RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

Drees

In May 2020, 4.5% of the population of metropolitan France had developed antibodies against SARS-CoV-2

The first results of the EpiCov national survey

According to the results of the EpiCov national survey, which was carried out on a representative sample of the population, seroprevalence of SARS-CoV-2 (meaning the proportion of individuals with antibodies against the virus, calculated from samples taken during lockdown in May 2020) is measured at 4.5% in metropolitan France for persons aged 15 and over. Seroprevalence is highest in Paris (9.0%), in the petite couronne suburban departments (9.5%) and in Haut-Rhin (10.8%).

Living in a densely populated urban area, working in the care sector, or living with a high number of people in the same household are factors associated with a higher risk of testing positive. Regardless of these factors, the proportion of positive tests is also higher when a member of the household has shown symptoms or has been tested positive for SARS-CoV-2, which also demonstrates the role of intra-household contamination in spreading the virus. Seroprevalence is more elevated in the 30-49 age group and for those facing extreme living conditions. It is also higher among immigrants born outside of Europe than among non-immigrants. This can be explained by the less favourable living conditions in which some of these individuals live, as this difference becomes irrelevant once socio-economic living conditions are taken into account.

In May 2020, 4.5% of the population aged 15 and over, living[1] in metropolitan France, had a positive serological result for SARS-CoV-2, measured by the detection of IgG antibodies directed against the viral envelope using the ELISA S method[2] *(box 1)*. This national seroprevalence, i.e. the percentage of people who have developed antibodies against the virus, is similar to that seen in other European countries for which the same kind of data are available[3-4]. It is in line with the estimates that have already been published in France[5].

These results are taken from the first phase of the Epidemiology and Living Conditions (EpiCov) survey associated with Covid-19, carried out in May 2020 among 370,000 people selected from INSEE's FIDELI survey dataset. From this group, 135,000 responded to the survey and 12,400 were tested using a home test kit. Increased testing was carried out in some departments selected for their elevated or reduced exposure to the virus in order to ensure a more precise result for these departments *(box 1)*.

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1. In ordinary households and communities, not including nursing homes ("étab-lissements d'héberge-ment pour personnes âgées dépendantes" or EHPADs), retirement homes and prisons.

2. *Enzyme Linked Immunosorbent Assay.*

3. 4.6% in Spain (Pollan, 2020); 6.9% in Belgium in May (Herzog, 2020); 6.6% in Geneva in May (Stringhini, 2020).

4. Salje *et al.* (2020).

5. Carrat *et al.* (2020) estimated seroprevalence in the Île-de-France region to be at 9.0% in May 2020.

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DIRECTION DE LA RECHERCHE, DES ÉTUDES, DE L'ÉVALUATION ET DES STATISTIQUES
In May 2020, 4.5% of the population of metropolitan France had developed antibodies against SARS-CoV-2

Seroprevalence above 9% in the Haut-Rhin region, Paris and the petite couronne suburbs

The percentage of individuals testing positive varied from 3.4% in Bouches-du-Rhône and Oise to 10.8% in the Haut-Rhin region (table 1). The percentage of individuals testing positive is at 7.6% in the Bas-Rhin region, 9.0% in the city of Paris and 9.5% in petite couronne sub- urbs (Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne). The regions with the highest levels of seroprevalence are Île-de-France (9.2%) and Grand Est (6.7%) and those with the lowest levels of sero-prevalence are Centre-Val de Loire (2.1%), Nouvelle-Aquitaine (2.0%), Occitanie (1.9%), Normandy (1.9%) and Bourgogne-Franche-Comté (1.5%) [table 2].

In the two regions most affected by the pandemic, the percentage of indivi-duals testing positive in Île-de-France as a whole (9.2%) is similar to that of Paris and petite couronne suburbs, however, it is lower in the Grand Est region (6.7%) than in the department of Haut-Rhin. Levels of prevalence are very similar in the urban areas of Mulhouse, Strasbourg and Paris: respectively 9.0% (6.3 to 11.6),

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⤢ BOX 1

Epidemiology and Living Conditions associated with Covid-19 (EpiCov) survey

The EpiCov survey was created by the French National Institute of Health and Medical Research (INSERM) and the DREES, in partnership with Santé publique France and the French National Institute of Statistics and Economic Studies (INSEE) to respond to the context of the current Covid-19 pandemic. It has a double objec-tive: to determine the progress of the pandemic on a national and departmental level and the factors, particularly those connected to living conditions, associated with exposure to the virus, and to study the repercussions of the lockdown measures on living conditions.

The first phase of the survey was carried out between 2 May and 2 June 2020, covering the period between the end of lockdown (which began on 17 March) and the start of measures relaxing the lockdown (started on 11 May). In total, 135,000 individuals over 15 years of age on 1 January 2020 responded, principally resi-ding in ordinary households in metropolitan France, Martinique, Guadeloupe and La Réunion. The survey worked towards an exten-sive coverage of all departments included and people on lower incomes, who are often less likely to respond to surveys, were over-sampled to provide accurate estimates in each social category. The survey mainly took place online as well as by telephone (to increase the participa-tion rate and recruit individuals with no or limited internet access).

A home blood testing kit was offered to some of the participants, to detect the presence of antibodies against SARS-CoV-2 (serol-ogy). A total of 12,400 people were tested. The national repre-sen-tativeness of the tests was ensured by the design of the survey, supplemented by statistical adjustment methods. The depart-ments used for sampling were chosen for their particularly high or low exposure to the virus: Bouches-du-Rhône, Oise, Bas-Rhin, Haut-Rhin, Paris and its petite couronne suburbs (Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne).

The participants who agreed to this self-testing sent their sample by post between 13 May and 1 July 2020, with three quarters send-ing their sample before 21 May. These samples were processed in the Centre for Biological Resources (CRB) at Pellegrin University Hospital of Bordeaux[1], which was responsible for preparing part of the paper test strips as they arrive (punching) to allow for biolo-gi-cal analysis and to store the rest of the strips. The tubes prepared by the CRB were then sent to a research laboratory specialising in emerging viruses (Emerging Viruses Unit, INSERM, Research and Development Institute [IRD], Université Aix-Marseille, Marseille), where the biological analyses were carried out. The results of the tests allowed us to give an estimate of the proportion of people who had been in contact with the virus since the beginning of the pandemic when relaxing the lockdown measures.

The second phase of the survey will be carried out in autumn 2020 with the participants in the first phase, with sample generalisation, in order to assess the level of seroprevalence in autumn 2020 at a departmental level. For a sub-sample of these individuals, tests will also be offered to all members of the household aged 6 years or older, in order to understand the progression of infections within the household.

The original study used an ELISA blood test[2] that detects the pres-ence of IgG antibodies directed against a protein (S protein), which is found on the surface of the SARS-CoV-2 virus and which allows it to enter and multiply in cells. These antibodies develop over a variable period following exposure to the virus (usually around 10 days in most cases). If the result of ELISA test is negative, there is a very strong probability that the person is not infected with SARS-CoV-2.

A complementary study has been carried out on samples with a "positive" or "limited" ELISA result[3] for which a serum neutrali-sa-tion test has been carried out (diagram below). This test makes it possible to identify the presence of antibodies that can prevent the virus from proliferating. It is a laborious process (it requires car-rying out multiple virus cultures for each sample) but is considered a reference test due to its extreme precision.
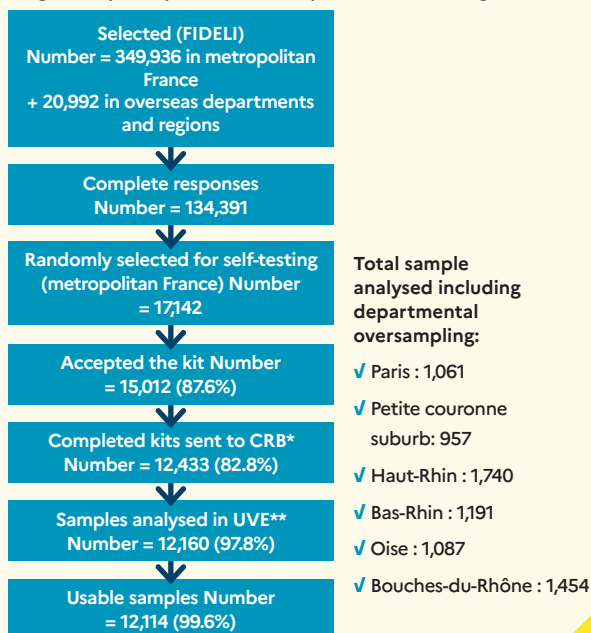
The strong consistency between the results of the ELISA test and serum neutralisation reaffirms the validity of the study's seropre-valence results. In total, 4.1% [3.6; 4.7] of the population had anti-bodies that are capable of neutralising SARS-CoV-2 (serum neu-tralisation test). The categorisation of departments is similar to that of the results from the sandwich ELISA tests: 1.9% [0.9; 2.9] in Bouches-du-Rhône, 2.7% [1.7; 3.6] in Oise, 5.6% [3.9; 7.3] in Bas-Rhin, 7.0% [5.0; 9.0] in the city of Paris, 8.1% [5.8; 10.3] in Paris' petite cou-ronne suburbs and 9.3% [7.7; 10.9] in Haut-Rhin.

1. N° BRIF BB-0033-00094.
2. EUROIMMUN® Anti-SARS-CoV-2 ELISA IgG anti-protein S (ELISA-S)
3. Presence of antibodies detected on the threshold of 0.7, but in an insuffi -cient quantity to be able to conclude a positive ELISA result.

Diagram of participants in the first phase of the investigation

Selected (FIDELI)
Number = 349,936 in metropolitan France
+ 20,992 in overseas departments and regions
↓
Complete responses Number = 134,391
↓
Randomly selected for self-testing (metropolitan France) Number = 17,142
↓
Accepted the kit Number = 15,012 (87.6%)
↓
Completed kits sent to CRB* Number = 12,433 (82.8%)
↓
Samples analysed in UVE** Number = 12,160 (97.8%)
↓
Usable samples Number = 12,114 (99.6%)

Total sample analysed including departmental oversampling:
√ Paris : 1,061
√ Petite couronne suburb: 957
√ Haut-Rhin : 1,740
√ Bas-Rhin : 1,191
√ Oise : 1,087
√ Bouches-du-Rhône : 1,454

*CRB: centre for biological resources.
**UVE: emerging virus unit.

8.8% (6.1 to 11.6) and 9.0% (7.1 to 11.0). These numbers are clearly lower in the urban areas of Creil and Marseille: 2.8% (0.04 to 5.7) and 3.6% (1.8 to 5.3). These results suggest a higher risk of exposure in dense urban areas in the regions where the virus is spreading more rapidly.

TABLE 1

Seroprevalence against SARS-CoV-2 in metropolitan France and in certain departments in May 2020

	Number of individuals with usable samples	Number of individuals who have antibodies against SARS-CoV-2[1]	% of individuals who have antibodies against SARS-CoV-2 (weighted percentages)	Confidence interval (IC) at 95%
Overall sample	**12,114**	**785**	**4,5**	**3.9-5.0**
Paris (75)	1,061	93	9,0	6.6-11.3
Petite couronne suburbs (92, 93, 94)[2]	957	93	9,5	7.0-11.9
Haut-Rhin	1,740	211	10,8	9.0-12.6
Bas-Rhin	1,191	86	7,6	5.7-9.6
Oise	1,087	49	3,4	2.4-4.4
Bouches-du-Rhône	1,454	56	3,4	2.3-4.4

1. Using the ELISA S method.
2. In the petite couronne suburbs, prevalence was, respectively, 11.7% (6.0; 17.4) in Seine-Saint-Denis, 8.5% (5.7; 11.4) in Hauts-de-Seine and 8.2% (4.5; 11.9) in Val-de-Marne.
Findings • We estimate that with a probability of 95%, the proportion of individuals who tested positive using the ELISA test in Bouches-du-Rhône is between 2.3% and 4.4% of the department's population. The median value of this interval is 3.4%. The uncertainty expressed by the confidence interval at 95% is linked to the method of estimating by surveys and the size of each group (unpredictable fluctuations), as it does not take into account the sensitivity and specificity of tests used.
Scope • Individuals aged 15 years or above, residing in metropolitan France, excluding EHPADs, retirement homes and prisons.
Source • EpiCov (INSERM-DREES), phase 1.

TABLE 2

Seroprevalence against SARS-CoV-2 on a regional scale in May 2020

	Number of individuals with usable samples	Number of individuals who have antibodies against SARS-CoV-2[1]	% of individuals who have antibodies against SARS-CoV-2 (weighted percentages)	Confidence interval (IC) at 95%
Auvergne-Rhône-Alpes	732	41	4.8	[3.3; 6.2]
Bretagne	314	10	3.1	[1.1; 5.1]
Bourgogne Franche-Comté	303	10	1.5	[0.2; 2.9]
Centre-Val de Loire	246	7	2.1	[0.6; 3.7]
Grand-Est	3,207	320	6.7	[5.1; 8.3]
Hauts-de-France	1,511	65	2.9	[1.3; 4.6]
Île-de-France	2,350	206	9.2	[7.1; 11.2]
Normandie	284	9	1.9	[0.6; 3.2]
Nouvelle-Aquitaine	548	14	2.0	[0.8; 3.2]
Occitanie	581	18	1.9	[0.9; 2.9]
Pays de la Loire	349	13	3.4	[1.4; 5.4]
Provence-Alpes-Côte d'Azur	1,643	70	5.2	[2.9; 7.5]

1. Prevalence in Corsica cannot be estimated (only 36 subjects with a test).
Interpretation • We estimate that with a probability of 95%, the proportion of individuals who tested positive using the ELISA test in Auvergne-Rhône-Alpes is between 3.3% and 6.2% of the region's population. The median value of this interval is 4.8%. The uncertainty expressed by the confidence interval at 95% is linked to the method of estimating by surveys and the size of each group (unpredictable fluctuations), as it does not take into account the sensitivity and specificity of tests used.
Scope • Individuals aged 15 years or above, residing in metropolitan France, excluding EHPADs, retirement homes and prisons.
Source • EpiCov (INSERM-DREES), phase 1.

Seroprevalence found using the ELISA test is highest among those between 30 - 49 years old and among those facing extreme living conditions

In May 2020, seroprevalence differed according to demographic and social factors (table 3). Variations were also observed according to sex and age: 5.0% of women and 3.9% of men had positive blood test results for IgG antibodies. In terms of age, prevalence is 3.6% for indi-viduals aged 15 - 20 and progres-sively increases towards a maximum prev-alence level among 30 - 49 year-olds, before dropping significantly for the more senior age groups. Adults between 30 and 49 years old make up the age bracket with the highest sero-prevalence, with 6.9% positive results, while this is only at 1.3% for people aged 65 or more or for those who no longer live in normal housing. The hypothesis that the first group, at the peak of their working life, may have more contact with oth-ers could explain these results. Inversely, people at the highest risk of developing a serious form of the disease, particularly those in the older age bracket, have been asked to stay at home as much as possible. Seroprevalence varies from 2.8% for those without a baccalaureate (high school diploma) to 5.8% among those with an education ranging from bac-ca-laureate to baccalaureate plus two years of higher education, and 6.2% for those with at least a baccalaureate plus three years of higher education. However, it is higher at the two extremes of the distri-bution of living standards: 5.7% for those in the lowest 10% in terms of living stan-dards and 6.0% for those in the highest 10%, while it is between 2.9% and 3.3% for the two median deciles (6th and 7th). These results could express a combination of various phenomena in terms of exposure to the virus that affect social groups differently or affect different professions before and during lockdown, as suggested by the results of the SAPRIS survey[6].

Working in the health sector or socio-medical sector is strongly associated with a higher seroprevalence

11.4% of care workers (medical and paramedical staff, pharmacists, fire-fighters, first aid staff, ambulance dri-vers) have a positive serology for SARS-CoV-2. This percentage is at 5.2% for

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6. Carrat et al. (2020).

TABLE 3

Proportion of positive results in ELISA tests depending on various sociodemographic characteristics and living conditions (national sample)

		Number	Number of positive tests	% (weighted percentages)	Confidence interval (IC) at 95%	
Sex	Men	5,469	321	3.9	[3.1; 4.7]	NS
	Women	6,645	464	5.0	[4.3; 5.8]	
5 age groups	15-20 years old	928	51	3.6	[1.8; 5.4]	*
	21-29 years old	1,253	81	5.7	[3.6; 7.8]	
	30-49 years old	4,072	366	6.9	[5.8; 8.1]	
	50-64 years old	3,375	204	4.5	[3.2; 5.9]	
	> 64 years old	2,486	83	1.3	[0.9; 1.8]	
Type of occupation[1,2]	Essential occupation in care sector	578	74	11.4	[7.7; 15.1]	*
	Essential occupation not in care sector	1,219	99	5.2	[3.6; 6.9]	
	Non-essential occupation	4,960	365	5.7	[4.7; 6.7]	
	Professionally inactive and occupied	5,356	247	3.0	[2.2; 3.8]	
Standard of living in deciles[3]	D01	798	52	5.7	[2.5; 8.9]	*
	D02-D03	1,430	86	4.8	[3.3; 6.4]	
	D04-D05	1,718	97	3.3	[2.3; 4.3]	
	D06-D07	2,423	128	2.9	[2.1; 3.7]	
	D08-D09	3,332	237	5.5	[4.4; 6.6]	
	D10	2,112	159	6.0	[4.5; 7.4]	
Qualification	< baccalaureate	4,236	204	2.8	[2.1; 3.6]	*
	Baccalaureate to bac. + 2 years' higher education	4,029	282	5.8	[4.7; 6.9]	
	≥ bac. + 3 years' higher education	3,849	299	6.2	[5.1; 7.4]	
First and second-generation immigrant[4,5]	No	9,546	597	4.1	[3.5; 4.7]	*
	Immigrant from a European background	374	24	4.8	[1.9; 7.9]	
	Immigrant from a non-European background	528	55	9.4	[5.5; 13.3]	
	Descendant of a European immigrant	706	41	3.6	[2.0; 5.3]	
	Descendant of a non-European immigrant	548	43	6.2	[3.4; 9.0]	
Living in a priority prioritaire neighbourhood	No	11,589	743	4.2	[3.7; 4.8]	*
	Yes	525	42	8.2	[3.8; 12.7]	
Urban density of the municipality of residence	Low density	3,666	219	3.4	[2.6; 4.3]	*
	Moderate density	3,562	199	3.3	[2.4; 4.1]	
	High density	4,886	367	6.4	[5.3; 7.5]	
Overcrowding in household[6]	Living alone	1,665	74	2.1	[1.3; 2.9]	*
	Living in a household that is not overcrowded	9,095	588	4.3	[3.7; 4.9]	
	Living in an overcrowded household	1,097	100	9.2	[6.1; 12.4]	
Number of people living in the same household	1 person only	1,665	74	2.1	[1.3; 2.9]	*
	2 people	4,266	203	2.7	[2.1; 3.3]	
	3-4 people	4,828	383	6.1	[5.1; 7.2]	
	5 people or more	1,349	125	8.5	[5.7; 11.3]	
Suspected case in the household	Living alone	1,665	74	2.1	[1.3; 2.9]	*
	No suspected case	8,828	433	4.0	[3.3; 4.7]	
	At least one suspected case	1,621	278	12.9	[10.4; 15.3]	
Smoking	Smokes daily	1,995	69	2.8	[1.8; 3.8]	*
	Smokes occasionally	470	33	5.1	[2.6; 7.5]	
	Stopping/stopped smoking	3,888	253	4.5	[3.4; 5.7]	
	No	5,756	430	5.1	[4.2; 5.9]	

1. Healthcare personnel, nursing assistants, paramedical staff, firefighters, first-aid workers, ambulance drivers and pharmacists are considered essential occupations belonging to the care sector. Home care workers, personal care workers, domestic cleaners, cashiers, food shop workers, delivery drivers, public transport, coach and taxi drivers, customer service and reception staff in banks, petrol station workers, police officers, postmen, cleaning and janitorial staff, security guards, craftspeople and construction workers, lorry drivers, farmers and social workers - excluding teachers (due to the closure of schools) - are considered to be essential workers not belonging to the care sector.
2. According to the INSEE definition, the occupied labour force includes individuals who have a job (the active population comprises all occupied persons and jobseekers). Apprentices and paid interns are counted as active.
3. According to INSEE, the standard of living is equal to the income available in the household, divided by the number of consumption units (CU). The standard of living is therefore the same for all individuals in the same household. The deciles are values that separate the population into 10 equal parts.
4. According to the definition adopted by the High Council for Integration and which serves as a frame of reference in work by INSEE, an immigrant is a person who is born a foreign national and abroad, and resides in France. They are always categorised as an immigrant, even though some may acquire French nationality.
5. According to INSEE, a descendant of an immigrant is an individual born in and residing in France who has at least one parent who is an immigrant.
6. According to INSEE's definition, a household is overcrowded if the area is less than 18 m² per person for dwellings of more than one person and less than 25 m² for dwellings occupied by only one person.
Note • A chi-squared statistical test has been carried out on each of the variables in order to determine whether the differences observed in the proportion of positive cases are significant (in this case, at least one of the proportions is actually different to the others). The asterisk (*) indicates that the proportions of positive cases differ significantly on the threshold of 5%; NS is given if the proportions are not significantly different.
Interpretation • The proportion of people living in an overcrowded household and who are positive according to the ELISA test is estimated to be between 6.1% and 12.4%, with a confidence interval of 95% (meaning that there is a 5% chance that the actual value is outside this interval). The median value of this interval is 9.2%. Conversely, we estimate that around 4.3% (between 3.7% and 4.9%) of people not living in an overcrowded household are positive in the ELISA test. The difference in seroprevalence between these two groups is statistically significant because the confidence intervals do not overlap.
Scope • Individuals aged 15 years or above, residing in metropolitan France, excluding EHPADs, retirement homes and prisons.
Source • EpiCov (INSERM-DREES), phase 1.

other key workers[7], and 5.7% for those in other professions. For the first group, the probability of being exposed to the virus, on a repeated basis, is directly linked to their professional activity. However, the lack of difference between seroprevalence among key workers not working in the care sector, in the context of the pandemic, and other workers is to be interpreted with caution, as this category covers a vast variety of professional profiles (Bajos, 2020), which cannot be taken into account in the analysis of this subsample for practical reasons. The results of the next phase of the survey (Autumn 2020) will allow us to better explore these situations.

Living conditions are strongly associated with higher seroprevalence, particularly for those living in a densely populated urban municipality

Living environment is a determning factor for exposure to the virus. People living in very densely populated municipalities are twice as likely to test positive: 6.4% had positive seroprevalence compared to 3.3% among those living in medium density municipalities and 3.4% among those living in low density municipalities. This result is to be expected due to the lack of opportunity for physical distancing in high density municipalities and the increased frequency of contact (public transport, streets), which could potentially increase the probability of being in contact with an infected person, particularly in the departments most affected by the virus. Twice as many people living in a priority neighbourhood of the city ("quartier prioritaire de politique de la ville" or QPV) are positive compared to those living in rest of the area, with a seroprevalence of 8.2% com-pared to 4.2% outside of the QPVs. This result could in part be explained by the fact that the QPVs are often situated in densely populated municipalities and by the increased exposure to the virus in more socially disadvantaged areas

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7. Home care workers, personal care workers, domestic cleaners, cashiers, food shop workers, delivery drivers, public transport, coach and taxi drivers, customer service and reception staff in banks, petrol station workers, police officers, postmen, cleaning and janitorial staff, security guards, craftspeople and construction workers, lorry drivers, farmers and social workers - excluding teachers (due to the closure of schools) - are considered to be essential workers not belong-ing to the care sector, and have been given exemption from the lockdown measures in France.

TABLE 4

Factors associated with the probability of positive seroprevalence for Covid-19 in May-June 2020 within the population

		Gross odds ratio	Confidence interval (IC) at 95%	P-value	Adjusted Odds-ratio	Confidence interval (IC) at 95%	P-value
Urban density	Low-density municipalities	ref		<0.001	ref		0.001
	Moderate-density municipalities	0.9	[0.7; 1.4]		1.1	[0.8; 1.6]	
	High-density municipalities	1.9	[1.4; 2.8]		1.9	[1.3; 2.7]	
Type of occupation	Occupation in care sector	2.1	[1.3; 3.2]	<0.001	2.2	[1.4; 3.4]	0.002
	Essential occupation not in care sector	0.9	[0.6; 1.3]		1.0	[0.7; 1.5]	
	Non-essential occupation	ref			ref		
	Professionally inactive and occupied	0.5	[0.4; 0.7]		0.9	[0.6; 1.4]	
Number of people in the household	1 person	ref		<0.001	ref		0.017
	2 people	1.3	[0.8; 2.1]		1.2	[0.7; 2.0]	
	3-4 people	3.1	[2.0; 4.8]		1.8	[1.1; 3.1]	
	≥ 5 people	4.4	[2.5; 7.6]		2.6	[1.3; 5.5]	
Suspected case in the household	No	ref		<0.001	ref		<0.001
	Yes	3.9	[3.0; 5.2]		3.1	[2.3; 4.2]	
Sex	Men	ref		0.054	ref		0.1
	Women	1.3	[0.9; 1.7]		1.3	[1.0; 1.7]	
5 age groups	15-20 years old	0.5	[0.3; 0.9]	<0.001	0.5	[0.2; 0.9]	0.003
	21-29 years old	0.8	[0.5; 1.2]		0.7	[0.4; 1.1]	
	30-49 years old	ref			ref		
	50-64 years old	0.6	[0.5; 0.9]		0.9	[0.6; 1.3]	
	> 64 years old	0.2	[0.1; 0.3]		0.4	[0.2; 0.6]	
First and second generation immigrant	No	ref		0.003	ref	ref	0.49
	Immigrant from a European background	1.2	[0.6; 2.3]		1.4	[0.7; 2.9]	
	Immigrant from a non-European background	2.4	[1.5; 4.0]		1.6	[0.9; 3.0]	
	Descendant of a European immigrant	0.9	[0.5; 1.5]		1	[0.6; 1.6]	
	Descendant of a non-European immigrant	1.6	[0.9; 2.6]		1.1	[0.6; 1.6]	
Standard of living en deciles	D01	2.1	[1.1; 4.0]	<0.001	1.7	[0.9; 3.5]	0.002
	D02-D03	1.7	[1.1; 2.6]		1.8	[1.1; 2.8]	
	D04-D05	1.1	[0.7; 1.6]		1.1	[0.7; 1.7]	
	D06-D07	ref			ref		
	D08-D09	1.9	[1.4; 2.7]		1.9	[1.3; 3.0]	
	D10	2.1	[1.4; 3.1]		2	[1.3; 3.0]	
Qualification	< baccalaureate	ref		<0.001	ref		0.09
	Baccalaureate to bac. + 2 years' higher education	2.1	[1.5; 3.1]		1.4	[1.0; 2.0]	
	≥ bac. + 3 years' higher education	2.2	[1.6; 3.2]		1.1	[0.8; 1.7]	
Tobacco consumption	Smokes daily	ref		0.031	ref		0.016
	Smokes occasionally	1.8	[1.0; 3.5]		2	[1.0; 4.0]	
	Stopping/stopped smoking	1.6	[1.0; 2.6]		2	[1.3; 3.0]	
	No	1.8	[1.2; 2.8]		2	[1.2; 3.2]	

Note • The multivariate analysis is based on logistic regression.
Interpretation • The crude odds ratio measures the association between a given variable, e.g. first and second-generation immigrants, and seropositivity, while the adjusted odds ratio controls this association with all of the other variables presented. Thus, the association between seropositivity and immigrants from non-European backgrounds that is significant when not adjusting for other variables disappears when we control this effect using other variables.
Scope • Individuals aged 15 years or above, residing in metropolitan France, excluding EHPADs, retirement homes and prisons.
Source • EpiCov (INSERM-DREES), phase 1.

(Bajos, 2020). Seroprevalence is twice as high for those living with others in overcrowded housing (9.3%) as for those living in non-overcrowded (4.3%) housing. Living conditions for immigrants, often less favourable than those for the rest of the French population, are very likely to be the reason for seroprevalence that is twice as high among immigrants from countries outside of Europe, i.e. born in a foreign country with a foreign nationality than among non-immigrant individuals (9.4% positive, compared to 4.1% among non-immigrants). As for immigrants coming from European countries, they have a seroprevalence that is equal to non-immigrant individuals (4.8%). Other analy-ses drawn from the EpiCov study show the nuanced differences that exist even within the immigrant population in terms of potential exposure to the virus, when we take country of origin into account (Bajos *et al.*, 2020). Further to the question of living conditions, seroprevalence increases with the number of people living together in the same household is increased, with a prevalence of 2.1% for those living alone, 2.7% for those living with one other person, 6.1% for those living in households of 3 or 4 and 8.5% for those living in households of 5 or more. The percentage of seropositivity is also

clearly more elevated (12.9%) for individuals living with someone who has tested positive for Covid-19 or who has had a fever or a cough compared to those who do not report having experienced this in their household (4.0%) and especially compared to people living alone (2.1%). This result does not allow us to establish the direction of contamination between the surveyed individual and the household member(s) affected. Furthermore, the percentage of positive results is lower among those who consume tobacco on a daily basis (2.8%) than among those who smoke occasionally, people who have quit, and people who have never consumed tobacco (5%). This result confirms the inverse correlation between infection markers for Covid-19 and tobacco consumption, which has already been reported in other studies.

Risk of seropositivity remains higher among those living in a densely populated municipality, those living in large households and among care workers, for fixed levels of other characteristics

The hypotheses suggested above are supported by a multivariate analysis, allowing us to measure the effect of various socio-demographic, working

and living conditions factors (*table 4*). Living in a densely populated urban area[8], being a key worker in the care sector, and living in a large household remain associated with a higher risk of seropositivity, independently of each other and independently of sex, age and level of education. Age also remains associated with a maximum risk of seropositivity in the 30-49 age group. For other socio-demographic and living conditions variables (as well as geographical variables related to the intensity of virus circulation), we observe that the risk of seropositivity remains higher for people with the highest or lowest standards of living. However, the difference in antibody prevalence among immigrants and non-immigrants completely disap-pears when we take socio-economic and domestic living conditions into account, confirming the hypotheses of recent literature (Bajos *et al.*, 2020).

Finally, the strong relation between seropositivity and the existence of a suspected case in the household, regardless of the number of household members, population density in the municipality, occupation and socio-economic conditions, suggests the significance of intra-household contamination as a cause for the spreading of the virus. ■

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8. When taking into account the cumulative death rate by department of residence, the effect of population density in the municipality diminishes, explaining the link be-tween the spreading of the virus and population density.

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