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Early View

Research letter

Impact of socio-economic status in patients hospitalised for COVID-19 in the Greater Paris area

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Impact of socio-economic status in patients hospitalized for COVID-19 in the Greater Paris area

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Take home message: Individual precarity seems to be associated with the initial severity of COVID-19 in hospitalized patients under the age of 70. Low socioeconomic status may contribute to the excess mortality observed in the poorest district of Greater Paris

Introduction:

In the United States, the coronavirus disease 2019 (COVID-19) is more likely to affect and kill African Americans [1], which raises the question of the contribution of several factors, including genetic background, socioeconomic status (SES), and comorbidities [2]. According to the French National Institute of Statistics and Economic Studies (INSEE) the highest excess mortality rate in France, during March and April 2020, linked to COVID-19 is found in the Seine-Saint-Denis (SSD) district [3]. SSD is the poorest district of Greater Paris [4]. We hypothesize that precarity influences the initial severity of COVID-19.

Methods:

We selected patients hospitalized for COVID-19 at Avicenne Academic Hospital, in SSD and at Beaujon and Ambroise Paré Hospitals, two academic hospitals located in the Hauts-de-Seine (HDS) district. HDS is a rich district of Greater Paris, with more hospital beds (56,7 versus 42.5 per 10 000 inhabitants) and intensive care unit intensive (ICU) beds (429 versus 244) than SSD for a number of inhabitants equivalent (1.6 million)[5] [6]. The goal was to compare patient characteristics between the two districts and determine whether precarity is a risk factor for severe COVID-19. All consecutive conscious patients hospitalized in the three hospitals for COVID-19 were prospectively screened on the same day (April 20, 2020). Patients were asked about their SES via a questionnaire (monthly personal self-reported income, deprivation index, insurance coverage, occupation, final educational degree and housing conditions), and information on smoking habits, comorbidities, and respiratory severity at admission was collected. The French deprivation index EPICES (Evaluation of Health Inequalities for Health Insurance Health Examination Centre) is an indicator of precarity taking into account marital status, insurance coverage, family support and leisure activity. The score varies from 0 (absence of precarity) to 100 (maximum precarity). Thirty is considered to be the precarity threshold [7]. The official French poverty line corresponds to a monthly income of less than 1,041 euros. Initial severity was classified as follows: no severity (oxygen requirements < 3L/min), moderate severity (oxygen requirements between 3 and 5 L/min), significant severity (respiratory rate > 30/min, or oxygen requirements > 5L/min, or lung damage on CT scan > 50%), and critical severity (admission to intensive care) [8][9] . Results are expressed as percentages or mean ± SD. Logistic regression was used to identify the factors associated with severe COVID-19 at admission. All patients signed a consent form and the study was approved by the local ethics committee (CLEA-2020-116).

Results:

190 patients hospitalized for COVID-19 were screened, and 41% of these were excluded (for cognitive disorders: 45%, language barrier: 21%, critical state: 15%, tutorship or curatorship: 11%, and lack of consent: 8%). The causes of exclusion differed according to the district, with higher language barrier in SSD but more lack of consent or cognitive disorders in HSD (p=0,02). Excluded patients were significantly older than included patients (74.5 ± 15.8 versus 66.6 ± 16.3 years, p< 0.001), with a higher proportion of patients over 70 years old (66% versus 41%, p< 0.001). The study population included 112 patients (65 (58.6%) men, age: 66.7 ± 16.3 years old, 12 (11.0%) Africans or Afro-Caribbeans, and 8 (7.7%) current smokers). Body mass index was 27.1 ± 6.23, 33 (30.0%) patients had diabetes and 58 (52.7%) arterial hypertension. Regarding SES, 32 (33.0%) patients had an income below the poverty line, and the mean deprivation index was 38.2 ± 24.4. The proportion of patients with at least one infected home co-resident was 12%. COVID-19 was severe in most cases (59.8%).

Patient characteristics are described in Table 1. SSD patients were younger (p=0.002) and had more comorbidities, such as being overweight (p<0.001) and diabetes (p= 0.041), than HDS patients. The SES of SSD patients was lower, with lower incomes (p= 0.004), less private insurance coverage (p=0.043), and a lower educational level (p=0.002). The proportion of SSD patients who owned homes was lower (p=0.039) while the proportion of those in low-income housing as well as the housing population density was higher (p= 0.009 and p =0.027, respectively). The distribution of initial severity was similar in both districts, although SSD patients were about 10 years younger than HDS patients (61.8 ± 14.0 versus 71.0 ± 17.1 years, p= 0.002). Seventeen patients (17%) were transferred in ICU and 3 patients (3%) died at hospital.

No predictive factors of initial severity were found in the overall population. In the sub-group of patients under 70 years of age (n=62), the predictive factors of severity were age (p= 0.002), high EPICES score (p=0.014), being retired (p=0.027), and an absence of private insurance coverage (p= 0.042). On multivariate analysis, age and EPICES score were independently associated to an increased risk of initial severity, with an odds ratio (OR) of 1.099 (95% CI: 1.038-1.178, p=0.003), and 1.029 (95% CI:1.003 - 1.059, p=0.033) per EPICES score point, respectively.

Discussion:

This is the first study to show that precarity is associated with the initial severity of COVID-19 in hospitalized patients under 70 years-old. Moreover, patients hospitalized in SSD, the poorest district in Greater Paris, were 10 years younger than patients hospitalized in the HDS district for the same distribution of initial severity.

First, these results confirmed the precarious conditions of patients hospitalized for COVID-19, even in HDS. Indeed, 24.5 % of the cases were living below the poverty line, while this concerns only 12% of the inhabitants of HDS district [4]. As expected, SSD patients were younger, which probably reflects the demographic structure of the district, with the youngest population in the region. Although age has been shown to be strongly associated to COVID-19 morbi-mortality [10], the young age of SSD patients does not seem to protect them from severe forms of the disease. This could be explained, by the increased prevalence of obesity and diabetes in this group, two comorbidities known to be associated with the severity of COVID-19 [11][12]. Furthermore, patients hospitalized in SSD had substantially lower incomes, a major indicator of life expectancy in literature [13]. These patients also had a lower level of education, a recognized source of health inequalities [14][15]. Finally, housing conditions differed between the two districts, including more social housing and greater promiscuity in SSD patients, with a trend towards more infected home co-residents. Poor housing conditions could have been a barrier to social distancing.

Noticeably, the EPICES score did not differ between the two districts, and it was not identified as a risk factor for disease severity in the overall population. The EPICES score is strongly correlated to the Townsend index [16]. It is generated as the sum of 11 items including leisure activity. However, this score, which was validated in a 45.5 ± 14.3 year-old cohort [7], may not be suitable for geriatric populations. Indeed, among the elderly, not having leisure activities may be more strongly related to dependency than to precarity. Thus, we focused on the sub-group of patients under the age of 70 in whom a high EPICES score was found to be a significant risk factor for severe COVID-19.

To our knowledge this is the first study to evaluate individual SES in patients hospitalized for COVID-19. However, it is limited by the high exclusion rate. Although this may have created a selection bias, it shows the complexity of this type of investigation in the acute phase of COVID-19. Moreover, the analysis of factors associated with poor survival was limited by the small number of events.

In conclusion, precarity seems to be associated with the initial severity of COVID-19 in hospitalized patients under 70 years of age. In addition to a lack of hospital beds and ICU beds, low SES may contribute to the excess mortality observed in SSD. Particular attention should be paid to more disadvantaged geographic areas to fight against health disparities in the context of the COVID-19 epidemic.

References:

1 Yancy CW. COVID-19 and African Americans. *JAMA* Published Online First: 15 April 2020. doi:10.1001/jama.2020.6548

2 Chowkwanyun M, Reed AL. Racial Health Disparities and Covid-19 — Caution and Context. *N Engl J Med* 2020;:NEJMp2012910. doi:10.1056/NEJMp2012910

3 Evolution of deaths since 1 March − Number of daily deaths | Insee. https://www.insee.fr/en/statistiques/4493806?sommaire=4493845#consulter-sommaire (accessed 20 May 2020).

4 Comparateur de territoire | Insee. https://www.insee.fr/fr/statistiques/1405599?geo=DEP-92+DEP-93+DEP-75+DEP-94+UU2010-00851 (accessed 20 May 2020).

5 Comparateur de territoire − Département des Hauts-de-Seine (92) | Insee. https://www.insee.fr/fr/statistiques/1405599?geo=DEP-92 (accessed 1 Jun 2020).

6 Le Projet Régional de Santé 2018-2022. https://www.iledefrance.ars.sante.fr/le-projet-regional-de-sante-2018-2022 (accessed 31 Aug 2020).

7 Sass C, Guéguen R, Moulin JJ, *et al.* [Comparison of the individual deprivation index of the French Health Examination Centres and the administrative definition of deprivation]. *Sante Publique* 2006;**18**:513–22. doi:10.3917/spub.064.0513

8 Zu ZY, Jiang MD, Xu PP, *et al.* Coronavirus Disease 2019 (COVID-19): A Perspective from China. *Radiology* 2020;:200490. doi:10.1148/radiol.2020200490

9 Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance, 13 March 2020. https://apps.who.int/iris/handle/10665/331446?search-result=true&query=10665%2F331446&scope=&rpp=10&sort_by=score&order=desc (accessed 1 Jun 2020).

10 Docherty AB, Harrison EM, Green CA, *et al.* Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. *BMJ* 2020;**369**:m1985. doi:10.1136/bmj.m1985

11 Simonnet A, Chetboun M, Poissy J, *et al.* High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. *Obesity*;**n/a**. doi:10.1002/oby.22831

12 Yang J, Zheng Y, Gou X, *et al.* Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *International Journal of Infectious Diseases* 2020;**94**:91–5. doi:10.1016/j.ijid.2020.03.017

13 Chetty R, Stepner M, Abraham S, *et al.* The Association Between Income and Life Expectancy in the United States, 2001–2014. *JAMA* 2016;**315**:1750–66. doi:10.1001/jama.2016.4226

14 von dem Knesebeck O, Verde PE, Dragano N. Education and health in 22 European countries. *Social Science & Medicine* 2006;**63**:1344–51. doi:10.1016/j.socscimed.2006.03.043

15 Life expectancy by standard of living: in men, 13 years of difference between the most affluent and the most modest - Insee Première - 1687. https://www.insee.fr/en/statistiques/3533552 (accessed 4 May 2020).

16 Labbe E, Blanquet M, Gerbaud L, *et al.* A new reliable index to measure individual deprivation: the EPICES score. *Eur J Public Health* 2015;**25**:604–9. doi:10.1093/eurpub/cku231

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Data sharing: The data are available on request

	[ALL] N=112	**Hauts de Seine N=60**	**Seine-Saint-Denis N=52**	**p-value**
Age (years): mean ± SD	66.7 ± 16.3	71.0 ± 17.1	61.8 ± 14.0	0.002
Age < 70 years: n (%)	65 (58.6%)	27 (45.8%)	38 (73.1%)	0.006
Males: n (%)	65 (58.6%)	40 (66.7%)	25 (49.0%)	0.065
Of African or Afro-Caribbean origin: n (%)	12 (11.0%)	9 (15.0%)	3 (6.1%)	0.244
Smokers: n (%)				0.746
Never	59 (56.7%)	32 (53.3%)	27 (61.4%)	
former	37 (35.6%)	23 (38.3%)	14 (31.8%)	
current	8 (7.7%)	5 (8.3%)	3 (6.8%)	
BMI: mean ± SD	27.1 ± 6.23	25.2 ± 5.67	29.6 ± 6.08	<0.001
Diabetes: n (%)	33 (30.0%)	13 (21.7%)	20 (40.0%)	0.041
Arterial hypertension: n (%)	58 (52.7%)	31 (51.7%)	27 (54.0%)	0.958

Socioeconomic status				
Under poverty line †	32 (33.0%)	12 (24.5%)	20 (41.7%)	0.078
Monthly income range: n (%)				0.004
400-800€	26 (28.6%)	9 (19.6%)	17 (37.8%)	
800-1200 €	20 (22.0%)	8 (17.4%)	12 (26.7%)	
1200-2500€	25 (27.5%)	12 (26.1%)	13 (28.9%)	
>2500 €	20 (22.0%)	17 (37.0%)	3 (6.67%)	
EPICES score §: mean ± SD	38.2 ± 24.4	39.1 ± 25.5	37.3 ± 23.3	0.707
High school graduate: n (%)	42 (40.8%)	30 (56.6%)	12 (24.0%)	0.002
Retired: n (%)	64 (57.7%)	36 (61.0%)	28 (53.8%)	0.568
State health insurance: n (%)	108 (97.3%)	58 (98.3%)	50 (96.2%)	0.599
Private health insurance: n (%)	73 (66.4%)	44 (75.9%)	29 (55.8%)	0.043
Housing				
Owner: n (%)	44 (40.0%)	29 (50.0%)	15 (28.8%)	0.039
Social housing tenant: n (%)	48 (43.6%)	18 (31.0%)	30 (57.7%)	0.009
Nb of co-residents: mean ± SD	1.75 (1.6)	1.67 (1.6)	1.85 (1.5)	0.557
Housing population density *(m2 per 1 habitant): mean ± SD	31.0 ± 33.7	37.3 ± 40.4	23.7 ± 22.1	0.027
Infected co-residents: n (%)	11 (12.0%)	2 (4.88%)	9 (17.6%)	0.068
Severity				
Initial severity £				0.821
0	44 (39.6%)	23 (38.3%)	21 (41.2%)	
I	39 (35.1%)	21 (35.0%)	18 (35.3%)	
II	25 (22.5%)	15 (25.0%)	10 (19.6%)	
III	3 (2.70%)	1 (1.67%)	2 (3.92%)	
Outcomes				
Admission in the intensive care unit	17(16%)	12(21%)	5(10%)	0.195
Death	3(3%)	2(2%)	1(1%)	-

Table: Characteristics of COVID-19 patients according to the district of hospitalization

Abbreviations: BMI: body mass index

†: The poverty line in France is defined by a monthly income lower than 1 041 euros per person according to INSEE (National Institute for Statistics and Economic Studies) in 2017.

§: Housing population density was measured by the area of the household divided by the number of residents.

*: The EPICES score (Evaluation of Health Inequalities for Health Insurance Examination Centres) is an individual deprivacy index that takes into account the multidimensional nature of precariousness. The score is continuous and varies from 0 (absence of precarity) to 100 (maximum precarity). The threshold of 30 is considered as the precariousness threshold.

£ Initial severity:

0: Not severe (oxygen requirements < 3L/min)

1: Moderate severity (oxygen requirements between 3 and 5 L/min)

2: Significant severity (respiratory rate > 30/min, or oxygen requirements > 5L/min or lung damage on CT scan > 50%).

3: Critical severity (admission to intensive care)