JHGD
Journal of Human Growth and Development

www. jhgd.com.br

ORIGINAL ARTICLE

Factors associated with carrying out molecular tests for the diagnosis of COVID-19 in the State of Espírito Santo, Brazil

João Paulo Cola[a], Thiago Nascimento do Prado[a], Heletícia Scabelo Galavote[b], Cathiana do Carmo Dalto Banhos[b], Ana Carolina Giobini Micaela[b], Ramylle Mayse dos Santos[b], Ethel Leonor Noia Maciel[a]

Open acess

[a]Universidade Federal do Espírito Santo, Programa de Pós-graduação em Saúde Coletiva, Laboratório de Epidemiologia, Vitória, ES – Brasil;

[b]Universidade Federal do Espírito Santo, Centro Universitário Norte do Espírito Santo, Departamento de Ciências da Saúde, Vitória, ES – Brasil.

Corresponding author
joaopaulocola@gmail.com

Manuscript received: may 2022
Manuscript accepted: december 2022
Version of record online: march 2023

Abstract

Backgroung: Brazil was slow to implement an expanded testing policy for COVID-19, which may have affected the most vulnerable population's access to testing services.

Objective: to evaluate the factors associated with performing the molecular test for COVID-19.

Methods: cross-sectional study of secondary data from the COVID-19 panel in the state of Espírito Santo. COVID-19 suspicion notification forms were included between September 11, 2020 and March 2, 2021. Hierarchical logistic regression was used to estimate the odds ratio (OR) with 95% confidence interval (CI95%).

Results: 419,771 notification forms were analyzed. The prevalence of performing the molecular teste for COVID-19 was 81.1% (CI95% 81.0-81.2). Elderly (OR= 2.70 – CI95% 2.56-2.85), health professional (OR=1 .43 – CI95% 1.36-1.50), chronic cardiovascular disease (OR=1.13 – CI95% 1.09-1.17), diabetes mellitus (OR=1.07 – CI95% 1.01- 1.14) and hospitalization (OR=5.95 – CI95% 4.53;7.82) were more likely to have undergone the molecular test. Male sex (OR=0.96 – CI95% 0.94-0.98), black skin color (OR=0.75 – CI95% 0.73-0.78), yellow skin color (OR=0.74 – CI95% 0.71-0.77), residing in the northern health region (OR=0.37 – CI95% 0.36-0.39) and the homeless population (OR=0.76 – CI95% 0.67-0.85) had the lowest chance of having undergone the molecular test.

Conclusion: Social, economic, contextual factors and the risk of aggravation of the disease were associated with carrying out the molecular test for COVID-19 in the state of Espírito Santo. Actions are needed to guarantee the access of the most vulnerable population to molecular testing.

Keywords: COVID-19; COVID-19 nucleic acid testing; COVID-19 testing; cross-sectional studies.

Suggested citation: Cola JP, Prado TN, Galavote HS, Banhos CCD, Micaela ACG, Santos RM, Maciela ELN. Factors associated with carrying out molecular tests for the diagnosis of COVID-19 in the state of Espírito Santo, Brazil. *J Hum Growth Dev. 2023; 33(1):113-123.* DOI: http://doi.org/10.36311/jhgd.v33.13568

Authors summary

Why was this study done?
The study emerged from the concern of the epidemiological surveillance service in observing that many individuals were notified as suspects for COVID-19 and did not undergo the diagnostic test. Although the diagnostic test was available in health services, many cases were not closed because they did not have diagnostic criteria. In view of this scenario, it was decided to carry out a study to analyze the factors associated with not carrying out the diagnostic test for COVID-19.

What did the researchers do and find?
Using public data available on the COVID-19 Monitoring Panel in the state of Espírito Santo, we performed a hierarchical analysis to identify which factors were associated with not performing the molecular test for COVID-19. We describe that male individuals, black skin color, residing in the northern health region of the state of Espírito Santo and the homeless population were those who had the lowest chances of performing molecular diagnostic tests for COVID-19.

What do these findings mean?
Social, economic, contextual factors and the risk of worsening the disease were associated with carrying out the molecular test for COVID-19 in the state of Espírito Santo. Regardless of the presence of signs and symptoms, comorbidities and other risk factors, social factors are associated with not performing the molecular test for COVID-19. Actions that guarantee access to molecular testing in the SUS for all suspects of COVID-19 are necessary, especially for the most vulnerable population.
We used a hierarchical analysis to identify which factors were associated with not performing the molecular test for COVID-19. We describe that male individuals, black skin color, residing in the northern health region of the state of Espírito Santo and the homeless population were those who had the lowest chances of performing molecular diagnostic tests for COVID-19.

INTRODUCTION

Brazil registered the first confirmed case for COVID-19 in February 2020 where there was a shortage of diagnostic tests for the disease1. With reference to the epidemiological week 12 of the year 2022, Brazil has already registered 29,832,179 cases of COVID-19, being the third country with the highest number of confirmed cases in the world. Among the Brazilian states, Espírito Santo had the highest cumulative incidence rate, 13,201.7 cases per 100,000 inhabitants[1,2].

As the pandemic progressed, new diagnostic tests were introduced into clinical practice, which expanded access to diagnostic tests for the Brazilian population[3-5]. The tests available for the laboratory diagnosis of COVID-19 are divided into three simplified categories[3-5]. Serological tests for the detection of IgM and/or IgG antibodies with rapid results, but their results cannot be used as absolute evidence due to heterogeneity in sensitivity values and a population with high vaccination coverage[3,5]. The rapid antigen diagnostic test, which consists of detecting the viral antigen in just a few minutes, has been widely used in Brazil[1,5].

Two meta-analysis studies, published in 2020, describe that immunological and antigen research tests should be used as an aid in the diagnosis of the disease, in addition to other tests[3,4]. The reverse transcription polymerase chain reaction molecular test (RTq-PCR) detects the presence of the SARS-CoV-2 viral RNA and is the gold standard for having high sensitivity and specificity compared to other methods[4,5].

Until the epidemiological week 12 of the year 2022, Brazil carried out 29,224,15 RTq-PCR tests 1. In this scenario, the state of Espírito Santo is the tenth in carrying out the molecular test for COVID-19, registering 1,160,206 tests. However, Brazil was slow to implement an expanded testing policy[1,2]. At the beginning of the pandemic, the Ministry of Health offered diagnostic tests for specific populations such as the elderly and people with risk factors with characteristic symptoms of COVID-19, which ended up restricting the access of a portion of the population to the molecular test for the diagnosis of COVID-19[6].

This restriction of the population to testing at the beginning of the pandemic, the low number of tests made available by the unified health system network and the limitations of the municipalities regarding the specific structure and logistics to carry out the molecular test may have affected the access of the most vulnerable population. vulnerable to testing services[1,6]. The black population, with low economic power, living on the streets and living in unhealthy places have difficulties in accessing diagnostic tests for COVID-19[7-9]. However, to improve our knowledge, no studies were found in Brazil and in other countries in a similar socioeconomic development process. Thus, the objective is to evaluate the factors associated with carrying out the molecular test for COVID-19.

METHODS

Study design and context

This is a cross-sectional study based on secondary data from the COVID-19 PANEL of the Secretary of State for Health of Espírito Santo, fed daily through notifications of suspected cases of COVID-19 carried out by health services through the electronic notification system e- SUS VS[10].

In 2019, the state of Espírito Santo had 4,018,650 inhabitants distributed in 78 municipalities, divided into four health regions, North, South, Central and Metropolitan, in which the only State Central Laboratory of Public Health is located that performs molecular tests for the diagnosis of COVID-19 in the Unified Health System, located in the capital, Vitória[11].

The selected period was determined by the technical notes published by the Secretary of State for Health of Espírito Santo. We included the forms from September 11, 2020 to March 2, 2021, which corresponds to the date of publication of Technical Note 073/2020 on September 11, 2020, which determined the testing of all suspects of COVID-19 by the method and Technical Note 02/2021 on March 2, 2021, which guides the performance of the specific antigen capture test with the first-choice method[12,13].

Figure1 A: Left tes

Participants

Notifications with municipality of residence in the state of Espírito Santo were included. Those that contained information about having performed other diagnostic methods such as serology and rapid tests were excluded.

Variables

Performing the test using the molecular method was considered the dependent variable of the study. A variable "Performed molecular diagnosis for COVID-19" (yes; no) was created. The sheets that had the molecular test collection date were classified as "Yes" and the sheets without collection date were classified as "No".

The explanatory variables were grouped in a model of hierarchical levels adapted from the model of tuberculosis determinants[14]:

Sociodemographic variables - Level I:

- Gender (female; male);
- Skin color (self-declared according to IBGE: white, black, brown, yellow, indigenous);
- Age (in life cycles: children (0 to 9 years old), adolescents (10 to 19 years old), adults (20 to 59 years old) and elderly (≥ 60 years old);
- Education (in years: 0; 1-4; 5-8; 9-12; >12).

Contextual Variables – Level II:

- Health region (metropolitan; south; central; north);
- Homeless population (no; yes);
- Health professional (no; yes);
- Disabled person (no; yes).

Variables of associated diseases/comorbidities - Level III:

- Chronic cardiovascular disease (no; yes);
- Chronic lung disease (no; yes);
- Chronic kidney disease (no; yes);
- Diabetes mellitus (no; yes);
- Smoking (no; yes);
- Obesity (no; yes).

Variables of the current clinical situation related to COVID-19 – Level IV:

- Fever (no; yes);
- Cough (no; yes);
- Breathing difficulty (no; yes);
- Coryza (no; yes);
- Sore throat (no; yes);
- Diarrhea (no; yes);
- Headache (no; yes);
- Hospital admission (no; yes).

Data source and measurement

Data were obtained from the COVID-19 public panel, available daily by the Secretary of State for Health of Espírito Santo at the electronic address: https://coronavirus.es.gov.br/painel-covid-19-es, accessed on 19 May 2021[10].

Statistical methods

For the description of the variables, absolute and relative frequencies were used. In the bivariate analysis, logistic regression was used to obtain the measures of association between the variables and having performed a molecular diagnosis for COVID-19.

Variables with a p-value <0.20 in the bivariate analysis were introduced into the regression model according to the hierarchical levels: level I (sociodemographic), level II (contextual), level III (associated diseases/comorbidities) and level IV (current clinical situation related to COVID-19)15. Variables were maintained at the following levels as an adjustment if p value < 0.05. The association of each factor with having performed the molecular test is interpreted as adjusted for the variables of the hierarchical levels above it and also of the same level.

Results were expressed by the measure of association odds ratio (OR) and 95% confidence intervals (95%CI). Statistical analyzes were performed in Stata v. 14.0 (StataCorp, CollegeStation, TX, USA).

Ethical aspects

This study used secondary data from notification forms, non-identifiable, in the public domain, with open access, available in the PANEL COVID-19 of the Secretary of State for Health of Espírito Santo, without being assessed by a research ethics committee.

RESULTS

A total of 664,301 suspected COVID-19 notification forms were identified during the study period, of which 340,678 (51.2%) contained information on carrying out the molecular test for COVID-19, 244,530 (36.9%) had performed other laboratory methods and in 79,093 (11.9%) there were no diagnostic tests. The total study sample was 419,771 notification forms. The overall prevalence of molecular testing for COVID-19 in the sample was 81.1% (95%CI 81.0%;81.2%).

In the hierarchical analysis, sociodemographic variables, level I, male gender (OR=0.96 – 95%CI 0.94-0.98), black skin color (OR=0.75 – 95%CI 0.73- 0.78), brown (OR=0.81 – 95%CI 0.79-0.83) and yellow (OR=0.74 – 95%CI 0.71-0.77) when compared to white skin color, had the lowest chance of performing the molecular test for COVID-19. Elderly aged ≥ 60 years (OR=2.70 – 95%CI 2.56-3.85), when compared to children aged 0 to 9 years, had a greater chance of undergoing the molecular test for COVID-19, as well as individuals with more than 12 years of schooling (OR=1.83 – 95%CI 1.73;1.93) when compared with illiterates. In level II, contextual variables, living in the northern health region (OR=0.37 – 95%CI 0.36-0.39) had the lowest chance of performing the molecular test when compared to the metropolitan health region. Health professionals had the highest chance (OR=1.43 – 95%CI 1.36-1.50), whereas the homeless population (OR=0.76 – 95%CI 0.67-0.85) had the lowest chance of performing the molecular test (table 3).

Among comorbidities, level III variables, chronic cardiovascular disease (OR=1.13 – 95%CI 1.09-1.17) and diabetes mellitus (OR=1.07 – 95%CI 1.01-1.14)

were more likely to perform the molecular test. Smoking, on the other hand, had the lowest chance of performing the test (OR=0.71 – 95%CI 0.67-0.75). At level IV, the variables of the clinical situation related to COVID-19, it is observed that characteristic symptoms of COVID-19 such as fever, difficulty breathing, runny nose, sore throat did not show statistical significance for performing the molecular test. Cough (OR=0.95 – 95%CI 0.92-0.97) and headache (OR=0.90 – 95%CI 0.88;0.92) had the lowest odds of having already been hospitalized for COVID-19. 19 (OR=1.50 – 95%CI 1.43;1.58) had the highest chance of having performed the molecular test for the diagnosis of the disease (table 3).

Table 1: Distribution of the frequency of molecular diagnosis for COVID-19 by sociodemographic variables, Espírito Santo, September 11, 2020 to March 2, 2021

Variables	Performance of molecular diagnosis for COVID-19	
	Yes N (%)	No N (%)
Sex		
Feminine	195.219 (57.55)	43.810 (55.87)
Masculine	143.968 (42.45)	34.606 (44.13)
Skin color		
White	103.083 (39.47)	19.783 (31.52)
black	20.244 (7.75)	5.383 (8.58)
brown	119.138 (45.62)	31.451 (50.11)
Yellow	18.262 (6.99)	5.644 (8.99)
Indigenous	452 (0.17)	507 (0.81)
Age (Lifecycle)		
Child	18.556 (5.47)	10.152 (12.94)
Adolescent	25.838 (7.62)	7.914 (10.09)
Adult	254.616 (75.05)	53.151 (67.76)
Elderly	40.482 (11.87)	7.226 (9.21)
Education (years)		
0	15.432 (6.96)	6.681 (12.71)
1-4	18.900 (8.52)	5.343 (10.16)
5-8	36.325 (16.38)	9.789 (18.62)
9-12	97.947 (44.18)	22.002 (41.85)
> 12	53.120 (23.96)	8.762 (16.67)
Health Region		
Metropolitan	244.930 (72.19)	50.993 (65.00)
South	49.158 (14.49)	7.024 (8.95)
Central	29.975 (8.83)	12.133 (15.47)
North	15.215 (4.48)	8.301 (10.58)
Street population		
No	337.354 (99.43)	77.888 (99.28)
Yes	1.924 (0.57)	563 (0.72)
Health professional		
No	294.173 (93.84)	70.216 (96.04)
Yes	2.895 (3.96)	19.294 (6.16)
Disabled person		
No	335.475 (98.88)	77.536 (98.83)
Yes	3.803 (1.12)	915 (1.17)

Table 2. Distribution of frequency of carrying out molecular diagnosis for COVID-19 by clinical variables, Espírito Santo, September 11, 2020 to March 2, 2021

Variables	Performance of molecular diagnosis for COVID-19	
	Yes N (%)	No N (%)
chronic cardiovascular disease		
No	298.642 (88.04)	70.601 (90.00)
Yes	40.576 (11.96)	7.845 (10.00)
chronic lung disease		
No	328.254 (96.77)	75.456 (96.21)
Yes	10.954 (3.23)	2.970 (3.79)
chronic kidney disease		
No	338.149 (99.68)	78.248 (99.75)
Yes	1.085 (0.32)	199 (0.25)
diabetes mellitus		
No	325.186 (95.86)	75.802 (96.63)
Yes	14.034 (4.14)	2.643 (3.37)
Smoking		
No	331.380 (97.69)	76.190 (97.13)
Yes	7.840 (2.31)	2.255 (2.87)
Obesity		
No	332.543 (98.11)	76.902 (98.04)
Yes	6.420 (1.89)	1.534 (1.96)
Fever		
No	212.936 (62.77)	47.868 (61.02)
Yes	126.276 (37.23)	30.574 (38.98)
Cough		
No	150.714 (44.43)	34.203 (43.60)
Yes	188.526 (55.57)	44.244 (56.40)
breathing difficulty		
No	290.109 (85.52)	67.191 (85.65)
Yes	49.137 (14.48)	11.256 (14.35)
runny nose		
No	193.454 (57.03)	44.121 (56.24)
Yes	145.783 (42.97)	34.327 (43.76)
Sore throat		
No	215.024 (63.39)	50.430 (64.30)
Yes	124.187 (36.61)	27.997 (35.70)
Diarrhea		
No	282.636 (83.32)	65.329 (83.28)
Yes	56.598 (16.68)	13.118 (16.72)
Headache		
No	157.396 (46.40)	36.931 (47.09)
Yes	181.813 (53.60)	41.497 (52.91)
Hospital internment		
No	335.995 (99.03)	78.298 (99.80)
Yes	3.283 (0.97)	153 (0.20)

Table 3: Odds ratio (OR) of performing molecular diagnosis for COVID-19 by study variables, Espírito Santo, September 11, 2020 to March 2, 2021

Variables	OR without ajustment (IC95%)	p-value b	OR ajusted (IC95%)	p-value b
Sociodemographic - Level I				
Sex		<0.001		0.001
Feminine	1.00		1.00	
Masculine	0.93 (0.91-0.94)		0.96 (0.94-0.98)	
skin color		<0.001		<0.001
White	1.00		1.00	
black	0.72 (0.69-0.74)		0.75 (0.73-0.78)	
brown	0.72 (0.71-0.74)		0.81 (0.79-0.83)	
Yellow	0.62 (0.60-0.64)		0.74 (0.71-0.77)	
Indigenous	0.17 (0.15-0.19)		0.97 (0.68-1.37)	
Age (Lifecycle)		<0.001		<0.001
Child	1.00		1.00	
Adolescent	1.78 (1.72-1.84)		1.46 (1.29-1.64)	
Adult	2.62 (2.55-2.68)		2.13 (2.03-2.24)	
Elderly	3.04 (2.94-3.15)		2.70 (2.56-2.85)	
Education (years)		<0.001		<0.001
0	1.00		1.00	
1-4	1.53 (1.46-1.59)		1.22 (1.16-1.28)	
5-8	1.60 (1.54-1.66)		1.19 (1.13-1.26)	
9-12	1.92 (1.86-1.99)		1.37 (1.31-1.44)	
> 12	2.62 (2.53-2.72)		1.83 (1.73-1.93)	
Contextual - Level II				
health region		<0.001		<0.001
metropolitan	1.00		1.00	
South	1.45 (1.41-1.49)		0.99 (0.96-1.02)	
Central	0.51 (0.50-0.52)		0.56 (0.54-0.58)	
North	0.38 (0.37-0.39)		0.37 (0.36-0.39)	
Street population		<0.001		<0.001
No	1.00		1.00	
Yes	0.78 (0.71-0.86)		0.76 (0.67-0.85)	
Health professional		<0.001		<0.001
No	1.00		1.00	
Yes	1.59 (1.52-1.65)		1.43 (1.36-1.50)	
disabled person		0.279		-
No	1.00		-	-
Yes	0.96 (0.89-1.03)		-	-
Associated diseases/ comorbidities - Level III				
chronic cardiovascular disease		<0.001		<0.001
No	1.00		1.00	
Yes	1.22 (1.19-1.25)		1.13 (1.09-1.17)	
chronic lung disease		<0.001		0.220
No	1.00		1.00	
Yes	0.84 (0.81-0.88)		0.96 (0.91-1.02)	

Table 3: Odds ratio (OR) of performing molecular diagnosis for COVID-19 by study variables, Espírito Santo, September 11, 2020 to March 2, 2021

Variables	OR without ajustment (IC95%)	p-value b	OR ajusted (IC95%)	p-value b
chronic kidney disease		0.002		0.057
No	1.00		1.00	
Yes	1.26 (1.08-1.46)		1.22 (0.99-1.49)	
diabetes mellitus		<0.001		0.016
No	1.00		1.00	
Yes	1.23 (1.18-1.29)		1.07 (1.01-1.14)	
smoking		<0.001		<0.001
No	1.00		1.00	
Yes	0.79 (0.76-0.83)		0.71 (0.67-0.75)	
Obesity		0.256		-
No	1.00		-	
Yes	0.96 (0.91-1.02)		-	
Current clinical situation related to COVID-19 - Level IV				
Fever		<0.001		0.022
No	1.00		1.00	
Yes	0.92 (0.91-0.94)		1.02 (1.00-1.04)	
Cough		<0.001		<0.001
No	1.00		1.00	
Yes	0.96 (0.95-0.98)		0.95 (0.92-0.97)	
breathing difficulty		0.329		0.279
No	1.00		1.00	
Yes	1.01 (0.98-1.03)		0.98 (0.95-1.01)	
runny nose		0.001		0.279
No	1.00		1.00	
Yes	0.96 (0.95-0.98)		1.01 (0.99-1.01)	
Sore throat		<0.001		0.143
No	1.00		1.00	
Yes	1.04 (1.02-1.05)		1.01 (0.99-1.03)	
Diarrhea		0.796		0.576
No	1.00		1.00	
Yes	0.99 (0.97-1.01)		1.00 (0.99-1.03)	
headache		<0.001		<0.001
No	1.00		1.00	
Yes	1.02 (1.01-1.04)		0.90 (0.88-0.92)	
Hospital internment		<0.001		<0.001
No	1.00		1.00	
Yes	4.99 (4.25-5.88)		5.93 (4.51-7.79)	

Adjusted for variables belonging to hierarchical levels above with p-value <0.05, as well as for variables at the same level. Wald test.

DISCUSSION

Social, economic, contextual factors and the risk of disease aggravation were associated with carrying out the molecular test for COVID-19 in the state of Espírito Santo. Elderly, more than 12 years of study, health professional, chronic cardiovascular disease, diabetes mellitus and hospitalization were positively associated with the performance of the molecular test. Black and yellow skin color, residing in the northern health region and the homeless population were negatively associated with carrying out the molecular test. Therefore, the data found in this study demonstrate that the social determinants of health are not only associated with transmission, hospitalization and deaths from COVID-19, as well as with access to and performance of tests for diagnosing the disease[16-19].

The research was based on secondary data, subject to filling errors, despite the availability of guidelines for filling in the notification forms. The exclusion of the population that performed other diagnostic methods from the study was due to the study period. Between September 11, 2020 and March 2, 2021, the state of Espírito Santo determined that all COVID-19 suspects should be tested using the molecular method, with no other diagnostic test methods provided by the Unified Health System[12,13].

To minimize these occurrences, hierarchical logistic regression analysis was performed only with individuals with full completeness of all variables. The exclusion of incomplete forms may have generated information and sample selection bias. This fact may have increased the decrease or increase in the prediction of some variables in the model. As the notification sheets were not identified, it was not possible to identify duplicate sheets.

Older individuals were more likely to undergo the molecular test for COVID-19 and this result may be linked to the prioritization of access to care and laboratory diagnoses. This prioritization can be a measure to reduce the rates of hospitalizations and deaths in this group. Adults and the elderly have the highest risk of worsening and death, as demonstrated in cross-sectional studies carried out in Europe and Brazil[16,19,20]. A cross-sectional study carried out in 2020 in Italy describes that aging is a risk factor for the development of morbidities and thus greater susceptibility and less resistance to infectious diseases such as COVID-19, particularly individuals over 65 years of age[17].

Regarding the skin color variable, it is believed that the result found in our study may be related to this self-declared black/brown population having less access to health services conditioned to low economic power and education in Brazil[18,21,22].

In several countries, black skin color was associated with a higher risk of transmission, hospitalization and death from COVID-19[22]. A study carried out in the United States described that the transmission rate is three times higher in predominantly black counties, while the mortality rate is six times higher in these counties[7]. In England, the black population had a 3.35 higher risk of being infected with the COVID-19 virus and being the most likely to be hospitalized[9]. Therefore, other culturally structured factors may contribute to the vulnerability of the black race to COVID-19 outcomes.

The homeless population was less likely to perform the molecular test for COVID-19. The homeless population is more vulnerable to COVID-19 infection and difficulties in accessing diagnostic tests in developed and developing countries[7-9]. This result is linked to socioeconomic factors, since homeless individuals are exposed to extreme poverty and have difficulty accessing the public health system. Living on the streets puts the individual in front of different circumstances that can lead to illness, being more frequent in the pandemic period, in addition to prejudice and social exclusion[22,23].

People residing in the metropolitan health region of the state of Espírito Santo had greater access to the molecular test when compared to residents of other regions. This data may be related to the fact that the first cases appeared in large centers and after some period the virus internalized[24]. Large regions and metropolises have income concentration and more complex and specialized health services that can provide a greater supply of laboratories that perform molecular tests and logistical support for sample collection to perform the test[25].

An ecological study carried out in 2020 with secondary data from 50 countries observed that regions with low and medium income have greater difficulty in carrying out tests because they do not have logistics and specialized laboratories for this, having a low testing rate[26]. Therefore, the northern region of the state of Espírito Santo is justified for presenting the lowest chance, since it is located far from the reference laboratory, as well as little infrastructure and logistics for carrying out the test.

Health professionals were more likely to perform the test. During the pandemic, it is health professionals who are directly exposed to individuals positive for COVID-19. Therefore, there is a need to make adequate tests available for timely diagnosis in order to interrupt the virus transmission chain[27,28].

In the state of Espírito Santo, in a cross-sectional study that analyzed the factors associated with hospitalization and death due to COVID-19 between February 28, 2020 and September 1, 2020, a prevalence of comorbidity was 2.66 times higher among hospitalized patients. and 3.63 times higher among deaths[29]. Individuals with comorbidities were the majority among those admitted in March 2020 to a hospital in Saudi Arabia[30]. Although comorbidities increase the chances of worsening and death of the disease, our study only cardiovascular diseases and diabetes mellitus showed differences in whether or not to perform the molecular test for COVID-19.

Hospital environments had to resort to adaptations and adaptations due to the COVID-19 pandemic and its demands, such as mass testing. The high percentage of patients with comorbidities and the elderly admitted to hospitals require frequent testing because this group has a higher risk of severe respiratory disease and the risk of local transmission[29,31]. Because of this, these environments have more access for sample acquisition, device preparation and operation, and thus, greater chances of performing the molecular test.

Several social determinants have effects on the outcomes of the COVID-19 pandemic. Thus, the theme should be one of the research priorities in the pandemic.

Studies with the objective of minimizing health inequalities, with efforts to guarantee access to diagnosis for the entire population and to implement policies for access to diagnostic tests aimed at the most vulnerable population, can reduce the negative effects of the pandemic in Brazil.

One of the strong points of the study is the sample size, allowing statistical power to capture the differences between the groups. In addition, data were extracted from the electronic panel for COVID 19, which provides open data in real time and with the quality of data already evaluated in other previously published studies[32].

To the best of our knowledge, this is the only Brazilian study that studied the factors associated with carrying out molecular tests for the diagnosis of COVID-19, in the context of a single health system, in a country with great social inequalities. The data obtained expose the most vulnerable groups that found it difficult to access laboratory diagnosis.

CONCLUSION

White skin color, higher education, elderly, residing in regions with greater structure and logistics for molecular test collection, health professionals, patients with chronic cardiovascular disease, diabetes mellitus and hospitalization were more likely to undergo molecular testing. Actions that guarantee access to molecular testing in the SUS for all suspects of COVID-19 are necessary, especially for the most vulnerable population.

Authors' contributions

All authors performed a critical review, approved the final version and declare themselves responsible for the manuscript's content, ensuring its accuracy and integrity. João Paulo Cola: designed the study and analyzed the data, interpreted the results and wrote the manuscript. Thiago Nascimento do Prado: designed the study and analyzed the data, interpreted the results and wrote the manuscript; Heletícia Scabelo Galavote: designed the study and analyzed the data, interpreted the results and wrote the manuscript; Cathiana do Carmo Dalto Banhos: designed the study and analyzed the data, interpreted the results and wrote the manuscript; Ana Carolina Giobini Micaela: designed the study and analyzed the data, interpreted the results and wrote the manuscript; Ramylle Mayse dos Santos: designed the study and analyzed the data, interpreted the results and wrote the manuscript; Ethel Leonor Noia Maciel: designed the study and analyzed the data, interpreted the results and wrote the manuscript.

Funding

The study was not funded.

Acknowledgments

Not applicable.

Conflict of interests

The authors have no conflict of interests.

REFERENCES

1. Ministério da Saúde. Secretaria de Vigilância em Saúde. Boletim Epidemiológico Especial – 106. Doença pelo novo Coronavírus – COVID-19. Secretaria de Vigilância em Saúde. Brasília-DF. 2022.
2. Sousa CDK, Morais TC, Daboin BEG, Portugal I, Calvalcanti MPE, Echeimberg JO, et al. Perfil epidemiológico da COVID-19 no Estado do Espírito Santo, Brasil, de março de 2020 a junho de 2021. J Hum Growth Dev. 2021; 31(3):507-520. doi: 10.36311/jhgd.v31.12770
3. Cheng MP, Papenburg J, Desjardins M, Kanjilal S, Quach C, Libman M, Dittrich S, Yansouni CP. Diagnostic Testing for Severe Acute Respiratory Syndrome–Related Coronavirus-2: A Narrative Review. Annals of Internal Medicine. 2020; 172(11): 726-734. DOI: 10.7326/M20-1301
4. Castro R, Luz PM, Wakimotoc MD, Velosoc VG, Grinsztejnc B, Perazzo H. COVID-19: a meta-analysis of diagnostic test accuracy of commercial assays registered in Brazil. Brazilian Journal of Infectious Diseases. 2020; 24(2): 180-187. DOI: 10.1016/j.bjid.2020.04.003
5. Böger B, Fachi MM, Vilhena RO, Cobre AF, Tonin FS, Pontarolo R. Systematic review with meta-analysis of the accuracy of diagnostic tests for COVID-19. Am J Infect Control. 2021; 49(1): 21-29. DOI: 10.1016/j.ajic.2020.07.011
6. Henriques CMP, Vasconcelos W. Crises dentro da crise: respostas, incertezas e desencontros no combate à pandemia da COVID-19 no Brasil. Estud. av. 2020; 34(99): 25-44. DOI: 10.1590/s0103-4014.2020.3499.003
7. Abrams E, Szefler SJ. COVID-19 and the impact of social determinants of health. The Lancet Resp. Medicine. 2020; 8(7): 659-661. DOI: 10.1016/s2213-2600(20)30234-4
8. Tsai J, Wilson M. COVID-19: a potential public health problem for homeless populations. The Lancet Public Health. 2020; 5(4): 186-187. DOI: 10.1016/s2468-2667(20)30053-0
9. Niedzwiedz CL, O'Donnell CA, Jani BD, Demou E, Ho FK, Celis-Morales C, et al. Ethnic and socioeconomic diferences in SARS-CoV-2 infection: prospective cohort study using UK Biobank. BMC Medicine. 2020; 18: 169. DOI: 10.1186/s12916-020-01640-8
10. Espírito Santo. Secretaria de Estado da Saúde do Espírito Santo. Painel COVID-19 – Estado do Espírito Santo. Vitória: Secretaria de Estado da Saúde do Espírito Santo; 2021.
11. Espírito Santo. Secretaria de Estado da Saúde do Espírito Santo. Plano Estadual de Saúde 2020-2023. Vitória: Secretaria de Estado da Saúde do Espírito Santo; 2019.

12. Espírito Santo. Secretaria de Estado da Saúde do Espírito Santo. Gerencia de Vigilância em Saúde. Nota técnica COVID-19 nº 73/2020 – GEVS/SESA/ES. Definição de Casos Operacionais e Critérios de Coleta. Vitória: Secretaria de Estado da Saúde do Espírito Santo; 2020.
13. Espírito Santo. Secretaria de Estado da Saúde do Espírito Santo. Gerencia de Vigilância em Saúde. Nota técnica COVID-19 nº 02/2021 – GEVS/SESA/ES. Definição de Casos Operacionais e Critérios de Coleta. Vitória: Secretaria de Estado da Saúde do Espírito Santo; 2021.
14. Maciel EL, Reis-Santos B. Determinants of tuberculosis in Brazil: from conceptual framework to practical application. Rev. Panam. Salud. Publica. 2015; 38(1): 28-34.
15. Shipe ME, Deppen AS, Farjah F, Grogon EL. Developing prediction models for clinical use using logistic regression: an overview. J Thorac Dis. 2019; 11(4): 574-84. DOI: 10.21037/jtd.2019.01.25
16. Cuschieri S, Grech S. At-risk population for COVID-19: multimorbidity characteristics of a European small Island state. Public Health. 2021; 192(1): 33-36. DOI: 10.1016/j.puhe.2020.12.012
17. Palmieri L, Vanacore N, Donfrancesco C, Lo Noce C, Canevelli M, Punzo O, et al. Clinical Characteristics of Hospitalized Individuals Dying With COVID-19 by Age Group in Italy. J Gerontol A Biol Sci Med Sci. 2020; 75(9):1796-1800. DOI: 10.1093/gerona/glaa146
18. Millett GA, Jones AT, Benkeser D, Baral S, Mercer L, Beyrer C, et al. Assessing differential impacts of COVID-19 on black communities. Annals of Epidemiology. 2020; 47(1): 37-44. DOI: 10.1016/j.annepidem.2020.05.003
19. Palmieri L, Palmer K, Lo Noce C, Meli P, Giuliano M, Floridia M, et al. Differences in the clinical characteristics of COVID-19 patients who died in hospital during different phases of the pandemic: national data from Italy. Aging Clin Exp Res. 2021; 33(1): 193–199. DOI: 10.1007/s40520-020-01764-0
20. Maciel EL, Jabor P, Goncalves Júnior E, Tristão-Sá R, Lima RCD, Reis-Santos B, et al. Fatores associados ao óbito hospitalar por COVID-19 no Espírito Santo, 2020. Epidemiol Serv Saúde. 2020; 29(4): e2020413. DOI: 10.1590/S1679-49742020000400022
21. Goes EF, Ramos DO, Ferreira AJF. Desigualdades raciais em saúde e a pandemia da Covid-19. Trab. Educ. Saúde. 2020; 18(3): e00278110. DOI: 10.1590/1981-7746-sol00278
22. Estrela FM, Soares CFS, Cruz MA, Silva AF, Santos JRL, Moreira TMO, et al. Pandemia da Covid 19: refletindo as vulnerabilidades a luz do gênero, raça e classe. Ciência & Saúde Coletiva. 2020; 25(9): 3431-3436. DOI: 10.1590/1413-81232020259.14052020
23. Ahmed F, Ahmed N, Pissarides C, Stiglitz J. Why inequality could spread COVID-19. The Lancet Public Health. 2020; 5(5): e240. DOI: 10.1016/S2468-2667(20)30085-2
24. Candido DS, Claro IM, Jesus JG, Souza WM, Moreira FRR, Dellicour S, et al. Evolution and epidemic spread of SARS-CoV-2 in Brazil. Science. 2020; 369(1): 1255-1260. DOI: 10.1126/science.abd2161
25. Albuquerque MV, Ribeiro LHL. Desigualdade, situação geográfica e sentidos da ação na pandemia da COVID-19 no Brasil. Cadernos de Saúde Pública. 2020; 36(12): e00208720. DOI: 10.1590/0102-311X00208720
26. Pilecco, FB, Coelho CG, Fernandes QHRF, Silveira IH, Pescarini JM, Ortelan N, et. al. Os efeitos da testagem laboratorial nos indicadores de acompanhamento da COVID-19: uma análise dos 50 países com maior número de casos. Epidemiol Serv Saúde. 2021; 30(2): e2020722. DOI: 10.1590/s1679-49742021000200002
27. Campos ACV, Leitão LPC. Letalidade da COVID-19 entre profissionais de saúde no Pará. Brasil. J Health NPEPS. 2021; 6(1): 22-34. DOI: 10.30681/252610105190
28. Fernandes FS, Toniasso SCC, Leitune JCB, Brum MCB, Leotti VB, Dantas Filho FF, et al. COVID-19 among healthcare workers in a Southern Brazilian Hospital and evaluation of a diagnostic strategy based on the RT-PCR test and retest for SARS-CoV-2. Eur Rev Med Pharmacol Sci. 2021; 25(8): 3365-3374. DOI: 10.26355/eurrev_202104_25748
29. Mascarello KC, Vieira ACB, Souza ASS, Marcarini WD, Barauna VG, Maciel ELN. Hospitalização e morte por COVID-19 e sua relação com determinantes sociais da saúde e morbidades no Espírito Santo: um estudo transversal. Epidemiol. Serv. Saúde. 2021; 30(3): e2020919. DOI: 10.1590/S1679-49742021000300004
30. Ghoraba MA, Albadi MA, Ibrahim AA, Alowais MM, Alqahtani GM, Alosaimi FA, et al. Clinical and demographic characteristics of patients with coronavirus disease 2019 in Security Forces Hospital, Riyadh, Saudi Arabia. J Family Med Prim Care. 2021; 10(2): 947-52. DOI: 10.4103/jfmpc.jfmpc_1484_20
31. Li SL, Pereira RHM, Prete CA Jr, Zarebski AE, Emanuel L, Alves PJH, et al. Higher risk of death from COVID-19 in low-income and non-White populations of São Paulo, Brazil. BMJ Glob Health. 2021; 6(4): e004959. DOI: 10.1136/bmjgh-2021-004959

32. Maciel EL, Jabor PM, Goncalves E Jr, Siqueira PC, Prado TN, Zandonade E. Estudo da qualidade dos Dados do Painel COVID-19 para crianças, adolescente e jovens, Espírito Santo – Brasil, 2020. Esc. Anna Nery. 2021; 25(spe): e20200509. DOI: 10.1590/2177-9465-EAN-2020-0509

Resumo

Introdução: o Brasil demorou a implementar uma política de testagem ampliada para COVID-19 no qual pode ter afetado o acesso da população mais vulnerável aos serviços de testagem.

Objetivo: analisar os fatores associados à realização de testes moleculares para o diagnóstico da COVID-19.

Método: estudo transversal de dados secundários do painel COVID-19 do estado do Espírito Santo. Foram incluídas fichas de notificação de suspeita de COVID-19 entre 11 de setembro de 2020 a 02 de março de 2021. Empregou-se regressão logística hierárquica para estimativa de razão de chances (odds ratio, OR) com intervalo de confiança de 95% (IC95%).

Resultados: Foram incluídos no estudo 419.771 fichas de notificação. A prevalência da realização do teste molecular para COVID-19 foi 81,1 % (IC95% 81,0%;81,2%). Idosos (OR= 2,70 – IC95% 2,56-2,85), profissional da saúde (OR=1,43 – IC95% 1,36-1,50), doença cardiovascular crônica (OR=1,13 – IC95% 1,09-1,17), diabetes mellitus (OR=1,07 – IC95% 1,01-1,14) e hospitalização (OR=5,95 – IC95% 4,53;7,82) apresentaram maior chance de ter realizado o teste molecular. Sexo masculino (OR=0,96 – IC95% 0,94-0,98), cor da pele preta (OR= 0,75 – IC95% 0,73-0,78), cor da pele amarela (OR=0,74 – IC95% 0,71-0,77), residir na região norte de saúde (OR=0,37 – IC95% 0,36-0,39) e a população em situação de rua (OR=0,76 – IC95% 0,67-0,85) apresentaram a menor chance de ter realizado o teste molecular.

Conclusão: Fatores sociais, econômicos e o risco de agravamento da doença foram associados a realização do teste molecular para COVID-19 no estado do Espírito Santo. É necessário ações que garantam o acesso da população mais vulnerável ao teste molecular.

Palavras-chave: COVID-19; teste para COVID-19; teste de ácido nucleico para COVID-19; estudos transversais.