a better meta-analysed prediction system can be developed. The HCP population is predominantly made up of younger people, and this may cause differences in the observations of this study versus studies conducted in older populations.21 22 Currently, laboratory-based RT-PCR is the recommended test for diagnoses of acute cases to ensure patients can be identified and isolated and to facilitate the public health response, as reviewed by Venter and Richter.23 However, the false-negative rate has important ramifications for gaining accurate clinical and epidemiological data, and false-negative results may lead to misdiagnoses in both patients and HCP with increased risk of infection transmission.24 So, combining routine laboratory test that can detect both acute phase proteins and specific altered leucocyte profile corresponding to COVID-19 infection could add parameters to more efficient control of suspected individuals. Nonetheless, the rapid development of point-of-care molecular or antigen tests are already a reality.25

Up to May 2020, the clinical diagnosis and medical intervention for COVID-19 has been restricted in HCP servicing the military, civil and federal police reaching 1626 confirmed cases.
In conclusion, positive SARS-CoV-2 NPS assays were associated with fever, anosmia or hyposmia, body pain and chills, and patients were all positive within the first 3–8 days after symptom onset. Elevated CRP, leucocyte counts under 5400/µL and relative mononcytosis (>9%) were all common among patients with COVID-19. These parameters may help to identify and isolate probable SARS-CoV-2 infections in the absence of RT-PCR tests.

Take home messages

► Healthcare professionals (HCPs) working at the frontline are among the groups most affected by the COVID-19 pandemic. We investigated the clinical features of 1297 individuals, mostly (80%) HCPs, who tested positive for the SARS-CoV-2 (COVID-19) during the period immediately following the pandemic declaration in Brazil (19 March–8 April 2020).
► Signs and symptom data and blood samples were collected for all individuals who were tested for SARS-CoV-2 by reverse transcription PCR (RT-PCR) assays in nasopharyngeal swab (NPS).
► C reactive protein (CRP), lactate dehydrogenase, aspartate aminotransferase and alanine aminotransferase were elevated among COVID-19 infected individuals, and leucometry differed between individuals within the different SARS-CoV-2 NPS detection results. Anosmia/hyposmia, fever, body pain and chills, in this specific order, were independent predictors for COVID-19. The estimated probability of COVID-19 detection when all four of these signs and symptoms were present was 72%. There was a trend of increasing number of SARS-CoV-2 positive test results in later weeks of analysis especially in HCP samples.
► Here, we identified that the significant clinical features of SARS-CoV-2 in Brazil included anosmia, fever, chills, body pain, elevated CRP, leucocytes under 5400x10^9/L and relative mononcytosis (>9%). These variables may help, in the absence of RT-PCR tests, to monitor the COVID-19 infection rate during a pandemic.

Handling editor Taher S Pillay.

Acknowledgements We would like to thank all team at the frontline for reception of patients, security and cleaning services. Undergraduate, interns and residents acting as volunteers were also deeply acknowledged. We would also like to thank Carlos Nunes, Andrea Benazzi, Karina Goulart, Tainah Lima, Miguel Garcia, Breno Sampaio and Marcus Alcolorado for data entry and Mário João Junior for electronic entry data development. We would like to thank Ana Clara Perrone and Editage (www.editage.com) for English language editing.

Collaborators PPC-UEJ against COVID-19 Group: Rosangela Gomes Martins (Research Division, Clementino Fraga Filho University Hospital, Federal University of Rio de Janeiro, Rio de Janeiro); Cinthia Duarte (Nurse Department, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Elizabeth Bittencourt (Administrative and Finance Services, Polyclinic Piquet Carneiro, Rio de Janeiro, State University, Rio de Janeiro); Anderson Loureiro (Pharmacy and Supply Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Maria Santos (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Vania Souza (Clinical Pathology Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Angela Maria Santos (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Angela Maria dos Santos (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Fábio de Oliveira Almeida (Clinical Pathology Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Fernando Silva, Maria Cristina Lopes (Nurse Department, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Marcelle Castro (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Areta Silva, Flavia Vasconcelos (Clinical Pathology Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Diego Moreira (Nurse Department, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Juliana Motta (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Cristiano Lima (Clinical Pathology Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Raphaella Menezes, Nathalia Brazão, Jeanie Nogueira, Ana Paula Villela Silva, Ingrid Abreu-Brito, Scarletta Costa, Roberta Lemes, Jessica de Paula, Giovanna Bongionanni, Ohana Bezerra, Valter Andrade-Neto (Histocompatibility and Cryopreservation Laboratory, Institute of Biology Roberto, Alcantara Gomes, Rio de Janeiro State University, Rio de Janeiro); Leonardo Morette (Clinical Pathology Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Rafael Barbosa, Jose Sanches (Logistic, Informatic and Infrastructure Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Pedro Melo (Laboratory of Biomedical Instrumentation, Institute of Biology Roberto Alcantara, Gomes, Rio de Janeiro State University, Rio de Janeiro); Sergio Freire (Information Technology and Education in Health Department, Faculty of Medical Sciences, Rio de Janeiro State University, Rio de Janeiro); Rolmo Souza (Communication and Human Resource Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Laiz Gomes (Health Research Support Facility Center (CAPCS), Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Deriz Feliizard, Alexandre Rodrigues (Administrative and Finance Services, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); Priscila Franco, Renata Miranda (Communication and Human Resource Service, Polyclinic Piquet Carneiro, Rio de Janeiro State University, Rio de Janeiro); RGM, IB, RR, CHC and LCP. Interpretation of data: IB, RR, CHC and LCP. Drafting of manuscript: LCP, RR and CHC. Critical revision: CHC and IB. All authors approved the final manuscript.

Funding The Laboratory of Histocompatibility and Cryopreservation received a thermocycler and a –80°C freezer from COVID-19 donation open account for Pedro Ernesto University Hospital. Rio de Janeiro Health Secretary provided nucleic acid extraction and reverse transcription PCR kits.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Local and National Ethics Committee (CAAE: 30135320.0.0000.5259).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. All data relevant to the study are included in the article. Data are not in a repository. Signs and symptoms, comorbidities and laboratory results may be available in a deidentified participant data.

This article is made freely available for use in accordance with BMJ’s website terms and conditions for the duration of the covid-19 pandemic or until otherwise determined by BMJ. You may use, download, and print the article for all lawful, non-commercial purpose (including text and data mining) provided that all copyright notices and trade marks are retained.

ORCID iD Luís Cristovao Porto http://orcid.org/0000-0003-1499-1821

REFERENCES


