SUPPLEMENT

Dynamic Covid-19 IgG Monitoring in Chile: differential response to the inactivated virus from Sinovac and the mRNA vaccine from Pfizer-BioNTech.

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1. Optimal allocation of testing sites

Considers the problem of selecting the locations at which a testing station must be located in a given city, so as to test a geographically representative sample of its population, at the county-level.

~~Since stations operate Monday to Friday, the decision where to locate a~~ S~~s~~tations were located Monday to Friday in specific locations based on ~~on each day. We consider~~ aggregate and anonymized cellular-phone mobility data, facilitated by the largest telecom in Chile. This data records daily movement of cell-phones between *census blocks* (a county is formed by several census blocks). Using this data, we estimate $n_{b,c,d}$, the number of participants from county c enrolled in the study on day d, if a testing station operates on census block b during a given ~~said~~ day.

Let $x_{b,d}$ denote the decision regarding block b on day d, i.e.

$$x_{b,d} = \begin{cases} 1 & \text{A testing station is located at census block } b \text{ during day } d \\ 0 & \text{otherwise} \end{cases}$$

We assume that no more than one station is located at the same census block on any given day. Given the decision encoded in variables x, we have that it is necessary to impose that no more than the number of available stations is assigned on any given day, i.e.

$$\sum_b x_{b,d} \leq S \quad \text{for any day } d$$

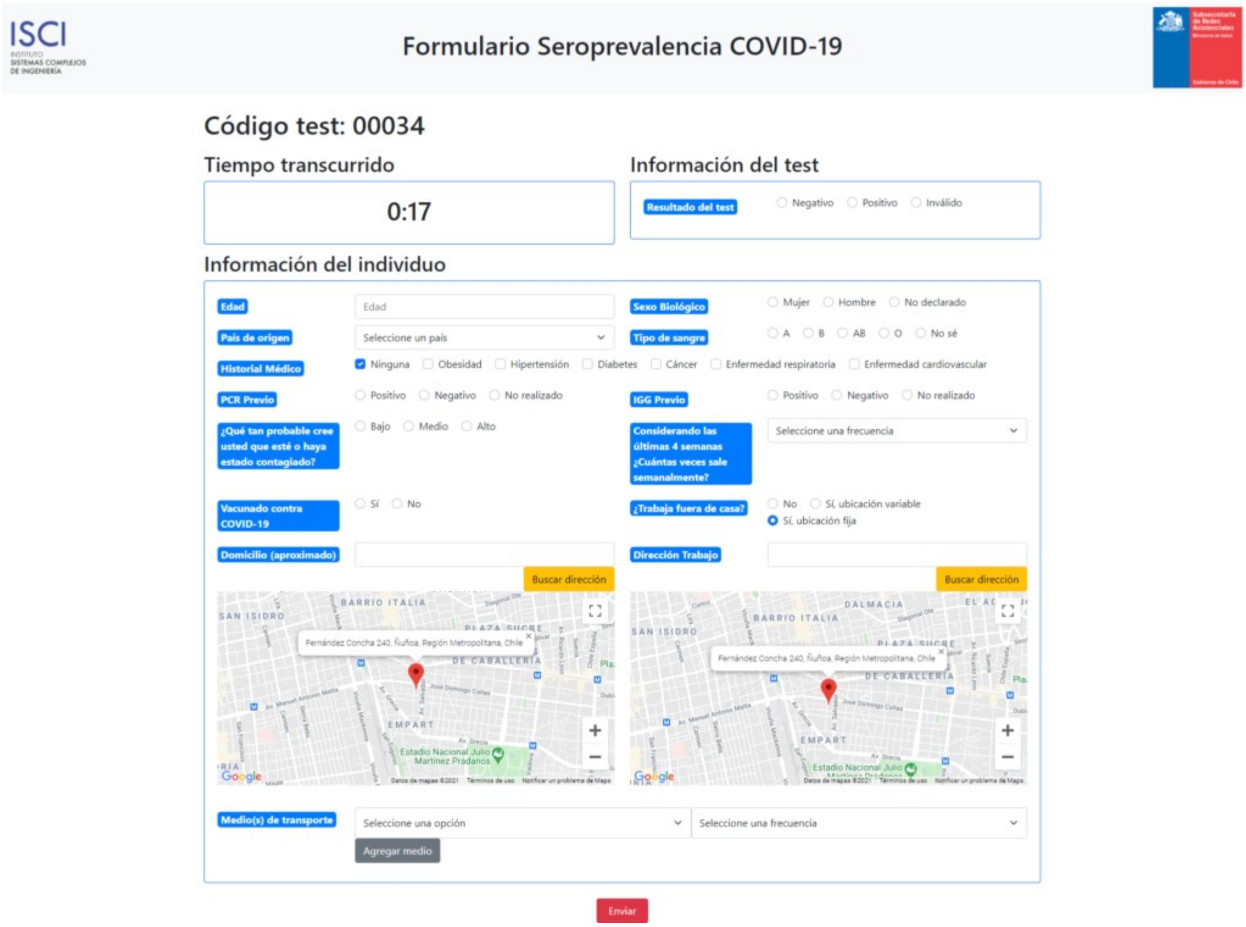
where S denotes the number of stations operating in the city. Let p_c denote the population of county c, as a fraction of the total population of the city, i.e. the target geographical distribution (obtained from census data). Also, let decision variable z denote the size of the largest representative sample obtained from operating the stations on each week. This implies that variables x and z should be such that

$$z \cdot p_c \leq \sum_d \sum_b x_{b,d} \cdot n_{b,c,d} \quad \text{for any county } c$$

Note that the right-hand side above denotes the total number of enrolled participants from county c, and the left-hand side denotes the number of said participants on a representative sample. Note that any given sample already collected can be incorporated directly in the right-hand side above. Our objective is to maximize the size of the representative sample, i.e. maximize z.

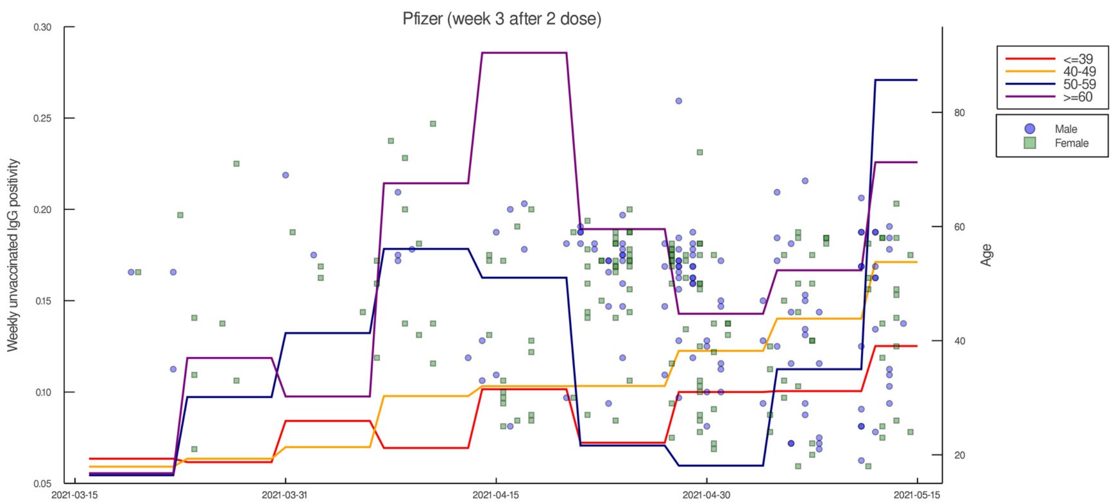
All of the above, together, forms a mixed-integer program, which can be solved using available state-of-the-art solvers and is a streamlined version of the optimization model used for the study. For the study, considering that some health services have jurisdiction over multiple cities, and that the largest cities are under the jurisdiction of more than one service, we solved the joint allocation problem faced by subsets of health services (those sharing jurisdiction over a city) and by a subset of cities (those under the jurisdiction of the same health service). This aggregation does not modify substantially the formulation above, but has the potential to increase running times significantly. In practice, running times always remained in the order of minutes, which is acceptable, as decisions are revisited on a weekly basis.

2. **Online web-based questionnaire for the surveillance COVID-19 IgG surveillance in large cities**



3. Computation of unvaccinated adjusted seropositivity

We illustrate the computation of the unvaccinated adjusted seropositivity for a given subgroup of participants by means of an example. Considering the subgroup of participants recruited during ~~in~~ their second week after being vaccinated with the second dose of the Pfizer-BioNTech vaccine; we call this the target subgroup~~pug~~. Supplementary Figure 1 below shows that participants in this target subgroup are relatively concentrated during~~on~~ the last weeks of April, and on the 50 to 60 years old age bracket. Note that seropositivity among unvaccinated participants in that age range was less than 8% during said weeks.



Supplementary Figure 1.- Age and gender of the target subgroup, and seroprevalence by date and age range among unvaccinated participants.

We now illustrate the matching procedure of the target subgroup with the distribution of unvaccinated participants, according to date, gender and age range. Let us start by week 6, to show detailed computation. Supplementary Table 1 below shows the seropositivity among unvaccinated participants, as a function of their age range and gender. Supplementary Table 2 shows the same, but for the target subgroup:

	18-39	40-49	50-59	≥60
Male	6·1%	9·6%	4·4%	14·3%
Female	8·1%	11·0%	9·3%	21·7%

Supplementary Table 1.- Seropositivity among participants in the target group recruited during week 6 of the study, as a function of their age range and gender.

	18-39	40-49	50-59	≥60
Male	5·5%	3·6%	27·3%	3·6%
Female	7·3%	10·9%	38·2%	3·6%

Supplementary Table 2.- Proportion of target subgroup recruited during week 6 of the study, as a function of their age and gender.

We obtained an adjusted unvaccinated seropositivity associated with participants in the target subgroup recruited during week 6 of the study by simply multiplying (element-wise) Supplementary Tables 1 and 2, and adding all 8 resulting terms. Repeating this procedure for each week of the study results in the adjusted seropositivity shown in Supplementary table 3 below. On the other hand, Supplementary table 4 below depicts the distribution in time of the target subgroup across the study.

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
5·1%	5·9%	11·9%	16·8%	14·5%	8·5%	8·6%	10·3%	19·6%

Supplementary Table 3.- Adjusted unvaccinated seropositivity by week

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
0·7%	3·2%	2·1%	5·7%	8·9%	19·6%	27·1%	16·8%	15·7%

Supplementary Table 4.- Distribution of the target subgroup across the study

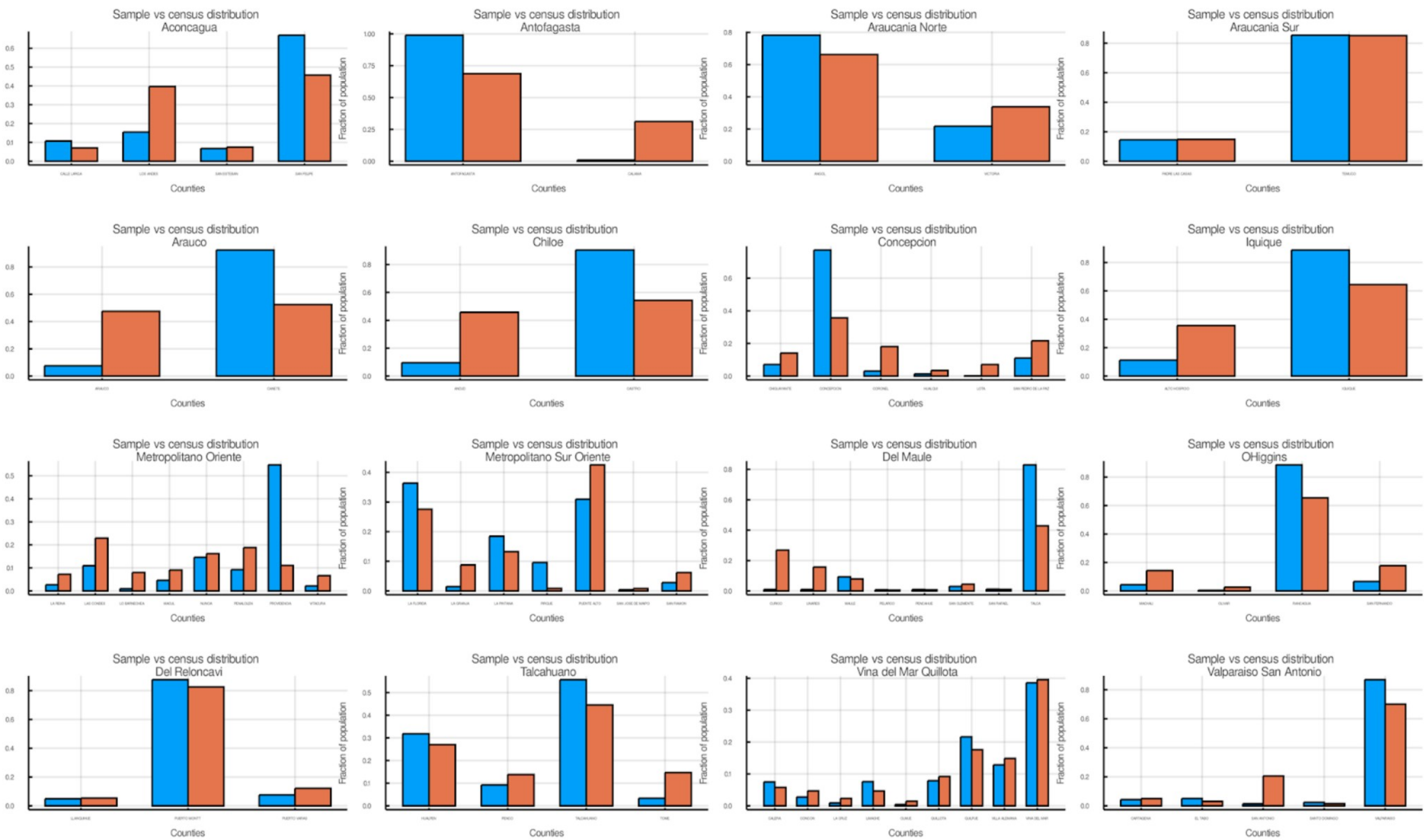
Finally, we obtained an adjusted unvaccinated seropositivity for the target subgroup by simply multiplying (element-wise) Supplementary tables 3 and 4, and adding all resulting terms.

Confidence intervals for adjusted unvaccinated seropositivity follows from considering a normal approximation for the seropositivity of unvaccinated participants (using the entries in Supplemental Table 1 as mean estimates) and noting that the adjusted unvaccinated seropositivity is a weighted sum of normal variables and thus distributes normal.

4. Data by Health Service

Health Service Area	Date of Onset (dd/mm/yy)	Total	Unvaccinated	Sinovac	Pfizer-BioNTech
Aconcagua	18/3/2021	1803	484	1208	111
Antofagasta	17/3/2021	815	46	563	206
Araucania Norte	24/3/2021	1900	508	924	468
Araucania Sur	15/3/2021	2481	1543	741	197
Arauco	16/4/2021	648	71	535	42
Arica	18/3/2021	2372	612	1268	492
Aysen	23/4/2021	410	80	223	107
Biobio	22/3/2021	1405	584	607	214
Chiloe	18/3/2021	1595	1098	318	179
Concepcion	24/3/2021	1241	449	657	135
Iquique	24/3/2021	655	380	195	80
Magallanes	12/4/2021	376	78	262	36
Metropolitano Oriente	16/4/2021	910	297	528	85
Metropolitano Sur Oriente	12/4/2021	1139	382	654	103
Del Maule	15/3/2021	2276	1179	911	186
OHiggins	15/4/2021	588	177	330	81
Osorno	7/4/2021	1053	230	683	140
Del Reloncavi	19/3/2021	2479	1035	1209	235
Talcahuano	26/3/2021	1167	342	699	126
Valdivia	6/4/2021	2479	127	2039	313
Vina del Mar Quillota	15/3/2021	2339	1035	1143	161
Valparaiso San Antonio	23/3/2021	1598	412	1042	144

Supplementary Table 5. Distribution of Participants According to Health Service Areas, Date of Site Onset, and Vaccination Status.



Supplementary Figure 2.- Distribution of study participants by counties as compared to the general population distribution in the 22 health care services. (Note: Six Health Services are not shown as they include only one large county (Arica, Aysen, Biobio, Magallanes, Osorno, Valdivia)

Characteristics	First dose - weeks 1 to 4				Second dose - weeks 1 to 4				Second dose - weeks 5 to 9			
	Sinovac	Unvaccinated (adjusted)	Pfizer-BioNTech	Unvaccinated (adjusted)	Pfizer-BioNTech	Unvaccinated (adjusted)	Pfizer-BioNTech	Unvaccinated (adjusted)	Sinovac	Unvaccinated (adjusted)	Pfizer-BioNTech	Unvaccinated (adjusted)
Overall	16·7% (14·9%, 18·5%)	11·4% (10·5%, 12·4%)	45·8% (42·8%, 48·7%)	10·9% (10·0%, 11·8%)	65·0% (63·7%, 66·3%)	12·5% (11·1%, 13·9%)	88·0% (86·4%, 89·6%)	11·6% (10·4%, 12·8%)	67·4% (66·4%, 68·4%)	14·1% (12·1%, 16·1%)	93·5% (91·8%, 95·1%)	12·7% (11·2%, 14·1%)
Gender												
Male	16·2% (13·6%, 18·9%)	10·8% (9·4%, 12·1%)	46·5% (42·1%, 50·8%)	10·3% (9·0%, 11·6%)	60·7% (58·7%, 62·8%)	12·5% (10·3%, 14·8%)	85·5% (82·8%, 88·2%)	11·3% (9·3%, 13·2%)	62·2% (60·5%, 63·8%)	13·0% (9·6%, 16·4%)	90·2% (86·6%, 93·9%)	13·4% (10·6%, 16·1%)
Female	17·1% (14·7%, 19·5%)	11·9% (10·6%, 13·3%)	45·2% (41·1%, 49·2%)	11·5% (10·2%, 12·7%)	68·0% (66·3%, 69·6%)	12·5% (10·7%, 14·2%)	89·8% (87·9%, 91·8%)	11·9% (10·4%, 13·4%)	70·7% (69·5%, 71·9%)	14·7% (12·3%, 17·2%)	94·9% (93·1%, 96·7%)	12·3% (10·6%, 14·1%)
Age Range												
18-39	19·7% (16·4%, 23·0%)	8·8% (8·0%, 9·5%)	54·4% (49·3%, 59·4%)	8·8% (8·0%, 9·6%)	70·8% (68·6%, 72·9%)	9·1% (8·4%, 9·9%)	92·6% (90·3%, 94·9%)	9·5% (8·6%, 10·3%)	70·0% (68·4%, 71·6%)	9·9% (8·9%, 10·8%)	97·0% (95·1%, 98·8%)	9·4% (8·6%, 10·3%)
40-49	16·1% (12·9%, 19·3%)	11·6% (9·8%, 13·4%)	38·9% (33·9%, 44·0%)	11·5% (9·9%, 13·1%)	66·0% (62·9%, 69·0%)	11·2% (9·7%, 12·7%)	89·4% (86·1%, 92·7%)	11·3% (9·7%, 12·9%)	70·4% (68·1%, 72·8%)	12·3% (10·4%, 14·2%)	96·2% (93·5%, 99·0%)	12·3% (10·3%, 14·3%)
50-59	16·0% (12·8%, 19·3%)	13·2% (10·9%, 15·6%)	43·4% (38·0%, 48·7%)	12·1% (9·9%, 14·4%)	58·4% (55·7%, 61·1%)	12·0% (9·4%, 14·6%)	86·6% (83·9%, 89·2%)	12·2% (9·6%, 14·9%)	68·7% (66·0%, 71·4%)	13·6% (10·2%, 17·1%)	94·5% (91·5%, 97·5%)	14·6% (10·3%, 19·0%)
≥60	9·8% (4·9%, 14·7%)	14·9% (10·5%, 19·2%)	44·8% (26·7%, 62·9%)	17·5% (11·9%, 23·1%)	63·1% (60·5%, 65·6%)	18·1% (13·4%, 22·7%)	70·3% (61·4%, 79·2%)	19·3% (13·9%, 24·6%)	62·3% (60·5%, 64·1%)	20·1% (14·2%, 25·9%)	73·4% (64·5%, 82·3%)	20·3% (14·0%, 26·5%)
Nationality												
Chile	16·4% (14·6%, 18·2%)	10·8% (9·9%, 11·8%)	45·5% (42·5%, 48·5%)	10·4% (9·5%, 11·3%)	65·3% (64·0%, 66·6%)	12·1% (10·6%, 13·5%)	87·9% (86·2%, 89·5%)	11·0% (9·8%, 12·3%)	67·3% (66·3%, 68·3%)	13·8% (11·7%, 15·8%)	93·3% (91·6%, 95·1%)	12·1% (10·6%, 13·5%)
Other	25·4% (15·0%, 35·8%)	N/A	50·9% (37·5%, 64·4%)	N/A	54·2% (46·0%, 62·3%)	N/A	93·0% (85·4%, 100·0%)	N/A	73·5% (66·6%, 80·5%)	N/A	100·0% (100·0%, 100·0%)	N/A
Times leaving home per week												
less than 3	14·3% (11·5%, 17·0%)	11·9% (10·1%, 13·7%)	42·0% (36·8%, 47·2%)	10·5% (8·8%, 12·1%)	61·3% (59·2%, 63·4%)	13·9% (10·9%, 17·0%)	88·3% (85·8%, 90·7%)	12·0% (9·6%, 14·3%)	63·1% (61·2%, 64·9%)	15·9% (10·9%, 20·9%)	88·4% (84·4%, 92·5%)	13·3% (10·1%, 16·6%)
3 to 5	18·1% (14·8%, 21·4%)	12·3% (10·6%, 14·1%)	49·8% (44·4%, 55·3%)	12·3% (10·5%, 14·0%)	68·2% (66·0%, 70·4%)	N/A	87·2% (84·2%, 90·3%)	N/A	69·7% (68·0%, 71·4%)	N/A	94·3% (91·5%, 97·0%)	N/A
6 to 7	19·5% (15·7%, 23·2%)	N/A	46·2% (40·9%, 51·6%)	11·0% (9·2%, 12·8%)	67·3% (64·7%, 69·9%)	N/A	89·8% (86·5%, 93·2%)	11·8% (9·6%, 14·0%)	68·2% (66·3%, 70·1%)	N/A	96·5% (94·1%, 98·9%)	N/A
more than 7	13·7% (8·0%, 19·4%)	N/A	44·1% (34·0%, 54·2%)	N/A	62·7% (58·0%, 67·5%)	N/A	85·0% (78·8%, 91·2%)	N/A	71·1% (68·0%, 74·1%)	N/A	97·4% (93·8%, 100·0%)	N/A
Comorbidities												
Obesity	16·2% (9·1%, 23·2%)	N/A	45·3% (31·9%, 58·7%)	N/A	60·2% (54·9%, 65·4%)	N/A	86·8% (79·9%, 93·8%)	N/A	67·0% (61·8%, 72·1%)	N/A	93·3% (84·4%, 100·0%)	N/A
HTA	17·5% (12·5%, 22·4%)	N/A	43·2% (34·3%, 52·2%)	14·9% (10·9%, 18·8%)	62·0% (59·3%, 64·6%)	N/A	88·5% (85·3%, 91·8%)	N/A	63·2% (61·0%, 65·3%)	N/A	90·1% (85·3%, 94·8%)	N/A
Diabetes	14·7% (8·2%, 21·1%)	N/A	37·5% (24·8%, 50·2%)	N/A	57·5% (53·7%, 61·2%)	N/A	89·4% (85·2%, 93·5%)	N/A	60·3% (57·0%, 63·5%)	N/A	86·6% (79·2%, 94·0%)	N/A
Cancer	10·0% (0·0%, 23·1%)	N/A	25·0% (0·5%, 49·5%)	N/A	62·4% (52·1%, 72·7%)	N/A	66·7% (47·8%, 85·5%)	N/A	60·0% (51·2%, 68·8%)	N/A	100·0% (100·0%, 100·0%)	N/A
Chronic pulmonary disease	19·8% (12·2%, 27·4%)	N/A	46·8% (32·5%, 61·1%)	9·2% (6·1%, 12·2%)	68·7% (63·2%, 74·2%)	N/A	93·9% (88·7%, 99·1%)	N/A	64·8% (60·3%, 69·3%)	N/A	86·5% (77·3%, 95·8%)	N/A
Chronic cardiovascular disease	18·6% (7·0%, 30·2%)	N/A	40·0% (20·8%, 59·2%)	N/A	59·2% (52·5%, 65·9%)	N/A	90·7% (82·0%, 99·4%)	N/A	63·7% (58·3%, 69·1%)	N/A	81·8% (65·7%, 97·9%)	N/A

Supplementary Table 6. Seropositivity by vaccination status and vaccine dosing period for all characteristics evaluated in the study (Note: N/A: In the adjusted analyses of unvaccinated individuals matched for the dates of vaccination of the corresponding periods, individuals with the indicated characteristics were not reported for at least one gender and/or age range).