



Transmission care: what led Ceará to be the epicenter of COVID-19?

Cuidados com a transmissão: o que levou o Ceará ao epicentro da COVID-19?

Cuidados de la transmisión: ¿qué ha hecho Ceará para ser el epicentro de la COVID-19?

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ABSTRACT

Objective: To investigate the care taken by the population of Ceará and their perceptions in search for answers about what may have led Ceará to be the epicenter of COVID-19 in Northeastern Brazil. **Methods:** An online questionnaire containing questions about sociodemographic aspects and perceptions and care related to the transmission of coronavirus 2 was administered to 2,452 people in 2020. Descriptive statistics was performed and associations between variables was checked by the Chi-squared test with a 5% significance level. **Results:** Men wore masks and washed their hands less often ($p < 0.001$) than women ($p < 0.001$). Those who lived in the countryside self-isolated less ($p = 0.004$), wore masks less often, washed their hands less often ($p < 0.001$) and perceived that people around them did not comply with preventive measures like wearing masks ($p < 0.001$). Similarly, the youngest were those who self-isolated the least ($p < 0.001$) and those who least wore masks ($p < 0.001$). Those with secondary education were the ones who were working the most and those with primary education were the most keen on returning to work ($p < 0.001$), the ones who least trusted the health system ($p = 0.002$) and who least wore masks ($p < 0.001$). **Conclusion:** Cultural and behavioral aspects, particularly among men, young people, people with low education and countryside dwellers, were already a sign back then that the state would become a regional epicenter of the pandemic in Brazil.

Descriptors: Pandemics; Coronavirus Infections; Perception.

RESUMO

Objetivo: Investigar os cuidados e as percepções da população cearense na busca de respostas sobre o que pode ter levado o Ceará ao epicentro da COVID-19 no Nordeste do Brasil. **Métodos:** Aplicou-se um questionário online contendo perguntas sobre aspectos sociodemográficos, percepções e cuidados relacionados à transmissão do coronavírus 2 com 2.452 pessoas em 2020. Foi realizada estatística descritiva, além da associação entre variáveis por meio do teste qui-quadrado, com nível de significância de 5%. **Resultados:** Os homens usavam menos máscaras e lavavam menos as mãos ($p < 0,001$) que as mulheres ($p < 0,001$). Aqueles que vivem no interior cumprem menos o isolamento social ($p = 0,004$), usam menos máscaras, têm lavado menos as mãos ($p < 0,001$) e percebem que as pessoas ao seu redor não cumprem as medidas de prevenção usando máscaras ($p < 0,001$). Semelhantemente, os mais jovens são os que estão menos em isolamento social ($p < 0,001$) e os que menos utilizam máscaras ($p < 0,001$). Aqueles com nível médio são os que mais estão trabalhando, e os com nível fundamental são os mais favoráveis ao retorno ao trabalho ($p < 0,001$), os que menos confiam no sistema de saúde ($p = 0,002$) e os que menos usam



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máscaras ($p < 0,001$). **Conclusão:** Aspectos culturais e comportamentais, notadamente de homens, jovens, pessoas com baixa escolaridade e moradores do interior já sinalizavam para que o estado viesse a ser um epicentro regional da pandemia no Brasil.

Descritores: Pandemias; Infecções por Coronavírus; Percepção.

RESUMEN

Objetivo: Investigar los cuidados y las percepciones de la población de Ceará en la búsqueda de respuestas sobre lo que ha permitido Ceará ser el epicentro de la COVID-19 en el Noreste de Brasil. **Métodos:** Se ha aplicado una encuesta online con preguntas sobre los aspectos sociodemográficos, las percepciones y los cuidados de la transmisión del coronavirus 2 con 2.452 personas en 2020. Se ha realizado la estadística descriptiva y la asociación entre variables a través de la prueba chi-cuadrado con el nivel de significación del 5%. **Resultados:** Los hombres usaban menos mascarillas y lavaban menos las manos ($p < 0,001$) que las mujeres ($p < 0,001$). Los que viven en pueblos cumplen menos el aislamiento social ($p = 0,004$), usan menos mascarillas, lavan menos las manos ($p < 0,001$) y perciben que las personas de su alrededor no cumplen las medidas de prevención usando las mascarillas ($p < 0,001$). De manera similar, los más jóvenes son los que menos cumplen el aislamiento social ($p < 0,001$) y los que menos usan las mascarillas ($p < 0,001$). Aquellos con el nivel medio de educación son los que más trabajan y los con el nivel básico son los más favorables para volver al trabajo ($p < 0,001$), los que se fían menos del sistema de salud ($p = 0,002$) y los que menos usan las mascarillas ($p < 0,001$). **Conclusión:** Los aspectos culturales y de conducta de hombres, jóvenes, personas de baja escolaridad y los que viven en pueblos han contribuido para que el estado fuera el epicentro regional de la pandemia en Brasil.

Descriptores: Pandemias; Infecciones por Coronavirus; Percepción.

INTRODUCTION

An outbreak of pneumonia caused by a newly identified type of coronavirus (COV) called SARS-CoV-2 has hit the world since the end of 2019, causing many deaths. Named in February 2020 by the World Health Organization (WHO) as coronavirus disease 2019 (COVID-19)⁽¹⁾, severe respiratory syndromes are its most common manifestations. However, involvement of the brain, kidneys, heart and intestine has also been described⁽²⁾.

COVID-19 emerged in the city of Wuhan, China, and has spread rapidly across the world⁽¹⁾. South Korea was one of the first countries following contamination outside Chinese territory and it immediately contained the progression of the disease. However, as contagion progressed, notably from east to west, countries in the Middle East, such as Iran, began to present a large number of cases of infected people and deaths. As a result, Italy, Spain, the United Kingdom, France, Germany, Belgium, the Netherlands, the United States and Brazil were strongly hit by deaths⁽³⁾.

The American continent was the end of the contagion line, with North America presenting the first cases with deaths followed by South America⁽⁴⁾. In Brazil, the first case was confirmed at the end of February 2020 in the city of São Paulo⁽⁴⁾. As of July 14, 2020, there were 12,964,809 confirmed cases of COVID-19, including 570,288 deaths associated with the disease⁽⁵⁾. Brazil's Ministry of Health registered 1,884,967 confirmed cases and 72,833 deaths in Brazil on July 14, 2020⁽⁶⁾. The state of Ceará ranks second in number of infected people (137,206) and third in number of deaths (6,947)⁽⁶⁾.

One fact has puzzled epidemiologists and infectious disease specialists is the wide variation in the incidence of contamination and mortality across regions of countries with a high number of cases of COVID-19⁽⁶⁾. It has been speculated that interpersonal behavior in Italy and Spain favored greater contact between people. In addition, isolation measures were implemented late in these countries⁽⁷⁾.

In the state of Ceará, a recent study on the behaviors and beliefs of the population at the initial moment of the epidemic showed vulnerability, especially among older people, men, groups with lower levels of education and people living in the countryside⁽⁸⁾. Speculation about the presence of an airline hub with flights to Europe, busy tourist spots in the state and even events, such as congresses and weddings, with the presence of people confirmed to be infected, have been discussed in order to investigate the reason for the incidence of the disease⁽⁹⁾. Failure to quarantine by people who came from international trips and the fact that Fortaleza has the highest population density in the country among the capitals⁽¹⁰⁾ can also be relevant factors.

Understanding the factors that led to the spread of COVID-19 in Ceará using epidemiological data will be vital to foster the development of public health policies for the prevention and mitigation of new waves of recontamination. Thus, the present study aimed to investigate the care taken by the population of Ceará and their perceptions in search for answers about what may have led Ceará to be the epicenter of COVID-19 in Northeastern Brazil.

METHODS

This cross-sectional study was carried out in 2020 with people living in the state of Ceará aged 18 years or over and able to answer the online questionnaire. Partially answered questionnaires were excluded from the study.

Data were collected using an online questionnaire containing multiple choice closed-ended questions on sociodemographic and behavioral aspects. The questionnaire was made available through Google Forms®, and the social media Instagram, Facebook and Whatsapp were used for sending it. The questionnaire was available between April 11 and 13, 2020 – the beginning of the third week of social distancing determined by government decree. At that time, the state had already registered 1,670 confirmed cases of COVID-19 and 74 deaths.

The study sample was determined using a 95% confidence level and a 2% margin of error. Thus, the data on 2,452 people from the state of Ceará living in the metropolitan region of Fortaleza and in the cities in the countryside of the state were analyzed.

The sociodemographic variables present in the questionnaire were: sex, age, place of residence (Metropolitan Region of Fortaleza; countryside of the state of Ceará) and level of education.

The questions related to the sociodemographic data were followed by 15 questions about the care with the transmission of COVID-19: Q1- Are you self-isolating? (No; Yes, but I only go out to perform essential tasks or in case of emergencies; Yes, but I receive people such as cleaners and caregivers; I'm working, but I self-isolate after work); Q2- Do you think most people in the region you live complied with social distancing measures? (Yes; No); Q3- Are you in favor of returning to work? (Yes; No); Q4- Do you believe that even without symptoms you may have the disease and pass it on to others? (Yes; No); Q5- Did you feel flu symptoms during this period and sought care? (Yes; No); Q6- Do you have any of these diseases: hypertension, diabetes, lung problems, heart disease or any other that weakens immunity? (Yes; No); Q7- If you need care, do you have a private health insurance? (Yes; No); Q8- Do you trust the health service you will go to if you need more serious care? (Yes; No); Q9- Have you been wearing a mask? (Yes; No; Sometimes); Q10- If you have not been wearing a mask, what is the reason for doing so? (I don't have one; I don't think it is important; it bothers me); Q11- If you have been wearing a mask, which type have you been wearing? (Disposable; Fabric; Both); Q12- Do you wear the mask correctly by covering nose and mouth? (Yes; No; Sometimes); Q13- Do you think most people in the region where you live complied with the preventive measures by wearing a mask? (Yes; No); Q14- Do you wash your hands carefully? (Yes; No); Q15- Do you think most people in the region where you live have kept a distance of at least one meter in essential services? (Yes; No).

The data were tabulated in a Microsoft Excel® spreadsheet and analyzed using SPSS software, version 24.0. Absolute and relative frequencies of all variables and questions in the study were calculated. Inferential statistics was performed using the Chi-squared test at a significance level of 5% to check for associations between variables.

This study was approved by the Human Research Ethics Committee, Approval No. 4.014.340.

RESULTS

A total of 2,452 people answered the questionnaire completely. There was a predominance of people who lived in the Metropolitan Region of Fortaleza (67.3%), women (66.6%), people aged 20-39 years (50%) and people with graduate degrees (41.6%). (Table I)

Most people were self-isolating and only left home to perform essential or emergency tasks (69.9%). However, 22.1% of the participants were working. When asked if the majority of people were complying with social distancing measures in the region where they lived, 51% of the participants said that people were not. Most of them did not agree with the return to work (79.5%) and believed that even without symptoms they can transmit the disease (75.7%). A total of 235 (9.6%) participants experienced flu-like symptoms and sought care, and 708 (28.9%) respondents had some comorbidity that could cause COVID-19 to manifest more severely. (Table I)

With regard to mask wearing, 49.9% of the respondents said they always wore it, 37.7% said they sometimes wore it, and 12.4% said they did not wear it. Among participants who wore a mask, 51.5% used disposable ones and 92.1% always covered the nose and mouth. Among those who did not wear a mask, the main reason was lack of access to the product (45%), while 21% said they did not see the importance of wearing it. However, according to the participants, 71.6% of the people who lived in the region where they lived did not comply with preventive measures – they did not wear a mask or kept social distance (72.4%). Hand washing was reported by 93.4% of the participants. (Table I)

The analysis of the association between sex and the other variables studied showed that male participants wore masks less often ($p < 0.001$), washed their hands less often ($p < 0.001$) and were more often in favor of returning to work than female participants ($p < 0.001$). However, men self-isolated more ($p < 0.001$) (Table I).

Table I - Association of sex with care and perceptions towards the transmission of COVID-19. Fortaleza, Ceará, 2020.

Questions	Sex				p value
	Women		Men		
	n	%	n	%	
Are you self-isolating?					<0.001
Not self-isolating	18	1.1	28	3.5	
Yes, but leaves for essential tasks	1171	71.4	543	67.0	
Yes, but receives people at home	104	6.3	45	5.5	
Working	348	21.2	195	24.0	
Do you think that most people in the region where you live have complied with social distancing measures?					0.066
Yes	783	47.7	419	51.7	
No	858	52.3	392	48.3	
Do you think that social distancing measures have been successful in controlling the new coronavirus in your city?					<0.001
Yes	1429	87.1	653	80.5	
No	212	12.9	158	19.5	
Are you in favor of returning to work?					<0.001
Yes	248	15.1	254	31.3	
No	1393	84.9	557	68.7	
Do you believe that even without symptoms you can have the disease and transmit it to other people?					0.567
Yes	1232	75.1	617	76.1	
No	404	24.6	191	23.6	
Have you felt flu-like symptoms during this period and sought care?					0.291
Yes	150	9.1	85	10.5	
No	1486	90.6	724	89.3	
Do you have any of these diseases? Hypertension, diabetes, lung problems, heart diseases or some other disease that may weaken immunity?					0.233
Yes	487	29.7	221	27.3	
No	1150	70.1	585	72.1	
In case you need care, do you have private health insurance?					0.578
Yes	1038	63.3	503	62.0	
No	601	36.6	306	37.7	
Do you trust the health service you should look for in case you need more serious care?					0.291
Yes	962	58.6	494	60.9	
No	671	40.9	314	38.7	
Have you been wearing masks?					<0.001
Yes	877	53.4	347	42.8	
No	171	10.4	133	16.4	
Sometimes	593	36.1	331	40.8	
Do you think that most people in the region where you live have complied with preventive measures wearing masks?					0.886
Yes	462	28.2	229	28.2	
No	1172	71.4	573	70.7	
Are you careful when washing hands?					<0.001
Yes	1556	94.8	731	90.1	
No	2	0.1	0	0.0	
Sometimes	82	5.0	78	9.6	
Do you think that most people in the region where you live have kept at least 1 meter away in essential services?					0.372
Yes	461	28.1	213	26.3	
No	1177	71.7	593	73.1	

n: number of individuals; %: percentage; Chi-squared test

People who lived in the countryside worked more and self-isolated less than those in the Metropolitan Region of Fortaleza (*Região Metropolitana de Fortaleza – RMF*) ($p=0.004$). The participants who lived in the countryside were also the ones who: believed that without symptoms they could not transmit the disease ($p=0.006$), felt less flu-like symptoms and sought care less often ($p=0.006$), wore masks less often ($p<0.001$), washed their hands less often ($p<0.001$) and said that people around them did not comply with the preventive measures by wearing masks ($p<0.001$). Private health insurance was found less often among people in the countryside compared with those who lived in the RMF ($p<0.001$) and people in the countryside were the ones who least trust the health service if they needed more serious intervention (Table II).

With regard to the age range, the youngest participants (18-19 years old) were the ones who: self-isolated less ($p<0.001$), said that people did not comply with social distancing ($p<0.001$), wore masks less often ($p<0.001$) and were less careful when washing their hands ($p<0.001$). On the other hand, the oldest participants (80 years old or older) were the ones who reported more comorbidities ($p<0.001$). Older participants aged 60-79 years were the ones who mostly reported having private health insurance ($p<0.001$) and who most trusted health services ($p<0.001$) (Table III).

After comparing the four levels of education we found that those with secondary education were the ones who worked the most ($p<0.001$), realized that people did not comply with social distancing ($p<0.001$) and experienced flu-like symptoms and sought care ($p=0.040$). Those with graduate degrees were the ones who most believed they could transmit the disease even without symptoms ($p<0.001$), had private health insurance ($p<0.001$), washed their hands more often ($p<0.001$) and noted that the distance of 1 meter was being respected in the region where they lived ($p=0.041$). The participants with primary education were the ones who most agreed with returning to work ($p<0.001$), least trusted their health system ($p=0.002$) and least wore masks ($p<0.001$) (Table IV).

DISCUSSION

According to the findings of the present study, male participants wore masks and washed their hands less often than female participants. The people who lived in the countryside of the state of Ceará were the ones who least complied with social distancing, wore masks and washed their hands less often and realized that the people around them did not comply with preventive measures such as wearing masks. The youngest were the ones who least self-isolated and wore masks. As for the level of education, those with secondary education were the ones who worked the most and those with primary education were the ones who most agreed with returning to work, least trusted the health system, and least wore masks.

Most countries around the world have endeavored to contain the spread of COVID-19⁽¹¹⁾. Social distancing has been one of the alternatives most encouraged by public health authorities to mitigate the spread of this disease^(11,12). Individuals at risk of exposure to COVID-19 are instructed to self-isolate from their families for a minimum of 14 days and effectively cease to interact closely with other people and attend workplaces, schools or public places⁽¹²⁾.

Given the presence of the airline hub with direct flights from France and the Netherlands, the flow of European tourists, as well as people who live in the state and took international trips in the critical period of the pandemic, social distancing measures should have been imposed and respected, but that did not happen.

On February 6, 2020, Brazil enacted Law No. 13979, which provides for measures to tackle the COVID-19 epidemic and lists the community nonpharmaceutical interventions that could be adopted^(13,14). But the state of Ceará defined the measures to face and control human infection with the new coronavirus only on March 16 and intensified its actions on March 19, 2020, with the publication of Decree No. 33,519, which made social distancing official in the state⁽¹⁵⁾.

Women tend to keep social distancing more than men⁽¹⁶⁾, which corroborates the findings of the present study. However, cultural factors that determine behavior, combined with non-compliance with laws, may have caused the imposed social distancing to have no effect. This is confirmed by the participants in the current study, as 51% of them considered that people in the region where they lived were not complying with social distancing measures. These data are in accordance with the ranking developed by the company In Loco, which recorded a social distancing rate of 48% in Ceará⁽¹⁷⁾.

Table II - Association of place of residence with care and perceptions towards the transmission of COVID-19. Fortaleza, Ceará, 2020.

Questions	Place of residence				p value
	Metropolitan Region of Fortaleza		Countryside of the state of Ceará		
	n	%	N	%	
Are you self-isolating?					0.004
Not self-isolating	33	2.0	13	1.6	
Yes, but leaves for essential tasks	1189	72.1	525	65.5	
Yes, but receives people at home	92	5.6	57	7.1	
Working	336	20.4	207	25.8	
Do you think that most people in the region where you live have complied with social distancing measures?					<0.001
Yes	895	54.2	307	38.3	
No	755	45.8	495	61.7	
Do you think that social distancing measures have been successful in controlling the new coronavirus in your city?					0.092
Yes	1387	84.1	695	86.7	
No	263	15.9	107	13.3	
Are you in favor of returning to work?					0.509
Yes	344	20.8	158	19.7	
No	1306	79.2	644	80.3	
Do you believe that even without symptoms you can have the disease and transmit it to other people?					0.006
Yes	1271	77.0	578	72.1	
No	373	22.6	222	27.7	
Have you felt flu-like symptoms during this period and sought care?					0.006
Yes	177	10.7	58	7.2	
No	1467	88.9	743	92.6	
Do you have any of these diseases? Hypertension, diabetes, lung problems, heart diseases or some other disease that may weaken immunity?					0.290
Yes	487	29.5	221	27.6	
No	1155	70.0	580	72.3	
In case you need care. do you have private health insurance?					<0.001
Yes	1290	78.2	251	31.3	
No	358	21.7	549	68.5	
Do you trust the health service you should look for in case you need more serious care?					<0.001
Yes	1079	65.4	377	47.0	
No	561	34.0	424	52.9	
Have you been wearing masks?					<0.001
Yes	911	55.2	313	39.0	
No	158	9.6	146	18.2	
Sometimes	581	35.2	343	42.8	
Do you think that most people in the region where you live have complied with preventive measures wearing masks?					<0.001
Yes	522	31.6	169	21.1	
No	1118	67.8	627	78.2	
Are you careful when washing hands?					<0.001
Yes	1560	94.5	727	90.6	
No	2	0.1	0	0.0	
Sometimes	86	5.2	74	9.2	
Do you think that most people in the region where you live have kept at least 1 meter away in essential services?					0.243
Yes	441	26.7	233	29.1	
No	1202	72.8	568	70.8	

n: number of individuals; %: percentage; Chi-squared test

Table III - Association of age with care and perceptions towards the transmission of COVID-19. Fortaleza, Ceará, 2020.

Questions	Age										p value
	18-19 years		20-39 years		40-59 years		60-79 years		80 years and older		
	n	%	n	%	n	%	n	%	n	%	
Are you self-isolating?											<0.001
Not self-isolating	4	9.5	30	2.4	10	1.0	2	0.9	0	0.0	
Yes, but leaves for essential tasks	30	71.4	846	68.9	669	69.4	165	77.8	4	57.1	
Yes, but receives people at home	8	19.0	62	5.1	39	4.0	37	17.5	3	42.9	
Working	0	0.0	289	23.6	246	25.5	8	3.8	0	0.0	
Do you think that most people in the region where you live have complied with social distancing measures?											<0.001
Yes	16	38.1	546	44.5	504	52.3	131	61.8	5	71.4	
No	26	61.9	681	55.5	460	47.7	81	38.2	2	28.6	
Do you think that social distancing measures have been successful in controlling the new coronavirus in your city?											0.965
Yes	35	83.3	1036	84.4	824	85.5	181	85.4	6	85.7	
No	7	16.7	191	15.6	140	14.5	31	14.6	1	14.3	
Are you in favor of returning to work?											0.728
Yes	6	14.3	258	21.0	190	19.7	46	21.7	2	28.6	
No	36	85.7	969	79.0	774	80.3	166	78.3	5	71.4	
Do you believe that even without symptoms you can have the disease and transmit it to other people?											0.974
Yes	31	73.8	927	75.6	727	75.4	158	74.5	6	85.7	
No	11	26.2	296	24.1	235	24.4	52	24.5	1	14.3	
Have you felt flu-like symptoms during this period and sought care?											0.875
Yes	3	7.1	115	9.4	98	10.2	18	8.5	1	14.3	
No	39	92.9	1110	90.5	862	89.4	193	91.0	6	85.7	
Do you have any of these diseases? Hypertension, diabetes, lung problems, heart diseases or some other disease that may weaken immunity?											<0.001
Yes	3	7.1	240	19.6	339	35.2	119	56.1	7	100.0	
No	39	92.9	984	80.2	622	64.5	90	42.5	0	0.0	
In case you need care. do you have private health insurance?											<0.001
Yes	28	66.7	706	57.5	637	66.1	166	78.3	4	57.1	
No	14	33.3	519	42.3	326	33.8	45	21.2	3	42.9	
Do you trust the health service you should look for in case you need more serious care?											<0.001
Yes	22	52.4	676	55.1	604	62.7	150	70.8	4	57.1	
No	20	47.6	547	44.6	355	36.8	60	28.3	3	42.9	
Have you been wearing masks?											<0.001
Yes	10	23.8	510	41.6	573	59.4	129	60.8	2	28.6	
No	12	28.6	195	15.9	83	8.6	14	6.6	0	0.0	
Sometimes	20	47.6	522	42.5	308	32.0	69	32.5	5	71.4	
Do you think that most people in the region where you live have complied with preventive measures wearing masks?											0.070
Yes	17	40.5	331	27.0	269	27.9	72	34.0	2	28.6	
No	25	59.5	891	72.6	691	71.7	133	62.7	5	71.4	
Are you careful when washing hands?											<0.001
Yes	34	81.0	1110	90.5	933	96.8	204	96.2	6	85.7	
No	0	0.0	2	0.2	0	0.0	0	0.0	0	0.0	
Sometimes	7	16.7	114	9.3	31	3.2	7	3.3	1	14.3	
Do you think that most people in the region where you live have kept at least 1 meter away in essential services?											0.894
Yes	13	31.0	338	27.5	269	27.9	52	24.5	2	28.6	
No	29	69.0	888	72.4	691	71.7	157	74.1	5	71.4	

n: number of individuals; %: percentage; Chi-squared test

Table IV - Association of level of education with care and perceptions towards the transmission of COVID-19. Fortaleza, Ceará, 2020.

Questions	Level of Education								p value
	Primary education		Secondary education		Higher education		Graduate education		
	n	%	n	%	n	%	n	%	
Are you self-isolating?									<0.001
Not self-isolating	3	3.3	14	2.8	18	2.2	11	1.1	
Yes, but leaves for essential tasks	65	71.4	337	66.3	612	73.1	700	68.9	
Yes, but receives people at home	5	5.5	15	3.0	49	5.9	80	7.9	
Working	18	19.8	142	28.0	158	18.9	225	22.1	
Do you think that most people in the region where you live have complied with social distancing measures?									<0.001
Yes	46	50.5	211	41.5	384	45.9	561	55.2	
No	45	49.5	297	58.5	453	54.1	455	44.8	
Do you think that social distancing measures have been successful in controlling the new coronavirus in your city?									<0.001
Yes	68	74.7	415	81.7	699	83.5	900	88.6	
No	23	25.3	93	18.3	138	16.5	116	11.4	
Are you in favor of returning to work?									<0.001
Yes	27	29.7	139	27.4	174	20.8	162	15.9	
No	64	70.3	369	72.6	663	79.2	854	84.1	
Do you believe that even without symptoms you can have the disease and transmit it to other people?									<0.001
Yes	63	69.2	348	68.5	625	74.7	813	80.0	
No	28	30.8	157	30.9	210	25.1	200	19.7	
Have you felt flu-like symptoms during this period and sought care?									0.040
Yes	8	8.8	65	12.8	69	8.2	93	9.2	
No	83	91.2	439	86.4	766	91.5	922	90.7	
Do you have any of these diseases? Hypertension, diabetes, lung problems, heart diseases or some other disease that may weaken immunity?									0.877
Yes	27	29.7	154	30.3	236	28.2	291	28.6	
No	64	70.3	353	69.5	596	71.2	722	71.1	
In case you need care. do you have private health insurance?									<0.001
Yes	23	25.3	205	40.4	505	60.3	808	79.5	
No	68	74.7	302	59.4	329	39.3	208	20.5	
Do you trust the health service you should look for in case you need more serious care?									0.002
Yes	42	46.2	297	58.5	477	57.0	640	63.0	
No	49	53.8	210	41.3	356	42.5	370	36.4	
Have you been wearing masks?									<0.001
Yes	30	33.0	206	40.6	379	45.3	609	59.9	
No	24	26.4	73	14.4	118	14.1	89	8.8	
Sometimes	37	40.7	229	45.1	340	40.6	318	31.3	
Do you think that most people in the region where you live have complied with preventive measures wearing masks?									0.232
Yes	26	28.6	126	24.8	253	30.2	286	28.1	
No	65	71.4	376	74.0	580	69.3	724	71.3	
Are you careful when washing hands?									<0.001
Yes	83	91.2	455	89.6	775	92.6	974	95.9	
No	0	0.0	0	0.0	0	0.0	2	0.2	
Sometimes	8	8.8	51	10.0	62	7.4	39	3.8	
Do you think that most people in the region where you live have kept at least 1 meter away in essential services?									0.041
Yes	23	25.3	120	23.6	224	26.8	307	30.2	
No	68	74.7	388	76.4	609	72.8	705	69.4	

n: number of individuals; %: percentage; Chi-squared test

The highest rate of social distancing in Ceará was 71%, which was recorded on March 22, two days after the establishment of the state decree that determined the closure of non-essential businesses⁽¹⁷⁾. The perception that people were not complying with social distancing on the part of the youngest participants (18-19 years old) ($p < 0.001$) and those with secondary education – who were the ones who were working the most ($p < 0.001$) and, consequently, were mostly on the streets – reinforces the idea of non-compliance with the measures. This leads us to think that stricter isolation measures should have been implemented from the beginning considering some factors that already signaled that the state of Ceará could possibly become the epicenter of the disease.

In a study⁽⁸⁾ carried out at the beginning of the decree of social distancing (March 19, 2020), groups composed of men, people with low levels of education and people living in the countryside of the state of Ceará were more resistant to the adoption of voluntary social distancing, a finding that agrees with the results of the present study.

The resistance to the adoption of social distancing measures by people living in the countryside of the state of Ceará may have cultural, economic and social aspects of this population as influencing factors. Initially, COVID-19 contaminated high-income families living in the upscale neighborhoods of Fortaleza. It gradually spread through the middle- and lower-class neighborhoods and slowly reached the countryside. On May 5, 2020, the Ceará State Department of Health (*Secretaria de Saúde do Estado do Ceará - Sesa*) had notified 12,644 confirmed cases of COVID-19, with 25,114 cases under investigation, 854 deaths (with daily increase in figures) and a lethality rate of 6.8%. Of the 184 municipalities in the state, 162 had already notified at least one confirmed case of COVID-19 and Fortaleza ranked first with 9,241 confirmed cases of the disease⁽¹⁸⁾.

In view of the alarming situation that placed the state of Ceará at the epicenter of COVID-19, on that day more rigid social distancing measures, popularly known as “lockdown”, were put into effect⁽¹⁹⁾.

It is necessary to understand that, due to the ease of transmission, a common factor among the main cities considered as epicenters of the pandemic is the high population density. New York (with a density of approximately 27,711 inhabitants/km²⁽²⁰⁾), Paris (with 20,386 inhabitants/km²⁽²¹⁾) and the Lombardy region in Italy (23,844 inhabitants/km²⁽²²⁾) are examples of that. When it comes to countries, the Netherlands (409 inhabitants/km²) and Belgium (380 inhabitants/km²) are among the most densely populated countries in Europe⁽²³⁾.

In Brazil, Fortaleza is the Brazilian capital with the highest population density (with 7,786.44 inhabitants/km²), followed by São Paulo (7,398.26 inhabitants/km²) and Recife (7,039.64 inhabitants/km²), two cities that are at the top of the pandemic in the country⁽¹⁰⁾. Specifically with regard to Fortaleza, which is divided into 6 regions with 119 neighborhoods, only 24% of the neighborhoods have a Human Development Index (HDI) greater than 0.5, while 28% have an HDI below 0.25⁽²⁴⁾. In several communities, sanitary and housing conditions – as many people live in houses with just a few rooms – can be a potential factor in the chain transmission of SARS-CoV-2⁽²⁵⁾.

For the implementation of social distancing measures, it is also necessary to take into account the conditions of vulnerability of certain population subgroups, such as low-income families, homeless people, people with disabilities and older adults^(8,13). Greater attention should be paid to older adults since they presented a higher rate of comorbidities. In the state of Ceará, specifically, people aged 80 or over were partially isolated due to the flow of family members or caregivers into their homes⁽⁸⁾.

The adoption of social distancing has an important impact on people's daily activities, on society and on the economy⁽¹³⁾. During the most critical phase, commercial activities must be stopped or reduced to the strictly essential, and work must be virtualized⁽²⁶⁾. However, 22.1% of the participants in the present study were still working, especially those with secondary education. Men left home more often to work than women⁽¹⁶⁾. This fact can be justified by the greater number of men (57.5%) among employed persons in Northeastern Brazil⁽²⁷⁾ and by the imposition on women for taking care of their children and the home⁽²⁸⁾. In addition, 26% of the population in the Northeast region at working age has completed secondary education⁽²⁷⁾, which is in accordance with the findings of the present study.

Among the factors responsible for helping to transmit the virus in China, one of them began to draw attention as the characteristics of the disease were defined. It was observed that there was a high incidence of the disease among young people and young adults. This led researchers to think that younger individuals are the major transmitters of coronavirus around the world because they are more involved with international travel, business, study abroad, greater social activity and work. In addition, because they experience a longer incubation period and better prognosis and just a few of them have shown signs and symptoms of the disease, they may have spread the disease around the world and transmitted it to their families⁽²⁹⁾.

This fact draws attention to the population of Ceará, as the youngest (18-19 years old) were those who least complied with social distancing measures, hand hygiene and mask wearing. This situation makes young people potential transmitters of the disease if there is close contact with people prone to develop a more severe form of

COVID-19, such as older adults. In a culture of very close interpersonal relationships, such as that experienced in the state of Ceará, where young people still live with their parents and grandparents, the mortality rate may increase, as seen in Italy⁽⁷⁾.

Those with lower levels of education were those who claimed to have less confidence in the health system, as they had significantly less access to private health insurance. Although many Brazilians do not believe in the public health system, Brazil's Ministry of Health, through the Unified Health System (*Sistema Único de Saúde - SUS*), has played an important role in responding to the disease, with the establishment of a specific protocol for the clinical management of patients, and in the control of community transmission⁽³⁰⁾.

SUS has a wide coverage, with operations throughout the national territory and an indescribable capacity for social inclusion. During the pandemic, SUS continues to offer free care to anyone and provides medication and trains professionals in order to provide better care to the affected people. In addition, it seeks more resources to face the disease and, consequently, improve and strengthen its program. The state of Ceará was better prepared to face the pandemic through the SUS. The state considerably increased the number of ICU beds, a factor directly linked to the control of mortality.

It is suggested that a major obstacle to compliance with social distancing measures is the concern with the reduction of household income or loss of jobs due to absence from work⁽³¹⁾. Informal workers, hourly-paid workers and construction workers are more vulnerable to the economic consequences of prolonged isolation as they generally do not have access to remote work options⁽³²⁾. Although the mean unemployment rate of the Brazilian population fell between 2018 and 2019, informal work grew by 4% and the country has 11.6 million informal workers⁽²⁷⁾. For these workers, the outbreak of COVID-19 has potentially transformative financial implications⁽³³⁾.

After recognizing this problem, the governments of Canada and Hong Kong have implemented specific plans to reimburse individuals who lost income during the SARS outbreak in 2003⁽³⁴⁾ and similar measures have been adopted in Brazil⁽³⁵⁾. There is a worldwide consensus that people, families, companies and countries must face significant economic losses due to the COVID-19 pandemic⁽¹³⁾. Despite this scenario, 79.5% of the participants in the present study did not agree with the return to work.

In addition to social distancing, basic hygiene measures and the use of personal protective equipment can reduce the spread of COVID-19^(36,37). Hand washing is a practical method of combating any source of infection, including the new coronavirus, and preventing its spread⁽³⁴⁾. Additionally, the wearing of disposable or fabric masks by the population is also an efficient form of protection against the virus as long as it is worn correctly and properly fitted – covering mouth, nose and chin⁽³⁶⁾. In this study, 49.9% of the participants said they always wore masks.

The refusal to wear masks may also be associated with the stigma of being mistaken for someone infected with COVID-19 and, thus, avoided, or with the fear of being confused with criminals⁽³⁶⁾. Meanwhile, 21% of the participants who did not wear masks said they did not wear them because they did not have access to them.

Only on April 15, 2020, the government of the state of Ceará, through Sesa, launched a public call for bids for the manufacture of reusable fabric masks to be distributed to the most vulnerable population⁽³⁸⁾ and, on May 5, the state of Ceará made mask wearing mandatory for the entire population in public environments through Decree No. 33.754⁽¹⁸⁾. These measures could have controlled transmission more if they had been carried out early. Fabric masks greatly reduce the risk of contamination when compared to people without a mask. Homemade masks made of single-ply fabric can block up to 95.15% of aerosols⁽³⁹⁾.

According to the World Health Organization, masks are effective only when used in combination with frequent hand cleaning with alcohol or soap and water. Male participants in the state of Ceará were more negligent than female participants in adopting protective measures against COVID-19 at the beginning of the pandemic⁽⁹⁾, and this behavior seems to continue, according to the data in the present study.

The cultural aspect seems to influence the adoption of means to tackle the pandemic⁽³⁶⁾. Asian countries have a higher incidence of virus infections and the population tends to almost automatically follow the rules imposed by health authorities⁽⁴⁰⁾ in addition to culturally wearing masks, which may have been determinant in the low transmission in Japan, Singapore and Hong Kong. The German people, regardless of sex, strictly follow the advice from public health authorities, such as washing hands and not behaving recklessly to the extent of contaminating other people or spreading COVID-19⁽⁴¹⁾. Brazil has little experience with catastrophe situations, which makes the incorporation of disease control measures, such as those adopted for COVID-19⁽⁸⁾, slower and more reluctant. Laws have been implemented in several Brazilian cities aiming at the mandatory wearing of masks, which has already occurred in the municipality of Iguatu, in the mid-south of the state of Ceará, through a municipal decree⁽⁴²⁾ well before the state decree.

Due to the impossibility of face-to-face data collection due to the imposed isolation, the study was limited to people with smartphones and internet. However, given the sample size, the results showed that there was little data collection bias.

CONCLUSION

It can be concluded that cultural and behavioral aspects, notably those in men, young people, people with low levels of education and people living in the countryside, already signaled that the state of Ceará would become a regional epicenter of the pandemic in Brazil.

CONTRIBUTIONS

Danilo Lopes Ferreira Lima and **Jiovane Rabelo Neri** participated in the design of the study, analysis and interpretation of data, writing of the manuscript and final approval of the version to be published. **Pedro Jessé Lima Veras**, **Thâmia Martins Marques** and **Samuel Carvalho Costa** participated in the analysis and interpretation of data, writing of the manuscript and final approval of the version to be published. **Helena Paula Guerra dos Santos** participated in the interpretation of data, critical review of the manuscript, and final approval of the version to be published.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in the development of this study.

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