

# Public Utilization of Face Masks in Brazil During COVID-19 Pandemic Outbreak: Temporal Trend Analysis

**Fernanda Maria Vieira Pereira-Ávila**

Universidade Federal Fluminense

**Eliã Pinheiro Botelho** (✉ [elipinbt@gmail.com](mailto:elipinbt@gmail.com))

Universidade Federal do Pará <https://orcid.org/0000-0002-9682-6530>

**Fernanda Garcia Bezerra Góes**

Universidade Federal Fluminense

**Elucir Gir**

Universidade de Sao Paulo

**Laelson Rochelle Milanês Sousa**

Universidade de Sao Paulo

**Natália Maria Vieira Pereira Caldeira**

Universidade de Sao Paulo

**Ana Cristina de Oliveira e Silva**

Universidade Federal da Paraiba

**Simon Ching Lam**

Open University of Hong Kong

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## Research article

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# Abstract

**Background:** The coronavirus disease 2019 (COVID-19) has recorded approximately 8.6 million confirmed cases and more than 450,000 deaths worldwide. As of today, Brazil remains the second most affected country, with more than 1 million confirmed cases and more than 50,000 related deaths. This study aimed to evaluate the temporal trend of the frequency of face mask use among Brazil's general population.

**Method:** A cross-sectional survey method was adopted in this study. Online survey regarding sociodemographic and protective personal measures against COVID-19 was used to collect data. Data were collected from April 17 to May 15, 2020. The frequency of face mask use was divided into five categories: "never," "rarely," "sometimes," "frequently," and "always." Joinpoint regression model was employed to analyze the daily percentage change (DPC) of each category. Ethics aspects were considered.

**Results:** A total of 14,756 volunteers comprised the study sample. The "frequently" and "always" categories represented 71% of the sample, with the former being superior to the latter (39.4% vs. 31.6%, respectively). Temporal trend analysis showed two trend periods for all categories. The "never," "rarely," and "sometimes" categories decreased in the first period and stabilized in the second period. Conversely, the "frequently" and "always" categories showed an upward trend. Like other categories, the "frequently" category had stabilized in the second period. However, the "always" category still showed an increasing trend in the second period. The association analysis results showed a decrease in the use of face masks in women, postgraduate people, those aged above 35 years, and those earning more than seven times the federal monthly income minimal wage. However, the use of masks increased among young people and those with elementary to graduate degrees. The "always" use of face masks increased in the south and decreased in the southeast of Brazil.

**Conclusion:** The preponderance of the "frequently" category and the slow DPC in the second trend period of the "always" category suggest the necessity of further enforcement of the use of face masks in Brazil. The adaptation of this new habit among Brazilians is time demanding, and thus strategies must be implemented in a more natural way.

## Background

The novel coronavirus SARS-CoV-2 (COVID-19) has reported approximately 12 million confirmed cases and more than 550,000 deaths worldwide. As of today, Brazil's Ministry of Health has confirmed more than 1,7 million COVID-19 cases and more than 69,000 related deaths. Consequently, Brazil has been recognized as the second most affected country by the pandemic after the United States (US) [1–2].

Given the COVID-19 pandemic outbreak, the use of face masks has been proposed as an effective means of protection against the virus that is transmitted primarily through respiratory droplets. The Centers for Disease Control and Prevention (CDC) guidance includes the use of N95 mask or higher-level respirators

to health professionals and surgical or cloth masks to the general population [3]. The efficacy level of N95, medical, and homemade masks regarding human-to-human virus transmission prevention is 99.98%, 97.14%, and 95.15%, respectively [4].

Simulation models for the impact of the use of face masks in the pandemic in New York and Washington (US) have suggested that community-wide utilization of face masks could reduce the risks of COVID-19, including transmission, hospitalizations, and deaths [5]. Another study supported this claim by showing an extremely lower incidence of COVID-19 in an administrative region of Hong Kong that implemented community-wide utilization of face masks than the countries doing differently, such as Spain, France, Italy, and Germany [6]. In addition to personal protection against COVID-19, the utilization of face masks reminds the people of the severity of the disease and highlights the importance of social distancing [7]. Given the internal political conflicts in Brazil and the insufficient evidence on face mask efficiency meanwhile, the public use of face masks started to implement on April 2, 2020, three weeks after the first 100 cases [8–9].

However, the number of COVID-19 cases and deaths are still increasing even with this implementation. The notification of new COVID-19 cases has increased rapidly up to 1,329.04% from April 2 to May 15 (1,071 and 15,305 cases, respectively). On June 29, 2020, a total of 24,052 new confirmed cases were reported to the Ministry of Health, corresponding to an increase of 2,145.75% since April 2, 2020 [2]. This continuously increasing number suggests a low adherence of the public to the use of face masks.

Therefore, this study aims to analyze the changes in the frequency of public utilization of face masks during this pandemic, within the period after federal implementation.

## **Methods**

### **Study design and settings**

A cross-sectional survey study was conducted and participated by Brazilians adult.

Brazil is known as the largest country in South America surrounded by the Atlantic Ocean on the east coast. The country's population is approximately 250 million. Brazil is divided into five main political regions: north, northeast, midwest, south, and southeast. It is surrounded by ten other countries (Uruguay, Paraguay, Argentina, Peru, Bolivia, Colombia, Venezuela, Suriname, Guiana, French Guiana). It makes clearly the importance of bringing under control the COVID-19 in Brazil. The results of this study provide implications to health authorities to implement new strategies and evaluate the already implemented ones to eliminate COVID-19 in Brazil.

### **Study sample and variables**

Convenience sampling was used to select the study sample, which was composed of adult people aged above 18 years. The specific adult population projection in 2019 (159,095,000) was used as the basis to calculate the sample size, considering 1.2% margin of error and 99% of confidence interval. Although the result provided a sample size of 11,556 adult people, a total of 14,756 volunteers had participated in this study.

The following variables were collected from the online survey: dates of answering the survey, age, sex, province of residency, monthly income, schooling, occupations, marital status, and the frequency of face mask use. The frequency of face mask use was divided into five categories: never, rarely, sometimes, frequently, and always.

The respondents were also asked if they consider their occupation at risk for SARS-CoV-2 transmission/infection, if they had close contact with someone diagnosed with COVID-19, if they consider themselves vulnerable to the virus infection, and if they developed feelings of fear toward it.

## Data collection procedure

Data were collected online from April 17 to May 15, 2020 via social media (Facebook, Twitter, Instagram, WhatsApp, and e-mail), employing online survey through Google forms. The survey was validated by a committee of experts. Afterwards, a pilot test participated by 20 people was conducted on each region.

This study was widely disseminated in all regions in Brazil. All volunteers read and accepted the free and informed consent terms included in the Google Forms. All ethics aspects were considered.

## Statistical analysis

Data were first analyzed descriptively considering absolute ( $n$ ) and relative (%) frequencies. Then, the joinpoint regression model was employed to analyze changes in relative frequency of face mask use during the period of this study. The daily frequency for each category was calculated according to the total of people that responded to the survey in that day. In the temporal trend analysis, the categories of frequency were taken as dependent variables and the days as independent variable. The best fitting joinpoint regression model was accessed by Monte Carlo permutation test, which employed 4,999 permutations. The daily percentage change (DPC), 95% confidence interval (95% CI) and  $p$ -value were considered for each category. Trends were considered increasing or decreasing if the DPC is positive or negative, respectively, and  $p < 0.05$ . Otherwise, they were considered stationary.

We employed the chi-squared test to verify the level of association among outcome variables with the periods identified in joinpoint regression for the category of “always.” We grouped the outcome variables in each one of the trend periods before applying the association test (April 17–25 and April 25 to May 15). Then, we applied binary logistic regression to all association with  $p < 0.20$  to estimate the

probabilities associated with the frequency of face masks use in each trend period. We considered Odds Ratio (OR), 95% confidence intervals, and  $p < 0.05$  as statistically significance.

## Results

The study sample was composed by 14,756 people. Most of them were female (75.4%), single (47.0%), postgraduate (43.5%), from the northeast region (39.2%), and had jobs out of the health field (58.0%) (Table 1). The sample averaged age was 35 years old (SD = 13.0), with minimal and maximum ages of 18 and 88 years, respectively.

Table 1  
 – Sociodemographic characterization of the study voluntaries (n = 14,756). Brazil, 2020.

<b>Variables</b>	<b>n (%)</b>
<b>Sex</b>	
Male	3623 (24.6)
Female	11133 (75.4)
<b>Marital status</b>	
Single	6929 (47.0)
Married	6658 (45.1)
Divorced	939 (6.4)
Widower	230 (1.6)
<b>Age</b>	
18–34	7708 (52.2)
35+	7048 (47.8)
<b>Brazilian Region</b>	
North	1346 (9.1)
Northeast	5784 (39.2)
Midwest	1762 (11.9)
Southeast	4475 (30.3)
South	1389 (9.4)
<b>Schooling</b>	
Elementary school	184 (1.3)
High school	2662 (18.0)
Graduated	5489 (37.2)
Postgraduated	6421 (43.5)
<b>Health professional</b>	
No	8564 (58.0)
Yes	6192 (42.0)

\*Brazilian monthly income (minimum wage) = R\$1045,00 or U\$199,43

Variables	n (%)
<b>Monthly income (minimal wage)*</b>	
< 1	548 (37)
1 a 2	3247 (22.0)
3 a 4	3756 (25.5)
5 a 6	2433 (16.5)
7+	4610 (31.2)
No income	162 (1.1)
*Brazilian monthly income (minimum wage) = R\$1045,00 or U\$199,43	

For the frequency of face mask use, the following values were the absolute and relative (%) frequencies for each category: never = 700 (4.7%), rarely = 902 (6.1%), sometimes = 2,674 (18.1%), frequently = 5,814 (39.4%), and always = 4,666 (31.6%). Figure 1 and Table 2 show the joinpoint analysis results. All categories had two trend periods. The “never,” “rarely,” and “sometimes” categories had downward trends in the first period and became stabilized in the second one. Conversely, the “frequently” and “always” categories had an upward trend in the first period. However, the “frequently” category had a stable trend in the second period, and the “always” category had a slow increasing trend.

Table 2  
– Temporal trend analysis of Mask usage frequencies (n = 14.756). Brazil, 2020

Face-mask usage frequency	Periods	DPC (%)	CI 95%	p-valor
Never	17 April – 13 May	-9.93	-11.6 - -8.3	0.000
	13–15 May	82.07	-42.5–476.7	0.309
Rarely	17 April – 11 May	-6.76	-8.0 - -5.5	0.000
	11–15 May	17.73	-4.9–45.07	0.120
Sometimes	17 April – 08 May	-2.17	-3.3 - -1.1	0.000
	08–15 May	-4.42	-8.9–0.3	0.070
Frequently	17–23 April	4.45	2.2–6.7	0.000
	23 April – 15 May	0.37	0.2–1.4	0.200
Always	17–25 April	6.95	3.1–10.1	0.000
	25 April – 15 May	1.23	0.3–2.1	0.004

Table 3 shows the association analysis results among the outcome variables with the two trend periods identified in the “always” category. In the second period, an increase in the frequency of face mask use was observed among males, singles, young people, and those living in the north, midwest, northeast, and south regions. The same phenomenon was observed in people with elementary to graduate degrees and those with low rental income.

Table 3

– Face mask usage category “always” association with sociodemographic variables in the two temporal trend periods (n = 4,666). Brazil, 2020

Variables	Temporal trend periods (n = 4.666)		p-value
	April 17-April 25 n(%)	April 25-May 15 n(%)	
<b>Sex</b>			
Male	272 (14.3)	738 (26.7)	0.000
Female	1632 (85.7)	2024 (73.3)	
<b>Marital status</b>			
Single	658 (34.6)	1627 (58.9)	0.000
Married	1024 (53.8)	972 (35.2)	
Separated/Divorced	191 (10.0)	111 (4.0)	
Widower	31 (1.6)	52 (1.9)	
<b>Age (years)</b>			
18–34	657 (34.5)	1842 (66.7)	0.000
35+	1247 (65.5)	920 (33.3)	
<b>Brazilian Region</b>			
North	117 (6.1)	373 (13.5)	0.000
Northeast	617 (32.4)	1235 (44.7)	
Midwest	166 (8.7)	400 (14.5)	
Southeast	915 (48.1)	259 (9.4)	
South	89 (4.7)	495 (17.9)	
<b>Schooling</b>			
Elementary	6 (0.3)	52 (1.9)	0.000
High school	192 (10.1)	661 (23.9)	
Graduate	506 (26.6)	1213 (43.9)	
Postgraduate	1200 (63.0)	836 (30.3)	
<b>Monthly income (minimum wage)</b>			
< 1	24 (1.3)	156 (5.6)	0.000

Variables	Temporal trend periods (n = 4.666)		p-value
	April 17-April 25 n(%)	April 25-May 15 n(%)	
1-2	286 (15.0)	783 (28.3)	
3-4	461 (24.2)	715 (25.9)	
5-6	358 (18.8)	397 (14.4)	
> 7	763 (40.1)	670 (24.3)	
No income	12 (0.6)	41 (1.5)	

An increase in the frequency of face mask use was observed among people who have low-risk jobs, those did not experience close contact with a sick person, and those who did not express vulnerability to the virus or fear about acquiring the disease.

Table 4

– Mask usage category “always” association with sociodemographic variables in two temporal trend periods. Brazil. 2020

Variables	Temporal trend periods (n = 4,666)		
	April 17th -April 25th	April 25th -May 15th	p-value
	n(%)	n(%)	
<b>Occupation at risk to COVID-19</b>			< 0.001
No	472 (24.8)	1246 (45.1)	
Yes	1432 (75.2)	1516 (54.9)	
<b>Close contact with someone diagnosed with COVID-19</b>			< 0.001
No	1481 (77.8)	2365 (85.6)	
Yes	423 (22.2)	397 (14.4)	
<b>Vulnerable to the virus</b>			< 0.001
No	39 (2.0)	152 (5.5)	
Yes	1865 (98.0)	2610 (94.5)	
<b>Fear toward the virus</b>			0.030
No	48 (2.5)	101 (3.7)	
Yes	1856 (97.5)	2661 (96.3)	

All variables were submitted to binary logistic regression to estimate the association probabilities among them with both periods in the “always” category. The variables associated to both trend periods were gender, age, region, monthly income, occupation considered at risk for virus infection, and feelings of vulnerability to virus. In the second period, an increased frequency of face mask usage was observed in ages 18–34 years (1.5x) and in the south region (2x). A decreased chance was observed to the following predictors: women (1.8x), those aged above 35 years (1.5x), those living in the southeast region (8.0x), those who had a postgraduate degree (7.0x), those who earned seven times the monthly minimal income (2.2x), those who worked in job positions considered at risk for COVID-19 (1.9x), and those expressing vulnerability and feelings of fear toward the disease (1.7x) (Table 5).

Table 5

– Binary logistic regression to category mask-usage “always”. Brazil. 2020

Variables	Mask-usage	
	OR (IC95%)	p-value
Female	0.55 (0.45–0.66)	< 0.001
35 years and over	0.65 (0.49–0.86)	< 0.001
Northeast region	0.63 (0.49–0.81)	< 0.001
South region	2.28 (1.64–3.1)	< 0.001
Southeast region	0.12 (0.09–0.15)	< 0.001
High school	0.34 (0.13–0.89)	0.026
Graduated	0.26 (0.10–0.66)	0.005
Postgraduated	0.13 (0.05–0.33)	< 0.001
Monthly income		
1–2	0.58 (0.35–0.95)	0.029
3–4	0.48 (0.29–0.79)	0.004
5–6	0.53 (0.32–0.88)	0.014
>7	0.45 (0.27–0.74)	0.002
Occupation at risk to COVID-19	0.52 (0.45–0.62)	< 0.001
Vulnerability feeling about getting COVID-19	0.57 (0.38–0.87)	0.008

## Discussion

This study is the first to evaluate the use of face masks in Brazil. Our results show an increase in the frequency of face mask usage by Brazilians during the COVID-19 pandemic outbreak. This finding may be due to the preventive mediatic campaign against COVID-19 promulgated and implemented by the health authorities. Media campaigns are efficient on promulgating information and stimulating the adherence to protective measures against COVID-19 [10]. The level of knowledge about COVID-19 is directly correlated with face mask use and other personal protective measures, which has been observed in Malaysia and China [11–12]. In our study, the “frequently” and “always” categories have represented 71% of the sample. However, the ideal “always” category is only 31.6%.

The temporal trend analysis results show that women did not always wear face masks in the second trend period. This result corroborates with previous studies [12–13]. In China, a study with 10,304 volunteers showed that although women practice more protective measures against COVID-19 during the

pandemic, only males have shown an upward trend [13]. This finding can be explained by the quarantine restrictions implemented by the Health Ministry in Brazil. After the school activities were interrupted, most women stopped their jobs to take care of their children, thereby decreasing their exposure to the virus. Given that women are less vulnerable to the virus, their frequency of face mask use is also lesser to that of men.

Discrepancies among regional implementations of face mask use were also observed. In the second period, an increasing trend was observed in the south region, whereas a decreasing trend was observed in the southeast region. The north region had the lowest frequency in both trend periods. Among all the regions, the south and north regions were the least and the most affected by COVID-19, respectively. The regional discrepancies in COVID-19 incidence are still evident today [2]. The following facts are also considered: 1) regional developmental differences: the south and southeast regions are the richest, whereas the north and northeast regions are the poorest; 2) provincial implementation of protective measures against COVID-19 were conducted at different times, and they started only when the Ministry of Health recommended the use of homemade masks in public places on April 2, 2020 [9]; and 3) wrong previews about the stabilization of COVID-19 curve transmission have been promulgated in the southeast region, which could have influenced the loosening of the use of face masks.

The continuous use of face masks increased among the youth in the second period and decreased in people aged above 35 years. A study in Pakistan showed the same result and suggested that young people have higher knowledge regarding prevention practices than the adults [14]. However, 42% of our sample is composed of health professionals, and 55.02% of them assumed older than 35 years old. Like other countries, Brazil has experienced scarcity in face masks and other personal protective equipment (PPE). Consequently, health workers are often working without proper medical gear and attire. Health professionals' long and stressful work and the scarcity of PPE in the national level have increased their feelings of vulnerability and fear of acquiring the virus [15].

Health workers could also have influenced the faster DPC observed in the first period than that of the second one (6.95% vs. 1.23%, respectively). By contrast, the slower DPC in the second period suggests a low gradual adherence of the population in general to face masks. This hypothesis corroborates with the increase of face mask use in people earning low monthly income and those with lower degrees compared with the ones in the first period.

The internal political conflicts in Brazil and the spread of fake news still influence the willingness of the public to adopt the promoted protective measures against COVID-19. The general population in Brazil remains clueless about the pandemic situation they are currently experiencing, and no specific guidelines are given to them to stop further transmission of the virus [18–20]. Negative assumptions and fake news regarding the risks of wearing face masks were widely disseminated during the second period (April 25 to May 15) [21–22]. In addition, utilization of face masks is not a cultural habit in Brazil, and it is never needed that much before. Strategies must be implemented with congruences among policymakers and

local authorities to incorporate this new habit in the daily routine of the general population and reinforce the importance of face masks [19–22].

The study sample is limited by the convenience method used in this study and by the limitation on response rate. Finally, the participants may have also provided socially desirable responses.

## Conclusion

Policymakers and local authorities need to reinforce further the frequent use of face masks to the public in addition to other protective personal measures to combat COVID-19. Although 71% of the sample fell under the “frequently” and “always” categories, the ideal “always” category was still lower than the “frequently” category. In addition, more than 29% were not using face masks at all. This finding was alarming given that SARS-CoV-2 could be easily transmitted from one person to another.

Providing PPE and better work conditions to health workers were extremely important and long overdue. Brazil had the highest number of health professionals that died by COVID-19. The government should recognize the scholarly efforts and prioritize public health to eliminate COVID-19 and avoid its second and subsequent waves.

## Abbreviations

DPC

Daily Percentage Changes

CI

confident Interval

PPE

Personal Protective Equipment

US

United States

## Declarations

### **Ethical approve and consent to participate**

This research project was submitted and approved by the National Research Ethic Committee under recording number CAAE: 30572120.0.0000.0008. Report: 4.094.626. Our sample was composed by Brazilian general population aged over 18 years old and all volunteers read and accepted the consent form.

### **Consent for publication**

Not applicable

## Availability of data and materials

All tables and the figure were constructed by the authors. Restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

## Competing interests

The authors declare that they have no competing interests.

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## Authors' Contributions

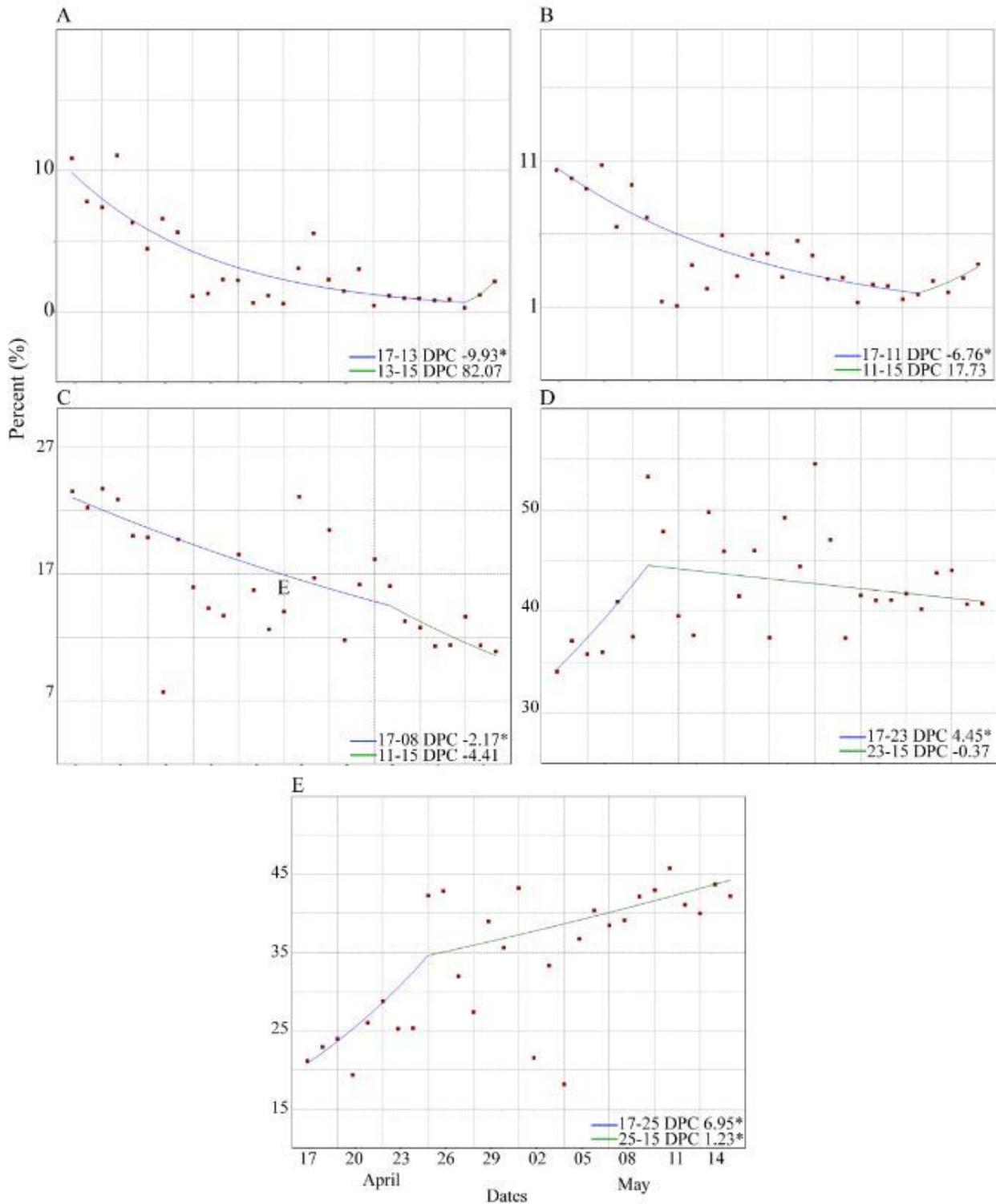
EPB, FMVPA, FG designed the study. All authors collected the data. EPB, FMVPA, FG, analyzed the data. EG, LRMS, NMVPC, SCL contributes to interpretation of the results. All authors revised the manuscript critically and approved the final version for publication.

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## Figures



**Figure 1**

Graphs showing the daily percentage change (DPC) of the frequency of face mask use: A) Never, B) Rarely, C) Sometimes, D) Frequently, E) Always.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [COVID19QUEST.pdf](#)