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Population-based surveys of antibodies against SARS-CoV-2 in Southern Brazil

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Supplementary information

Supplementary table 1 summarizes the analytical strategies, which were described in the Methods section.

In the primary analytical strategy, prevalence of positive tests in surveys 1 to 3 were 0.048% (95% confidence interval [CI] 0.006%; 0.174%), 0.135% (95% CI: 0.049%; 0.293%) and 0.222% (95% CI: 0.107%; 0.408%), respectively (Supplementary Table 2). There was statistical evidence supporting that the prevalence increased between surveys: $P=0.017$ and $P=0.048$ in absolute and relative comparisons, respectively. Not only the P-value for comparisons in the additive scale was smaller, but also the point estimates changed by a very similar amount (~ 0.087 percent points) between consecutive surveys. Although conclusions based on only three time points should be taken with caution, these results indicate that at this stage the prevalence is progressing arithmetically, rather than geometrically. Strategy 2 yielded identical results, with the exception that confidence intervals were wider and, therefore, the statistical evidence for an increase in the prevalence between surveys was even lower, but still achieving conventional significance levels.

Strategy 3 essentially yielded corrected prevalence estimates of 0%. Similar results were obtained using analytical strategy 3, but varying sensitivity and specificity estimates (Supplementary Table 3). In an absolute sense, this is not substantially different from the uncorrected results. Moreover, as discussed in section 2, it is possible that this result is an overcorrection.

Sample sizes and numbers of positive results by city are shown in Supplementary Table 4. Supplementary Table 5 displays the test results on family members of index subjects who tested positive.

Supplementary Table 1. Summary of analytical strategies used to estimate the prevalence of infection.

Strategy	Accounting for multi-stage sampling	Accounting for test validity
1		
2	X	
3	X	X

Supplementary Table 2. Prevalence of infection, number of cases in the state and absolute and relative differences between the surveys. Values are point estimates (95% confidence intervals).

Strategy	Survey	Prevalence (%)	Number of cases in the state ^a	Absolute difference, in percent points	Relative ratio
1				P=0.017 ^b	P=0.048 ^b
	1	0.048 (0.006; 0.174)	5482 (664; 19789)	0 (Ref.)	1 (Ref.)
	2	0.135 (0.049; 0.293)	15306 (5619; 33288)	0.086 (-0.040; 0.213)	2.792 (0.564; 13.823)
	3	0.222 (0.107; 0.408)	25283 (12130; 46453)	0.174 (0.021; 0.327)	4.612 (1.011; 21.033)
2				P=0.046	P=0.047
	1	0.048 (0.001; 0.280)	5482 (139; 31862)	0 (Ref.)	1 (Ref.)
	2	0.135 (0.042; 0.319)	15306 (4831; 36296)	0.086 (-0.069; 0.241)	2.792 (0.566; 13.775)
	3	0.222 (0.101; 0.423)	25283 (11501; 48132)	0.174 (-0.001; 0.350)	4.612 (1.014; 20.971)
3				c	c
	1	0.000 (0.000; 0.000)	0 (0; 0)	c	c
	2	0.000 (0.000; 0.000)	0 (0; 0)	c	c
	3	0.000 (0.000; 0.036)	0 (0; 4102)	c	c

^aAssuming a population size of 11,377,239, as estimated by the Brazilian Institute of Geography and Statistics for 2019.

^bP-values were calculated using Cochran's Q heterogeneity test assuming a linear (in the absolute or relative scales) trend over time (and thus with 1 degree of freedom), implemented as fixed-effects meta-regression.

^cTime trends were not calculated because all point estimates were zero.

Supplementary Table 3. Additional results on prevalence of infection and number of cases for each survey using strategy 3 for different sensitivity and specificity estimates. Values are point estimates (95% confidence intervals).

Source of validity estimates	Survey	Prevalence (%)	Number of cases in the state ^a
Manufacturer	1	0.000 (0.000; 0.171)	0 (0; 19432)
	2	0.000 (0.000; 0.264)	0 (0; 30064)
	3	0.000 (0.000; 0.391)	0 (0; 44516)
Local validation study	1	0.000 (0.000; 0.129)	0 (0; 14712)
	2	0.000 (0.000; 0.245)	0 (0; 27922)
	3	0.000 (0.000; 0.374)	0 (0; 42582)

^a Assuming a population size of 11,377,239, as estimated by the Brazilian Institute of Geography and Statistics for 2019.

Supplementary Table 4. Number of positive results and sample size by city and survey round.

City	Survey round (positive results / number tested)		
	1	2	3
Canoas	0/332	1/500	0/500
Caxias do Sul	0/500	0/500	1/500
Ijuí	0/463	0/460	2/500
Passo Fundo	0/500	0/500	4/500
Pelotas	1/500	1/500	1/500
Porto Alegre	0/396	3/500	1/500
Santa Cruz do Sul	0/500	0/500	1/500
Santa Maria	0/461	1/500	0/500
Uruguaiana	1/499	0/500	0/500

Supplementary Table 5. Results of tests on family members of index subjects who tested positive.

Survey round	City	Family members			
		Positive	Negative	Not tested	Total
1	Pelotas	0	5	0	5
1	Uruguaiana	0	1	0	1
2	Canoas	2	2	0	4
2	Pelotas	0	2	0	2
2	Porto Alegre*	0	0	0	0
2	Porto Alegre	0	0	1	1
2	Porto Alegre	5	0	0	5
2	Santa Maria	0	1	0	1
3	Caxias do Sul	1	1	0	2
3	Ijuí	0	0	0	0
3	Ijuí	0	3	0	3
3	Passo Fundo	0	3	0	3
3	Passo Fundo	0	0	1	1
3	Passo Fundo	0	1	0	1
3	Passo Fundo	3	3	0	6
3	Pelotas*	0	0	0	0
3	Porto Alegre	1	0	0	1
3	Santa Cruz do Sul	1	2	0	3
Total		13	24	2	39

(*) Index subject lived alone.

COVID-19 Population Survey

Resident board

Order number	Name (first and last)	Gender	Age	Do you work or study?	If you work, are you active outside the home?
1		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
2		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
3		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
4		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
5		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
6		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
7		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
8		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
9		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
10		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
11		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
12		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
13		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
14		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA
15		☐ M ☐ F	__ __	☐ work ☐ study	☐ yes ☐ no ☐ NA

Start the list by who is considered the head of the household.

Age: put zero if younger than one year.

Work / study: check one, both or neither, if you don't work or study.

Activity outside the home: mark yes for those who work and are working outside the home. NA = not applicable

SELECTED RESIDENT ORDER NUMBER __ __

RESULT OF THE REQUEST

☐ Accepted to participate

☐ Refused to participate -> another resident of the household must be drawn

SELECTED SECOND RESIDENT ORDER NUMBER __ __

RESULT OF THE SECOND RESIDENT'S REQUEST

☐ Accepted to participate

☐ Refused to participate -> the house must be replaced

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QUESTIONNAIRE

1- FU: (IBGE FU code)

2- ROUND:

3- CITY CODE:

4- Sector: (TWO DIGITS)

5- Sequential number of the interview in the sector: (TWO DIGITS)

6- Interviewee's household number: (TWO DIGITS)
(ACCORDING TO ADDRESS LIST)

7- Number of regular residents in the household

- ☐ 1 resident
- ☐ 2 residents
- ☐ 3 residents
- ☐ 4 residents
- ☐ 5 residents
- ☐ 6 residents
- ☐ 7 residents
- ☐ 8 residents
- ☐ 9 residents
- ☐ 10 residents
- ☐ 11 residents
- ☐ 12 residents
- ☐ 13 residents
- ☐ 14 residents
- ☐ 15 residents

8- Number of selected resident: (According to resident board)

9- Name of selected resident:

10- Number of resident who answers the questionnaire (Consult the resident board)

11- Who answers the questionnaire?

- ☐ The person himself
- ☐ Mother
- ☐ Father
- ☐ Another responsible or caregiver

12- Gender of (NAME):

- ☐ Male
- ☐ Female

13- What is the birth date of (NAME)?

___ / ___ / _____

14- What is the age of (NAME)? (If less than 1, put 0)

15- Did (NAME) attend school?

- ☐ Yes
- ☐ No

16- (NAME'S) education level:

- ☐ Child education
- ☐ Incomplete elementary school
- ☐ Complete elementary school
- ☐ Incomplete High school
- ☐ Complete High school
- ☐ Incomplete Graduation
- ☐ Complete Graduation
- ☐ Postgraduate

17- What was the last grade / year that (NAME) completed at school?

18- What level of education of resident that has studied the most?

- ☐ Illiterate/ did not study
- ☐ Child education
- ☐ Incomplete elementary school
- ☐ Complete elementary school
- ☐ Incomplete High school
- ☐ Complete High school
- ☐ Incomplete Graduation
- ☐ Complete Graduation
- ☐ Postgraduate

19- What was the last grade completed by the resident that most studied in this house?

20- How does (NAME) identify yourself in terms of color or race?

- ☐ White
- ☐ Brown
- ☐ Black
- ☐ Yellow

- Indigenous

21- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had FEVER:

- Yes
- No

22- How many days did it start?

23- Do you still have a fever?

- Yes
- No

24- How many days did fever last?

25- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had SORE THROAT:

- Yes
- No

26- How many days did it start?

27- Do you still have a sore throat?

- Yes
- No

28- How many days did sore throat last?

29- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had COUGH:

- Yes
- No
- Always has/ constantly

30- Was the cough with phlegm/secretion?

- Yes
- No

31- How many days did it start?

32- Do you still have a cough?

- Yes
- No

33- How many days did the cough last?

34- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had DIFFICULTY BREATHING:

- ☐ Yes
- ☐ No
- ☐ Always has/ constantly

35- Was the nose stuffy?

- ☐ Yes
- ☐ No

36- How many days did it start?

37- Do you still have a difficulty breathing?

- ☐ Yes
- ☐ No

38- How many days did a difficulty in breathing last?

39- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had HEARTBEAT, HEART SHOT OR HEATER IN THE HEART:

- ☐ Yes
- ☐ No
- ☐ Always has/ constantly

40- How many days did it start?

41- Do you still have this heart problem?

- ☐ Yes
- ☐ No

42- How many days did a heartbeat last?

43- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had HAS LOST THE SMELL OR TASTE OF THINGS?

- ☐ Yes
- ☐ No

44- How many days did it start?

45- Still having this problem?

- ☐ Yes
- ☐ No

46- How many days did you miss the smell or taste of things?

47- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had DIARRHEA:

- ☐ Yes
- ☐ No

48- How many days did it start?

49- Do you still have diarrhea?

- ☐ Yes
- ☐ No

50- How many days did the diarrhea last?

51- In the last two weeks, that is, since (DAY OF THE WEEK) of the week before, (NAME) had VOMITING:

- ☐ Yes
- ☐ No

52- How many days did it start?

53- Do you still have vomiting?

- ☐ Yes
- ☐ No

54- How many days did the vomiting last?

55- Has any doctor ever said that (NAME) has:

	Yes	No
Hypertension or high blood pressure	☐	☐
Diabetes or blood sugar	☐	☐
Asthma or bronchitis	☐	☐
Cancer (any type)	☐	☐
Chronic kidney disease	☐	☐
Some heart disease	☐	☐
Another chronic disease	☐	☐

56- (NAME) went to a health service in the last 15 days?

- ☐ Yes
- ☐ No

57- What kind of health service?

- ☐ Health Center
- ☐ Emergency room
- ☐ Private doctor
- ☐ Hospital
- ☐ Other health service

58- Why you sought the service?

- ☐ Vaccination
- ☐ Existing health problem

- Scheduled return
 - Flu symptoms or sore throat
 - Get medicine
 - Another motive
- 59- Regarding the social distance that is being guided by health authorities, that is, staying at home and avoiding contact with other people, how much (NAME) do you think you are managing to do? (read alternatives)
- Very little
 - Little
 - More or less
 - Quite
 - Practically isolated from everyone
- 60- How has the activity routine of (NAME) been? (read alternatives)
- Stay home all the time
 - Go out only for essential things like buying food
 - Go out from time to time to shop and stretch your legs
 - Go out every day for some activity
 - Go out every day, all day, to work or other regular activity
- 61- Thinking about the routine of the house, who has entered the house? (read alternatives)
- Only family members who live together, if any, and no one else
 - Some close relatives visit 1-2 times a week
 - Some close relatives visit almost every day
 - Friends, relatives, or others who visit 1-2 times a week
 - Friends, relatives, or others who visit almost every day
- 62- TEST IDENTIFICATION: (Nº: ROUND + MUNICIPALITY + SECTOR + HOUSEHOLD) (READ OUT)
-
- 63- TEST RESULT:
- POSITIVE
 - NEGATIVE
 - INCONCLUSIVE
- 64- IF POSITIVE, MARK THE RESIDENTS TO BE TESTED: (SEE HOUSEHOLD TABLE)
- Resident 1
 - Resident 2
 - Resident 3
 - Resident 4
 - Resident 5
 - Resident 6
 - Resident 7
 - Resident 8
 - Resident 9
 - Resident 10
 - Resident 11
 - Resident 12
 - Resident 13
 - Resident 14
 - Resident 15

65- Interviewee name:

66- Contact phone:

() _____ - _____