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Supplementary appendix

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Factors associated with the spatial heterogeneity of COVID-19 in France: a nationwide ecological study

Appendix 1: List of data used in the study, at the department level

Table A1.1 – List of data used in the study.

Data used in the study (and details)	Data transformation	Inclusion in GAM models: Incidence ratio (SIR)	Mortality ratio (SMR)	Fatality ratio (SFR)
Daily in-hospital COVID-19 data per department between March 19th and May 11th 2020				
Cases	no	outcome	cofactor	offset
Deaths	no	no	outcome	outcome
Daily COVID-19-associated deaths per department from February 7th 2020				
Relative lag between the first COVID-19 associated death and the March 17th lockdown	yes	cofactor	cofactor	cofactor
Total population	no	offset	offset	
Population age structure estimated in 2020 per department	classification	cofactor	cofactor	cofactor
Population per 5-year and sex strata				
Intensive-care capacity	no	no	cofactor	cofactor
Number of intensive-care beds (ICU beds) in 2018				
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	no	cofactor	cofactor	cofactor
Baseline population health and healthcare services	classification	cofactor	cofactor	cofactor
Basal number of total deaths per department between March 19th and May 11th 2018 and 2019				
Availability of healthcare resources: densities of medical doctors, general practitioners, nurses, pharmacies and hospital beds per inhabitants				
Subsidized medical or dependency insurance: proportion of the population covered by Universal Health Insurance (CMU), proportion of the population receiving home nursing care, proportion of the elderly population recipient of the autonomy allowance (APA) at home				
Ageing index				
Proportion of hospital stays in endocrinology, cardiology, pneumology and medicine wards				
Economic indicators	classification	cofactor	no	no
Poverty ratio				
Median standard of living				
Unemployment ratio				
Housing allowance ratio				
Earned income supplement (RSA) ratio				
Average amount of the autonomy allowance (APA)				
Social assistance ratio				
Urbanization	classification	cofactor	no	no
Proportion of the population living in metropolitan cities				

Proportion of the population living in multipolar cities				
Proportion of the population living in remote communes				
Proportion of the population living in other communes				
Roads density outside urban areas				
Surface area				
Climate (% of surface area)	classification	cofactor	no	no
Mountain; semi-continental and sub-montane; modified oceanic of centre and north plains; altered oceanic; franc oceanic; altered Mediterranean; south-west basin; franc Mediterranean				
Spatial	spline	cofactor	cofactor	cofactor
Centroid coordinates				

GAM, generalized additive models.
Outcome in GAM: SIR, standardized incidence ratio; SMR, standardized mortality ratio; SFR, standardized fatality ratio.

Table A1.2 – List of data used in the study.

Data used in the study	Web source
In-hospital COVID-19 data per department between March 19^{th} and May 11^{th} 2020	
Daily cases and Deaths	https://www.data.gouv.fr/fr/datasets/donnees-hospitalieres-relatives-a-lepidemie-de-covid-19/
COVID-19-associated death per department from February 7^{th} 2020	
Daily deaths	https://github.com/opencovid19-fr/data
Population	
Total population estimated in 2020 per department	https://www.insee.fr/fr/statistiques/1893198
Population age structure estimated in 2020 per department (per 5-year and sex strata)	https://www.insee.fr/fr/statistiques/1893198
Baseline intensive-care capacity	
Number of intensive-care beds (ICU beds) in 2018	https://drees.solidarites-sante.gouv.fr/etudes-et-statistiques/publications/article/nombre-de-lits-de-reanimation-de-soins-intensifs-et-de-soins-continus-en-france
Chloroquine and hydroxychloroquine dispensations	
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1^{st} to April 19^{th} 2020	https://www.ansm.sante.fr/S-informer/Points-d-information-Points-d-information/Usage-des-medicaments-en-ville-durant-l-epidemie-de-Covid-19-point-de-situation-apres-cinq-semaines-de-confinement-Point-d-information
Baseline population health and healthcare services	
Number of total deaths per department between March 19^{th} and May 11^{th} 2018 and 2019	https://www.insee.fr/fr/statistiques/4487988?sommaire=4487854
Availability of healthcare resources: densities of medical doctors, general practitioners, nurses, pharmacies and hospital beds per inhabitants	https://www.insee.fr/fr/statistiques
Subsidized medical or dependency insurance: proportion of the population covered by Universal Health Insurance (CMU), proportion of the population receiving home nursing care, proportion of the elderly population recipient of the autonomy allowance (APA) at home	https://www.insee.fr/fr/statistiques
Ageing index	https://www.insee.fr/fr/statistiques

Proportion of hospital stays in endocrinology, cardiology, pneumology and medicine wards	https://cartographie.atih.sante.fr/#c=home
Economic indicators	
Poverty ratio	https://www.insee.fr/fr/statistiques
Median standard of living	https://www.insee.fr/fr/statistiques
Unemployment ratio	https://www.insee.fr/fr/statistiques
Housing allowance ratio	https://www.insee.fr/fr/statistiques
Earned income supplement (RSA) ratio	https://www.insee.fr/fr/statistiques
Average amount of the autonomy allowance (APA)	https://www.insee.fr/fr/statistiques
Social assistance ratio	https://www.insee.fr/fr/statistiques
Urbanization	
Proportion of the population living in metropolitan cities	https://www.insee.fr/fr/statistiques
Proportion of the population living in multipolar cities	https://www.insee.fr/fr/statistiques
Proportion of the population living in remote communes	https://www.insee.fr/fr/statistiques
Proportion of the population living in other communes	https://www.insee.fr/fr/statistiques
Roads density outside urban areas	https://www.insee.fr/fr/statistiques
Surface area	https://www.insee.fr/fr/statistiques
Climate (% of surface area)	
Mountain; semi-continental and sub-montane; modified oceanic of centre and north plains; altered oceanic; franc oceanic; altered Mediterranean; south-west basin; franc Mediterranean	http://journals.openedition.org/cybergeo/23155
Spatial	
Shapefiles of administrative departments	https://www.data.gouv.fr/fr/datasets/admin-express/

All URLs were last accessed on December 12th 2020

Appendix 2: Sensitivity analysis on the hierarchical ascendant classification (HAC) on principal component analysis (PCA)

To assess the stability of the HAC on PCA process, we simulated 1000 data samples, with normal distributions for each studied factor. We applied the same classification process, and performed the same univariate analysis, providing 1000 univariate SIR, SMR and SFR estimations for each factor. The 95% intervals of the 1001 estimations are presented in Tables A2.1, A2.2 and A2.3. Results of this sensitivity analysis were the same as results obtained in the main analysis: when a classified variable was associated with the outcome, the estimated standardized ratio was not included in the simulated 2·5 – 97·5 percentile interval.

Table A2.1 – Simulation analysis: Factors associated with in-hospital COVID-19 incidence rates at the department level in metropolitan France

Covariate	Univariate analyses: Estimated SIR [95%-CI]	Univariate analyses: Simulated SIR: Median [2·5-97·5] Percentiles
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	1·02 [1·004–1·03]	0·9997 [0·99–1·01]
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	1 [-]
Class 2: high proportion of <25 years-old	0·86 [0·64–1·15]	0·996 [0·76–1·32]
Class 3: high proportion of 50-85 years-old	0·72 [0·53–0·99]	1·004 [0·77–1·31]
Class 4: high proportion of >85 years-old	0·96 [0·64–1·42]	0·997 [0·77–1·31]
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	1·001 [1·0003–1·001]	1 [0·9996–1·0004]
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	1 [-]
Class 2: high health professional density	1·19 [0·94–1·51]	1·002 [0·79–1·24]
Class 3: high proportion of hospital stays	1·07 [0·82–1·38]	0·998 [0·79–1·26]
Economic indicators		
Class 1: high median standard of living	1 [-]	1 [-]
Class 2: high rate of social assistance	1·07 [0·87–1·32]	1·006 [0·80–1·27]
Class 3: high poverty and unemployment ratios	0·97 [0·68–1·38]	1·004 [0·80–1·23]
Urbanization		
Class 1: very high proportion of the population living in metropolitan cities and high roads density	1 [-]	1 [-]
Class 2: high proportion of the population living in metropolitan cities and lower roads density	0·48 [0·3–0·78]	0·993 [0·77–1·32]
Class 3: high proportion of the population living in multipolar cities	0·48 [0·29–0·79]	0·999 [0·77–1·31]
Class 4: high proportion of the population living in remote communes	0·42 [0·24–0·74]	0·989 [0·75–1·29]
Climate		
Class 1: central plains with modified oceanic climate	1 [-]	1 [-]

Class 2: oceanic or south-west basin climate	0·84 [0·56–1·26]	1·003 [0·76–1·31]
Class 3: semi-continental, sub-montane or mountain climate	0·93 [0·63–1·36]	0·994 [0·77–1·30]
Class 4: Mediterranean climate	1·61 [0·86–3·0]	0·998 [0·76–1·30]

SIR, standardized incidence ratio;
Simulations (n=1000) were performed on each observed variables according to Normal distributions with the estimated averages and variances. For each simulation set, HAC on PCA were performed and classes were included in univariate analyses, following the method described in the main manuscript, in order to obtain 1000 simulated SIR.
Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log population as an offset.

Table A2.2 – Simulation analysis: Factors associated with in-hospital COVID-19 mortality rates at the department level in metropolitan France

	Univariate analyses	
Covariate	**Estimated SMR [95%-CI]**	**Simulated SMR: Median [2·5-97·5] Percentiles**
In-hospital COVID-19 incidence		
Number of in-hospital cases accumulated from March 19th to May 11th, 2020	1·0002 [1·0001–1·0003]	1·0 [0·9999-1·0001]
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	1·03 [1·01–1·04]	0·999 [0·99-1·01]
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	1 [-]
Class 2: high proportion of <25 years-old	0·85 [0·60–1·20]	0·99 [0·73-1·40]
Class 3: high proportion of 50-85 years-old	0·74 [0·51–1·06]	0·995 [0·75-1·38]
Class 4: high proportion of >85 years-old	0·96 [0·60–1·54]	1·004 [0·74-1·38]
Intensive-care capacity		
Number of intensive-care beds in 2018	1·002 [1·0004–1·003]	1·0 [0·999-1·002]
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	1·001 [1·0002–1·001]	1·0 [0·9995-1·0004]
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	1 [-]
Class 2: high health professional density	1·19 [0·94–1·51]	1·007 [0·76-1·30]
Class 3: high proportion of hospital stays	1·07 [0·82–1·38]	1·0 [0·76-1·30]

SMR, standardized mortality ratio;
Simulations (n=1000) were performed on each observed variables according to Normal distributions with the estimated averages and variances. For each simulation set, HAC on PCA were performed and classes were included in univariate analyses, following the method described in the main manuscript, in order to obtain 1000 simulated SMR.
Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log population as an offset.

Table A2.3 – Simulation analysis: Factors associated with in-hospital COVID-19 case fatality rates at the department level in metropolitan France

Covariate	Univariate analyses: Estimated SFR [95%-CI]	Univariate analyses: Simulated SFR: Median [2·5-97·5] Percentiles
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	1·01 [1·002–1·02]	1·0 [0·995-1·005]
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	1 [-]
Class 2: high proportion of <25 years-old	1·01 [0·91–1·13]	0·999 [0·88-1·12]
Class 3: high proportion of 50-85 years-old	1·08 [0·96–1·22]	1·001 [0·88-1·13]
Class 4: high proportion of >85 years-old	1·11 [0·93–1·33]	1·002 [0·89-1·14]
Intensive-care capacity		
Number of intensive-care beds in 2018	0·9997 [0·999–1·0002]	1·0 [0·999-1·001]
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	0·9999 [0·9997–1·0001]	1·0 [0·9998-1·0002]
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	1 [-]
Class 2: high health professional density	1·01 [0·91–1·12]	0·999 [0·90-1·11]
Class 3: high proportion of hospital stays	0·999 [0·89–1·12]	0·998 [0·90-1·11]

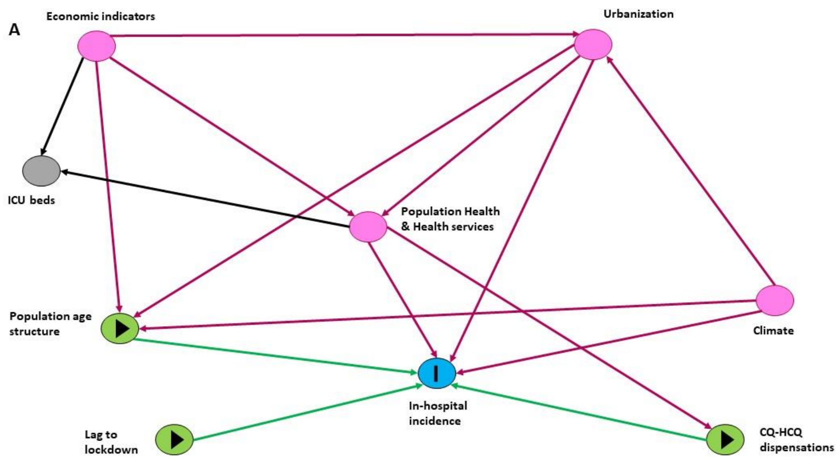
SFR, standardized fatality ratio;

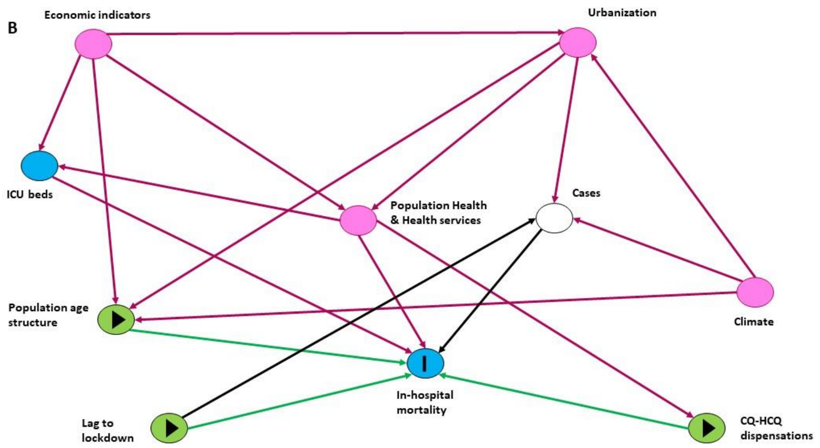
Simulations (n=1000) were performed on each observed variables according to Normal distributions with the estimated averages and variances. For each simulation set, HAC on PCA were performed and classes were included in univariate analyses, following the method described in the main manuscript, in order to obtain 1000 simulated SFR.

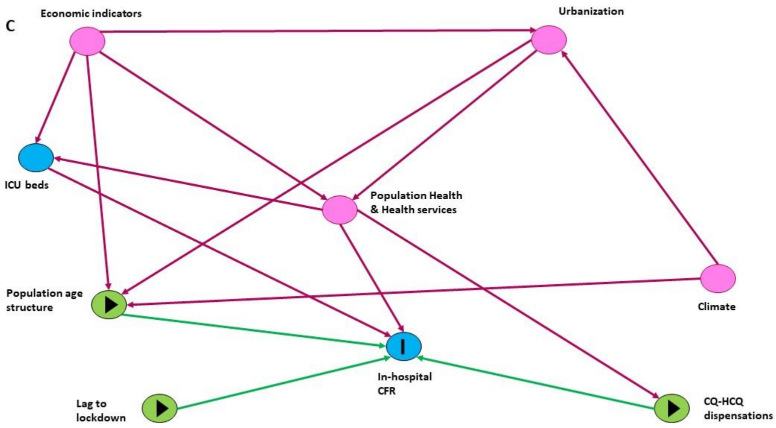
Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log population as an offset.

Appendix 3: Directed acyclic graphs for the selection of covariates included in multivariate analyses

Figure A3 – Directed acyclic graphs (DAG), for (A) COVID-19 incidence, (B) mortality and (C) case fatality rates. For each of the three outcomes, the potentials confounders were selected using DAG (http://dagitty.net, last accessed on December 12th 2020). Blue circles with « I » are outcomes. Empty blue circles are ancestors of outcomes. Green circles are studied exposures. Pink circles are ancestors of both exposures and outcomes. Green links represent causal paths, while pink links represent potential biasing paths.

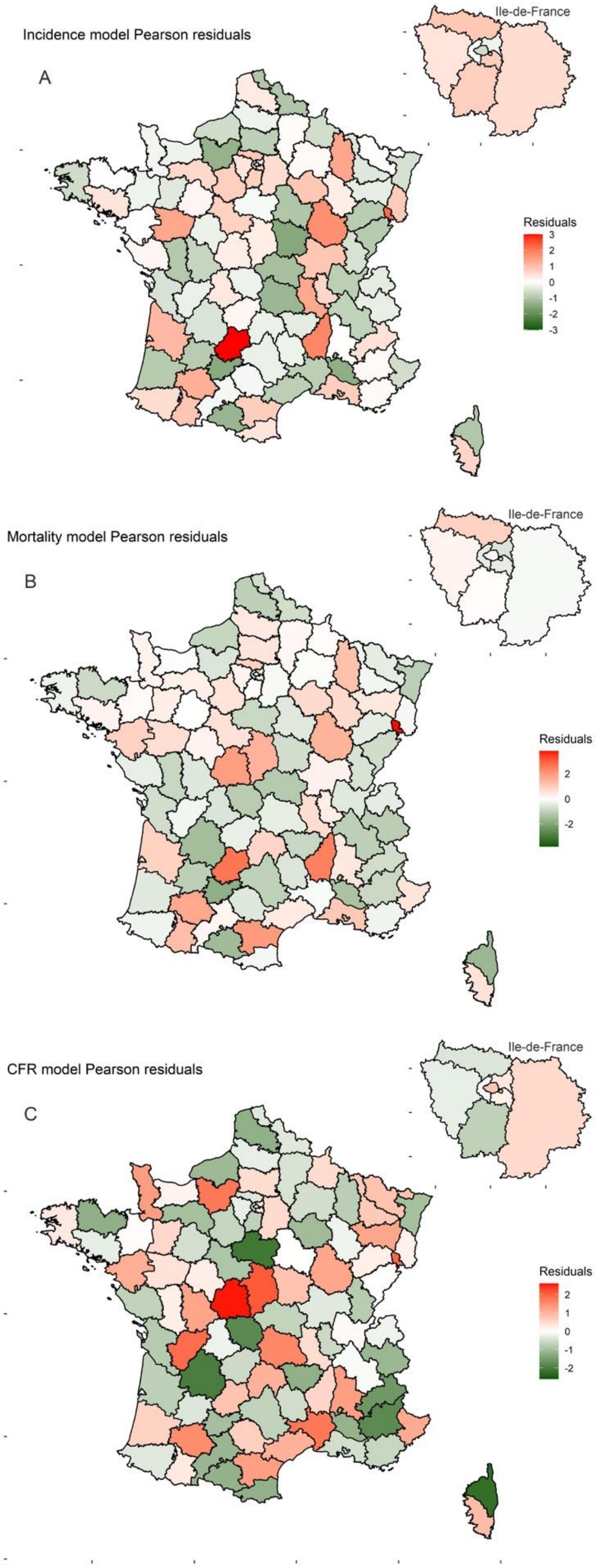





C
Economic indicators
Urbanization
ICU beds
Population Health
& Health services
Population age
structure
Climate
In-hospital
CFR
Lag to
lockdown
CQ-HCQ
dispensations

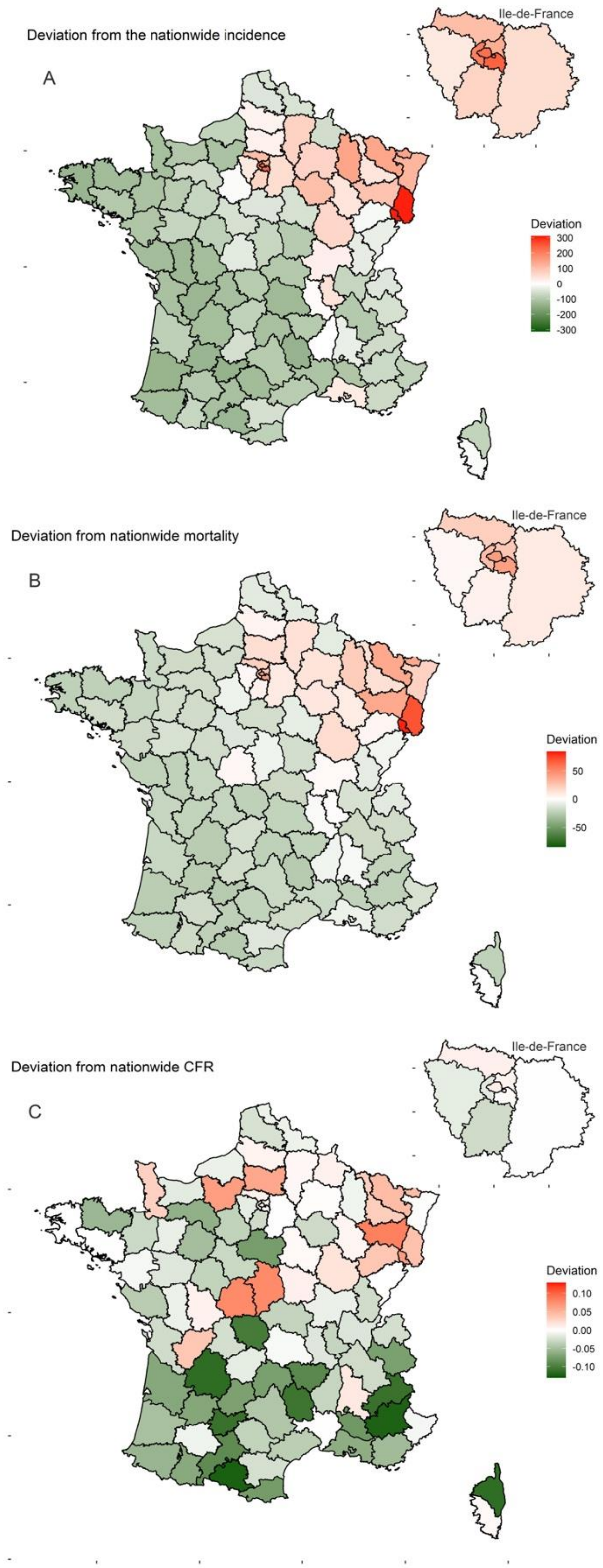
Appendix 4: Pearsons' residuals for the multivariate models

Figure A4 – Mapping of the Pearsons' residuals for the (A) in-hospital incidence rate model, (B) in-hospital mortality rate model, and (C) in-hospital case fatality rate model



Appendix 5: Deviation from the nationwide incidence, mortality and case fatality rates

Figure A5: Estimations of the department deviations from the nationwide (A) incidence rates, (B) mortality rates and (C) case fatality rates



Appendix 6: Sensitivity analysis by outcome substitution

We used outcome substitution (Table A6.1) in order to assess the impact of ecological bias. No variables were associated to the substitute outcomes (Tables A6.2, A6.3, A6.4), showing that the main results are not impacted by ecological bias.

Table A6.1 – Sensitivity analysis: outcome substitutions

Statistical Model	Studied Outcome (Offset)	Substitute Outcome (Offset)
In-hospital incidence rate	In-hospital cases (Population)	Emergency allergies (Emergency patients)
In-hospital mortality rate	In-hospital deaths (Population)	In-hospital allergies (Emergency patients)
In-hospital case fatality rate	In-hospital deaths (In-hospital cases)	In-hospital allergies (Emergency allergies)

Table A6.2 – Factors associated with the number of allergies among patients at the emergency departments, the department level in metropolitan France

Covariate	Multivariate analysis aSR [95%-CI]	p-value
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	1·005 [0·996–1·02]	0·25
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	-
Class 2: high proportion of <25 years-old	0·97 [0·82–1·14]	0·67
Class 3: high proportion of 50-85 years-old	0·94 [0·73–1·22]	0·64
Class 4: high proportion of >85 years-old	0·83 [0·58–1·19]	0·30
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	0·9999 [0·9997–1·0002]	0·64
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	-
Class 2: high health professional density	0·96 [0·83–1·10]	0·53
Class 3: high proportion of hospital stays	1·11 [0·92–1·33]	0·27
Urbanization		
Class 1: very high proportion of the population living in metropolitan cities and high roads density	1 [-]	-
Class 2: high proportion of the population living in metropolitan cities and lower roads density	1·12 [0·88–1·43]	0·36
Class 3: high proportion of the population living in multipolar cities	1·14 [0·85–1·54]	0·38
Class 4: high proportion of the population living in remote communes	1·37 [0·92–2·04]	0·13
Climate		
Class 1: central plains with modified oceanic climate	1 [-]	-

Class 2: oceanic or south-west basin climate	0·98 [0·80–1·20]	0·84
Class 3: semi-continental, sub-montane or mountain climate	0·96 [0·78–1·19]	0·73
Class 4: Mediterranean climate	1·26 [0·90–1·78]	0·18

SR, standardized ratio; aSR, adjusted standardized ratio, adjusted on the different cofactors and spatial structure; 95%-CI, 95%-confidence interval

Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log number of emergency patients as an offset.

Table A6.3 – Factors associated with the number of hospitalizations among the number of patients at the emergency departments, the department level in metropolitan France

	Multivariate analysis	
Covariate	**aSR [95%-CI]**	**p-value**
Emergency Allergies		
Number of allergy cases at emergency department accumulated from March 1st to April 30th, 2020	1·001 [0·99–1·004]	0·24
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	1·0004 [0·97–1·03]	0·98
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	-
Class 2: high proportion of <25 years-old	1·16 [0·75–1·79]	0·51
Class 3: high proportion of 50-85 years-old	1·06 [0·5868–1·9047]	0·85
Class 4: high proportion of >85 years-old	0·7989 [0·3497–1·8255]	0·59
Intensive-care capacity		
Number of intensive-care beds in 2018	1·0004 [0·99–1·006]	0·88
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	0·999 [0·998–1·001]	0·39
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	-
Class 2: high health professional density	1·03 [0·69–1·55]	0·88
Class 3: high proportion of hospital stays	1·45 [0·90–2·31]	0·12

SR, standardized ratio; SRa, adjusted standardized ratio, adjusted on the different cofactors, spatial structure, and the interaction between allergy cases at emergency department and lag between the first COVID-19 death and lockdown (p=0.2462); 95%-CI, 95%-confidence interval

Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log number of emergency patients as an offset.

Table A6.4 – Factors associated with number of hospitalizations among emergency allergies, the department level in metropolitan France

Covariate	Multivariate analysis aSR [CI-95%]	p-value
Temporal progression of the epidemic wave across the country and the effect of the national lockdown		
Relative lag between the first COVID-19 associated death and the March 17th lockdown	0·99 [0·97–1·01]	0·27
Population age structure estimated in 2020 per department		
Class 1: high proportion of 25-49 years-old inhabitants	1 [-]	-
Class 2: high proportion of <25 years-old	1·06 [0·71–1·59]	0·78
Class 3: high proportion of 50-85 years-old	1·002 [0·57–1·76]	0·99
Class 4: high proportion of >85 years-old	0·76 [0·34–1·69]	0·50
Intensive-care capacity		
Number of intensive-care beds in 2018	1·0002 [0·99–1·01]	0·52
Number of new chloroquine and hydroxychloroquine dispensations in pharmacies from January 1st to April 19th 2020	0·999 [0·998–1·001]	0·38
Baseline population health and healthcare services		
Class 1: high proportion of the population receiving at home health assistance	1 [-]	-
Class 2: high health professional density	1·09 [0·73–1·61]	0·68
Class 3: high proportion of hospital stays	1·28 [0·81–2·03]	0·29

SFR, standardized ratio; aSR, adjusted standardized ratio, adjusted on the different cofactors and spatial structure; 95%-CI, 95%-confidence interval

Analyses were conducted using generalized additive models (GAM) with a negative binomial regression, a Gaussian kriging smoother based on geographical coordinates, and the log of allergy cases at emergency departments as an offset.

Appendix 7: Characteristics of the classes for the multidimensional variables

Table A7.1 – Climate

Mean (SD)	**Class 1 Central plains with modified oceanic climate (n=27)**	**Class 2 Oceanic or south-west basin climate (n=29)**	**Class 3 Semi-continental, sub-montane or mountain climate (n=27)**	**Class 4 Mediterranean climate (n=13)**
Mountain	0·16 (0·42)	0·45 (1·13)	7·27 (4·51)	2·18 (2·18)
Semi-continental and sub-montane	0·65 (1·02)	0·17 (1·08)	5·52 (3·23)	1·15 (1·17)
Modified oceanic of centre and north plains	14·09 (2·24)	0·55 (1·23)	1·63 (2·29)	0·01 (0·01)
Altered oceanic	0·97 (1·60)	7·44 (4·73)	1·35 (1·84)	0·45 (1·01)
Franc oceanic	0·23 (0·69)	5·14 (5·6)	0·08 (0·22)	0·03 (0·05)
Altered Mediterranean	0 (0)	0·31 (0·5)	0·17 (0·62)	4·43 (2·29)
South-west basin	0·002 (0·01)	1·79 (3·8)	0·13 (0·32)	0·65 (0·98)
Franc Mediterranean	0 (0)	0·0003 (0·001)	0·03 (0·15)	7·09 (4·74)

SD, standard deviation

Table A7·2 – Urbanization

Mean (SD)	Class 1 Very high proportion of the population living in metropolitan cities and high roads density (Paris area) (n=4)	Class 2 High proportion of the population living in metropolitan cities and lower roads density (n = 48)	Class 3 High proportion of the population living in multipolar cities (n =32)	Class 4 High proportion of the population living in remote communes (n=12)
Proportion of the population living in metropolitan cities	100 (0)	86·3 (8·35)	57·19 (8·67)	38·49 (14·25)
Proportion of the population living in multipolar cities	0 (0)	3·95 (2·64)	13·74 (4·25)	9·37 (3·88)
Proportion of the population living in remote communes	0 (0)	3·63 (4·23)	11·47 (4·9)	29·68 (9·88)
Proportion of the population living in other communes	0 (0)	6·13 (3·79)	17·62 (5·34)	22·47 (10·31)
Roads density outside urban areas	11·59 (2·60)	2·23 (0·58)	1·88 (0·53)	1·67 (0·5)
Surface area	191 (65)	5561 (1841)	6435 (1105)	5863 (1146)

SD, standard deviation

Table A7·3 – Baseline population health & heathcare service

Mean (SD)	Class 1 High proportion of the population receiving at home health assistance (n=26)	Class 2 High health professional density (n=36)	Class 3 High proportion of hospital stays (n=34)
Basal number of total deaths per department	2244 (937)	3156 (1803)	1457 (990)
Densities of medical doctors	261 (55)	382 (94)	257 (29)
Densities of general practitioners	128 (22)	172 (23)	143 (18)
Densities of nurses	845 (150)	1192 (176)	1106 (173)
Densities of pharmacies	97 (11)	121 (17)	107 (13)
Densities of hospital beds	309 (60)	439 (72)	360 (63)
Proportion of the population covered by Universal Health Insurance (CMU)	6·55 (2·24)	7·45 (2·30)	7·41 (2·06)
Proportion of the population receiving home nursing care	19·14 (2·46)	20·40 (4·48)	23·29 (3·58)
Proportion of the elderly population recipient of the autonomy allowance (APA) at home	20·56 (6·01)	19·23 (4·02)	13·80 (3·92)
Ageing index	80·68 (22·27)	95·31 (18·90)	121·67 (22·55)
Proportion of hospital stays in endocrinology wards	0·005 (0·001)	0·005 (0·001)	0·006 (0·002)
Proportion of hospital stays in cardiology wards	0·01 (0·002)	0·01 (0·002)	0·02 (0·002)
Proportion of hospital stays in pneumology wards	0·01 (0·001)	0·01 (0·002)	0·02 (0·002)
Proportion of hospital stays in medicine wards	0·15 (0·01)	0·16 (0·01)	0·18 (0·01)

SD, standard deviation

Table A7·4 – Economy

Mean (SD)	Class 1 High median standard of living (n=45)	Class 2 high rate of social assistance (n=38)	Class 3 high poverty and unemployment ratios (n=13)
Poverty ratio	12·5 (1·71)	15·32 (1·60)	20·04 (2·76)
Median standard of living	21525 (1676)	19791 (509)	18917 (813)
Unemployment ratio	7·24 (0·84)	8·19 (1·22)	11·18 (1·11)
Housing allowance ratio	18·49 (2·09)	18·01 (2·49)	18·8 (1·93)
Earned income supplement (RSA) ratio	3·95 (0·99)	4·97 (1·09)	8·15 (1·17)
Average amount of the autonomy allowance (APA)	81·7 (20·9)	128·6 (34·4)	103·9 (21·9)
Social assistance ratio	509 (49)	622 (72)	704 (68)

SD, standard deviation

Table A7·5 – Population structure

Mean (sd)	Class 1 high proportion of 25-49 years-old inhabitants (n=16)	Class 2 high proportion of <25 years-old (n=32)	Class 3 high proportion of 50-85 years-old (n=35)	Class 4 high proportion of >85 years-old (n=13)
Men 0-4	0·032 (0·004)	0·027 (0·001)	0·024 (0·001)	0·025 (0·001)
Men 5-9	0·034 (0·004)	0·031 (0·001)	0·028 (0·001)	0·03 (0·001)
Men 10-14	0·033 (0·004)	0·032 (0·002)	0·030 (0·002)	0·027 (0·001)
Men 15-19	0·032 (0·003)	0·033 (0·002)	0·029 (0·002)	0·027 (0·002)
Men 20-24	0·031 (0·004)	0·029 (0·004)	0·023 (0·002)	0·021 (0·002)
Men 25-29	0·031 (0·005)	0·026 (0·002)	0·023 (0·001)	0·021 (0·002)
Men 30-34	0·033 (0·003)	0·028 (0·002)	0·026 (0·001)	0·023 (0·001)
Men 35-39	0·034 (0·002)	0·030 (0·001)	0·028 (0·001)	0·025 (0·001)
Men 40-44	0·032 (0·002)	0·029 (0·001)	0·028 (0·001)	0·026 (0·001)
Men 45-49	0·034 (0·001)	0·033 (0·001)	0·033 (0·001)	0·033 (0·001)
Men 50-54	0·032 (0·002)	0·032 (0·001)	0·034 (0·001)	0·034 (0·001)
Men 55-59	0·03 (0·002)	0·032 (0·002)	0·034 (0·001)	0·035 (0·002)
Men 60-64	0·025 (0·002)	0·03 (0·002)	0·034 (0·002)	0·037 (0·002)
Men 65-69	0·022 (0·002)	0·028 (0·002)	0·034 (0·002)	0·038 (0·002)
Men 70-74	0·019 (0·002)	0·025 (0·002)	0·030 (0·002)	0·034 (0·002)
Men 75-79	0·012 (0·002)	0·015 (0·001)	0·018 (0·002)	0·021 (0·001)
Men 80-84	0·009 (0·001)	0·012 (0·001)	0·015 (0·001)	0·017 (0·001)
Men 85-89	0·006 (0·001)	0·008 (0·001)	0·010 (0·001)	0·012 (0·001)
Men 90-94	0·002 (0·0004)	0·003 (0·001)	0·004 (0·001)	0·005 (0·0004)
Men >94	0·001 (0·0001)	0·001 (0·0002)	0·001 (0·0002)	0·012 (0·0002)
Women 0-4	0·030 (0·004)	0·026 (0·001)	0·022 (0·001)	0·019 (0·001)
Women 5-9	0·032 (0·004)	0·030 (0·002)	0·027 (0·001)	0·023 (0·001)
Women 10-14	0·032 (0·003)	0·031 (0·002)	0·028 (0·002)	0·026 (0·001)
Women 15-19	0·031 (0·002)	0·031 (0·002)	0·026 (0·002)	0·024 (0·001)
Women 20-24	0·031 (0·006)	0·027 (0·005)	0·020 (0·003)	0·017 (0·001)
Women 25-29	0·033 (0·006)	0·026 (0·002)	0·022 (0·002)	0·019 (0·001)
Women 30-34	0·035 (0·003)	0·029 (0·002)	0·026 (0·002)	0·023 (0·001)
Women 35-39	0·036 (0·002)	0·032 (0·001)	0·029 (0·002)	0·026 (0·001)
Women 40-44	0·033 (0·002)	0·030 (0·001)	0·028 (0·001)	0·027 (0·001)
Women 45-49	0·035 (0·002)	0·033 (0·001)	0·034 (0·001)	0·033 (0·001)
Women 50-54	0·033 (0·001)	0·033 (0·001)	0·035 (0·001)	0·034 (0·001)
Women 55-59	0·031 (0·001)	0·033 (0·001)	0·036 (0·001)	0·037 (0·001)
Women 60-64	0·028 (0·002)	0·032 (0·001)	0·036 (0·001)	0·039 (0·002)
Women 65-69	0·025 (0·002)	0·032 (0·001)	0·036 (0·002)	0·04 (0·002)
Women 70-74	0·022 (0·003)	0·028 (0·002)	0·034 (0·002)	0·037 (0·002)
Women 75-79	0·015 (0·002)	0·018 (0·001)	0·022 (0·002)	0·025 (0·001)
Women 80-84	0·013 (0·002)	0·017 (0·001)	0·021 (0·001)	0·024 (0·001)
Women 85-89	0·010 (0·002)	0·014 (0·001)	0·017 (0·001)	0·020 (0·001)
Women 90-94	0·005 (0·001)	0·007 (0·001)	0·009 (0·001)	0·012 (0·001)
Women >94	0·002 (0·001)	0·002 (0·001)	0·004 (0·001)	0·004 (0·001)

Appendix 8: Maximum intensive-care beds occupancy

In order to study whether scaling up of intensive-care capacities during the epidemic wave could explain why no association between the basal ICU capacities and mortality and CFR rates was identified in our models, we calculated the maximum ICU beds occupancy per department during the March 19th – May 11th period.
We downloaded the publicly available database of the daily number of hospitalized patients in ICU (https://www.data.gouv.fr/fr/datasets/donnees-hospitalieres-relatives-a-lepidemie-de-covid-19/, accessed November 15th 2020), and divided the maximum daily number of ICU patients by the number of intensive-care beds (ICU beds) in 2018.
As illustrated on Figure A6, the ICU beds occupancy rate of COVID-19 patients exceeded 100% in 63 out of the 96 French metropolitan departments and exceeded 200% in 21 of them. This means that hospitals could scale up their ICU beds capacities by ≥100% in at least 21 departments.

Figure A8 – Distribution of the department maximum intensive-care beds occupancy rate by COVID-19 patients